PARENTING IN THE CONTEXT OF OPIOID USE: MECHANISMS, PREVENTION SOLUTIONS, AND POLICY IMPLICATIONS

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Editorial: Parenting in the Context of Opioid Use: Mechanisms, Prevention Solutions, and Policy Implications

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Editorial on the Research Topic

Parenting in the Context of Opioid Use: Mechanisms, Prevention Solutions, and Policy Implications

The United States (U.S.) is experiencing an opioid epidemic of historic significance. In 2019, 10.1 million people misused prescription opioids in the past year (Substance Abuse Mental Health Services Administration, 2020) and more than 70,000 overdose deaths occurred (Hedegaard et al., 2020). The U.S. economic costs of this epidemic during 2017 alone were estimated at more than 1 billion USD (Florence et al., 2021). National-level epidemiological data from the U.S. indicate that the rates of opioid misuse, addiction, overdose, and fatalities are increasing at a particularly fast rate among women and individuals of childbearing and child-rearing age (Center for Disease Control Prevention, 2017; Hedegaard et al., 2020). Opioid-using behaviors among individuals who are parenting can have detrimental effects on their parenting and parent-child relationships, and can have downstream effects on child brain development, health, and subsequent risk for drug use (Wilens et al., 2002; Lander et al., 2013). Further, despite knowledge rooted in neuroscience that drug addiction is a disease, substance use in pregnancy is often perceived to be a choice, and women are frequently blamed for not having enough self-control to stop using substances (Schiff et al., 2021). Pregnant women who use opioids report having their pregnancy criminalized—experiencing harsh judgement by hospital staff (e.g., being called "drug addicts" or "dope fiends") and/or being rejected from OB/GYN clinics because they are on medication assisted treatment (Syvertsen et al., 2021). These experiences threaten the likelihood that women seek and have access to prenatal care, access treatment for opioid use disorder, and access early intervention services for their children (Peacock-Chambers et al., 2020).

In 2017, the U.S. Department of Health and Human Services designated the opioid epidemic as a public health emergency and announced a 5-point strategy to combat this crisis, which included supporting cutting-edge research on addiction and improving access to prevention, treatment, and recovery support services (U.S. Department of Health Human Services, 2017). However, despite knowledge about the harmful associations between opioid use and parent and child development outcomes and national efforts to combat this crisis, significant gaps in the extant literature remain. Further, the COVID-19 pandemic has precipitated additional parenting challenges and stressors (Roos et al., 2021). Deaths related to opioid use are considered "deaths of despair" that have only magnified during this pandemic (Volkow, 2020). Given the well-established effects of substance use on parenting skills (Suchman et al., 2011, 2017; Lander et al., 2013) and the known effects of parental opioid use on infant and child development (Kocherlakota, 2014), addressing these knowledge gaps could improve the health and well-being of millions of children and families worldwide.

This book brings together 13 papers focused on increasing the scientific understanding of associations between parenting and opioid use. The papers cut across three broad themes: (1) theoretical and methodological insights that attend to the complex systems in which neurobiological, psychological, social, and structural features interact; (2) development and testing of new prevention and intervention programs; and (3) attention to a diversity of parent types and family structures. Cutting across all themes readers will notice attention to COVID-19 pandemic-related needs (see for example Clark et al.; DiPietro et al.; Smith et al.) and solutions (see Stormshak et al. for a telehealth example), and to the experiences of stigma (see Boeri et al.).

THEME 1: THEORETICAL AND METHODOLOGICAL INSIGHTS THAT ATTEND TO THE COMPLEX SYSTEMS IN WHICH NEUROBIOLOGICAL, PSYCHOLOGICAL, SOCIAL, AND STRUCTURAL FEATURES INTERACT

A common theme throughout this book is that identifying effective intervention targets for addressing opioid misuse in families requires attending to the complex systems in which neurobiological, psychological, social, and structural features interact. For instance, as documented in Barrett et al., Reese et al., and Swain and Ho, stress-sensitivity and reward dysregulation theories highlight the promise of developing interventions to target the neurobiological impacts of substance use on the brain and subsequent parenting behaviors. Nichols et al. illustrate how social ecological and systems theories offer promise for understanding how social contexts can serve as barriers or facilitators to opioid use prevention, treatment, and recovery efforts. Indeed, Smith et al. show how using causal loop diagrams as part of a systems science approach (e.g., Cruden et al.) can help document the complex pathways between individual and structural risk and protective factors, identifying mechanisms of change that may be promising levers for intervention. For instance, fear of stigmatization, concerns about surveillance from Child Protective Services, substance use treatment facility characteristics (e.g., hours of operation, costs, location, transportation, and childcare availability), and neighborhood built environment may represent significant barriers worthy of intervention, as highlighted in Boeri et al., Clark et al., and DiPietro et al. Multi-pronged intervention approaches that attend to upstream social determinants of health may thus offer unique promise for addressing opioid misuse in families.

THEME 2: DEVELOPMENT AND TESTING OF NEW PREVENTION AND INTERVENTION PROGRAMS

This book also highlights the critical need for the development of evidence-based prevention and intervention programs designed specifically for families and parents when there is a history of opioid misuse. To our knowledge, the programs presented in this book are among the very first to be tested specifically for this population. Saldana et al. describe the results from a randomized trial of the Families Actively Improving Relationships (FAIR) program. Compared to those receiving traditional treatment services, parents in the FAIR program showed statistically and clinically significant improvements in parental opioid and methamphetamine use, mental health symptoms, parenting risk, and parenting stability. Six other reports describe promising new directions achieved through adaptations of existing interventions to better serve parents with a history of opioid misuse. Labella et al. describe an adaptation of the Attachment and Biobehavioral Catch-up intervention and provide case examples that highlight the challenges in working with this population as well as gains made by mothers. Cioffi and DeGarmo present an adaptation of Fathering through Change as an example of tailoring and accelerating the pace of science for this population. Stormshak et al. describe modifications to the Family Check-Up intervention for this population to allow for more wide-scale dissemination, ease of training with community providers, and increased public health reach for families in remote, rural areas. Barrett et al. present a video feedback intervention, Filming Interactions to Nurture Development, that can serve as a mechanistic experiment to illuminate mechanisms of change in interventions for this population. Cruden et al. describe the rigorous adaptation of the FAIR program (see Saldana et al.) to design a prevention-oriented intervention (PRE-FAIR). Finally, Reese et al. include a discussion of Mindfulness-Oriented Recovery Enhancement as a means of addressing mechanisms undergirding perinatal opioid use, parenting, and attachment. We are hopeful that this constellation of new and adapted prevention and intervention models, if ultimately shown to be effective, will increase the reach of services for families with a history of opioid misuse.

THEME 3: ATTENTION TO A DIVERSITY OF PARENT TYPES AND FAMILY STRUCTURES

Collectively, the articles in this book highlight the need for a diversity of parent types and family structures in studies of parenting in the context of substance use. For instance, Cioffi and DeGarmo describe how existing parenting interventions, largely evaluated with mothers, could be adapted to include fathers and other caregivers. Parents who were formerly incarcerated or who are involved in the child welfare system and are reentering both their communities and the parenting space are a uniquely vulnerable population in need of support. Clark et al. describe the parenting and other service needs as well as intervention recommendations for this population after surveying community service providers. Cruden et al. shed light on the need to adapt existing parent interventions to support prevention of initiation and escalation of opioid use for parents involved in child welfare. Nichols et al. focus on adolescents who may be at risk for opioid misuse, given their history of a substance use disorder. In order to have a broad reach, geographic diversity is also important.

Stormshak et al. focus specifically on rural families, whereas Boeri et al. focus on barriers and motivators to opioid treatment in suburban areas. Finally, several contributions in this book focus on prenatal opioid use (Labella et al., Reese et al., DiPietro et al., Boeri et al.), in addition to this book's focus on postnatal use.

FUTURE DIRECTIONS

This book collection highlights several important directions for future research and clinical work on parenting and opioid use. First, not only are more rigorous evaluations needed of prevention and intervention programs designed for families and parents with histories of opioid misuse, but cost analyses of these programs are needed to support efficient program planning with limited resources (see Saldana et al. for one example of this approach). Ideally, such efforts will be based in community-based participatory research methods to help strengthen the acceptability, viability, and effectiveness of interventions for this population. Second, there is a clear need for consideration of how problematic opioid use is defined and operationalized in the research literature, as the diverse definitions used by researchers can present challenges to synthesizing findings across the literature. Third, few studies have focused on both prenatal and postnatal periods, which makes it challenging to assess the causal pathways leading to child outcomes. Fourth, there is a critical need for more research and clinical work focused on parenting and opioid use in families of color. Prescription opioid use is highest among non-Hispanic whites and American Indian and Alaskan Natives, though recent reports suggest that opioid use is increasing in non-Hispanic Black adults (Harrison et al., 2018). Typically underreported are the rates of drug overdose deaths, which, in 2015, were highest among American Indian and Alaskan Natives (Mack et al., 2017). Increased representation of families of color is of utmost importance in future studies of opioid use in families.

AUTHOR CONTRIBUTIONS

LL, EC, and ET-S contributed to the conceptualization, writing, and editing of this editorial. All authors contributed to the article and approved the submitted version.

ACKNOWLEDGMENTS

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Improving Parenting Practices Among Fathers Who Misuse Opioids: Fathering Through Change Intervention

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Fathers have been largely neglected in the parenting literature though there is a critical need to improve parenting practices among fathers who misuse opioids in the midst of the opioid epidemic. Urgency is critical to rapidly intervene in the lives of fathers and children to reduce misuse and interrupt intergenerational cycles of substance misuse. Thus, we provide an overview of solutions to adapt existing parenting interventions for fathers who misuse opioids to accelerate the pace of science for this population.

Keywords: parenting, opioids, fathering, intervention, behavior, substance use, misuse

INTRODUCTION

Approximately one in eight children in the United States live with at least one parent who has a substance use disorder (Lipari and Van Horn, 2017). Problematically, it is well-documented that children exposed to parental drug use are at greater risk for maladjustment, deviant peer affiliation, and substance use initiation (Biglan et al., 2003; Dishion et al., 2003). Child welfare cases, including foster care placements and complex and severe child welfare cases, have increased in recent years and are associated with the opioid epidemic (Radel et al., 2018). Like most parenting research, much of the attention on opioid use and parenting has been focused on improving parenting among mothers who misuse opioids (Slesnick et al., 2014; Mirick and Steenrod, 2016; Gannon et al., 2017; Peisch et al., 2018; Romanowicz et al., 2019). For example, in a recent systematic review of research on the effects of parents' opioid use on children, only one study included fathers (Romanowicz et al., 2019). Given longstanding evidence that quality father involvement by residential and non-residential fathers has independent beneficial impacts on children (Aquilino, 2006; DeGarmo, 2010; Adamsons and Johnson, 2013), we argue there are benefits to understanding and improving parenting among fathers who misuse opioids. Indeed, even in the context of social disadvantage, positive father involvement is related to a host of positive outcomes for children (Cabrera et al., 2000; Gordon et al., 2012; Adamsons and Johnson, 2013; Higgs et al., 2018).

Recent work has highlighted the need to accelerate the pace of science for parents who misuse opioids in order to rapidly improve the lives of children and families affected by the rise in opioid use in the United States (Cioffi et al., 2019). To accelerate the pace of science specifically for fathers who misuse opioids, this paper describes the extant research on fathers who misuse opioids and highlights the opportunity to use and adapt existing fathering interventions to improve fathering practices among fathers who misuse opioids while simultaneously filling gaps in basic scientific knowledge about this population. Throughout this report, we broadly define fathers who misuse opioids as those who misuse a class of drugs that include heroin, synthetic opioids such as fentanyl, and pain relievers available legally by prescription, such as oxycodone, hydrocodone, codeine, morphine, and others.

FATHERING AND OPIOID USE

Importance of Father Involvement

Quality father involvement across contexts and father residency status has been associated with improved child social, emotional, behavioral, and academic outcomes (Adamsons and Johnson, 2013; Lee and Schoppe-Sullivan, 2017; Suizzo et al., 2017; Higgs et al., 2018). Involving fathers early in processes related to child welfare—including involvement in the child's case plan and enrollment in parenting, mental health and behavioral health treatment and other necessary supports to promote reunification and general father involvement—improves the father-child relationship. In turn, improved father-child relationships are related to better child behavioral health outcomes (Gordon et al., 2012). Additionally, given the high levels of co-morbid mental health and high rates of mortality experienced by parents with opioid use (Skinner et al., 2012), a father may be the only biological parent available to provide care for their child in the event that a child has been removed from custodial care of their biological mother or their mother is deceased.

Individual Father Characteristics and Context Associated With Elevated Risk

Parents living with opioid misuse are at high risk for incarceration, family disruptions, health problems, and financial hardship (Skinner et al., 2012; Austin and Shanahan, 2017). However, research on drug abuse with men has largely neglected the role of fathering, parenting roles, and parenting status for these men (Phares, 2002; McMahon et al., 2005). Moreover, our understanding of the unique effects of opioid misuse on fathering behaviors is even more limited than our knowledge base for mothers. Within the preventive intervention and treatment research, fathers are vastly underrepresented in studies of parent training, with only a handful of studies including father-related outcomes (Panter-Brick et al., 2014). Even less is known about fathers who do or do not misuse opioids and what mechanisms are unique to opioid use that interfere with effective parenting.

The research on fathers who misuse opioids clarifies that these fathers are more likely to have experienced childhood adversity (e.g., a parent who used substances, physical abuse, foster care involvement) and early-onset substance use (Back et al., 2011; Marotta, 2017), and, if in recovery, may be facing challenges due to detoxification or withdrawal, financial instability, and family instability (e.g., marital problems, lack of family support; Bawor et al., 2015; Renk et al., 2016). Additionally, there are marked differences between men and women who misuse opioids, suggesting increased susceptibility as a function of gender. Compared to women, men are more likely to need treatment for polysubstance use and injection drug use, less likely to drop out of treatment (unless exhibiting "heavy use"), and less likely to experience psychological challenges (Back et al., 2011; Franklyn et al., 2017; Jones et al., 2017; Evans et al., 2020). Compared to mothers, fathers are more likely to be misusing opioids when they first become a parent (McMahon, 2020), and more fathers than mothers enter into drug abuse treatment (McMahon et al., 2005, 2008).

Unstable Relationships

Fathers who misuse opioids experience a myriad of relationship challenges both with their current and previous romantic partner and their offspring. Fathers who misuse opioids report a greater prevalence of violence toward their child's mother—both over the course of the relationship and in the past year—and report greater violence perpetrated against them by their child's mother (Moore et al., 2011).

Compared to fathers without a substance use disorder, fathers who misuse opioids exhibit concerning parenting behaviors and report other limitations that may affect their children (McMahon et al., 2008). Fathers who misuse opioids report lower parental efficacy, engage in fewer positive parenting behaviors—such as consistency and positive involvement—and report less satisfaction with the parenting role (McMahon et al., 2008). Additionally, fathers with greater number of post-traumatic stress disorder symptoms engage in more problematic substance use and predict a greater frequency of negative parenting behaviors and lower frequency of positive parenting behaviors (Stover et al., 2012).

When fathers—and mothers—misuse opioids, their children are more likely to misuse opioids (Griesler et al., 2019). Moreover, in the presence of father antisocial behavior and coercive fathering, father involvement may increase a child's likelihood of engaging in antisocial behavior, leading to intergenerational transmission of antisocial behavior (Jaffee et al., 2003; Dishion et al., 2004; DeGarmo, 2010). Adolescent antisocial behavior is also associated with adolescent substance use disorders (Brennan et al., 2017). Thus, it is likely that the effects of father opioid use, antisocial behavior, coercive parenting, and social disadvantage compound and result in intergenerational transmission of substance use disorder along with other behavioral challenges. Together, these findings suggest that providing support to fathers who misuse opioids is critical to mitigating potential family disruptions and long-term consequences for children (McMahon, 2020).

Father Services Involvement

Fathers are uniquely challenging to engage in parent training. A systematic review showed that 25% of parents in need of behavioral parent training do not enroll or engage in treatment when offered, and of those who do initially engage, 26% prematurely drop out, leaving fewer than half of the parents who had been identified as likely to benefit from behavioral parent training receiving appropriate treatment (Chacko et al., 2016). Father involvement is more limited than mother engagement in part because of approaches to engagement and training that are mother-centric (Panter-Brick et al., 2014; Parent et al., 2017). In this report, we illustrate and propose an intervention development and tailoring strategy for fathers who misuse opioids (DeGarmo, 2020).

The Need to Accelerate Intervention Research for Fathers Who Misuse Opioids

Although there is more to be understood regarding fathering and opioid misuse, in line with recent proposals to accelerate the pace of science for parents who misuse opioids (Cioffi et al., 2019), it is

prudent to apply existing fathering interventions to fathers who misuse opioids and simultaneously seek to answer basic science questions. Although there are existing effective medically-assisted treatments (e.g., methadone, naltrexone, buprenorphine) and established cognitive behavioral therapies for individuals who misuse opioids (Lam et al., 2009)—including some that have been directly tested among fathers who misuse opioids—we know of no evidence-based programs that are specifically tailored for fathers who misuse opioids.

Additionally, research is needed to understand more about the unique lived experiences of fathers with opioid use disorder and how fathers who misuse opioids may differ from; (a) mothers who misuse opioids, (b) fathers with other substance use disorders, and (c) fathers without substance use disorders. Research is also needed to understand how race and socioeconomic context intersect with these differences. Understanding the lived experiences of fathers who misuse opioids and the differences between fathers who misuse opioids and other populations will provide information on how interventions can be adapted and developed to improve fathering outcomes for fathers who misuse opioids. However, there is limited time to conduct basic research when there is an imminent need to improve outcomes for parents who misuse opioids (Cioffi et al., 2019). Thus, there are opportunities to incorporate basic science questions into intervention research and for existing fathering interventions to be adapted for fathers who misuse opioids to facilitate recovery and improve parenting practices among fathers who misuse opioids.

ADAPTING AND TAILORING EXISTING PROGRAMS FOR FATHERS WHO MISUSE OPIOIDS

We have outlined a summary of considerations for tailoring existing parenting interventions to fathers with opioid misuse in **Table 1**. We include individual characteristics and context, father relationships, and father engagement with services. We describe recommendations for potential adaptations for fathers who misuse opioids in line with each of these considerations in the following section. We proposed that to effectively tailor these interventions for fathers, adaptation must (1) build individual capacity through a father-centric theoretical model; (2) build relationships from a strengths-based perspective, including an emphasis on the positive effect of quality father involvement; and (3) address barriers to father engagement.

Building Individual Capacity
First, father-centric frameworks relevant for fathers include attachment theory for fathers of infants (Ramchandani et al., 2013), social interaction and learning theory for children ages three and above (Patterson, 1982; Lewis and Lamb, 2003), and identity theory for fathers of children across the life course (Fox and Bruce, 2001; Henley and Pasley, 2005). In a county representative sample of 231 divorced fathers, for example, salience of the fathering identity and positive fathering involvement were causally associated with reductions in father

substance use over time (DeGarmo et al., 2010). Although mother-centric views surrounding father substance use highlight increased stress on the mother—such as making it more difficult for the mother to quit, contributing to financial instability, and affecting the child (e.g., secondhand smoke, inadequate food or shelter, lack of father-child interaction; Magnus and Benoit, 2017)—father-centric views focus on how to increase father affiliation to their fathering role. For fathers with opioid misuse, this includes helping fathers regain control of their father identity by stimulating rewarding parent-child interactions and highlighting the positive emotional impacts of fathering on the child (Williams, 2014). In line with identity theory, enhancing the fathering role may have the benefit of shrinking father self-identification as an "addict" and reducing father substance use. To facilitate positive father self-concept, interventions must consider how to alleviate father guilt and shame about issues such as unpaid child support, prior absence, limited access to their child, previous negative or abusive interactions with their child, and their identity as an "addict" or former drug user. Additionally, fathering can play a protective role by increasing the likelihood that men will engage in treatment and sustain abstinence following treatment (Stover et al., 2011, 2018).

Strengths-Based Relationship Building
Second, strength-based treatments increase engagement, whereas interventions based on deficit models (i.e., emphasize fathering flaws needing corrective action) are averse to fathers and threaten participation (Panter-Brick et al., 2014; Lechowicz et al., 2019). Programs that raise awareness of fathers' developmental effect on their children build father motivation. This type of approach builds rapport and trust and frames those services or treatments as a partnership working with fathers rather than working on fathers (Pfitzner et al., 2017). For example, in clinical treatments with fathers who are involved with child welfare, these fathers are responsive to interventions raising awareness of fathers' impacts on their children and interventions that emphasize the value of fathers' contributions to children's well-being (Guterman et al., 2018). This includes providing opportunities for positive parent-child interactions, supportive peer relationships, and parenting knowledge and skill acquisition opportunities (Usher et al., 2015). These differing skills will vary across the child's lifespan. For example, interventions specific to infancy may include skills related to safe infant care and bonding strategies; interventions in toddlerhood through childhood may focus on positive engagement strategies, healthy boundaries, and consistency; and in adolescence, may focus on autonomy support, building relationships, and parental monitoring.

Repairing and restoring other relationships beyond the parent-child relationship is also important for fathers in recovery. For example, attempts to reduce domestic violence and improve parenting among fathers who misuse substances have been successful (Moore et al., 2011; Stover et al., 2019).

Addressing Barriers to Father Engagement
Finally, barriers to father engagement in parenting interventions include scheduling conflicts and timing, transportation and childcare, fatigue, motivation, stigma, and geographic location.

TABLE 1 | Parenting intervention adaptations for father who misuse opioids.

Domain	Considerations	Potential adaptations
Building individual capacity	• Co-morbid mental health challenges • Polysubstance use • Financial instability	• Managing stress and emotions, therapeutic support • Managing intrusive thoughts related to substance use cravings • Leveraging peer support to connect fathers to resources, provide food and housing vouchers, case management, and service navigation support
Relationship barriers	• Domestic violence • Possible separation or divorce • New, potentially unstable romantic relationships • Relationships with other people in recovery (e.g., mentor or sponsor, peers) • Father-child relationship marked by instability (e.g., removal, frequency of visits), changing norms or expectations, children at-risk for greater behavioral challenges	• Therapeutic support to rebuild relationships • Managing conflict and communication with child's other parent • Protecting child and recovery in the context of new relationships • Peer support to facilitate intervention engagement • Making the most of short visits, managing transitions, importance of consistency in parent behavior
Barriers to engagement	• Criminal justice involvement • Child welfare involvement • Behavioral treatment (inpatient or outpatient) • Standalone medication-assisted treatment (MAT)	• Balancing multiple commitments and communication • Integrating parenting skills into programming, delivered by counselor in-person or virtually or delivered on a mobile device outside of treatment hours • For MAT, short mobile-delivered sessions that can be delivered at the same time as a dose receipt

There is a need for interventions to address barriers related to socio-economic status and system involvement (Usher et al., 2015). This may include peer supports to help fathers balance multiple commitments and offering services in multiple modalities such as web-based or in-person as well as offering services at the same time other services are being accessed. Childcare and meals may also reduce barriers to father participation, both in research and in practice.

To illustrate an approach to tailoring an existing parenting intervention to fathers who misuse opioids, we turn our attention to an adaptation of the Fathering Through Change intervention (FTC) to provide an example of tailoring and accelerating the pace of science for this population.

TAILORING THE FTC FOR FATHERS USING OPIOIDS

Multiple parenting programs exist that show strong efficacy for improving parent self-efficacy and child behavioral outcomes [e.g., Family Check-Up (Dishion et al., 2003); Strong African American Families (Brody et al., 2006); Familias Unidas (Pantin et al., 2009; Sandler et al., 2011; Logan et al., 2014; Allen et al., 2016)]. Others have been tailored specifically for fathers, such as the Incredible Years and Triple P (Sanders et al., 2000; Webster-Stratton et al., 2004; Fletcher et al., 2011) or include fathers, such as Supporting Father Involvement and Family Foundations (Cowan et al., 2007; Feinberg et al., 2009). One example of a well-established, efficacious parent training program is Parent Management Training Oregon

(PMTO). PMTO is a parent training program that has been tailored for at-risk fathers navigating the transition to the stepfather relationship (DeGarmo and Forgatch, 2007), the transition in and out of deployment cycles for military families (Gewirtz et al., 2018a,b), and for fathers navigating martial separation (DeGarmo and Jones, 2019). PMTO is recognized on numerous evidence-based practice registries and is based on social interaction learning theory, a moniker that reflects the merging of social interaction, social learning, and behavioral perspectives. Social interaction learning theory addresses ways that coercive behavioral patterns for parent-child interactions become established, maintained, and grow through reinforcing contingencies. PMTO intervention entails teaching parents how to rearrange and manage contingencies that shape children's behavior, specifically by promoting positive reinforcement of desired prosocial child behaviors and learning to eliminate coercive parenting strategies. PMTO has obtained medium to large effect sizes for observed and reported parenting behaviors and observed and reported child behaviors (DeGarmo et al., 2004; Forgatch and Patterson, 2010). FTC is a web-based adaptation of PMTO for fathers who are divorced and separated (DeGarmo and Jones, 2019). We are currently testing the feasibility of offering FTC to fathers who misuse opioids since it is web-based (i.e., suitable to the current pandemic context) and has already been tailored for fathers in particular. Thus, we consider how to tailor FTC to fathers who misuse opioids. To tailor the FTC for fathers who misuse opioids, it is critical to consider individual father characteristics and context, relationships, and engagement with services (**Table 1**).

Tailoring to Build Individual Capacity

From a recovery capital perspective, substance use recovery is best understood as a contextual model that includes the "depth and breadth of internal and external resources" a parent has access to in order to initiate and sustain recovery from psychological and behavioral maladies (Kelly and Hoeppner, 2015). Simply put, recovery capital is the total sum of support resources for the recovery process. Thus, providing parenting supports independent of the fathering context is likely to be unsuccessful to achieve optimal parenting and recovery outcomes. For example, initial and ongoing engagement for fathers who misuse opioids can be particularly challenging (Lechowicz et al., 2019), therefore, there is growing integration of peer support specialists into addiction recovery services. Peer support specialists can also be trained as a coach to help problem-solve life challenges and are also effective for increasing the likelihood of abstinence (Barlow et al., 2014; Ashford et al., 2018). They can also provide connections to resources such as food and housing vouchers and case management.

Additional adaptations may include strategies to help prevent relapse in fathers with opioid misuse. A range of effective and promising treatment strategies exist to prevent relapse including Cognitive Behavioral Therapy (CBT), motivational interviewing, Twelve-Step Facilitation Therapy, community reinforcement approach, and Mindfulness-based strategies for relapse prevention (Morin et al., 2017; Ray et al., 2020). Skills taught in these evidence-based programs can be provided in modules specific to stress-reduction and craving management and principles can be embedded within modules to add depth to parent-training. For example, fathers with opioid misuse may benefit from CBT approaches to manage their anxiety symptoms triggered by stressful parenting encounters, prior to engaging with their child to address behavior.

Tailoring to Build Relationships

Emphasizing the importance of fathers and the father-child relationship is critical to mitigate shame and guilt and increase father engagement and identity salience. This strategy may be especially important for addressing opioid abuse. Approaches that address father relationships within the whole family context, including strategies aimed at repairing relationships and addressing domestic violence, if present, increase father engagement in treatment, improve family relationships, and reduce long-term opioid misuse (Fals-Stewart and O'Farrell, 2003; Stover et al., 2019).

Peer support specialists may also be beneficial for building relationships and navigating parenting concerns for fathers with opioid misuse. Engaging a peer support specialist who has lived experience as a father may help facilitate initial intervention uptake and ongoing engagement with parentingsupports. Additionally, peer support specialists may help the father navigate other interpersonal relationships such as those with a child's other caregiver(s) and provide a bridge to additional therapeutic resources to help facilitate community and healthy relationship building.

Tailoring to Address Barriers to Engagement

FTC for fathers in recovery should consider a variety of settings. For example, nesting delivery in a group-based setting in intensive outpatient, day treatment, or inpatient programs may promote collective support and problem-solving. Skills could also be delivered one-on-one in counseling sessions or a blend between these two approaches. However, a limitation of integration into treatment settings is that it is rare for fathers to have the same access to childcare or ability to bring their child to inpatient treatment, something which is still limited but more available for mothers. Alternatively, some fathers may be receiving medication-assisted treatment and no behavioral treatment. In these instances, brief interactions may increase engagement and mobile-based delivery may be optimal. Mobile-based delivery could also be used following treatment to reinforce skills and provide access to ongoing support.

CONCLUSION

We have described the extant research on fathers who misuse opioids and used FTC as an example of how to adapt existing fathering interventions to improve fathering practices among fathers who misuse opioids while simultaneously filling gaps in basic scientific knowledge. It is prudent to direct our resources to simultaneously test existing fathering interventions among fathers who misuse use opioids and gather basic science information about this population in order to accelerate the pace of science for families affected by opioid misuse.

AUTHOR CONTRIBUTIONS

CC wrote the first draft of the manuscript. DD wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

FUNDING

ACKNOWLEDGMENTS

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Dynamics of Parental Opioid Use and Children's Health and Well-Being: An Integrative Systems Mapping Approach

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The seemingly intractable opioid epidemic compels researchers, the media, and families to better understand the causes and effects of this complex and evolving public health crisis. The effects of this crisis on people using opioids, maternal prenatal opioid exposure, and neonatal abstinence syndrome are well-documented, but less is known about the impact of caregivers' opioid use on children's health and well-being. One challenge to understanding the effects of parental opioid use disorder (OUD) on child and adolescent outcomes is the numerous interrelated pathways in which a child's health and well-being can be impacted. To better understand these dynamic relationships, we applied a systems mapping approach to visualize complex patterns and interactions between pathways and potential leverage points for interventions. Specifically, we developed a causal loop diagram system map to elucidate the complex and interconnected relationships between parental OUD, social determinants of health at the family and socio-environmental levels, family strengths, social supports, and possible adverse impacts on children's physical and mental health and risks for future substance misuse. The goals of this research are to (1) identify factors and dynamics that contribute to the relationship between parental OUD and children's health and well-being and (2) illustrate how systems mapping as a tool can aid in understanding the complex factors and dynamics of the system(s) that influence the well-being of children and their parents or primary caregivers.

Keywords: opioid use disorder, systems mapping, parenting, children's health, systems thinking, substance use

INTRODUCTION

The adverse physical and behavioral effects of the opioid crisis for adults with opioid use disorder (OUD) and their infants are well-documented, but less is known about the effects of a caregiver's opioid misuse on child and adolescent health and well-being (Peisch et al., 2018; Winstanley and Stover, 2019). One challenge to understanding the effects of parental OUD on child and adolescent health outcomes includes the numerous interrelated pathways by which parental OUD can affect a child. Yet, distinguishing the various

ways parental OUD may impact a child's health and well-being is critical to identifying opportunities to intervene with treatment, prevention, and support strategies.

To better understand these relationships, systems thinking principles and tools can be utilized to help diverse groups of stakeholders build a shared picture of a complex issue, across what are often siloed, reinforced perspectives, and boundaries. This shared picture includes developing an agreed-upon definition of the issue, the systemic structure and elements at play, and how those elements potentially influence, and feed back into each other. Accordingly, systems mapping is a collaborative, visual tool that makes more explicit the complex relationships, interactions, and pathways contributing to the outcomes, potential upstream intervention points to increase desired outcomes, as well as potential unintended effects of interventions (Arnold and Wade, 2015; Manteuffel et al., 2019). In this way, systems maps can help identify the elements that contribute to parental use and misuse of opioids, risk factors for developing an OUD, factors that can sustain cycles of substance misuse, intervention points for breaking such cycles, and potential pathways leading to adverse outcomes for both parents and children.

In this study, we develop one type of systems map-a causal loop diagram-to display a high-level, holistic depiction of some of the interconnected relationships between OUD, parenting, social determinants of health (SDoH), family health and environment, and children's health and well-being. The goal of this study is to further the understanding of dynamics in this complex, boundary-spanning issue by (1) identifying factors that contribute to the relationship between parental OUD and children's health and well-being and (2) illustrating the systems mapping process as a tool to view the structure of the system(s) that may influence the health and well-being of children and their parents or primary caregivers. By making these structures and relationships more visible, we aim to identify leverage points in the structure where interventions may have an impact, make connections between existing research, and present where additional research can fill gaps and test new hypotheses.

Considering that many readers may be new to systems thinking in general, and that only a handful of studies have conducted systems mapping of the opioid epidemic in particular (Jalali et al., 2020), we begin by describing the basic components of systems thinking and systems mapping. We then detail the specific methodology applied to the development and refinement of the causal loop diagram that is the focus of the current study. Next, empirical evidence from the literature and themes from our discussions with subject matter experts are provided to credibly establish the various causal relationships depicted in the causal loop diagram. The paper concludes with a discussion of potential intervention opportunities, gaps in the evidence base and areas for future research, and the strengths and limitations of the causal loop diagram.

MATERIALS AND METHODS

Systems Thinking and Systems Mapping

Health promotion, including the promotion of parent and family well-being, is complex, shaped by a range of health determinants that interact and influence each other in non-linear ways and are dependent on a variety of health promotion systems (Baugh Littlejohns et al., 2018). These systems include several health and social systems that are often separated by invisible boundaries that contain distinct, yet interrelated elements which can influence each other and create feedback loops that reinforce cycles in ways that are virtuous or vicious. Delays between some of these interactions and eventual impacts mean that some relationships can be overlooked and not factored into intervention considerations. As such, many have called for systems thinking to be applied to health promotion science (Baugh Littlejohns et al., 2018). Systems thinking tools, such as maps and simulation models, have been used to study and address a variety of seemingly intractable public health challenges, including mental health services delivery, childhood obesity prevention, tobacco control, the opioid epidemic generally, and regional health system transformation (Homer et al., 2016; Zimmerman et al., 2016; National Cancer Institute, 2017; Powell et al., 2017; Manteuffel et al., 2019).

Problem-solving using systems thinking involves identifying and characterizing often invisible interactions, feedback loops, and information delays among system elements (components or variables of a system) that, together, determine the behavior of the system(s), and ultimately health outcomes (Currie et al., 2018). Rather than analyzing system "elements" individually, systems thinkers synthesize the relationships within and between elements to understand how they come together to produce the outcome(s) of interest. For example, a systems approach to identify why a health system is experiencing a spike in medical errors would not focus on characteristics of the individual provider, but rather on the structure of the system that may be producing the outcome (e.g., financial structure that incentivizes seeing more patients in a day, vs. a structure that incentivizes quality of health outcomes) (Currie et al., 2018). In this way, a systems map can support more informed choices by expanding traditional siloed practices and mental models and identifying potential trade-offs and advantages of proposed interventions that may be cross-cutting within a system (Goodman, 2018).

Systems thinking is a particularly valuable approach in health promotion as it helps reframe poor or beneficial health outcomes away from the individual unit (person, family), to the broader system(s) at play that produce outcomes within certain populations. This is especially relevant when examining the contributors and impacts of OUD or substance use disorder (SUD) more broadly because it requires us to think about what factors may be driving and perpetuating cycles of substance use and adverse childhood experiences (ACEs)-not just how we can intervene or prevent misuse or harm at the individual level. Using this mindset, we can begin to think about shifting the system to improve outcomes for parents, caregivers, children, and our communities.

Approach and Process

Using a systems map to illustrate the complex dynamics influencing parental OUD and child health and well-being was inspired by the Georgia Health Policy Center's (GHPC) earlier work applying systems thinking. GHPC has used systems thinking and mapping to address a variety of public health

concerns, including childhood obesity, neonatal abstinence syndrome, and children's behavioral health in Georgia. Specific to this topic, the center previously developed a systems map to describe the elements contributing to—and perpetuating—the opioid epidemic (see **Supplement 1**). GHPC's original opioid systems map describes the pathways from opioid use and misuse to individual and potential intergenerational outcomes (Manteuffel et al., 2019). Specifically, the map describes pathways through which people move into and out of (as well as back into) prescription and illicit opioid use and misuse, alternative treatment with or without opioid prescriptions, incarceration, death, as well as treatment and paths to stabilized recovery. The map also includes hypothesized intergenerational effects from persons misusing opioids as contributors to ACEs of their children, and the feedback loop from these experiences (with a delay) to next generation opioid or other substance misuse, as well as the contextual contribution of SDoH. The call for research on the connection between parental OUD, parenting, and child health and well-being provided an excellent opportunity for GHPC to take a more focused approach in one area depicted in the earlier opioid systems map—potential intergenerational risks for OUD. Our interdisciplinary team of researchers with expertise in behavioral health (child and adult, including OUD and SUD), sociology, Health in All Policies, SDoH, and systems thinking collaborated to develop one type of systems map, a causal loop diagram, to explore these dynamics.

What Is a Causal Loop Diagram? Why Is It Used? How Do You Read It?

Causal loop diagrams begin with asking why certain phenomena occur, what variables and relationships are involved, and where feedback mechanisms are located that might promote or interrupt the outcome(s) desired (Haraldsson, 2004). They are comprised of four components which, together, shift the focus from linear relationships to more realistic interdependent relationships that can help illustrate the behaviors of the system (Haraldsson, 2004): primary variables, arrows, feedback loops, and delays (Lannon, 2012).

1. Stakeholders identify and agree upon *primary variables*.
2. *Arrows* show relationships between variables and flow from cause (tail) to effect (arrowhead). An (S) label assigned to an arrow indicates the two connected variables change in the same direction, and an (O) label indicates the two connected variables change in the opposite direction. For example: (S): When X increases, Y increases; or when X decreases, Y decreases. (O): When X increases, Y decreases; or when X decreases, Y increases.
3. *Feedback loops* are created from interactions between variables (often, a focus for potential interventions). The directional relationship of variables creates two types of feedback loops: balancing and reinforcing. Balancing loops (B) attempt to bring things to and maintain them in a desired state, often referred to as stable or stubborn parts of the system. A change of a variable in one direction then counters the change of a related variable in the opposite direction. An oft-cited example in systems thinking literature is a thermostat regulating

the temperature in a house (Haraldsson, 2004). Another is hunger and food consumption. As hunger increases, food consumption increases (S), which then decreases (O) our hunger. Reinforcing feedback loops (R) occur where a change in one direction creates change in the same direction, thereby compounding change in that direction (think of a snowball rolling downhill as an example of compounding growth). Reinforcing feedback loops are often referred to as virtuous or vicious cycles (Baugh Littlejohns et al., 2018). One common example for a reinforcing loop is a bank account: money is deposited into a savings account, the account then generates interest, the interest then increases (S) the amount of money in the savings account, and the higher bank account balance increases (S) the amount of interest earned, and so on (Lannon, 2012). A vicious cycle has the opposite worsening effect.

4. *Delays* occurring between interaction and outcome. All systems have delays, which can range from seconds to years, and cause fluctuations in systems. A delay occurs when an interaction between two variables takes more time to produce an outcome than the rest of the system. For example, it takes time (which can vary) between turning on a shower and for the water that flows to become hot (Haraldsson, 2004). Another example is the delay between a child's exposure to one or more ACEs, and later known potential outcomes to appear.

Two causal loop diagramming rules are important to note. First, because causal loop diagrams are intended to identify and help explain the direction, (S) or (O), of relationships between variables, the variables should represent quantities that can vary over time to allow for statements that an increase in one variable will increase or decrease a related variable (Kim, 1992). As such, the variables we include in our causal loop diagram are framed in terms of "quality of," because quality can vary over time; otherwise, it would be difficult to quantify the relationship between the variables. Second, it is recommended to use a positive sense of the variable name when possible (e.g., increasing or decreasing well-being is clearer than increasing or decreasing illness) (Kim, 1992).

Developing a Causal Loop Diagram Systems Map

Our causal loop diagram was developed through an integrative, multistage process. In preparation for the first stage, the team reviewed the original GHPC opioid systems map and participated in an interactive mapping session facilitated by an external systems mapping expert. In the mapping session, the team began by identifying variables that play a role in three key domains: (1) risk of developing an OUD, (2) parenting abilities, and (3) child health and well-being. We then focused on variables that appeared to interact with and connect across multiple domains. The challenge then became understanding and visualizing connections among each variable and capturing the progression of these relationships over time and across generations. By the end of the session, the team had developed several draft maps to illustrate the complex relationships between

parental OUD, family health and environment, SDoH, and child health and well-being.

In stage two, the team conducted a supplemental review of existing gray and peer-reviewed literature to identify the extent to which the literature supported (or conflicted with) the proposed causal pathways in the draft maps, as well as where gaps in research on potential causal pathways remain. To review the impact of OUDs on parenting in the context of child health and well-being and SDoH, we searched the following electronic databases: Google Scholar, JSTOR, PubMed, and ScienceDirect. Keywords used were *opioid use disorder*, *substance use disorder*, *parenting*, *parenting stress*, *family health*, *family functioning*, *social determinants of health*, *health inequities*, *child welfare*, *child maltreatment*, *adverse childhood experiences*, *child and adolescent development*, *child and adolescent mental health*, and *child and adolescent well-being*. We also checked reference lists and articles which cited relevant works. The findings from this stage of the literature review were used to combine pieces of the draft maps into a single causal loop diagram.

To leverage the dialogue systems thinking promotes among stakeholders that are often siloed, in stage three, the team further tested and refined the map through an interactive session that convened a diverse group of external subject matter experts in OUD, child and adolescent development and well-being, and ACEs, as well as individuals involved in the treatment and implementation of interventions for populations with OUD. Participants included three members of leadership in state programs focused on addictive disease treatment, prevention, and coordination; and four academic researchers with subject area expertise in child development, child welfare and maltreatment, maternal substance use, and synthesizing research to promote effective treatment and prevention strategies. One of the subject matter experts is a person in recovery whose lived experience brought a critical perspective to the development of the map.

At the convening, members of our research team provided a brief overview of our systems mapping approach, including a review of causal loop diagrams and an explanation of the relationships and dynamics presented in the map. The subject matter experts were then asked to provide feedback on their interpretation of the map, the appropriateness of relationships, guidance on the placement of map elements, and what variables should be included or excluded from the map. Their input was critical to informing the next phase of our literature review, making further revisions to the map, and helping the research team frame the contributions of the map within the existing body of research.

RESULTS

Causal Loop Diagram Systems Map

Our causal loop diagram and an interpretation of each map element is provided in **Figure 1** and **Table 1**, respectively. In **Figure 1**, we identify primary variables, a series of unidirectional and bidirectional relationships between variables (represented by arrows), as well as reinforcing feedback loops that capture the mediation and interaction between multiple variables in

the map. While we do not include any balancing loops in our casual loop diagram, we consider substance misuse as a balancing loop. In this loop, there is a physical need for a substance, taking the substance to meet this need returns the individual to physical equilibrium until the substance level attenuates in the body, triggering the cycle of use to begin again (Stringfellow, 2019). The causal loop diagram also includes one delay to represent a period of time between a state of health and well-being during childhood and risk of developing an OUD later in life. The relationships between elements portrayed in the causal loop diagram are supported and informed by findings in the literature and discussions with practitioners and researchers with expertise in child welfare, child development, and substance use treatment and prevention. We first address how input from subject matter experts was incorporated throughout our mapping process. Next, we discuss the mapped relationships and the literature corroborating the dynamics in the causal loop diagram.

Subject Matter Expert Input

Feedback from our convening of experts was used to revise our initial causal loop diagram map and the focus of our literature review exploring the mapped relationships. The subject matter experts made significant suggestions and recommendations for changes in the causal loop diagram. Discussions on what the variables and elements of the map represented was an important part of our convening. While having a diverse group of experts involved in the discussion was desired to develop a map that aligned with systems thinking objectives, everyone came to the table with their own understanding and interpretations of what the terms used in the map meant. Once we were able to reconcile the varying perspectives, the subject matter experts involved in policy and programmatic decision-making encouraged the team to clearly define terms utilized in the map, which resulted in the creation of **Table 1**.

The subject matter experts also advised our team to include research that focused more broadly on SUDs, not just OUD. As a result, in the discussion of the map components, supported by the literature review, every relationship depicted in the causal loop diagram includes information on SUDs followed by specific information on OUD effects. Expanding the review to include other SUDs enhances the generalizability of the causal loop diagram and reminds us to consider how the mapped relationships also impact parents and families affected by other types of substance misuse. The subject matter experts also emphasized that children have varying needs throughout their life cycle and encouraged us to explore research on the effects of parental SUD and OUD on child health and well-being at different ages.

Based on our discussion with the subject matter experts, some substantial changes were made to the causal loop diagram presented at the convening (see **Supplement 2**). Changes to the map included adding an overarching social support component to capture the influence of social networks and supports on reducing stressors for parents, caregivers, and children; adding a feedback loop to illustrate the reinforcing relationship between SDoH on risk of developing an OUD; making the relationship

FIGURE 1 | Casual Loop Diagram: Relationships between parental OUD and child well-being.
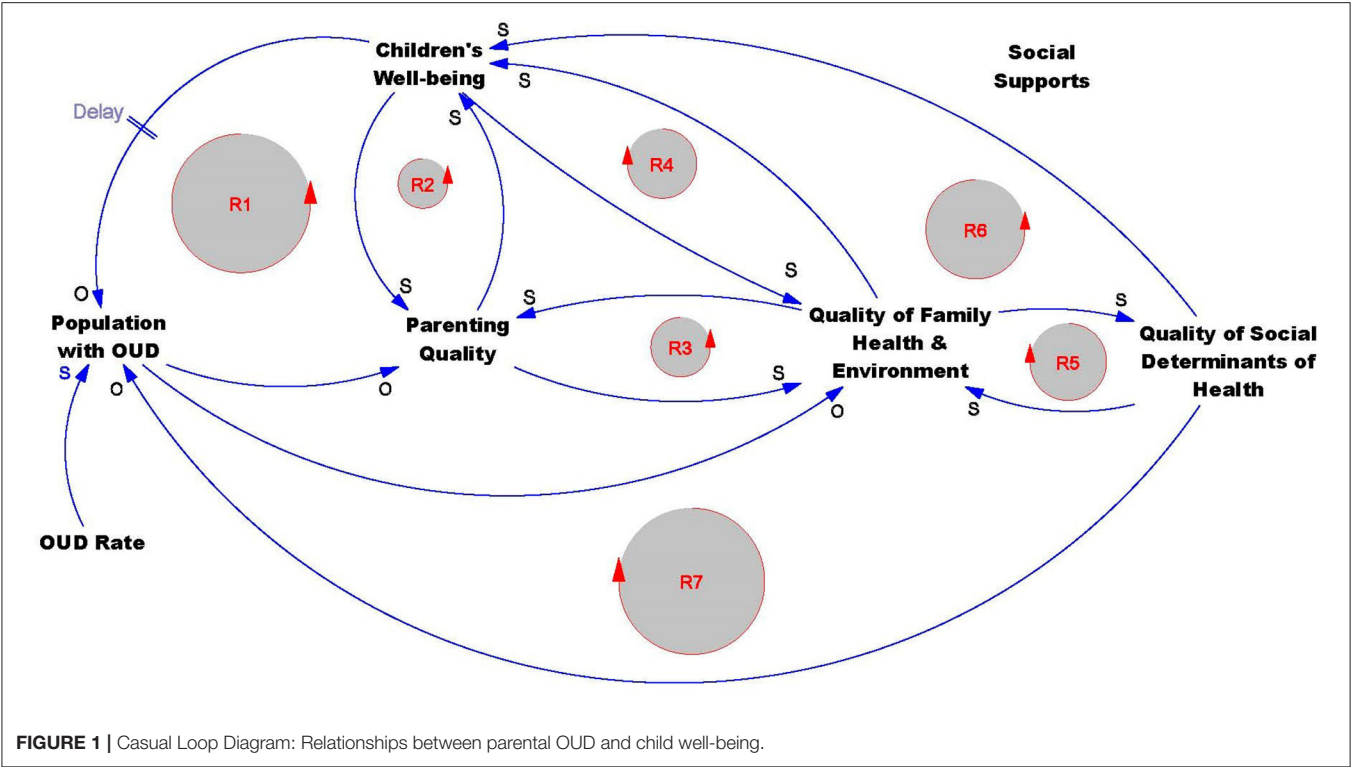
TABLE 1 | Casual loop diagram elements and definitions.

Map element	Definition
OUD rate	OUD rate is a measure of the prevalence of OUD. Specifically, it is the number of individuals diagnosed with an OUD per 100,000 individuals in the United States' population for a given year.
Population with OUD	A given OUD rate results in a population with OUD. Use of the term *population* acknowledges the varied social, economic, and demographic makeup of the individuals living with OUD and moreover recognizes that OUD is a social problem requiring numerous types of interventions (Salmond and Allread, 2019).
Quality of Children's Well-being	Child health and well-being is a multidimensional construct that encompasses the dynamic process of a child's physical, mental (cognitive, psychological), social, and material/economic situation as an outcome of intrapersonal, interpersonal, societal, and cultural processes (Pollard and Lee, 2003; Minkkinen, 2013).
Quality of Parenting	Parenting refers to support and promotion of a child's physical, emotional, social, and intellectual development with the goals of health and safety, preparation for life as a productive adult, and transmission of cultural values (Brooks, 2012; American Psychological Association (APA), 2021). Parenting is described by differing parenting styles, dimensions, skills, and practices (Smetana, 2017).
Quality of Family Health and Environment	Family health and environment refers to the physical and social conditions and climate of the family, including the health and well-being of family members, living situation, resources, structure and functioning, social dynamics and interactions within and outside the family. Vulnerable family environment (poor family functioning, low social support, and caregiver psychological distress) is an important predictor of children's mental health needs and functioning (Thompson et al., 2007).
Quality of Social Determinants of Health	SDOH refer to "the conditions in the environments where people are born, live, learn, work, play, worship, and age" (U.S. Department of Health Human Services, 2021) that impact health outcomes. SDOH can be grouped into five domains: economic stability; education access and quality; health care access and quality; neighborhood and the build environment; and the social and community context (U.S. Department of Health Human Services, 2021). These domains directly impact the experience of illness, the social patterning of population health and disease, and are recognized by many social scientists as the fundamental causes of disease and premature mortality (Link and Phelan, 1995; Phelan et al., 2004, 2010; Cockerham, 2013).
Social Supports	Social supports are broadly defined as the various types of help, aid, and assistance given by others that are perceived and/or received by an individual (Thoits, 2011).

between quality of parenting and family health bidirectional and adding a reinforcing loop; and making the relationship between parenting and child well-being bidirectional and adding

a reinforcing loop. The causal loop diagram presented at the convening also included a variable representing "toxic stress," but the subject matter experts recommended removing this from the

map as it was difficult to define and risked oversimplifying the ways in which SDoH contribute to child well-being.

While we were not able to capture all subject matter expert viewpoints in our definitions and mapped relationships, reflections from the experts enabled us to revise our causal loop diagram to better represent both relationships identified in the literature and relationships observed in practice. Our hope is that the diversity of perspectives distilled in this map will make it relevant to a variety of stakeholders and researchers.

Mapped Relationships

At the far left of the map, we begin with a stock *population with OUD*. In the causal loop diagram map the stock represents the accumulation of the population with OUD, which is driven by the prevalence of OUD (represented in the map as the element OUD rate). The remainder of the map's bolded components are the variables that each play an important role within the system. The map captures how the variables *parenting*, *family health and environment*, *social determinants of health*, and *children's well-being* connect with the stock population with OUD and the influence of *social supports* throughout the system. We incorporate evidence specific to parental OUD and more broadly parental SUDs to describe and support the causal loop diagram dynamics discussed in the remainder of this section.

Effects of Opioid Misuse on Parenting and Child Well-Being

To understand the ways in which parental opioid use can impact child well-being, we first examine how opioid use affects parenting. The impacts of parental OUD begin early. Newborns experience neonatal abstinence syndrome as an effect of maternal opioid or other substance use during pregnancy. Opioid use and medication-assisted treatment for OUDs during pregnancy can lead to neonatal abstinence syndrome or neonatal opioid withdrawal syndrome, specific to opioids, in some newborns (Substance Abuse and Mental Health Services Administration (SAMHSA), 2016). Infants with NAS often are born with low birth weights (Creanga et al., 2012; Patrick, 2015), may experience muscle rigidity, tremors, seizures, difficulty feeding, and be unable to regulate their core body temperature (Substance Abuse and Mental Health Services Administration (SAMHSA), 2016; Ko et al., 2017; Lynch et al., 2018). Infants prenatally exposed to opioids are often born pre-term and/or with low-birth weights, which may in turn contribute to a higher chance of developing long-term outcomes including cerebral palsy, developmental delays, and learning and behavioral problems (U.S. Department of Health and Human Services Health Resources and Services Administration (HRSA), 2014). However, known long-term outcomes of children exposed to opioids during pregnancy are still few and inconsistent (Sutter et al., 2014; Mactier and Hamilton, 2020).

Parental OUDs can also lead to an unstable relationship between parents and children and can be a predictor or consequence of child maltreatment and several maladaptive behavioral outcomes (Romanowicz et al., 2019). Parental OUDs can impair parents physically, emotionally, and mentally, which can compromise effective parenting. Parents' impaired emotional

regulation can interfere with their responsiveness to child needs. This, in turn, can affect children's socioemotional development and later health outcomes. For example, young children of parents with OUDs show greater disorganized attachment (Mirick and Steenrod, 2016), and parental opioid use is associated with increased suicide risk among adolescents (Brent et al., 2019). Parental prioritization of substance use over a child's needs can lead to unsanitary and unsafe home environments or result in a parent's separation from their child due to incarceration (Davis and Shlafer, 2017) or the child being placed in foster care (Brook and McDonald, 2009; Testa and Smith, 2009; Berger et al., 2010). Children may also witness drug-related activity and be exposed to dangerous drug-related environments (Winstanley and Stover, 2019).

Dynamics Between Parenting and Child's Well-Being

The next step in the systems map is identifying how parenting directly influences child well-being among parents with OUD. Parent-child attachment plays a critical role in healthy infant development (Alhusen et al., 2013). During secure or healthy attachments, infants learn that they can rely on their caregivers for security. A caregiver fosters a secure attachment through responsiveness, which means that the caregiver pays attention to how the child moves and vocalizes, then the caregiver makes correct interpretations of when a child is tired, hungry, or sick, and quickly responds to provide consistent care that addresses the need the child is experiencing (Eshel et al., 2006). Responsive parenting can have protective effects on child development (i.e., increasing the quality of parenting increases child well-being). One of the main predictors of how well a child thrives is having at least one stable, consistent responsive adult in their lives. Responsive relationships early in life are important for building sturdy brain architecture and for providing the buffering protection needed to prevent challenging experiences from producing a toxic stress response and negatively affecting child outcomes (Center on the Developing Child at Harvard University, 2017). In the case of adolescent development, parent-child connectedness, authoritative parenting styles, open communication, and parental monitoring are shown to have a protective effect on adolescent high-risk behaviors (DeVore and Ginsburg, 2005).

However, parental substance misuse, such as opioid misuse, can distract parents from adequately responding to their children's physical and/or emotional needs (Smith et al., 2016). Enduring failure to meet a child's basic needs constitutes child neglect (Smith et al., 2016) and can result in an insecure attachment between parent and child. To date, the literature on parental OUDs and early childhood development has largely focused on mother-child dyads. A systematic literature review of 304 unique studies by Romanowicz et al. (2019), found that in direct observation studies, mothers with OUDs are more irritable, disinterested, ambivalent, and they also exhibit greater difficulty interpreting children's cues, resulting in their children developing insecure attachments. More information is needed on the father-child dyad and the effect of paternal OUD on child outcomes.

A child's well-being and behavior can also affect parenting and parental well-being. Parents' responsibilities include meeting their child's emotional and financial needs, ensuring the child's physical safety, and teaching the child how to have socially appropriate interactions with others. These activities, particularly if a child is experiencing challenges, can result in parental stress that can affect the general well-being and health of the parent, demanding emotional energy from them and potentially resulting in damaging effects on parents' attitudes and behaviors toward children (Jennings and Dietz, 2007). Generally, this type of stress is associated with a less positive outlook on parenting and less satisfaction in the parental role (Jennings and Dietz, 2007). In populations with SUDs/OUDs, this stress can increase parent's vulnerability to substance use (Rutherford and Mayes, 2019).

Financial and psychological difficulties associated with OUDs can also contribute to increased parenting stress (Suchman and Luthar, 2001), and/or a lack of social support (Luthar and Suchman, 2000). By their nature, OUDs can impair a parent's ability to maintain employment and increase the likelihood that a parent engages in illegal activities, which may worsen financial difficulties. Moreover, when a parent with an OUD also has a mental illness, the symptoms of the mental illness can exacerbate parenting stress, and work to diminish the attachment between a parent and child (Suchman and Luthar, 2001). Psychiatric medications may also contribute to further substance misuse due to competing effects of these medications and OUD treatment medications. Buprenorphine/naloxone, one OUD medication, has a negative effect on the dopaminergic circuitry, and serotonin reuptake inhibitors (e.g., paroxetine, fluoxetine, or fluvoxamine) may impede the body's metabolization of methadone and buprenorphine, which would trigger withdrawal symptoms and precipitate relapse (Snyder et al., 2019). Also, many people with OUD have other SUDs and engage in polysubstance use. Persons who use multiple substances tend to have worse mental health symptoms and are less compliant with treatment requirements (Snyder et al., 2019).

Link to Mapped Relationships in Casual Loop Diagram
Proposed causal relationships:

- Increased opioid misuse by a parent or caregiver can decrease the quality of parenting.
- Decreases in the quality of parenting can decrease child health and well-being.
- Declines in child health and well-being can decrease parenting capabilities.

Reinforcing relationships:

- The dynamics between opioid misuse, parenting, and child well-being are also captured by a reinforcing feedback loop in the causal loop diagram (R1). In R1, an increase or decrease in one section of the loop (population with OUD, quality of parenting, or child well-being) amplifies relational effects in the other loop variables. For example, a decline in a child's well-being due to parental opioid use and a decline in quality of parenting may increase the child's risk of later developing an OUD and, if they become a parent that misuses opioids,

may decrease the quality of their parenting. This effect on the quality of parenting may in turn be a detriment to their child's well-being, perpetuating a negative cycle.
- In the causal loop diagram, reinforcing loop R2 illustrates that the relationship between parenting and children's well-being is not one-directional. Decreases in a child's well-being, whether due to physical, behavioral, or emotional matters, can create stress and challenges for parents and caretakers. Additional stressors may decrease the quality of parenting and lead to further declines in child well-being.

The causal loop diagram allows us to identify some of the distinct ways in which opioid use can negatively affect and decrease the quality of parenting and child well-being. These are some of the relationships that we may typically consider when thinking about the potential detrimental effects of parental OUD on children's health and well-being. Next, we begin to build upon these dynamics by introducing and connecting OUD, parenting, and child well-being to the other variables in our causal loop diagram.

Influence of Social Supports

In the causal loop diagram, social supports are presented as a variable but not connected to any other variable by causal arrows, warranting discussion of this important element of the map. Decades of previous research has strongly established the important role that social supports play as a mechanism that can ameliorate the impact of various adverse events on physical and mental health (Thoits, 1995, 2011; Uchino, 2006). At least three types of support are particularly salient: (1) Instrumental support, the oftentimes tangible help received in forms like financial assistance or daily help with routine tasks (Umberson et al., 2010); (2) Information support, advice and knowledge sharing that is received from others (Harvey and Alexander, 2012); and (3) Emotional support, the psychological help offered by others, for example encouragement and moral support offered during difficult times that individuals assign important meaning to (Semmer et al., 2008). Taken together, these elements of social support work to buffer against adverse outcomes of OUD.

Given the myriad protective effects that social supports provide and their presence throughout the literature that supports the elements and relationships in the causal loop diagram, we have not specifically mapped this variable to the others because doing so would render the causal loop diagram overly complex. It is possible that some may conceptualize social support as one type of a social determinant of health. We make the small but important distinction that social support networks, the linkages between the distinct set of individuals providing the various types of social support discussed above (Heaney and Israel, 2008), are more appropriately categorized as a social determinant of health, while social supports are more appropriately characterized as a mechanism through which variables act in the causal loop diagram.

Additionally, we make the distinction that these protective social support mechanisms can be conceptualized as prosocial social supports. Importantly, there are circumstances in which social supports can have unintended and even adverse consequences on physical and behavioral health outcomes

(Rook, 1990; Dodge et al., 2006). For example, the breakdown of otherwise nurturing and supportive family bonds places youth and young adults at risk for becoming homeless, and once homeless these individuals may replace their family members with new social networks that can cause and reinforce a variety of maladaptive behaviors, such as substance use and risky sexual behavior (Wright et al., 2017). Additional research has found a similar relationship in youth exiting the juvenile justice system, who needed to limit their contact with negative peer influences to reduce the temptation to reengage with criminal activity (Martinez and Abrams, 2013). These types of negative influences are not only limited to youth and adolescents. For example, research among adults in recovery has found that avoiding potentially negative influences from others engaging in substance use was necessary to reach and maintain recovery (Weston et al., 2018; Pettersen et al., 2019). Therefore, our conceptualization of social support used in the current causal loop diagram can be thought of as the aspects of supportive relationships that help rather than harm.

Effects Between OUD, Parenting, and Family Health and Environment

Parenting skills and practices can directly affect family environments and how family members interact with one another within the larger social context (Moos, 1994; Greenberg et al., 2012). The effects of parental substance misuse on children can be viewed in relation to the family environment, and can manifest in detrimental effects on the physical, psychological, and cognitive functioning of the child (Kuppens et al., 2020). Parental SUDs are associated with lower levels of supervision, poor-quality parent-child interactions, and inconsistent discipline (Dunn et al., 2002; Arria et al., 2012). As a result, environments in which one or two parents or caregivers have an SUD are often characterized as traumatic and unpredictable, directly affecting the overall well-being of the family nucleus (Arria et al., 2012). Social norms within the home influence the environment and define the acceptability of drug use; children and adolescents who witness drug use or drug-related behaviors in their environment may perceive drug use as acceptable (Hawkins et al., 1992). Prior research shows that child involvement in parental substance use (i.e., opening an alcoholic beverage or lighting a parent's cigarette) is a predictor of child substance use (Bailey et al., 2018).

Link to Mapped Relationships in Casual Loop Diagram
Proposed causal relationships:

- Declines in the quality of parenting can decrease the quality of the family environment and health.
- Declines in the quality of the family environment and health can lead to decreases in the quality of parenting.
- Presence of OUD can decrease the quality of the family environment and health.

Reinforcing relationship:

- R3 in the causal loop diagram captures the reinforcing effects that parents and the family health and environment have with one another. For example, declines in the quality of a

family's health and environment may generate stressors that further reduce parenting quality, which then feeds back into the dynamics at home leading to declines in family health.

Relationship Between Family Health and Environment and Children's Well-Being

While the interaction between parenting and family health and environment affects children's well-being, parenting itself does not mediate for all the dynamics between family health and environment and children's well-being. Separate from parenting, these two factors interact and influence one another. For example, household chaos, defined by disorganization or environmental confusion in the home and a variable of family health and environment influences children's well-being. Household chaos may include high levels of background stimulation, overly fast-paced family life, and lack of family routines, and is linked with caregiver education, family income, and the number of people living in the household (Marsh et al., 2020). Lower family income and higher number of individuals living in a household are correlated with higher household chaos, which is specifically related to adverse childhood outcomes including poor social-emotional functioning, cognitive development, academic achievement, and behavioral problems (Martin et al., 2012).

The effect of children's well-being on family health and environment can be seen in the relationship between children with disabilities and family health/environment. Children with disabilities may influence family health and environment positively by teaching family members positive characteristics. For example, siblings of children with Down or Rett Syndrome show positive personality traits including increased tolerance of difference, a compassionate nature, and increased maturity in comparison to their peers (Stoneman, 2005). Conversely, disadvantages to family health and environment also exist. Caregivers and families to children with disabilities report financial restraints on family outings, material goods, and other resources, as well as societal stigma and an overwhelming sense of household responsibilities (Dyke et al., 2009).

Link to Mapped Relationships in Casual Loop Diagram
Proposed causal relationships:

- Declines in the quality of children's well-being can lead to decreases in the quality of the family health and environment.
- Decreases in the quality of family health and environment can lead to declines in children's well-being.

Reinforcing relationship:

- R4 is a reinforcing loop connecting quality of family health and environment and children's well-being.

Relationships Between SDoH and Family Health and Environment

SDoH are the conditions within a home, family, school, and community that can impact a person's ability to be healthy and include factors like socioeconomic status, education, employment, social support networks, and neighborhood characteristics (Healthy People, 2020). When health inequities

such as poverty, homelessness, or parental incarceration are present, the entire family is affected, not just the parent experiencing OUD (Chung et al., 2016).

Family health and environment are intertwined with and mediate the effects of SDoH on parental SUDs (Deatrick, 2017). Social networks, social supports, social cohesion, and social capital are important for the general physical and emotional well-being of individuals and communities. Social cohesion specifically refers to the sense of solidarity among members and social capital refers to the resources present in the community (Healthy People, 2020). For example, if a parent is unemployed, the other members of the family can assist with finances or they may have knowledge of existing job opportunities. Both resource and knowledge-sharing may lessen the effects of unemployment. By contrast, if this parent lived in an environment where the other family members were unemployed, or one had costly and recurring health-needs, the financial stress of unemployment would be more likely to severely affect the parent.

Link to Mapped Relationships in Casual Loop Diagram
Proposed causal relationships:

- Declines in the quality of SDoH can lead to decreases in the quality of the family environment and family health.
- Decreases in the quality of family health and environment can lead to declines in other SDoH.
- Both declines in quality of SDoH and family health and environment can exacerbate the effects of having a parent with OUD on parenting and child/adolescent outcomes.

Reinforcing relationship:

- R5 is a reinforcing loop connecting quality of family health and environment and SDoH. Declines in the quality of the family environment and family health can decrease SDoH. These decreases, in turn, can further lead to declines in other family health.
- Because quality of family health and environment shares a bidirectional relationship with children's well-being, quality of parenting, and quality of SDoH, a change in any of these variables will influence each remaining variable in the R3, R4, and R5 feedback loops, intensifying along the way. For example, increasing the quality of family health and environment can increase SDoH, which then can generate improvements in family dynamics that can improve the quality of parenting.

Connections Between SDoH and the Population With OUD
The literature highlights specific SDoH that are intertwined with and influence OUDs: incarceration, homelessness, and low socioeconomic status (Galea and Vlahov, 2002; Dube et al., 2003; Dasgupta et al., 2018; Barocas et al., 2019). Opioid use is higher in communities with high unemployment rates, and opioid overdoses are higher in communities with greater poverty and unemployment, and lower levels of education (Hollingsworth et al., 2017; Ghertner and Groves, 2018). High mortality rates as a result of an opioid overdose are also seen in populations that have just been released from incarceration. One study showed

that the relative risk of opioid overdose death was 40 times higher within the first 2 weeks of release than that of the general population (Ranapurwala et al., 2018). Incarceration of a parent or caregiver can cause gaps in treatment and there may not be a smooth linkage to treatment, including the provision of medication-assisted treatment upon release.

Additional SDoH like access to healthcare and medical treatment, affordable housing, food insecurity, income inequality, structural racism, racial segregation, and stigma also influence opioid use and require further research to better understand the complexity of these relationships (Park et al., 2020). Research links substance use initiation via injection to specific neighborhood-level determinants such as income inequality, racial segregation, and low educational attainment (Fite et al., 2009; Friedman et al., 2016). Public health initiatives would benefit from further research in understanding the role and severity that each various determinant play on opioid initiation, sustained use, and recovery.

Link to Mapped Relationships in Casual Loop Diagram
Proposed causal relationship:

- Declines in the quality of SDoH can lead to an increased risk of OUD.

Reinforcing relationship:

- R7 connects the population with OUD, parenting, family health and environment, and SDoH. In this loop, a parental OUD can decrease the quality of parenting and family environment and health, which then feed into SDoH through (R3) and (R5). Declines in SDoH can then increase the risk of opioid misuse and further perpetuate the negative impacts this generates at other stages in the causal loop diagram.

SDoH Effects on Child Well-Being
Child well-being is also susceptible to the adverse effects of poor quality of SDoH. For example, poverty directly affects children's physical and cognitive development, as well as educational achievements and outcomes (Brooks-Gunn and Duncan, 1997). Poverty and low socioeconomic status are associated with higher risk of mortality in infancy and childhood, the onset of chronic illnesses, and are closely linked with child mental health problems (Spencer, 2003). Opportunities exist for SDoH to serve as protective factors for child well-being when one or both parents have a SUD. Healthy social support networks positively influence child and adolescent development. Connectedness, defined as a sense of being cared for, support, and a sense belonging, is a protective factor (Camara et al., 2017). Children and adolescents who feel a sense of connectedness are less likely to engage in high-risk behaviors such as substance use, sexual or criminal activity, and instead can produce an increased sense of autonomy, access to resources and health information, and engagement in social activities (Foster et al., 2017; Steiner et al., 2019). In-depth interviews with Black youth, ages 18-24, with at least one parent using substances, found that youth were less likely to engage in risky behaviors when they felt a sense of connectedness to other family members or loved ones. These relationships (e.g., uncles, aunts, grandparents) served as protective factors, highlighting the

need for connectedness and nurturing relationships when there is an absence presented due to parental SUD or OUD (Offiong et al., 2020).

Link to Mapped Relationships in Casual Loop Diagram
Proposed causal relationship:

- Declines in quality of SDoH can decrease child well-being.
- Alternately, increases in SDoH such as increased social support networks can increase child well-being, even in an environment with parental opioid misuse.

Reinforcing relationship:

- R6 links the causal loop diagram variables parenting, family health and environment, SDoH, and child well-being. Because the relationship between each of these variables is the same (S), increasing (or decreasing) one variable in the loop perpetuates increases (or decreases) in the remaining elements.

Children's Well-Being and Risk of Developing OUD

Parental SUDs are linked to intergenerational substance misuse; having a parent with an SUD is a strong risk factor for the child or adolescent developing an SUD. Child and adolescent substance use are shown to be influenced by both genetic and environmental factors (Thatcher and Clark, 2008). A multisite longitudinal study on 295 children by Kaplow and colleagues found that lower levels of verbal parental reasoning and parental SUD are predictors of early-onset substance use for children (Kaplow et al., 2002).

Individuals with a higher number of ACEs are at greater risk for chronic disease, mental illness, violence and being a victim of violence (Felitti et al., 1998). Additionally, in studies of individuals with SUDs or OUDs, ACEs are often cited (Merrick et al., 2019). ACE scores range from zero to ten, with each type of trauma experienced by an individual counting as one point. In a study of 152 parenting women with OUDs, the total mean ACE score for the population was 4.3 (SD 2.3; range 0-8) and 65% of the sample reported having 4 or more ACEs, while only 5.0% reported zero ACEs (Gannon et al., 2020).

Link to Mapped Relationships in Casual Loop Diagram
Proposed causal relationship:

- A decline in child well-being can increase the risk of developing an OUD.
- An increase in ACEs and traumatic stress can lead to increases in the risk of developing an OUD.

Reinforcing relationship:

- The intergenerational risk of opioid misuse and reinforcing relationship between quality of parenting, child well-being, and developing an OUD is captured in R1.

DISCUSSION

Opportunities for Intervention and Leverage Points

Developing a systems map allows researchers, practitioners, and policy makers to identify potential leverage points in the system where interventions may be effective in supporting a positive relationship or in modifying a more adverse relationship. For example, identifying parents at risk for substance misuse and providing parenting skills training and support as part of their treatment may be an effective way to change the relationship between parental OUD and poor parenting skills and consequential effects on poorer child well-being. SAMHSA reports that policies and procedures that encourage parents to enter substance use treatment and consider their parenting role as a part of their recovery process help to reduce the effects of parental SUDs on their children (Lipari and Van Horn, 2017). Helping parents to be more effective and nurturing with their children may also help to alleviate some of the stress that may lead to increased substance use.

Intervening in the relationship between the quality of parenting and child outcomes may be another potential leverage point where, in addition to parent skills training, identifying other adult caregivers in the home or in the nearby community (e.g., teacher, daycare provider, etc.) who can provide a stable, consistent positive environment for the child may help to buffer some of the adverse effects of having a less responsive parent due to opioid misuse. Another potential leverage point for disrupting the cycle of parental opioid use and adverse child outcomes may be in examining and addressing the various SDoH factors that impact parental opioid use and family environment such as economic stability, education access and quality, health care access and quality, and the communities in which people live, to identify families at risk and connect them with necessary social and health services to prevent or minimize some of these adverse behaviors and outcomes. Programs that address SDoH for families at risk may have broad reaching effects that can address multiple points in the causal loop diagram that may influence both parental opioid use and the effects of this on child and adolescent outcomes.

Laying out the various potential relationships in a systems map allows critical stakeholders to discuss where the most effective places may be to intervene, to collect data to further develop and refine how these factors work together to influence child outcomes and identify where the most effective upstream or downstream interventions may lie. This information can also then inform key policies to support parents who are struggling with substance use and their children.

Strengths and Potential Limitations of the Study

Human capacity is limited in processing information reliably and accurately when that information involves elements that are interacting simultaneously (Bureš, 2017). Systems maps can help make such processes more explicit and understandable, while allowing others to share or surface their own mental models of those processes. These tools, however, do not remove the complexity of the system(s) at play, but can focus in on the parts of the system deemed relevant by those developing the map, by, for example, limiting which variables to include, or identifying the boundaries to apply in the map. A rule of thumb in systems mapping is that less is more, to start small and simple and add to the map iteratively as needed (Goodman, 2018). A more complex map may provide a more accurate representation of a system, but

that accuracy gained in adding more elements and relationships may create the problem the mapping process is designed to avoid–creating a visual that is too complicated to comprehend (Bureš, 2017).

Our causal loop diagram is intended to serve as a new way to view and learn about the complex relationship between parental OUD and child health and well-being. It is in no way complete— it does not contain all variables, relationships, or feedback loops that factor into this relationship. With the causal loop diagram as a starting point, other researchers may seek to investigate, for example, what feedback loops are missing, or which variable dynamics are the strongest to recommend where to reinforce or interrupt specific feedback loops. Additional research can also identify the quantitative data needed to develop a more complex computerized systems dynamic models to test a variety of intervention options before implementing them (for example, see Jalali et al., 2021). As such, we have developed this map to catalyze new insights and dialogues among researchers and policymakers.

We also note that the literature review and discussion with subject matter experts that supported the causal loop diagram's development were not designed or intended to be an exhaustive look at all the complex dynamics between parental OUD and children's health and well-being. The map would have benefited from additional feedback from more parents and other individuals with lived experience, particularly to support its effectiveness as a tool to promote beneficial policies and programs. Because systems maps are often iterative, we may have an opportunity to incorporate perspectives from parents, families, and children in a future version of the casual loop diagram.

We recognize that while systems mapping is a powerful tool to visualize complex relationships in a simplified fashion, in the process of creating a map important relationships or variables will be omitted. For instance, the subject matter experts suggested that the map address impacts for both children and adolescents, and the current map does not differentiate this dynamic. However, we consider the input provided by subject matter experts to be a strength and valuable contribution to our understanding of the pathways that connect parental OUD to child health and development, what disparities exist that perpetuate intergenerational cycles of misuse, and where opportunities for change may exist.

Gaps in Evidence, and Areas for Future Research

Subject matter experts who were interviewed mentioned comorbid mental health problems as significant factors related to OUDs, and this was supported in the literature. OUD is associated with comorbid psychiatric conditions, including major depressive disorder, which can also exacerbate OUD by making individuals with both conditions less likely to have psychological insight into their illness (Maremmani et al., 2007; David et al., 2008). Additionally, women, as opposed to men, are more likely to have comorbid mood or anxiety disorders (Evans et al., 2020). The scope of the current map does not explicitly capture this, although it could be considered as part of

the quality of family health. This interaction and its consequences may be worth future exploration and could contribute to a better understanding of leverage points in the map. We also note that while the majority of the feedback provided by subject matter experts was directly supported by the existing literature, their recommendation to focus on protective factors for positive parenting and child well-being was challenging; the majority of the literature focuses on risk factors. Additionally, as mentioned in our results discussion, more information is needed on the effect of paternal OUD on child outcomes and the father-child dyad to balance what is known about the effects of maternal OUD on children's health.

We would be remiss to not acknowledge the impacts of the COVID-19 pandemic on substance use, parenting, and child well-being. At the time of our subject matter expert convening, the effects of COVID-19 were already being felt by some with SUDs/OUDs, and the experts asked if this was considered in the creation of the map. While new evidence and trends continue to emerge on the impacts of the COVID-19 pandemic on OUDs and the population, as well as treatment options, this was not an element emphasized in the causal loop diagram development. It will be important to remember parents with OUDs as the pandemic has exacerbated OUDs for some, and treatment has become more difficult to obtain. The loosening of some of the restrictions on the provision of treatment, including medication-assisted treatment that has occurred due to the pandemic may need to continue (Green et al., 2020). There has already been a call to revise and modernize addiction treatment services by improving access to care, including an increased use of telemedicine services, and providing care through more integration of specialists and non-specialists in response to the pandemic (Lopez-Pelayo et al., 2020). Additionally, social supports may have been impacted by COVID-19, and targeted interventions, including an increased use of technology, could be helpful (Weaver et al., 2020). These considerations are not yet presented in the map, however, moving forward should be more fully examined, particularly as they relate to parents.

CONCLUSIONS

Using systems thinking, we developed a systems map to surface and understand the numerous, interdependent pathways by which parental OUD can impact children's health and well-being. Our aim was to: (1) create a visual map that captures the complex dynamics and elements that comprise the broader system of relationships between parental OUD and child outcomes and (2) illustrate how systems mapping can be applied to connect existing research and expertise across content areas to further our understanding this complex public health issue. Using systems thinking to address the challenge of parental opioid use and the lasting effects on children and adolescent outcomes can be an important tool in addressing the dynamic interplay among the various structures, systems and relationships involved, and in promoting critical, open dialogue around these issues.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

JS organized and managed the research team, developed the research plan, participated in map development, subject matter expert convening, map revisions, and wrote and revised a significant portion of the manuscript. LA led the systems mapping development, revisions, and subject matter expert convening, also wrote sections on systems thinking and systems mapping. BA and BM contributed to research design, wrote portions of the results section, wrote definitions for system map variables, and revised the manuscript. BM also helped lead the convening of subject matter experts. WA and JC led the literature review phases and drafted a significant portion of the results section. SS participated as a subject matter expert at our convening, reviewed, revised, added to the initial literature review findings, and revised the manuscript. AD contributed to the research design, assisted in the subject matter expert convening, provided expertise in psychology, and contributed to the writing and revision of the manuscript. KM generated the idea for this manuscript, provided mentorship to the research team, assisted in the subject matter expert convening, and reviewed and revised the manuscript. All authors contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.687641/full#supplementary-material

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Barriers and Motivators to Opioid Treatment Among Suburban Women Who Are Pregnant and Mothers in Caregiver Roles

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Women of childbearing age who misuse opioids are a particularly vulnerable population, and their barriers to treatment are unique because of their caregiver roles. Research on treatment for opioid use generally draws from urban and rural areas. This study fills a gap in research that focuses on barriers and motivators to opioid treatment in suburban areas. The aim of this study was to give voice to suburban pregnant women and mothers caring for children while using opioids. Ethnographic methods were used for recruitment, and 58 in-depth interviews were analyzed using a modified grounded theory approach. Barriers to medication-assisted treatment (MAT) included stigma, staff attitudes, and perceptions the women had about MAT treatment. Barriers associated with all types of treatment included structural factors and access difficulties. Relationships with partners, friends, family, and providers could be barriers as well as motivators, depending on the social context of the women's situation. Our findings suggest increasing treatment-seeking motivators for mothers and pregnant women by identifying lack of resources, more empathetic consideration of social environments, and implementing structural changes to overcome barriers. Findings provide a contemporary understanding of how suburban landscapes affect mothers' treatment-seeking for opioid dependence and suggest the need for more focus on emotional and structural resources rather than strict surveillance of women with opioid dependence who are pregnant or caring for children.

Keywords: opioid treatment, pregnant women, mothers, motivators, facilitators, barriers

INTRODUCTION

Over the last two decades, drug overdose deaths have more than quadrupled in number (Scholl et al., 2019). Between 2010 and 2017, opioid-related overdose deaths increased five-fold (Hedegaard et al., 2019). After a slight decrease in overdose death rates from 2017 to 2018, the introduction of synthetic fentanyl into the United States drug market resulted in a sharp rise of overdose deaths during 2019 (Lambdin et al., 2019). Recent reports from the Centers for Disease Control and Prevention (CDC) suggest COVID-19 is accelerating overdose death trends (Centers for Disease Control and Prevention (CDC), 2020). Failures in the management of the opioid crisis were

compounded after COVID-19 disrupted services, resulting in more barriers to opioid treatment (del Pozo and Beletsky, 2020; Haley and Saitz, 2020).

The opioid problem in the United States began with healthcare providers overprescribing prescription opioids (Okie, 2010; Kolodny et al., 2015; Humphreys, 2017; Ciccarone, 2019). Data show that women fill more prescriptions than men, and women are more likely than men to be given a prescription by their provider (Centers for Disease Control and Prevention (CDC), 2018; Hirschtritt et al., 2018; Marsh et al., 2018; Becker and Mazure, 2019). The CDC reports that use of prescription (oxycodone, hydrocodone) and illegal (fentanyl, heroin) opioids has risen steadily among women of reproductive age (15–44) throughout the past decade, and deaths from opioid overdose increased nearly 500% among women, more than double the rate among men (Centers for Disease Control and Prevention (CDC), 2018; Mazure and Fiellin, 2018). We know that medical opioid use serves as a stepping-stone to the use of heroin and illegal opioid analogs, creating greater risk for overdose events (Vuong et al., 2010; Whiteman et al., 2014; Kolodny et al., 2015). During the commercial lockdown and social isolation policies implemented to address the coronavirus pandemic, opioid overdose incidents increased again, particularly among minority and vulnerable populations (Ochalek et al., 2020; Slavova et al., 2020; Sun et al., 2020).

Women of childbearing age who misuse opioids are a particularly vulnerable population as they juggle their own substance dependence, pregnancy, and motherhood. To address the rising rates of overdose morbidity and mortality, there has been a shift toward medication-assisted treatment (MAT) for opioid dependence (Scholl et al., 2019; Abraham et al., 2020; Adams and Volkow, 2020). MAT has become the gold standard for opioid dependence in pregnant women (Timmermans and Berg, 2010; Klaman et al., 2017; Reddy et al., 2017; Verduin, 2017). MAT used in the United States include methadone, an opioid agonist, burprenorphine, a partial opioid agonist, and naloxone and naltrexone, which are opioid antagonists. Although pregnant women are recommended methadone, providers also recommend MAT such as Suboxone, which includes both agonistic and antagonistic properties (Meyer et al., 2015). MAT like all drug treatment for mothers is concomitant with assertive child protective interventions (Cochran et al., 2018; Lacaze-Masmonteil and O'Flaherty, 2018; Murphy et al., 2018), and fear of intensified scrutiny from healthcare providers leads women to hide their use or relapse when resources needed to cope with life stressors are not provided (Woodall and Boeri, 2013; Goodman et al., 2019; Whittaker et al., 2019; Lamonica et al., 2021).

The barriers to treatment for mothers are unique because of their caregiver roles, and they often fear government intrusion will result in loss of their custodial rights as parents (Paltrow et al., 2004; Howard, 2016; Dondorp and de Wert, 2017). Increased surveillance and stigmatization by medical staff and law enforcement present additional barriers to seeking necessary treatment (McMahon et al., 2002; Paltrow and Flavin, 2013; Olsen, 2015; Angelotta et al., 2016; Frazer et al., 2019; Honein et al., 2019).

Stigmatization is the process of labeling and stereotyping that often leads to social rejection, exclusion, and isolation, as well as internalizing discrediting attitudes perceived in others (Goffman, 1959; Chaudoir et al., 2013). Fear of stigmatization discourages women from seeking help and engaging in treatment (VanDeMark, 2007; Radcliffe, 2011; Stone, 2015). Losing custody of their children due to opioid use adds to feelings of shame and guilt, as social stigmatization increases (Howard, 2015; Knight, 2015; Lee and Boeri, 2017; Nichols et al., 2021). Parental drug abuse is the reason associated with one-third of child removal cases in the United States in 2019 (U.S. Department of Health and Human Services, 2020), creating an incentive for mothers to keep their drug use hidden (Angelotta et al., 2016).

Previous studies identified common barriers to drug treatment that include costs, access, waiting lists, institutionalized stigma, transportation, lack of social support, and isolation (Pollini et al., 2006; Redko et al., 2006; Wisdom et al., 2011; Harris and McElrath, 2012; Hammarlund et al., 2018; Kahn et al., 2019; Acevedo et al., 2020). Barriers specific to mothers also include lack of childcare services and difficulties in relational situations (Marsh et al., 2000; Frazer et al., 2019). Findings on barriers to treatment far outweigh findings on facilitators to treatment (Wisdom et al., 2011), and research on facilitators tends to focus on individual traits, such as mental health, motivation, and treatment readiness (Rapp et al., 2007; Hiller et al., 2009). Treatment readiness research on women who are mothers or pregnant is scarce (Frazer et al., 2019), and research on the impact of treatment for pregnant women with opioid dependence is evolving (McCarthy et al., 2017; Rizk et al., 2019). Research on opioid use generally focuses on urban areas or rural communities, including research on treatment for women with children (Marsh et al., 2000; Young et al., 2010; Jonas et al., 2012; Wang et al., 2013; Frazer et al., 2019; Ochalek et al., 2020). In this study, we fill a gap in research that focuses on both barriers and motivators to opioid treatment among pregnant women and custodial mothers who live in suburban areas.

In the past, suburban communities were not viewed as high-risk areas for drug research or drug treatment funding. Reports on increased opioid use and opioid-related overdose mortality rates in the suburbs (Cicero et al., 2014; Kuehn, 2014) only recently drew greater awareness of the suburbs as a risk environment for opioid use (Zoorob and Salemi, 2017; Boeri and Lamonica, 2020). Suburban towns have fewer treatment programs for women and other needed health and social services compared to cities, and residential treatment in the suburbs for women with children in their care is virtually non-existent (Allard and Roth, 2010; Lamonica et al., 2021). Reports of increased opioid dependence among women with children and pregnant women reveal an urgent need for treatment that addresses the social and familial situation of suburban mothers (Marsh et al., 2000; Maeda et al., 2014; Patrick et al., 2015; Angelotta et al., 2016; Klaman et al., 2017; Reddy et al., 2017; Boeri and Lamonica, 2020; Lamonica et al., 2021).

In this paper, we provide a contemporary understanding of how suburban landscapes affect mothers' treatment-seeking for opioid dependence. As a qualitative study, we provide verbatim perspectives from women who were using opioids while pregnant

or rearing children. Our aim is to understand the factors that motivate or discourage treatment-seeking behaviors among these women in order to inform opioid treatment and associated healthcare and social services for pregnant women and mothers of young children living in the suburbs.

MATERIALS AND METHODS

The data analyzed for this paper were drawn from the Suburban Opioid Study (SOS). The goal of the study was to fill a gap in our understanding of opioid use patterns in suburban communities where overdose mortality rates were increasing. Qualitative and quantitative data were collected using audio-recorded in-depth interviews and life history surveys. The Institutional Review Board (IRB) from the investigators' academic institutions approved the study, and a "Certificate of Confidentiality" was obtained from a federal agency to protect study data and researchers from *sub poena*. Data were collected between June 2017 and July 2019. The study sites were the suburban towns around Atlanta, Georgia; Boston, Massachusetts; and New Haven, Connecticut.

Recruitment and Participants

Ethnographic fieldwork was used to provide direct access to people who used opioids. Fieldwork consisted of spending time in areas where drug use or drug selling were observed, developing rapport with community members, and leaving study fliers with our phone number in strategic places (e.g., laundromats, bus stations, fast food restaurants, harm reduction centers) (Page and Singer, 2010). The fieldwork was occasionally aided by community consultants, who are people in the community who have knowledge of use patterns and settings of opioid use. Targeted and snowball sampling methods were used to increase diversity of race and gender (Biernacki and Waldorf, 1981; Watters and Biernacki, 1989). Eligibility criteria included (1) having misused/abused opioids at least once in the last month, (2) resided in a suburban location, and (3) were 18 years of age or older. Of the 173 interviews collected in the larger study, females represented 44.5% of the sample.

This paper is based on interviews conducted with 58 women drawn from the SOS sample who were using opioids during a time when they were pregnant or taking care of children in their custody. **Table 1** provides the demographic and social context of the women who were part of the analysis for this paper. The women ranged in age from 25 to 63 with a mean of 42.8 years. Among the sample of mothers, 63.8% were White, 20.8% identified as African American/Black, and 15.5% as Latina. Forty-four women had been involved with the criminal justice system and 45 had been homeless at some time in their lives. Almost 90% said they had been in treatment, often multiple times. The types of treatment that women experienced included MAT (82.8%), 12-step meetings (36.2%) and residential treatment (34.5%). Women discussed outpatient treatment in reference to MAT and 12-step meetings; therefore, outpatient is not distinguished in the table. Six of the women had not been in structured treatment but said

they experienced barriers to entering treatment during pregnancy and child-rearing.

Data Collection

Interviews were conducted in participants' homes, private offices, library rooms, fieldworkers' cars, parks, and other quiet places in private or public spaces. Participants were provided a consent form to read before the interview that explained study procedures, risks, and benefits. Participants gave oral consent that was audio-recorded so signatures were not required on the consent form. At no point were the participants asked to provide identifying information, such as names, addresses, or phone numbers. The audio-recorded interviews were transcribed with instructions to delete any identifying material that may have been said inadvertently. All data were further anonymized to ensure no identifying information remained.

Participants received $40 for their time at the end of the interview. Interviews lasted between two to four hours. Long interviews are typical in qualitative research conducted in environments where participants feel safe and comfortable. We used a participant-focused interview style in which a semi-structured interview guide provided questions, but we allowed participants to take the interview in different directions. Interviewees were asked to refer potential participants to call the study phone number for a small referral fee.

Data Analysis

The data analyzed for this paper focused on the sections of the qualitative interview in which the women talked about their feelings toward opioid treatment, experiences with different treatment modalities, reasons for seeking or participating in treatment, and perspectives on maintaining a treatment regime while pregnant or caring for children. While grounded theory methods have developed in different directions by the creators of this method (Glaser and Strauss, 1967; Strauss and Corbin, 1998), here we use a modified grounded theory approach, which allows for only parts of the transcripts to be coded and not a

TABLE 1 | Participant demographic and social information (*N* = 58).

Characteristic	M (range) or% (*n*)
Age Mean (range)	42.8 (25–63)
Race/Ethnicity	
White	63.8 (37)
African-American/Black	20.7 (12)
Latina/White	8.6 (5)
Latina/Black	1.7 (1)
Latina/Other	5.2 (3)
Ever CJ involved	75.8 (44)
Ever Homeless	77.6 (45)
Ever in Treatment	89.7 (52)
Types of Treatment	
MAT	82.8 (48)
12-Step	36.2 (21)
Residential	34.5 (20)
None	10.3 (6)

line-by-line analysis of the entire interview (Charmaz, 2014). Grounded theory is responsive to subjective meanings revealed by participants during the interview and meanings that emerge during analysis. Other parts of the women's interviews were used to provide more clarity or context to treatment seeking.

As is common in grounded theory methods, data analysis and data collection are conducted simultaneously (Strauss and Corbin, 1998). Coding began before all interviews were collected. The process for identifying themes was dynamic, as new codes emerged from the data. Each transcript was read and coded by at least two authors of this paper and many were coded by three. Final coding occurred after all data were collected. Coding began by reading the transcripts to identify key themes and conceptual categories underlying the subjective meanings revealed in the women's narratives. All transcripts were entered into NVivo, a software program for organizing qualitative data to make them more manageable and to enhance the reliability of the results.

Trustworthiness of the coding was achieved by frequent meetings among the authors in which emerging findings were dissected and reviewed for legitimacy using "mixed-methods triangulation" as well as "theoretical triangulation" (Renz et al., 2018, p. 827). Triangulation refers to using more than one method for data collection, or more than one theory when analyzing and interpreting qualitative data. Our mixed-methods analysis combined in-depth interviews and brief surveys to increase confidence in the data and trustworthiness of the interpretation (Plano Clark, 2010; Laenen, 2011). The qualitative data sources informing the analysis included transcripts of audio-recorded in-depth interviews, field notes, memos, and quantitative data collected with surveys. The theoretical frameworks that guided the analysis included social stigma and life course theories (Goffman, 1959; Elder, 1999; Harris and McElrath, 2012; Chaudoir et al., 2013; Howard, 2015; Nichols et al., 2021). A life course perspective helps to unravel the effect of structural constraints from situational contexts that change over time by focusing attention on transitions and turning points (Elder, 1999; Hser et al., 2007; Whalen and Boeri, 2014). Life course analysis provides insights on the interaction between social bonding mechanisms, such as relationships, and social control (Laub and Sampson, 2003), as well as the interactional processes between emotions and social control (Collins, 2004). Consistent with grounded theory analysis, a triangulation of these theories was used to identify themes and patterns in the data to develop knowledge of new phenomena that move beyond one theoretical framework (Glaser and Strauss, 1967; Charmaz, 2014).

All codes and concepts were discussed among the authors to compare definitions, assess illustrative quotes, and ensure consistency of meaning. Categories were re-examined, defined, fragmented, or integrated into two guiding concepts: *barriers* and *motivators* to engaging in treatment. Barriers to treatment were greater in terms of variety and number of obstacles, and in terms of the depth of difficulties that are unique to women who use opioids while they are pregnant or have children in their custody. Motivators could be barriers depending on the situation or circumstances of the women.

The results of this analysis are supported by quotes from the women that are verbatim except when an ellipsis is inserted in

brackets [.] to indicate words are deleted that do not change the meaning of the quote. Words are inserted in brackets to protect the anonymity of participants. All names are pseudonyms. Child Protective Services () is called by different names in the three states. To protect anonymity, we use CPS regardless of the state where the mother lived.

RESULTS

We uncovered several barriers to seeking opioid treatment in our qualitative interviews. The life history data used in the analysis relate to when women were pregnant or caring for small children while they were opioid dependent. This means that some of the incidents discussed were before contemporary recommendations to provide MAT to pregnant women; yet, many of the barriers discussed by our participants focused on contemporary access to MAT. These include the social and structural stigma associated with using MAT, clinic staff's attitudes toward patients, perceptions and pharmacological effects of MAT, and the procedures and operating times of the treatment facilities. Other barriers that were not specific to MAT treatment included treatment facility related barriers such as access for women, costs, and location. We uncovered several factors in the women's lives that acted as potential barriers or motivators to seeking treatment. Relationships with romantic partners and family or friends could either be helpful or harmful to recovery. Similarly, pregnancy was sometimes a motivator and other times a barrier to treatment. Lastly, the complicated relationships our respondents had with CPS either prompted treatment or led mothers to hide their use and avoid treatment.

Medication-Assisted Treatment Barriers

Nearly 83% of our participants had experience with using MAT at some point in their lives, which has become more accessible in the past decade; however, this type of treatment also presented challenges. Among the barriers discussed by our participants are stigma of using MAT, the clinic staff's attitudes, perceptions and pharmacological effects of MAT, and the procedures and operating times of the treatment facilities.

MAT Stigma

The majority of the women in our study participated in MAT at some point in the past and relapsed. A common barrier to returning to MAT was the stigma attached to these programs. Some participants experienced stigma by healthcare providers who were not involved in their treatment for their opioid use. Annie, a White mother of four in her 30s, was once motivated to seek treatment to retain her mother role but was now discouraged from seeking MAT because of how stigmatized she perceived this treatment to be. Annie shared her thoughts:

> Me and my husband were talkin'...the stigma about the methadone. I just—he's gonna go and he's gonna get on the methadone. He's gonna, but I don't want to so I don't know what to do; [...]. Because I don't wanna go to a program every day and I don't wanna take her there every day. I don't want a stigma on me. I just want it to be done. I just want it to be over.

Annie's fear of stigmatization was based on her prior experience in the healthcare setting when she was using methadone. She explained:

> I wasn't treated very nice by certain doctors. And like when I had my baby, (Name), I was on methadone. I felt like the hospital treated me bad. When she was born, I wasn't on anything and I was treated so much better.

She was adamant about not using methadone to help her treat her opioid use. Krystal, a Black mother in her 50s, concurred with Annie's hospital experience and added: "It wasn't the greatest because I'm on methadone so you're viewed as a drug addict." Being seen as someone using drugs as opposed to someone using medication was a common complaint among those who had experienced stigmatization.

Stigmatization of MAT use was not always associated with medical providers and staff members of healthcare settings. Some of our participants stigmatized those who used MAT. Here, our example shows that not all MAT were created equal in the minds of our mothers. Particularly methadone was viewed negatively by Vanessa, a White woman in her 30s who considered herself a mother to her spouse's children. At the time of the interview, she was interested in using Suboxone, the brand name of a MAT composed of buprenorphine (an opioid agonist) and naloxone (an opioid antagonist), to stop her heroin use. She thought "people that are methadone users are finding a cheap way to get high" and casted doubt on their treatment commitment. She insisted that she would never go on methadone.

MAT Clinic – Staff Attitudes

Similar to the barriers stigma created for our participants, the behaviors and attitudes of some MAT clinic staff members were discussed as discouraging and identified as barriers to treatment. Several mothers described staff attitudes that negatively influenced their treatment seeking behaviors. One went so far as to just call her doctor at the MAT clinic "an asshole" because of this provider's demeanor toward her. Likewise, Tess, a White mother of two in her 40s, criticized the staffs' uncaring attitude:

> I just wish that the counselors actually gave a shit. [...] If I would miss three days, my counselor would call me and be like, is everything okay? What's going on? But when I stopped going altogether, I never heard from her. She never once called to say, you haven't been here in a month; what, what the hell? Are you okay? Are you dead? Nothing.

In Tess's situation, the behavior of the clinic staff played a role in her not returning to treatment. She wanted the treatment staff to show compassion and care, and when this was not provided, she did not return to treatment. To Tess, treatment was more than a mere dose of methadone, she sought a positive relationship with the provider. She was hoping that the clinic staff would reach out to her to see how she was doing and was deeply disappointed by the lack of follow-up.

Other women took initiative and asked for assistance when they knew they were going to relapse. Mallory, a White mother in her 30s and pregnant at the time of the interview, recently experienced a setback after being sober for four years. She described an episode where she thought she was about to relapse, and she reached out to the methadone clinic for help:

> They weren't helping me. Because I wanted to relapse. I mean they give you. You have to go to a group. They group – you're not gonna talk in front of 20 people in a group, you're just not. And I asked my counselor for help; didn't get it.

Mallory sought someone to talk to who would help her navigate this experience of wanting to relapse. She did not find the group setting that the clinic offered suitable to her needs. In the end, her cravings for heroin became too strong.

Rebecca, a Latina mother of three in her 40s, also struggled with the staff's attitude at her MAT clinic. She insisted that "they treat you different. It's always about if you don't do this, do that, this is what's gonna happen." More than anything, Rebecca wished that she had someone to talk to about her opioid use and problems with cessation. At this point, she stated that "I don't wanna sit down and talk to nobody and tell them this and have groups. I don't believe in anybody, I don't trust anybody." Rebecca desired a more caring clinic environment to support her through the treatment experience, a feeling expressed by other participants.

MAT Perception

Some of our participants were hesitant to believe that MAT would be beneficial to them based on their own perceptions and observations. These perceptions were often shaped by hearing others share their negative MAT experiences. Despite being able to afford them, some mothers would not initiate use of MAT. Tiffany, a Black mother of two daughters in her 40s was hiding her opioid use from her physician and husband, fearing that disclosing her use, even with the intention of getting sober, could result in CPS intervention and a divorce. When asked about enrolling in a MAT program, Tiffany described negative perceptions of this kind of treatment: "I don't wanna do that either because a lot of people tell me that that's addictive. So, no." Tiffany feared exchanging one drug with another, and her goal was to wean herself off the opioids. Thus far, that had not been successful.

Tiffany was not alone with thoughts that hindered the utilization of MAT. Vanessa's perceptions of MAT derived from observing painful methadone withdrawals in other women, and she believed that the opioid medication "does more harm than good." These observations were complimented by her belief that methadone was just another drug: "I get it's cheaper. I get that, but the whole point of methadone is to get you off of drugs, when really all it's doing is getting you off of one and putting you on another." These observations ultimately led her to say that she would "never go to a methadone clinic."

Pharmacological Effects of MAT

For each MAT modality, there is a wide variety of pharmacological side effects reported in the research literature, and these side effects can range from mild to more severe. Some women in our study experienced adverse pharmacological effects of using MAT or witnessed those effects in others. These

experiences affected their willingness to use or continue this method of treatment. Katie, a White woman in her 30s who was motivated to move from a rural area to the suburbs to access MAT, could not continue using Suboxone because it was no longer effective "as a crutch to get through the withdrawal process." When asked about using methadone, Katie recalled her experience:

> But I hated it. I mean it just makes you like so (emphasis on "so") lethargic and tired. All I wanted to do was sleep. I could not be productive. I could not work a job. I mean I just wanted to lay around and sleep. And I mean I was on a pretty low dose too. I think I was only on like 30 or 40 milligrams a day and I still could not pick my head up.

Katie was now deterred from using MAT because of her experience with the pharmacological side effects of the drug.

Jennifer, a Latina woman in her 40s agreed with Katie. She stopped attending the MAT program and refused to initiate this type of treatment in the future because of its pharmacological effect. She described how methadone made her feel unable to operate a vehicle safely:

> I was on the methadone clinic. It was 85 milligrams. I just hopped on it for a minute and got off because I, I just get scared. People are like, what? I don't know, what if I get a traffic ticket? My, my record's horrible. They'll send me to jail for something. I'm not doing it.

She revealed that she was not interested in these "liquid handcuffs."

Personal experience with MAT was not always necessary for mothers to have reservations to this type of treatment. For example, Bella, a White mother in her 50s with one daughter, had no personal experience with methadone's side effects and was a rare case of a woman in our study who had never used MAT. However, her husband had been using methadone, and she described how observing his experience deterred her from seeking methadone treatment:

> I didn't wanna do the methadone anyway only because I've watched people...I don't like [husband] when he takes it. He gets really nasty, demanding, ordering, and if it's not done his way you are degraded down to dirt, and I don't like it anymore. I don't like that methadone. When he doesn't take it, he's sick. So he doesn't move around. He just stays in one frickin' spot, curls up in a frickin' ball and deals with it 'til he gets down there to get it, because he did use to sell it.

Her husband's reaction to using methadone served as a barrier to treatment for Bella who did not want to have similar experiences.

MAT Clinic Operating Hours

Medication-assisted treatment clinics often open early in the morning, sometimes at 5:00 am, and close mid-afternoon. This accommodates some patients who work in a traditional 9-5 job setting and have no transportation or housing issues but does little for those who work overnight and/or have transportation and housing challenges. Particularly mothers in caregiver roles struggle with the rigid schedules when they must juggle treatment

and family obligations. In our sample of mothers, we found that the MAT clinics' operating times can serve as a barrier to seeking treatment. Vicky, a White mother of three in her 50s, had previous treatment experiences with Narcotics Anonymous, detox centers, methadone and Suboxone clinics. Following her time in a methadone clinic, Vicky highlighted her reasons for not wanting to re-enroll:

> Cause it's a daily commitment; it's a pain in the ass. You know what I mean? It's every fuckin' day you gotta go at 6:00 in the morning when I'd rather have a strip of medication that I can take when I want to, not because I have to. You know what I mean? Or be supervised to take it.

The hassle of going every morning to receive her methadone dose under supervision was too much of a hassle for Vicky who was in and out of homelessness during the past two years. Katie, who did not like the way methadone made her feel, concurred with Vicky in that the restrictive opening times presented a major hurdle to entering and continuing treatment. She shared:

> Now in other states[...], one of my friends that lives up there. That clinic is open all day, you know, so you can go get your dose and you can take it before you go to bed. Now I may have had more success with it that way because it knocks you out. So, instead of having to take it in the morning and nod out at work all day, you know, you can go get it in the evening, fall asleep, take it so that by the time you wake up in the morning, you can actually get up and go to work.

Both women experience the opening times of the clinics as barriers to entering treatment.

Jessica was a White mother of two in her 30s who aspired to be completely sober, obtain a job, and purchase a car. As she worked toward her goal of quitting drugs, she was driven to the clinic by family members. Despite the familial support, however, Jessica described the struggles of the time and commitment to attending treatment:

> Yes. And, you know, and I feel like that they should, you know - I don't know if this had anything to do with it - give you more take homes. It is so hard to get up there every freakin' day.

The clinic's regulations do not allow for take-home bottles until patients have been with the program for a certain time and have been able to stay sober. For those that relapse, like Jessica, take-home bottles are out of reach, and she had to make the trip to the clinic every morning to receive her dose of methadone. The inflexibility presented a large barrier to mothers who were trying to stay sober.

Treatment Facilities and Programs Barriers

Many of the barriers discussed by our respondents were tied to structural aspects of treatment facilities and programs, which were common to MAT as well as other types of treatment such as residential and outpatient programs. Women reported that it was difficult for them to find available treatment and they lamented the scarcity of programs designed to meet the special needs of mothers. When treatment was available the costs were often

insurmountable without having access to Medicaid or private health insurance. To complicate matters for our participants who resided in the suburbs, treatment was often located in the cities and not easily accessible.

Access for Females

Treatment disparities for women are often exacerbated when women become pregnant and have children. Some women in our study indicated that their sex/gender acted as a barrier to entering treatment, and even more so when they became mothers. Lynette is a White mother in her 30s whose son who was removed by CPS. When we interviewed her, she was in search of employment to give her life "purpose" as well as to fulfill requirements requested by CPS necessary to regain custody of her son. She struggled to find a job and described that being a woman seeking treatment had limited her access to treatment compared to the resources and treatments available to men:

> I don't know, I've seen men get help better; like there's more places for men. Women just have…it seems like they just have—like 'cause they're addicts they're just washed up, used women. That's what it seems like. Like there's so many places for men, like I've seen it all around.

In the past, her family often paid for her treatment but now that Lynette was without that financial assistance, she struggled to find a place suitable for women that she could afford. She lamented that in her county "there's one women's spot and that it and the rest are men. And I'm like what the fuck?"

Katie echoed Lynette's experience with accessing treatment centers focused on women, adding additional insight on barriers created by specific requirements:

> I say it's definitely more difficult because there are so many places that men can go to, especially homeless men. And there are some places that you know, if you're a woman, you have to have a kid, but if you're a single female with no children, good luck with your life.

While Katie found a program for women, it was only for women with children in their care, creating an additional barrier. For those mothers whose children had been removed by CPS, treatment access was made even more difficult, which in turn jeopardized the mother's ability to abide by CPS imposed treatment regulations.

Cost

The costs associated with inpatient and outpatient opioid use treatment can stand in the way of seeking care. At times, our participants showed a willingness to seek treatment but could not get access to a program due to their financial situation. For example, the most accessible treatment is MAT, yet the costs of MAT vary from location to location as does the Medicaid coverage. As of 2018, through their respective Medicaid programs, all states reimbursed for some form of MAT but only 42 states paid for methadone treatment, for example (Substance Abuse and Mental Health Services Administration, 2018). At the time of data collection, Medicaid expansion was available in two states where we collected data, Connecticut and Massachusetts. Only one state, Georgia, did not have Medicaid

expansion and had limited access to healthcare for those without private insurance. Not every participant in our sample qualified for Medicaid or had other access to health insurance, which exacerbated financial barriers to accessing MAT. Tess, a White mother of two in her 40s, recently stopped utilizing MAT after two years because of the mounting costs. Tess described her experience with comparing prices for MAT at different providers:

> $11 per dose for the liquid and $12 for the tablet. And when we were in the trap house, we had called the one that was on [street]. The one with $11 and $12 was in [town], and the one on [street] said that they charged anywhere between $15 and $35 for a dose. And I said, so what if we're homeless? And he was like, it's $15 to $35 depending on your situation. And I was like, dude, I (laughs), I can get two days' worth of heroin for what you're charging for methadone. I'm going to find someplace. And then it was like $60 to start, and you didn't get dosed that day. So I'm like, I can't give you $60 and then have no money.

Tess situation exemplifies how the financial burden of paying for MAT can serve as a barrier to treatment. With a history of homelessness and unemployment and no access to health insurance, she was unable to afford entering methadone treatment and instead continued using the cheaper alternative, heroin.

Vanessa was actively trying to get on Suboxone as a form of MAT but she could not afford this treatment. For the past four years, she had been struggling with homelessness, incarceration, and lack of employment. She explained:

> Suboxone's retarded, and you have to get a prescription. First you got to find an actual doctor that will even mess with the shit, and then it's like what, 4- or $500 each time you fill the fucker. Insurance doesn't help, even if you had it. Suboxone is, unless you've got money, you're not getting it.

This young woman serves as an example of someone who would be willing to try stopping her heroin use if only she could get access to a prescribing doctor and the medication. Her limited financial resources did not allow her to pay out-of-pocket for this treatment.

Treatment costs were not just associated with MAT but also with other types of treatments such as behavioral health treatment. Janet, a White woman in her 20s who was struggling with homelessness had utilized 12-step programs to help her stop injecting heroin. At the time of the interview, she had an appointment with an outpatient behavioral health center. This was not her first attempt at seeking treatment that went beyond a 12-step setting. She described her prior experience to find an inpatient behavioral treatment center: "I've tried to get into those facilities before and it's—they told me either I have to have insurance or I have to have this amount of money." Having neither, Janet continued going to her 12-step program, while desiring more targeted treatment to help her address the cause of her addiction.

Location

In our research, we found that opioid treatment and harm reduction resources were mostly located in the city, which impacted women living in the suburbs negatively. The ability

to travel to treatment locations was often not part of the women's realities when they also had to juggle childcare and job responsibilities. Valerie, a mother of two in her 50s, helped watch her grandson, which put her between one and two hours away from her MAT clinic. She noted that this set-up was "not convenient at all. [. . .] which makes it hard." Even when she did not stay with her daughter but in her own suburban apartment, the clinic was far away at the other end of the closest city, and it took Valerie several buses to get there.

Amanda, a White mother of two children in her 30s, was trying to regain custody of her children. One of the requirements imposed by CPS was that Amanda had to attend an Intensive Outpatient Program (IOP) several times a week which was not located close to her place of residence or work. Without access to a car and mounting bills for shared ride services, she struggled to attend regularly. She described the hardship the program's location had created for her:

> I have three meetings left to finish this IOP and that's been a nightmare for me to get to [town]. I have to be there from 5:30 to 6:45 for this one meeting that I get nothing out of. I have to take the train and the train gets there at 3 so I have to kill two hours. I hate this. I literally have three to complete the service plan so I can at least say yeah, I did this.

There were no appropriate programs near where Amanda lived or worked. Treatment locations that require significant travel and time commitment posed barriers for women who were seeking help. In Amanda's case, she was able to pay for the transportation that brought her to the IOP. Many women in our sample who struggled with housing and job insecurities would not have been able to comply with this CPS mandated treatment plan.

Whether or not treatment was available, women faced barriers due to the location of these treatment facilities. For example, one woman asked for a residential treatment facility to attend the day we interviewed her, but the only available bed was in a city area where she used to buy drugs. She was reluctant to go to this area for treatment. Our notes indicate that when we found a residential treatment bed for pregnant women or women with small children, and they did not want to go too far away, treatment professionals responded with stigmatizing allegations, such as "if she is not willing to go to another city, she doesn't really want treatment."

Relationships Acting as Barriers or Motivators

Extensive barriers to treatment emerged from our interviews with suburban mothers. These included harmful relationships with romantic partners and family or friends. Being pregnant also emerged as a barrier to treatment in some cases, as did the relationship with CPS personnel. However, we also found that many of these same or similar relationships functioned as motivators to seek treatment. Primarily, relationships with people who are supportive were often critical for treatment success. The emotional, physical, and sometimes financial support provided through relationships can make a difference in the women's decision to seek treatment and ability to participate in treatment.

Romantic Partners

Having a partner who uses or provides opioids can prevent women from seeking treatment. Often these partners make the drugs easily accessible, and sometimes they advise against treatment.

Tess, the White mother of two in her 40s who struggled with both the cost of MAT and staff attitudes at the clinic, rekindled her relationship with her current partner and described a promising beginning when he supplied her with methadone:

> Well, first of all, when I went and met him after work, he gave me 10 milligrams, and I was literally just so excited to be around him that like the adrenaline. I probably could've quit everything and (laughs) been fine because I was just so on cloud nine.

Unfortunately, the emotional and happy reunion facilitated a transition back into heroin use, something Tess attributed to her husband: "If I had never got back together with [husband], I would've never touched heroin. [.] I probably either would've been on pills or weaned myself off, or done something about getting clean." Her words demonstrate that Tess's relationship with her partner was a barrier to her seeking treatment.

Rebecca's experience supported Tess's story. When Rebecca could not afford drugs, she would ask her husband and father of her children to provide drugs for her, and he obliged. These romantic relationships effectively stood in the way of seeking treatment.

Romantic relationships were not always obstacles to entering treatment. Some romantic relationships surfaced as a mode of encouragement for mothers to seek treatment for their opioid dependence. Women who had partners to support them emotionally and who were supportive of their treatment were found to seek treatment more often than women who had partners that either used opioids, were abusive, or both.

Jennifer was a Latina with two children in her 40s who was able to stop using prior to getting pregnant with her twins. She explained: "Yes, we got clean together, and he's still clean right now." Her partner supported her decision to stop using drugs by joining the effort. Jennifer was able to stay sober for over 10 years when she was raising her sons and only relapsed when she lost her children to her partner.

Like Jennifer, Janet also had a partner who supported her cessation efforts. Janet was a White mother in her 20s who previously had two years of sobriety, describing this time as the "happiest I ever was in my entire life." However, Janet relapsed when she lost her job and car. Despite these obstacles, she remained resilient, and she and her boyfriend sought detoxification together: "But me and [boyfriend] are very serious so we're trying. We both—we didn't wanna leave each other, but we knew we were gonna be separated for detox." Both prioritized treatment over being together and supported each other through the first step of this process with the detoxification program.

Family and Friends

Similarly, relationships with family and friends can also act as a barrier or a motivator to seeking treatment. Typically, women's narratives revealed more hindrances to treatment due to family and friend relationships. Hardships with the family or difficulties

with friends often made treatment not a priority. Attitudes of friends who use opioids, such as "I like you better when you're high" stopped some mothers from seeking help for fear of losing their social circle. Losing a supportive social network and feeling isolated and lonely kept respondents from engaging in treatment.

Abby, the White mother of four in her 30s who was motivated to move to the suburbs to access a mobile Suboxone unit, was currently homeless and temporarily sleeping in a park gazebo with the winter looming. Abby lost her mother and stepmother to cancer and primarily had using-friends, who she referred to as "backstabbers." Abby summarized how she felt about her current situation: "Cause there's nothing for you to do, and you're trying to stay clean but it's really hard; trying to stay clean and to do the right thing when you don't have the right support systems." With no positive relationship in her life, Abby found the obstacles of entering treatment insurmountable.

Vanessa, the mother described previously, also suffered from having difficult relationships. Vanessa's father walked out on her family at an early age, and her mother was emotionally abusive. Her few non-using friends lived in another state and were unaware of her relapse into heroin use. During a year of treatment seeking, Vanessa described strains in her relationships: "Me and her [Vanessa's wife] were busting our ass and all of our friends turned their back on us, and nobody wanted to help us out." Aside from her wife, Vanessa did not feel supported: "Like I'm so fucked right now, and nobody will help me and nobody cares, so why should I care about myself if nobody else gives a damn? What the hell do I have to fight for, then?" Vanessa's situation highlights the predicament of having difficult relationships with family and friends. The feeling of being alone and not cared for in this life present barriers to wanting to make changes such as entering a treatment program.

Lynette echoed Vanessa's feelings of feeling unsupported. She recently moved from another state and found herself without a supportive network of 12-step friends that she had for more than 10 years. She described how helpful they have been in the past:

> [I]f I ever need anything or need treatment or anything, they'd help me. Like up here it kinda—'cause I'm so far away from anyone I have like that it kinda—I'm not held accountable. So when I use up here I, you know, I...kinda—I use a lot differently than I would in Florida when I'm around them.

Being isolated from positive social interactions, Lynette started using heroin again.

Relationships with family and friends are not categorically barriers to treatment. We found that similar to having a supportive romantic partner who motivates treatment seeking behaviors, some women have non-using family members and friends who encourage them to pursue treatment. Rita, a Black woman in her 60s, recently moved from another state with her husband. She was staying with her daughter in the suburbs and relapsed with her husband. She recounted what motivated her to enter treatment:

> We were clean when we came down here. So then we found [city] and that's where we started sneaking to get drugs, you know, because we was living with my daughter, so we couldn't just out, we'd get high, you know. So we were sneaking. So then she sat me

down one day and she said, I will take your ass to the bus stop, put you on the bus and get you out of here. "You either decide to stay clean now, or get out my house." And so I said, "well that don't sound too good, so I decided to get clean."

Her daughter had been a positive influence in Rita's life for years, allowing her mother to stay when she did not have a home or helping her find treatment throughout the years. The strict rules she imposed motivated Rita to seek treatment in order to keep her housing and be able to see her grandchildren.

Not every non-using family member offered as much assistance as Rita's daughter. Others took a different approach to motivate their loved ones to enter treatment. Before Valerie entered MAT treatment, she was homeless. Turning to her daughter, she described what happened next:

> She turned me—'cause usually my family don't turn me down. And I went to my daughter's house and she turned me down. Told me, "Mom, you can't stay here." That really, you know, put a burden on me. I mean like somebody took a knife and just stabbed me in my heart 'cause she—depend—don't matter how I looked at—she always opened the door for me.

Valerie considered this her "breaking point." Her daughter, who was always there for her, denied her help. As Valerie put it: "They got tired of it." This incidence motivated Valerie to seek treatment.

Annie, who lost two children in tragic ways, recounted how her 12-year-old daughter motivated her to go to treatment for seven months:

> And then my daughter, her birthday was in [month], and I was askin' her what did she want for her birthday and she said she want—she was like, 'Mom, I just want you to live.' So, I did, and I went to treatment.

At the same time, Annie also was supported by a nurse who befriended her when she spent time at the hospital before her son passed away.

Moving away from drug using friends and acquaintances was a reoccurring theme in our sample. These friendships were unsupportive of treatment and encouraged further drug use. Katie, a White woman in her 30s who just suffered her fourth miscarriage, moved out of her hometown because many in her social circle were using drugs. She describes her move to the suburbs where she has helpful friend relationships:

> That was a quick fix. Out here, you know, it's like I have enough friends out here. And it's just comfortable. It's quiet, you know? Um, I'm close to anything that I need but I'm far enough away...from any bad shit that it would be like a real pain in the ass if I decided, oh I wanna go get high.

Being removed from relationships that would encourage drug use, and finding new friend in a new place, helped Katie to abstain, which shows the positive influence of supportive relationships on drug using behaviors.

Other women described ways that non-using friends motivated them to enter treatment for their opioid use. For example, these friends introduced non-drug related activities that were attractive to those seeking recovery. Amanda, who was

trying to regain custody of her children, shared her thoughts on the social benefits of 12-step meetings:

> AA and NA allow you to get back into the real world, meet sober people, start doing kind of more normal things. Let's go get coffee, let's go to the movies. They have different things going, like a sober dance. You have to find the meetings you like, like some people don't like the war stories they don't want to hear about how great and how crazy or whatever. I try to look for uh—like more the ones that talk about recovery, what they did to keep themselves clean the last twenty years.

She recounted that she spent years in isolation because all she could concentrate on was how she would get money to buy drugs. This took up the vast majority of her time. Gaining access to a group of non-using friends who engaged in fun activities was a motivator for Amanda to seek out and continue with this type of treatment.

Pregnancy

Pregnancy was revealed to also be both a motivator and barrier to seeking and enrolling in treatment. The relationship our participants had with the unborn child influenced treatment decisions because of potential treatment side effects. However, women's access to treatment was affected by their pregnancies. For example, Mallory did not believe it was best for her unborn child to be exposed to Suboxone while pregnant, "because I just think it's awful. It's not worth it. [...] I don't think it's good for a baby to get...be born that's kickin' Suboxone like that [...] 'Cause if I can't, I don't think a baby can." To complicate matters, when Mallory tried getting into detox she described being denied entry because of her current pregnancy: "I tried and they told me that— that's when I found out that I was pregnant. [...] They kicked me out. [...] They said they don't deal with pregnant women." When the interviewer offered helping Mallory find a place to detox, Mallory said "Oh I'd go in a second." The inability to get into detox due to her pregnancy and her current use made Mallory consider terminating her pregnancy, "Like I don't even know if I'm gonna keep this baby." Mallory's pregnancy was inadvertently a barrier to entering treatment.

While we found that pregnancy could prevent treatment, we also discovered that pregnancy functioned as a motivator for entering treatment. Many of our participants indicated that as soon as they discovered their pregnancies, they either discussed treatment options with their providers or they detoxed with the help of professionals. For example, Carol, a White woman in her 50s and mother of a daughter who resided with her father in a different state, explained:

> When I found out I was pregnant I went immediately into detox and got detoxed and then I just stopped 'cause I did not wanna have my child be born on any kind of meth—I've seen methadone babies and I've heard about it and I didn't want anything to be wrong with my daughter. And...when my daughter was born, just the love I felt for her was—I—you know how it feels. You know how it feels.

The above quote exemplifies the mindset that many women who discovered they were pregnant while using opioids had. Believing that methadone could harm the unborn was a common

theme and sometimes resulted in women withdrawing from opioids without MAT. Carol made it very clear that she had the well-being of the child in mind and that her pregnancy motivated her to detox immediately.

Contrary to Carol's fear of methadone and its unintended consequences for her unborn, Amanda, a White woman in her 30s took her doctor's recommendation to heart. The mother of two, who had lost custody of her older son to the father, recently gave birth. When she got pregnant for the second time, she decided to seek treatment after conversations with her medical provider. She explained:

> But when you get pregnant they scare the crap out of you, they say you cannot stop using, you have to continue this program, because I was a heroin addict at that point. They said I had to continue doing something whether it be Suboxone or methadone, you can't stop using. [...] if I just stopped cold turkey, I could miscarry. So they pushed me over to the subutex. Of course they have no blocker so I was kind of abusing here and there. So they said I needed a higher form, so they put me on the methadone. Which is good, I stopped using, I wasn't using.

Suboxone did not work for Amanda and she continued using opioids. Methadone, however, allowed her to come off the opioids successfully. At the time of the interview, she was working with CPS to gain custody of the newborn.

Child Protective Services

Child Protective Services (CPS) aim to work with families and communities to keep children safe from abuse and neglect. In many cases CPS is able to provide support and services to keep children safe with parents or family members. CPS provides foster care or finds new permanent families for children through kinship, guardianship, or adoption if the need arises. However, for many mothers who use opioids, there is a constant worry that CPS administrators or staff will judge them unfit to parent their children effectively. While CPS involvement can motivate some mothers to enter treatment in order to keep or regain custody of their children, participants in our sample were clear that it could also have the opposite effect on them. The fear of involving the social service agency drove some to hide their drug use from everyone and avoid any type of treatment.

Tiffany, who earlier expressed having negative perceptions of MAT use, also feared involvement of CPS. The agency had never been involved in her life, and she considered herself lucky that "their father always picked up. If I fell, he picked up." Tiffany knew what it felt like to have access to her children denied when her husband took her daughter away from her the last time he found out she was using drugs. She ended up being homeless until she became pregnant again. This fear of losing her children drove her to hide her drug use even when she saw her primary care physician. She explained her reasons for keeping her use a secret: "No, 'cause I don't want nobody callin' [CPS] on me or anything on me, and I feel like that's what'll happen." Her fear resulted in Tiffany not entering any type of treatment. She felt that if CPS became involved in her life she "would probably lose it." In her situation, potential CPS involvement acted as a barrier to treatment.

The threat of having a child removed by CPS loomed large in the lives of mothers who use opioids. Nevertheless, while anxiety can lead to drug use and mental health problems, we found that in some cases, the anxiety associated with CPS intervening in a family can be great enough to motivate some women to seek treatment.

Annie was a White woman in her 30s and a mother of four. She saw herself as a "functioning addict" and in her own words "tries to keep up appearances" when she is out and about in the neighborhood. She describes her interaction with CPS:

> They done urine screens, they done hair follicle tests. Because my urine screens were good and I told them, like, "this is what I'm doin'. I'll go to treatment. I don't mind. I'll do treatment, but you're not taking my kids. Tell me what to do, and I'll do it." So that's how—my approach to it was always, "Alright, tell me what to do and I'll do it."

Annie's quote shows that some women were very willing to enter treatment in order to keep their children. Because she met the terms of all CPS mandates, Annie never lost custody of her children. She always complied and entered treatment instead. She stayed sober throughout her last pregnancy and at the time of the interview had an eight-week-old daughter in her custody. She just recently relapsed on the five-year anniversary of one of her son's death.

Our field notes indicate that some women went so far as to attempt having their children at home rather than give birth at a hospital for fear of losing the baby to CPS. These women were risking childbirth complications in order to avoid contact with and punishment by social services.

DISCUSSION

This is the first qualitative study investigating barriers and facilitators to treatment among mothers and pregnant women who use opioids living in suburban environments. Our findings build on previous literature showing that both stigma and lack of access due to structural factors are significant barriers to treatment (Redko et al., 2006; Wisdom et al., 2011; Hammarlund et al., 2018; Kahn et al., 2019; Abraham et al., 2020; Acevedo et al., 2020; Nichols et al., 2021), which are exacerbated for women who are pregnant or mothers (Howard, 2015; Stone, 2015; Angelotta et al., 2016; Whittaker et al., 2016, 2019; Lee and Boeri, 2017; Frazer et al., 2019; Lamonica et al., 2021).

The barriers caused by the stigma of MAT, including attitudes from service professional staff and community, were reinforced by perceptions the women had about MAT from their own experiences or experiences they heard from others. While the social stigma associated with MAT is changing as public education on the success of MAT to combat rising overdose death rates increases (Heavey et al., 2018; Irvine et al., 2018; Silverstein et al., 2019; Adams and Volkow, 2020), institutionalized and public stigma of mothers or pregnant women who use opioids is still prevalent (Stone, 2015; Nichols et al., 2021). Being seen entering a MAT clinic increases the chances that such women will be discredited by the community (Goffman, 1959;

Chaudoir et al., 2013), and disapproving attitudes of some providers toward pregnant women who use opioids remain.

Previous research shows increased stigma in rural areas toward people who use opioids, resulting in less support for harm reduction initiatives in rural and non-urban areas (Borders and Booth, 2007; Childs et al., 2021). Similarly, the suburbs are often viewed as having fewer drug use problems than urban areas, thereby increasing stigma of drug use and decreasing the availability of treatment. Barriers related to accessing treatment facilities included distance to the locations, compounded by lack of public transportation, costs for treatment, hours of operation, and few treatment programs for women with children. Location, waiting lists, and cost of treatment were common barriers to seeking MAT, outpatient, or residential treatment. Lack of places where mothers could live with their children were barriers for women seeking residential programs. These findings add to extant literature showing geographical obstacles and a dearth of treatment for women are barriers to treatment seeking (Marsh et al., 2000; Paltrow and Flavin, 2013).

Research on rural areas found that fewer treatment options, social stigma, and lack of transportation create barriers to treatment adherence (Amiri et al., 2018; Childs et al., 2021). Research in urban areas found that in addition to stigma, fear of losing custody of children and loss of relationships with partners were barriers specific to pregnant women (Whittaker et al., 2016; Frazer et al., 2019). Our findings confirm that the barriers common in rural and urban areas are also barriers for women living in the suburbs. However, these barriers differed by structural aspects, such as lack of access due to costs of treatment and transportation. For example, women in suburban Atlanta, Georgia, where MAT was virtually non-existent at the time and there is no public transportation to the city, had very limited access to treatment.

Social stigma was experienced by women in suburban areas in all three states, including those where health insurance and services were widely available. Like women in rural and urban areas, fear of losing custody of children and separation from family and partners were critical barriers to treatment-seeking expressed by all women in all three suburban areas regardless of the state. Consistent with studies on treatment-seeking in urban and rural areas, our suburban study revealed the impact of social stigmatization on pregnant women and mothers who use opioids was a common barrier, while other barriers were structural (Pollini et al., 2006; Redko et al., 2006; Wisdom et al., 2011; Harris and McElrath, 2012; Hammarlund et al., 2018; Kahn et al., 2019; Acevedo et al., 2020).

Informed by a triangulation of stigma and life course theoretical frameworks (Goffman, 1959; Elder, 1999; Laub and Sampson, 2003; Chaudoir et al., 2013; Howard, 2015), we suggest that many of these barriers can be addressed by targeted structural changes. These include policy modifications that focus on reducing institutionalized stigma by decreasing blatant surveillance and providing more compassionate care for women of child-bearing age who are opioid dependent. This is most evident in how service providers convey messages that stigmatize women's relationships. Women who are pregnant or caring for small children are often emotionally and financially dependent

on their relationships with others. Without acknowledging the women's intimate relations with family and partners, including financial reliance, efforts addressing opioid dependence among pregnant women and mothers will unintentionally construct barriers to seeking treatment. Our data show that when women are asked to abandon relationships or suggested to terminate partnerships, they are often overwhelmed with emotional stress or economic burdens that hinder treatment-seeking.

We add to the literature not only by providing insights on suburban women who use opioids, but also by disentangling barriers that can be addressed structurally from those that are entwined as potential barriers and/or motivators, specifically relational factors impacting treatment-seeking behavior. We know stigma related to MAT and perspectives of MAT are changing in the public view due to the opioid crisis (Adams and Volkow, 2020). Moreover, the structural barriers we identified regarding facilities can be addressed through policy change, such as increased funding for residential treatment exclusive to the needs of pregnant women and mothers, and consideration of location and operating hours of treatment facilities. However, the relational barriers discussed here need more research to be fully addressed. Women's relations with romantic partners, family or friends can motivate them to seek treatment or they can be a barrier, which often is contingent on the social context of the relationship, as well as the mental, emotional, or economic situation of the women. While relational factors have been examined in previous studies, research often focuses on relations that act as barriers to treatment (Marsh et al., 2000) or relations that act as motivators (VanDeMark, 2007). Rarely is analysis focused on both relational barriers and motivational influences (Frazer et al., 2019). Our findings suggest that relations that act as barriers can be transformed to potential motivators for the women if intervening factors such as emotional and mental health are assessed, family situations are acknowledged, and financial resources are provided.

Our findings support studies showing that more effort is needed to reduce real and perceived stigmatization of pregnant women and mothers who use opioids (Nichols et al., 2021). Empathy, compassion, respect, and support provide greater treatment-seeking motivation among opioid-dependent women with children than the current focus on supervision and surveillance (Howard, 2015; Stone, 2015; Adams and Volkow, 2020). We enhance the findings of these studies with evidence provided by our life course examination of the women's experiences over time. Their lives show that punitive and moral-focused policies have resulted in barriers to treatment as well as potentially creating obstacles to intact families where mothers can remain together with their children and partners. While institutional and structural changes are needed to address economic and geographic logistical difficulties to treatment, providers working directly with women through social and healthcare services can go a long way in helping reduce social stigma and fears of losing children and intimate relationships. Our analysis provided insights on life course patterns of relationships that suggest social and emotional processes must be considered when designing programs for opioid dependent pregnant women and mothers with children in their care

(Giordano et al., 2007). Consistent with findings on the social bonding aspects of life course theory (Laub and Sampson, 2003), women's emotional relationships can be a barrier or a motivator to seeking treatment for opioid use. The current focus on surveillance may be counter-productive if the relationships that pregnant women and mothers have with children, family, friends, and partners are not taken into consideration.

Limitations

This study was limited by a relatively small sample compared to quantitative studies; however, a sample of 58 participants is large for qualitative studies. Qualitative findings are not meant to be generalizable but to provide in-depth and detailed information that can inform large scale studies to test the results. While we achieved diversity in terms of drawing from a range of geographic locations, the small sample size in each location does not adequately represent diverse racial and ethnic populations, and an over-sampling of pregnant women and mothers who are African American/Black, Latina, and other ethnicities is desirable. Finally, our study is limited by including the perspectives of only one side of the relationships between public agencies and pregnant women or mothers who use opioids. Studies including all actors in this relationship are needed, as well as studies of custodial fathers who use opioids.

While we used a life course analysis to examine current as well as historical barriers and motivators to treatment-seeking behavior among pregnant women and mothers who use opioids, we acknowledge that continuing Medicaid expansion provided by the Affordable Care Act will help to address some of the barriers found here. However, health insurance is not a panacea for the widespread stigmatization of opioid-dependent pregnant women and mothers, and the nearly hegemonic call for increased surveillance. Our study shows the need for less surveillance and a greater focus on emotional aspects of mothering can provide motivation rather than barriers to treatment-seeking.

Future Research

Our findings suggest more research is needed on ways to increase treatment-seeking motivators for mothers and pregnant women. Treatment research suggests that treatment motivation is a predictor for remaining in treatment (Rapp et al., 2007; Hiller et al., 2009). Many women thought they were not motivated for treatment, although our in-depth inspection of their narratives uncovered personal problems connected to seemingly unsurmountable hardships attributed to their lack of motivation (Pollini et al., 2006; Acevedo et al., 2020). While previous studies show there is critical time for treatment motivation, the responsibility is often on law enforcement, social services professionals, and treatment providers to assess the need for treatment, as well as identify barriers that hinder access to treatment (Binswanger et al., 2011; Kahn et al., 2019). Good intentions, such as increased surveillance by these agencies, can result in unintentional barriers to seeking necessary treatment (McMahon et al., 2002; Paltrow and Flavin, 2013; Olsen, 2015; Angelotta et al., 2016; Frazer et al., 2019; Honein et al., 2019). More research is needed on how health and social services providers, who are the first contact with mothers, might

practice motivational interviewing skills with mothers and newly pregnant women (Mullins et al., 2004). Studies are needed to identify links between emotional and social processes, how these processes are impacted by structural disadvantage (Giordano et al., 2007), and how emotional relationships can be used to initiate new lines of action (Collins, 2004) among opioid dependent women.

While our finding on the interactional effect of stigma, structure, and emotional relationships was an emerging result of a triangulation analysis, how to address this is beyond the scope of our paper and left for further research. Research also is needed on how peer support services and shared decision making might increase motivation by identifying and addressing emotional and relational barriers (White, 2004; Rigg and Murphy, 2013; Kahn et al., 2017). More studies are needed on peer support throughout the course of opioid treatment and beyond, how peers might identify structural disadvantages that intersect with social relations and reveal the emotional dynamics that serve as motivators or barriers to treatment (Giordano et al., 2007). Research at the institutional level is needed to examine the effect of more supportive care practices versus surveillance as social control mechanisms. Studies at the structural level are needed to identify how to implement more humane and compassionate policies in contrast to moral policies governing pregnant women and mothers who use opioids (Whittaker et al., 2019).

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Southern Connecticut State University IRB. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AP, GM, and CB conducted the preliminary analysis and wrote a first draft of this manuscript with MB, who helped guide the conceptualization. AL and JT contributed to the analysis with additional data and enhanced conceptualization. AK wrote the Results. MB contributed to the organization of the results and enhanced conceptualization, wrote the Introduction, Methods, and Discussion. MB and AK worked together on revisions and editing and approval of the final manuscript for submission. All authors contributed to the article and approved the submitted version.

FUNDING

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Meeting the Needs of Families Involved in the Child Welfare System for Parental Substance Abuse: Outcomes From an Effectiveness Trial of the Families Actively Improving Relationships Program

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Limited evidence-based practices exist to address the unique treatment needs of families involved in the child welfare system with parental substance abuse. Specifically, parental opioid and methamphetamine abuse have increased over the last decade, with associated increases of families reported to the child welfare system. The Families Actively Improving Relationships (FAIR) program was developed to address the complexities of these families. Evidence-based strategies to address the interrelated needs of parents—including substance abuse and mental health treatment, parent skills training, and supportive case management to improve access to ancillary needs—are integrated in an intensive community outpatient program. This study examined the clinical effectiveness of FAIR when delivered in a Medicaid billable outpatient clinic. Parents ($n = 99$) were randomized either to the immediate FAIR condition or to the Waitlist (WL) condition, using a dynamic wait-listed design, with all parents provided the opportunity to eventually receive FAIR. Outcomes show statistically and clinically significant reductions in parental opioid and methamphetamine use, mental health symptoms, and parenting risk, and improvements in stability in parents receiving FAIR. Providing services to families who require travel in excess of 20 miles for sessions has challenging implications for program costs under a Medicaid structure. Study outcomes highlight the need for policies to support funding of intensive family-based programs.

Keywords: FAIR, opioid, methamphetamine, child welfare, mental health, evidence-based practice, parent

INTRODUCTION

During 2019 across the United States, the child welfare system (CWS) received 4.4 million referrals for child maltreatment involving ~7.9 million children (DHHS, 2021). The rate of referral rose from 52.3% in 2015 to 59.5% in 2019, with a 5.8% increase in referrals that were screened-in for services during this same period. The majority of children were exposed to child neglect (75%), and the majority of perpetrators were parents (91.4%). Similarly, following a decade of steady decline in the number of children in foster care, rates began to rise nationally in 2012, with an increase of

over 10% by 2016 (DHHS, 2019). During this period, there was a parallel increase in the number of CWS reports related to parental drug abuse, prompting formal federal tracking of these referrals beginning in 2015. Since then, rates of parental drug abuse continue to rise, with drug abuse risk factors greatest for children under 1 year old (DHHS, 2021).

States' rates of child maltreatment and rates of parental substance use vary, but across the nation, 36 states have experienced a significant increase in CWS caseloads (DHHS, 2019). These increases are simultaneous with the rise in the nationwide opioid epidemic, with the CWS being particularly impacted by its effects (Crowley et al., 2019). In parallel, particularly in the western states, methamphetamine use has shown marked increase in populations that use opioids (Ellis et al., 2018), and the co-occurrence of opioids and methamphetamine is rising (Volkow, 2020). Children whose parents are referred for methamphetamine abuse are more likely to enter into foster care, and less likely to reunify home than children of parents referred for other reasons (Akin et al., 2015). Despite these notable challenges, few evidence-based behavioral interventions have been developed specifically to address the complex needs of families involved in the CWS where opioid and/or methamphetamine abuse is the primary referring problem.

To fill this critical gap, the Families Actively Improving Relationships (FAIR) program was developed (Saldana, 2015). The goal of FAIR is to provide evidence-based practices (EBPs) within the environment in which parents live and function, to a population that is extremely difficult to engage. FAIR addresses the shared correlates of, and interplay between, substance abuse, mental health, and parenting needs, and it operates from a treatment plan that addresses a comprehensive set of CWS goals (**Figure 1**). Specifically, FAIR aims to address the gap between the known correlates that drive both

parental substance abuse and child neglect and receipt of services that are needed to achieve both proximal and distal positive outcomes.

Using a well-specified behavioral approach, FAIR treatment is individualized to fit the unique circumstances and needs of families presenting with opioid and methamphetamine use disorders. FAIR clinicians coordinate with CWS staff to ensure that parents are meeting their CWS treatment plan goals. Parents are incentivized for working toward their treatment goals that increase child safety and permanency. FAIR allows for delivery of EBP within a flexible environment including meeting times and places (e.g., home, shelter, tent, park) and in the community where parents have the opportunity to practice success (e.g., store, school, playground). Similar to other family-based EBPs, such as Multisystemic Therapy (MST; Henggeler et al., 2009), the FAIR team is available 24/7 for on-call support and ongoing engagement strategies.

FAIR involves four major treatment components, supported by ongoing purposeful engagement (**Figure 2**): (1) Substance use treatment including contingency management and positive reinforcement, frequent urinalysis, relationship building, day planning, skill building in creating healthy environments and peer choices, and refusal skills; (2) Mental health treatment including cognitive behavioral strategies, developing healthy coping skills, emotion regulation skills, exposure therapy, and referral for medication management; (3) Parent management training including parenting skills, nurturing and attachment, reinforcement, emotion regulation, supervision, structure, non-harsh discipline, and nutrition; and (4) Resource building and provision of ancillary supports including assistance with securing housing, education, employment, and support with court and CWS attendance, and other probationary requirements. Traditionally, each of these treatment components are delivered in a siloed manner, with multiple providers. This traditional arrangement often requires parents to balance a complex
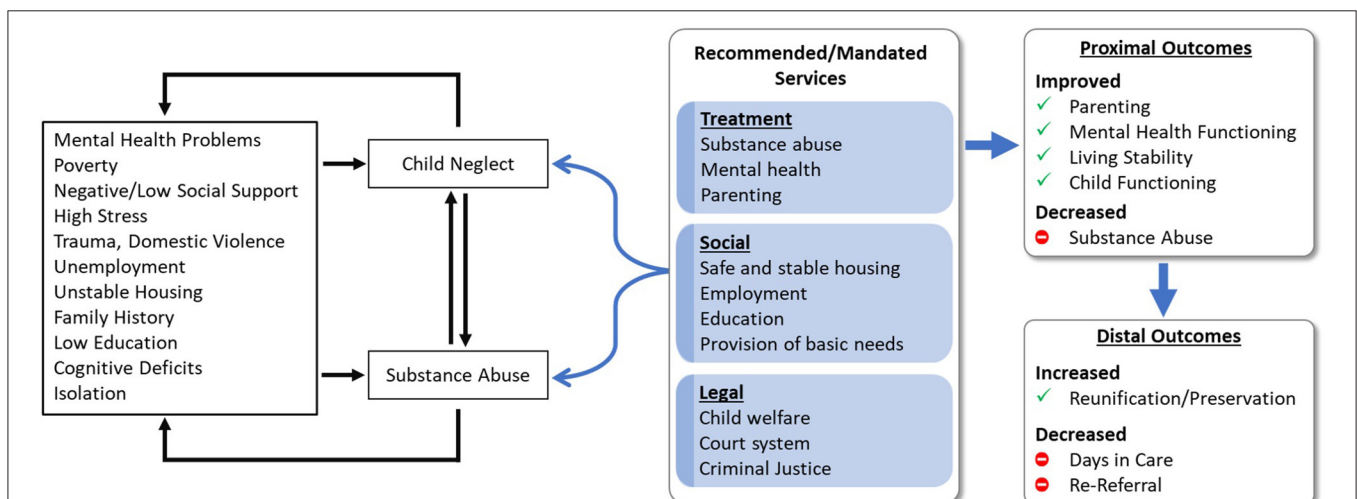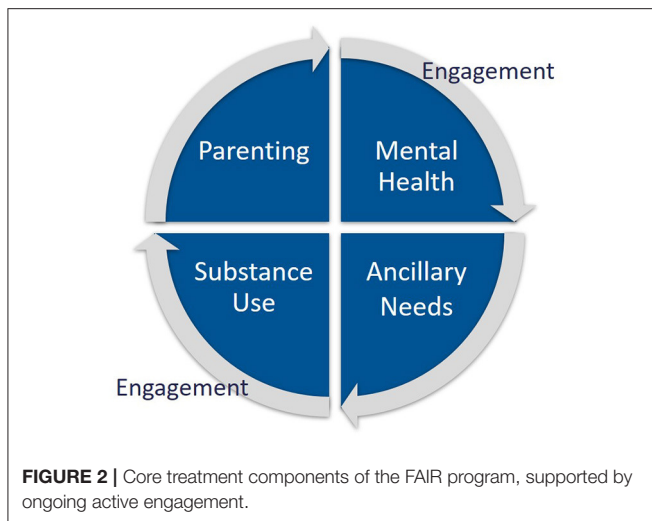

FIGURE 1 | Logic model for the Families Actively Improving Relationships (FAIR) program for parents involved in the child welfare system for parental substance abuse and child neglect.

FIGURE 2 | Core treatment components of the FAIR program, supported by ongoing active engagement.

treatment schedule and find transportation to multiple service settings. Moreover, many of the services that are accessible to families are not evidence-based or designed with their unique treatment needs in mind (e.g., childcare, competing court requirements).

FAIR provides an action-oriented approach to treatment. Unlike a typical treatment session, parents and counselors engage in hands-on problem-solving and solution-focused goal setting. In this way, the FAIR model is perceived as supportive and useful to parents, while counselors are able to role-play, model, and skill build with parents during real-world scenarios (Cruden, Crawford, and Saldana, submitted manuscript). FAIR counselors also leverage a team resource builder to identify incentives and prosocial community activities that can be used throughout treatment. Tailoring incentives to the individual needs of families, while adhering to the key FAIR treatment components, allows parents to experience evidence-based services that are meaningful to their daily lives, in the environments in which they live. Incremental feedback on behaviors is provided through behavioral reinforcement strategies in ways that feel natural to parents, including text messages from counselors about a job well-done, a small goal set, or an observation of progress. Counselors also learn the preferences of individual parents and might provide engagement strategies such as a favorite warm beverage for an early morning session, or a sandwich when meeting on a lunch break.

The use of home and community-based treatment and contingency management strategies are consistent with other programs that have evidenced promise in addressing the needs of parents involved in the CWS with substance abuse. Family Behavior Therapy (FBT; Donohue et al., 2014) demonstrated success in the treatment of mothers referred to the CWS, with treatment showing the greatest effectiveness for mothers whose children were not drug exposed. Mothers randomized to FBT also increased days employed. An adaptation of Multisystemic Therapy (Henggeler et al., 2009) called Building Stronger Families (MST-BSF;

Swenson and Schaeffer, 2018) has been piloted in a quasi-experimental matched design showing promise for the reduction of maternal substance use and aggression toward children (Schaeffer et al., 2013). Similar to FAIR, these programs help overcome barriers that have long been identified for parents who are involved in the CWS (Young et al., 1998), including lack of childcare, inadequate support from family and friends, copayments, and time allowed away from work (Rockhill et al., 2008). Parents often require ancillary services, including employment assistance, food security, housing, and transportation (Choi and Ryan, 2007). Not surprisingly, receipt of these basic services enhances caregiver ability to start and complete substance abuse treatment (Smith and Marsh, 2002; Greenfield et al., 2007), which ultimately facilitates reunification (Grella et al., 2009).

Using intervention strategies intentionally focused on overcoming the barriers that parents involved with the CWS for substance abuse and neglect experience, the FAIR program has demonstrated positive outcomes for mothers randomized to receive FAIR, including reductions in substance use, cravings, mental health symptoms, and parenting stress and improvements in child behavior (Saldana, 2015). Due to the positive outcomes obtained from these original feasibility and randomized pilot trials, the CWS requested ongoing availability of the FAIR program and, thus, FAIR moved from a research funded environment to a Medicaid billable free-standing clinic. Referrals were made directly by child welfare case workers and/or parent self-referral. Moreover, services were extended to fathers as well as mothers. As community clinicians were hired to provide services and supervision and the program grew to be independent from the original research trials, there was an opportunity for the current effectiveness trial, under real-world conditions.

Due to the perceived benefits of the FAIR program, the local CWS agreed to provide referrals to the current study under the condition that all parents would have the opportunity to receive FAIR. Because of the nature of CWS involvement and federal timelines imposed for potential CWS treatment plan completion (i.e., 18 months), along with the length of treatment for FAIR (i.e., ~9 months), a traditional randomized clinical trial was not plausible. A dynamic wait-listed design (Brown et al., 2006), described in more detail below, was employed to maintain rigor, but provide the opportunity for all to receive the experimental intervention. Effectiveness trial primary hypotheses included: Parents receiving FAIR would experience reductions in (1) parental substance abuse, in particular opioid and methamphetamine use, (2) parental mental health problems, and (3) parenting risk. Further, it was hypothesized that these parents would experience improvement in ancillary needs and stability (i.e., days employed, more stable housing). In addition to these clinical effectiveness questions, this trial allowed the opportunity to assess the conditions under which such a program can be sustained in the real world—an economic analysis examined the feasibility of providing this comprehensive, integrated program within a Medicaid billable environment.

MATERIALS AND METHODS

Study Design

The study was designed to accommodate several ethical and practical considerations. Most critically, participants could not be randomized to a traditional services condition due to the desire of the local CWS to have the opportunity for every referred parent to eventually receive FAIR. That is, all participants needed to be able to have access to the experimental intervention. However, in order to evaluate FAIR, it was important to obtain comparison data from traditional services. To address this, the study was designed as a restricted case of a dynamic wait-listed design, with each participant potentially having repeated outcome measurements during a longitudinal waitlist phase and, upon initiating FAIR, longitudinal measurements during the FAIR phase. From this, a key feature of the design is that intervention condition was not a single status for each participant; rather, it changed over time if participants transitioned from the waitlist to FAIR. Regardless of condition, a baseline assessment was scheduled within 72 h of a parent agreeing to be in the study. All participating parents were assessed for 20 to 24 months post-final baseline. This variation in the final assessment time-point was due to the grant period ending—all participants were assessed as close to their 24-month period as feasible (hereafter referred to as 24-month).

Another design consideration was the need to be able to move parents off of the waitlist, if they desired, as soon as openings became available. This was necessary to address the rapid timeline imposed by federal mandate (Adoption and Safe Families Act, 1997) that parents have to complete CWS treatment plans and establish permanency goals. While it was anticipated that many parents randomized to the waitlist (WL) would engage in traditional treatment (as they were encouraged to do at the time of randomization), and therefore not be interested in FAIR when offered an opening, in fact the majority chose to participate and to do so quickly. This resulted in only 17 of 99 participants having multiple measurements in the waitlist phase, of which only ten were assessed more than twice. As such, it is not possible to compare changes during the waitlist phase to changes during the FAIR phase. Despite this limitation, with a non-trivial percentage of the total observations in the waitlist phase (10%; 43 of 448 observations), these data were retained in the final analyses (as detailed in the Data Analysis Strategy). Further, as is encouraged for parents randomized to the WL condition, eight parents chose to engage in alternative services and not ever engage in FAIR. Outcomes related to these parents provide a very small, but valuable comparison for discussion.

Referrals, Consent, and Randomization

Referrals were made directly to the clinical coordinator who screened for eligibility criteria. When the parent met eligibility criteria, the coordinator set up a meeting with the parent to describe the study and review the Oregon Social Learning Center IRB-approved informed consent and protocol.

Eligibility criteria mirrored the FAIR program real-world criteria and included: (a) identification of child neglect as determined by child welfare, (b) a finding or other indication of parental substance abuse, (c) child(ren) remaining in the home or having a plan for reunification (i.e., termination of parental rights had not occurred), and (d) the parent was English speaking. Parents must have reported problems with substances other than THC and/or alcohol alone. The reason for these exclusionary criteria was the contingency management approach to treatment: alcohol alone was too difficult to reliably detect, and THC is detected by urinalysis for several days to weeks after last use; in both cases, it was not feasible to provide immediate reinforcement for certain level of evidence. There were no exclusionary criteria related to parental age, race/ethnicity, or child age. Throughout the study, 124 parents were referred and screened, 108 of whom were eligible. Of these, 99 consented to participate.

Following baseline assessment, participants were randomized to either FAIR or traditional treatment as part of the WL condition, with the exception of the first cases ($n = 5$) that were assigned to FAIR to fill counselor caseloads and provide an opportunity for a waitlist period. Parents randomized to FAIR were referred to the FAIR intake assessor to schedule an appointment. Parents initially allocated to WL were offered a list of referrals for traditional services and assistance in contacting them. Regardless of the initial study condition, the referring caseworker was notified so that additional referrals could be made as necessary.

For parents who were initially allocated to WL, their later invitation to the FAIR condition was based on the availability of an opening on a caseload. Once those assigned to FAIR terminated the intervention (i.e., either treatment completion or drop-out), thereby creating an opening on the FAIR caseload, if the next referred parent was not randomized to FAIR, the next parent on the waitlist was contacted to determine if (s)he was engaged in traditional services and if (s)he was still interested in receiving FAIR. Importantly for the adapted dynamic wait-listed design, parents were not notified when they were "next in line" in order to avoid the potential of them not engaging in traditional services based on the hope that a FAIR slot would soon be available. The final sample included $n = 59$ parents randomized to FAIR, $n = 32$ initially randomized to WL who then later transitioned to FAIR, and $n = 8$ who were randomized to WL and decided never to receive FAIR.

Participants

Of recruited parents, 74 were mothers and 25 were fathers. Of these, 47 mothers and 20 fathers reported being non-Hispanic and White/Caucasian, 5 mothers reported being Hispanic and White/Caucasian, 13 mothers and 2 fathers reported being non-Hispanic and multi-racial, and 5 mothers and 2 fathers reported being Hispanic and multi-racial. The average age of participants at baseline was 31.34 years old (range = 15–51 years), and their average number of children was 2.41 children (range = 0 to 6). One mother reported 0 children at the time of her baseline assessment because she was pregnant with her first child; a second mother also was referred when pregnant, but she already had given birth to other children. Parents primarily never were married (57%) or married (19%). The majority of parents were referred for methamphetamine use (71%), with

others referred for co-occurring opioid use (24%) or opioids alone (5%).

Treatment Conditions

FAIR

The FAIR program is an intensive community-based treatment model that integrates components of two evidence-based behavioral interventions: (1) Parent Management Training-Oregon (PMTO, recently renamed Generation PMTO; Forgatch and Patterson, 2010), developed at the FAIR home institution, to increase parenting skills, and teach and support positive family interactions, and (2) Reinforcement Based Therapy, a community reinforcement approach of contingency management (RBT; Jones et al., 2005) to address adult substance use. The FAIR home and community-based delivery of care, alongside the inclusion of indigenous supports, is consistent with other EBPs for family-based problems (e.g., Functional Family Therapy; Alexander and Parsons, 1982; Multidimensional Family Therapy; Liddle et al., 2018), and the FIT assessment was adapted for use, with permission, from Multisystemic Therapy (Henggeler et al., 2009). FIT assessments help counselors to understand the interconnection of challenging behaviors and areas of strength, to identify the best point of intervention (Saldana and Henggeler, 2006).

A key component of the FAIR program is the use of the FAIR store. Parents receive FAIR bucks as reinforcers for positive treatment gains. This contingency management system is used to reinforce negative urinalysis, the use of positive parenting strategies, completion of applications toward achievement of ancillary goals, or other positive steps toward goal achievement. FAIR bucks are delivered liberally to recognize the incremental gains that parents make. The FAIR store is purposefully stocked with donated goods provided through deliberate outreach by a resource builder. Store items include adult and child seasonal clothing, interactive games and toys, hygiene supplies and toiletries, household goods, and child safety equipment. Donations are sought in order to ensure a sustainable supply of parent-targeted incentives that can be accessed without fiscal support. In addition, community resources are sought to help support parents in engaging in prosocial community activities (e.g., passes for swimming lessons, scholarships for child summer camps). Parents are able to spend their FAIR bucks on incentives that help them support their individual and parenting goals. Through the use of FAIR bucks, parents learn that it is their "job" to make prosocial choices for themselves and their families, and that doing so enables them to progress toward their goals. Moreover, the FAIR store provides the opportunity for counselors to work with parents on issues of budgeting, prioritizing needs, and selection of developmentally appropriate supplies.

The FAIR team includes counselors, a clinical supervisor, and a resource builder. A single supervisor can support up to 7 counselors, with a part-time resource builder serving families across counselors. Because the majority of services are delivered in the community, the FAIR clinic space is minimal and includes a shared team office, supervisor office, FAIR store, and a session room for parents who want to meet at the clinic (e.g., unhoused parents during inclement weather).

The principles for counselor-family interactions are based on elements that have demonstrated success in engaging caregivers in EBPs such as PMTO (Forgatch and Patterson, 2010) and KEEP (Chamberlain et al., 2008). Counselors engage parents in their natural home and community environments and reinforce the use of prosocial strategies to accomplish the parents' goals. Sessions are action oriented and often involve role plays and hands-on teaching of new skills in the environments in which they will be used, followed by practice assignments. Counselors are trained to find opportunities in every interaction to reinforce parents for positive gains (Saldana, 2015). Counselors maintain frequent (at least monthly) contact with child welfare caseworkers to provide updates on progress and to ensure that treatment includes the goals targeted on the CWS treatment plan.

Traditional Treatment Services

Parents who were randomized to the WL condition were encouraged to seek traditional therapy services offered in the community. Of the 40 parents that were initially allocated to WL, seven received some level of mental health treatment. Specifically, participants received: Individual therapy ($n = 5$ parents; range 2–42 visits), family therapy ($n = 4$ parents; range 1–14 visits), and group therapy ($n = 3$ parents; range 2–15 visits). Of the three parents receiving group therapy, one also received individual therapy, one also engaged in family therapy, and one engaged in all three forms of therapy. One parent received both individual and family therapy, but no group therapy.

In addition, substance abuse-specific services were received. Four individuals who received traditional therapy also received substance abuse treatment, for a total of seven parents who received substance abuse treatment (range 1–77 days; average of 24 days). Two parents participated in a day treatment program (for 3 and 100 days) and one parent received 1 day of inpatient treatment. One parent reported 15 residential treatment attempts for a total of 102 days. Three parents reported attending a substance use disorder support group and two reported attending a recovery/rehabilitation group. Finally, 10 participants reported attending NA/AA groups (range 1–64 times; average 15.7 times). Of these, five were participants who reported some type of substance abuse treatment service also.

Data Collection Procedures

In-person assessments were collected at Baseline, 4-, 8-, 16-, and 24-months. All assessments were collected by trained research assessors at times that were convenient and in the parents' homes or places of their choosing, including the research office. Brief monthly assessments with parents were collected via telephone for the first 15 months post-baseline. As expected, repeated attempts often were needed to arrange in-person appointments and complete monthly data collection. In instances where contact was not made successfully via telephone, the research team made efforts to locate the parents at home, work, or other community settings. The participating parents were compensated for their time with gift cards to commonly utilized stores or gas stations. Payments were $100 for each full assessment battery time-point, and $20 for each monthly phone assessment. Across data collection waves, completion rates were high (Baseline = 100%;

4-month = 88%; 8-month = 89%; 16-month = 81%; 24-month = 93%; monthly phone calls = 67%). As part of the study design, participants could have repeated measurements in the WL phase and/or the FAIR phase, and as such, there could be more than five measurements per participant.

Data Management

Assessment measures were programmed into the SNAP Survey software package, and all responses were entered directly into a computer during the assessments. The SNAP program allowed for field parameters to be set to ensure that items were not missed and that invalid codes were not entered. Using this system, data quality and integrity was ensured from the point of collection. Changes to data due to entry errors could only be made by the data manager. The measures for each interview were linked by a participant identification number. Data were transferred to the secure server either through an encrypted upload system, or directly from an encrypted external drive depending on internet availability. Data immediately were exported to SPSS files for cleaning, verification, and processing. Data from this trial are not publicly available, but requests for trial data can be made to the first author.

Full Assessment Battery Measures

Assessments were collected using web-based data collection software, with an offline option, to aid in reliable assessments under varying technology conditions. Paper and pencil options were available as back-up if necessary.

Parental Substance Abuse

The Addiction Severity Index (ASI)

The ASI (McLellan et al., 1980) is a standardized tool for evaluating days, amount, and kind of substance used, as well as psychosocial correlates of use including family, housing, and employment outcomes. This self-report assessment includes use, behaviors, and correlates across the lifespan as well as in the last 30 days. The ASI has strong psychometrics and is commonly used in research and clinical practice. The parent self-reported methamphetamine, opioid, and IV drug use outcomes were dichotomous, reflecting any reported use in the past 30 days.

Parenting Risk

The Parenting Stress Index (PSI)

The PSI (Abidin, 1995) is a 101-item questionnaire developed to assess the level of stress in a parent–child system. The PSI was developed on the theory that the total stress a parent experiences is a function of certain salient child characteristics, parent characteristics, and situations that are directly related to the role of being a parent. Psychometric properties are adequate, and higher PSI scores reflect higher levels of parent-reported stress. Scores at or above the 85% are considered clinically significant.

The Brief Child Abuse Potential Inventory (BCAP)

The BCAP (Ondersma et al., 2005) is a validated 33-item self-report questionnaire that includes six subscales: distress, family conflict, rigidity, happiness, feelings of persecution, loneliness, and financial insecurity. The BCAP is a strong predictor of

neglectful parenting. Higher scores reflect a greater risk for child neglect.

Parental Mental Health

The Trauma Symptom Inventory (TSI)

The TSI (Briere, 1995) is a 100-item questionnaire that assesses posttraumatic symptomatology and psychological functioning. Subscales include assessment of anxiety, arousal, anger, intrusive thoughts, defensive avoidance, dissociation, sexual concerns, impaired self-reference, and tension reduction behavior. Validity scales evaluate inconsistent responding. The TSI has demonstrated strong psychometric properties with a range of populations. The present study considers anxiety T-scores, with higher scores reflecting higher levels of anxiety, as well as a dichotomous clinical-level score for the anxiety subscale, and a clinical-level trauma score across any subscales above the clinical threshold.

The Beck Depression Inventory (BDI)

The BDI (Beck and Steer, 1993) is a well-established, 21-item self-report measure, widely used with acceptable reliability and validity. Participants are asked to choose one of four statements that range from positive to depressed feelings about life in the past week. Higher scores reflect higher levels of depression symptoms.

Individual Characteristics

Demographics Questionnaire

The demographics questionnaire queried parents about their personal demographics and the characteristics of their children. It only was asked at baseline.

Monthly Assessments

The Parent Daily Report (PDR)

The PDR (Chamberlain and Reid, 1987) is a 31-item questionnaire completed by caregivers about child behaviors in the previous 24 h. Parents reported whether or not any of the problem behaviors occurred and if the occurrence was stressful for the parent. The PDR has demonstrated adequate psychometric properties (Keil, 2007). The PDR has been adapted for the FAIR treatment trials with additional items to query about parental cravings and mental health concerns. Parents reported "in the last 24 h" how often they had thought about using drugs, how strong their cravings were at their most severe point, how difficult it would have been to resist using drugs if available, overall rating of cravings, feelings of anxiety, depression, and stress. Cronbach's alpha for the scale was acceptable ($\alpha = 0.88$). The Drug Cravings scale was dichotomous, with a value of 1 if parents reported any drug cravings at a given occasion, and for the remaining subscales, higher scores reflect higher levels of the respective domain.

Service Utilization Survey (SUS)

The SUS is a self-report measure of health care and social service utilization within a prescribed period (i.e., monthly). The SUS not only allows comparison across conditions of services being received, but also is a strong assessment of what traditional services include for clients during the WL phase. The SUS was developed by the first author and study consultant to assess

service utilization, and has been used across a number of studies (e.g., Franz et al., 2019).

FAIR Fidelity

A 15-item measure was developed to evaluate the content (e.g., "My counselor encouraged me to try fun activities with my child"), process (e.g., "My counselor is available to me when I need support"; "I receive FAIR bucks for my success"), and structure (e.g., "My counselor and I spend a lot of our time together out and about") of FAIR sessions. Parents were asked to rate their level of agreement (1 = *Strongly Disagree*, 5 = *Strongly Agree*) with the series of statements about their counselor. Further psychometric evaluation is needed; however, preliminary IRT-based Rasch measurement models from this trial indicated that the instrument measures a single dimension of fidelity. The primary distinction in parent ratings was between the highest rating of 5 and all lower ratings, and the level of reliability was 0.72 (interpreted consistently with Cronbach's coefficient alpha).

Tracking Program Costs

As described, the FAIR program is an intensive treatment program, with unbillable activities (e.g., driving) and therefore, challenging to fund under Medicaid. However, given the client base and the point in a parents' life that FAIR is introduced, Medicaid is the most likely payor for such a program. In order to inform the future transportability and scalability of the program into a billable environment, the FAIR program components were tracked and costed under the assumption of a Medicaid-billable environment. Due to the limited traditional services received in this evaluation, a cost-*effectiveness* evaluation was not conducted. However, this project did allow for an evaluation of program costs to understand the capacity and infrastructure needs necessary to yield a financially stable and sustainable program.

Data Analysis Strategy

Self-reported parental opioid and/or methamphetamine use, parental mental health, parenting risk, and parental stability outcomes had a common data structure, with repeated measurements (level-1) nested within a maximum of 99 participants (level-2). Of note, the SUS and PDR were administered on a monthly basis, and other outcomes were measured at the full assessment battery occasions. The nested data structure was addressed using mixed-effects regression models (Hedeker and Gibbons, 2006) with a random effect for the nesting of repeated measurements within participants. The models were implemented in HLM software (Raudenbush et al., 2013). There were two types of outcome distributions: Continuous (TSI T-scores, BCAP, BDI, PSI, PDR, months at current residence), which were modeled with a Gaussian distribution and restricted maximum likelihood estimation, and dichotomous (methamphetamine use, opioid use, IV drug use, TSI clinical anxiety, TSI clinical levels in any subscale, PDR cravings, paid work, and money spent on drugs), which were modeled with a Bernoulli distribution (logit link) and penalized quasi-likelihood (PQL2) estimation.

To evaluate FAIR, the research design introduced a unique consideration: intervention condition was not restricted to a single status for each participant. Specifically, participants who transitioned from WL to FAIR were in both conditions over time, and as such, intervention condition was time-varying. Because there were relatively few WL phase observations (see section Referrals, Consent, and Randomization), the model was formulated with *FAIR as the reference phase*, and observations in the WL phase were controlled using a single time-varying indicator (i.e., 0 = FAIR, 1 = WL). To test for change during the FAIR phase (i.e., within-group change), the model included a series of time-varying, dummy-coded indicators to differentiate each of the full assessment battery occasions in the FAIR phase (i.e., Month 4, Month 8, Month 16, and Month 24) from the FAIR baseline. Month indicators were used because outcomes were not expected to change at a constant rate over the 2-year follow-up period and occasion-specific change estimates were more useful for evaluating and revising the intervention. The model formulation—with month indicators for the FAIR phase observations only, and a single WL phase indicator—controlled for WL phase observations and tested for a difference between the FAIR baseline and each later occasion in the FAIR phase. For dichotomous outcomes, odds ratios (ORs) and predicted probabilities are reported in text. The ORs reflect change between the FAIR baseline and each later occasion, and the predicted probabilities reflect the estimated score at the respective occasion. FAIR fidelity was evaluated descriptively based on monthly measurements during the FAIR phase.

RESULTS

As described in the data analysis procedures, outcomes for this FAIR effectiveness trial examined the change over time from baseline for each of the primary treatment targets, controlling for waitlist. Descriptive statistics for self-reported parental substance use, parental mental health, and parenting risk are reported in **Table 1** and mixed-effects regression model results are reported in **Table 2**. These results are followed by a presentation of the cost-related outcomes for service delivery under a Medicaid reimbursement structure.

FAIR Engagement and Service Delivery

Prior to interpreting clinical outcomes, it was key to determine if referred parents received the intervention being studied. Thus, treatment engagement was considered by examining the percentage of parents who engaged with their FAIR counselor, and the percentage that were retained in services. Across all 91 parents who consented to receive treatment (i.e., were either randomized to FAIR or opted to consent to FAIR when their time arrived to transition from the WL condition), 95% (n = 86) engaged in services and, of those, 72% completed their recommended treatment. Of note, 17 parents who received FAIR services engaged in more than one treatment attempt before completing the program (this is not atypical for parents involved in FAIR in the real world, and protocols exist, including a "what will be different this time?" analysis, for parents who seek to re-engage after deciding to discontinue).

TABLE 1 | Descriptive statistics for substance abuse, mental health, parenting risk, and parental stability outcomes.

Outcome	Waitlist	Month 0	Month 4	Month 8	Month 16	Month 24
	M(SD)/%	M(SD)/%	M(SD)/%	M(SD)/%	M(SD)/%	M(SD)/%
Substance Abuse[a]						
ASI any methamphetamine use	43%	47%	26%	15%	15%	18%
ASI any opioid use	20%	20%	7%	5%	1%	1%
ASI any IV drug use	5%	22%	7%	4%	4%	1%
PDR drug cravings[b]	51%	54%	35%	40%	28%	32%
Mental Health						
TSI anxiety (T-score)	53.16 (10.98)	58.93 (10.60)	53.93 (11.73)	52.59 (10.33)	51.71 (11.20)	50.34 (10.04)
TSI anxiety (clinical)	16%	29%	23%	14%	11%	10%
TSI any (clinical)	36%	60%	41%	43%	39%	38%
BDI (total score)	18.07 (14.50)	19.76 (13.71)	17.01 (14.92)	14.33 (11.9)	16.76 (14.50)	15.27 (13.77)
Parenting Risk						
PSI (total)	230.50 (43.06)	236.29 (41.8)	222.89 (47.52)	220.51 (46.23)	217.51 (46.06)	225.77 (41.7)
BCAP (total)	10.53 (5.47)	10.30 (6.04)	9.77 (6.09)	8.52 (5.63)	9.29 (5.89)	8.17 (5.67)
PDR child behavior[b]	5.50 (4.47)	6.75 (4.88)	5.31 (4.22)	4.09 (3.75)	3.93 (3.97)	4.31 (4.68)
PDR parental stress[b]	7.81 (7.13)	9.68 (8.33)	7.11 (6.55)	5.68 (6.06)	5.02 (5.32)	6.10 (8.10)
PDR emotional distress[b]	1.94 (1.49)	1.92 (1.09)	1.78 (1.25)	1.76 (0.99)	1.78 (1.43)	1.69 (1.45)
Parental Stability						
Paid for any work this month	55%	32%	33%	38%	44%	51%
Paid for ≥20 work days this month	23%	7%	12%	14%	26%	28%
Months at current residence[c]	1.84 (1.14)	1.48 (1.21)	1.49 (1.16)	1.73 (1.07)	1.63 (1.16)	1.84 (1.08)

TSI, trauma symptom inventory; BDI, beck depression inventory; PSI, parent stress index; BCAP, brief child abuse potential inventory; PDR, parent daily report. Percentages are reported for dichotomous outcomes. For substance Abuse, Mental Health, and Parental Stability outcome domains, ns across instruments ranged from 44 to 47 during the Waitlist Phase and from 90 to 91 at FAIR Baseline. Across time in the FAIR condition, n was at 81 during Month 4, and ranged from 78 to 80 at Month 8, from 71 to 72 at Month 16, and from 79 to 80 at Month 24. Several Parenting Risk questionnaires were only administered if the parent was currently in contact with their children. Thus, for this outcome domain, ns across instruments ranged from 32 to 47 during the Waitlist Phase. For the FAIR condition, ns across instruments ranged from 65 to 90 at FAIR Baseline, from 56 to 81 at Month 4, from 55 to 80 at Month 8, from 42 to 72 at Month 16, and from 52 to 79 at Month 24.
[a] Participants' self-reported substance use over the past 30 days.
[b] The PDR was administered on a monthly basis. For descriptive purposes, these reports were averaged by parent, and then across parents, for the time period corresponding to each of the major assessment occasions. All observations were included in mixed-effects regression models.
[c] 1 = 1 Month or Less, 2 = 2–6 Months, 3 = 7–12 Months, 4 = ≥13 Months.

Monthly, participating parents were asked about their perceptions of FAIR counselor service delivery using the FAIR Fidelity measure. On a scale of 1–5, across counselors, the average FAIR Fidelity rating was 4.6, which remained consistent over the course of the study. Fidelity items that demonstrated the greatest challenge for counselors were process focused: "my counselor could have been more helpful to me as a parent" and "there are things I did not like about this program," with an average rating of 1.92 and 2.0, respectively (note these items were reversed scored). Counselors appeared competent on adherence items for content: "I am asked to give a urine sample to test for drugs and alcohol" and "my counselor tests me for drug and alcohol use" with consistent ratings of 5. Thus, it was assumed that FAIR was delivered as intended, with even the most challenging items being rated as above average.

Primary Effectiveness Outcomes

As shown in **Table 2**, and described below, parents receiving FAIR demonstrated statistically significant improvements in all treatment target areas compared to baseline. **Table 1** provides the descriptive analyses for each assessment at each time point.

Parental Methamphetamine and Opioid Use

At baseline, referred parents reported substantial substance abuse histories. Across all participants, 69% had previous substance abuse treatment experience (range 1–15 times), 17% reported a previous history of overdose (range 1–5 times), and 22% reported using intravenously currently. On average parents reported using methamphetamine 6.39 days ($SD = 10.04$, range 0–30) in the last 30 days, and an average of 7.38 years ($SD = 6.51$; range 0–30). Parents reported using opioids for an average of 2.08 days ($SD = 6.21$; range 0–30) in the last 30 days and for an average of 3.15 years ($SD = 4.78$; range 0–22).

Across each of the parent-reported methamphetamine and opioid use outcomes, there were statistically significant decreases in reported use between the FAIR baseline and each later assessment occasion (see **Table 2**). For methamphetamine, the predicted probability of use at baseline was 48%, and over time, this decreased significantly to 20% at Month 4 ($OR = 0.28$), 9% at Month 8 ($OR = 0.10$), 9% at Month 16 ($OR = 0.10$), and 11% at Month 24 ($OR = 0.13$). For opioids, the baseline rate of use was 18%, which decreased significantly to 6% at Month 4 ($OR = 0.31$), 4% at Month 8 ($OR = 0.20$), 1% at Month 16 ($OR = 0.05$),

TABLE 2 | Mixed–effects regression model estimates for all outcomes.

	Baseline level			Change from baseline												
	M00			M04			M08			M16			M24		
Outcome	Est.	SE	p	Est.	SE	p	Est.	SE	p	Est.	SE	p	Est.	SE	p
Substance Abuse[a]															
ASI any methamphetamine use[b]	−0.09	0.29	0.771	−1.29	0.39	0.001	−2.27	0.45	<0.001	−2.28	0.46	<0.001	−2.03	0.43	<0.001
ASI any opioid use[b]	−1.49	0.30	<0.001	−1.18	0.51	0.022	−1.60	0.59	0.007	−2.96	1.05	0.005	−3.03	1.05	0.004
ASI any IV drug use[b]	−1.40	0.31	<0.001	−1.49	0.54	0.006	−2.36	0.69	0.001	−2.31	0.70	0.001	−3.56	1.08	0.001
PDR Drug cravings[b]	0.20	0.23	0.394	−0.92	0.23	<0.001	−1.00	0.20	<0.001	−1.86	0.36	<0.001	−1.44	0.33	<0.001
Mental Health															
TSI anxiety (T–score)	58.81	1.11	<0.001	−5.17	1.09	<0.001	−6.84	1.10	<0.001	−8.41	1.14	<0.001	−8.71	1.10	<0.001
TSI anxiety [b] (clinical)	−1.09	0.31	0.001	−0.36	0.41	0.378	−1.29	0.46	0.005	−1.68	0.50	0.001	−1.64	0.50	0.001
TSI any [b] (clinical)	0.59	0.30	0.050	−1.06	0.37	0.004	−1.07	0.37	0.004	−1.39	0.39	<0.001	−1.25	0.37	0.001
BDI (total score)	19.61	1.42	<0.001	−3.01	1.44	0.037	−5.99	1.44	<0.001	−4.43	1.49	0.003	−4.66	1.45	0.001
Parenting Risk															
PSI (total)	235.73	4.64	<0.001	−13.40	4.77	0.005	−14.44	4.82	0.003	−17.99	5.00	<0.001	−9.58	4.91	0.052
BCAP (total)	10.29	0.64	<0.001	−0.92	0.67	0.171	−2.23	0.67	0.001	−2.16	0.70	0.002	−2.57	0.67	<0.001
PDR child behavior	7.07	0.50	<0.001	−1.92	0.40	<0.001	−2.97	0.37	<0.001	−2.66	0.62	<0.001	−2.43	0.57	<0.001
PDR parental stress	10.01	0.81	<0.001	−3.09	0.65	<0.001	−4.31	0.60	<0.001	−3.96	1.00	<0.001	−3.12	0.92	0.001
PDR emotional distress	1.91	0.11	<0.001	−0.22	0.10	0.035	−0.30	0.09	0.001	−0.26	0.16	0.092	−0.25	0.15	0.102
Parental Stability															
Paid for any work this month[b]	−0.86	0.28	0.003	0.10	0.36	0.773	0.34	0.36	0.347	0.64	0.36	0.077	0.97	0.35	0.006
Paid for ≥20 work days this month[b]	−3.05	0.48	<0.001	0.78	0.58	0.181	0.97	0.58	0.094	1.90	0.54	0.001	1.97	0.53	<0.001
Months at current residence[c]	1.48	0.12	<0.001	0.02	0.13	0.904	0.24	0.14	0.072	0.21	0.14	0.144	0.40	0.14	0.004

TSI, trauma symptom inventory; BDI, beck depression inventory; PSI, parent stress index; BCAP, brief child abuse potential inventory; PDR, parent daily report. Confidence intervals (95%) can be calculated as $\beta \pm (1.96 \times SE)$. All models controlled for waitlist observations. Parameter estimates for the waitlist term and variance components are available upon request.
[a] *Participants' self–reported substance use over the past 30 days.*
[b] *Indicates a dichotomous outcome.*
[c] *1 = 1 Month or Less, 2 = 2–6 Months, 3 = 7–12 Months, 4 = ≥13 Months.*

and 1% at Month 24 (OR = 0.05). For IV drugs, the baseline rate of 20% decreased significantly to 5% at Month 4 (OR = 0.23), 2% at Month 8 (OR = 0.09), 2% at Month 16 (OR = 0.10), and 1% at Month 24 (OR = 0.03). A summary of the self-reported methamphetamine and opioid use outcomes, shown in **Figure 3**, suggests that both methamphetamine and opioid use showed marked decreases between baseline and 4 months (controlling for waitlist), with incremental decreases and maintenance over time. Of note, each of these outcomes—one occasion at a time and controlling for baseline—were tested for differences between mothers and fathers. No significant effects were found, and therefore, due to the number of analyses run and modest sample size, sex was not included in the subsequent models.

For the PDR drug cravings scale, the baseline rate of any reported problems was 55%, which decreased significantly to 33% at Month 4 (OR = 0.40), 31% at Month 8 (OR = 0.37), 16% at Month 16 (OR = 0.16), and 22% at Month 24 (OR = 0.24).

FIGURE 3 | Predicted probabilities of opioid or methamphetamine use by parents across the assessment period.

Parental Mental Health

At baseline, parents reported a significant history of experiencing abuse. Across all participants, 70% reported a lifetime history of physical abuse, with 10% reporting experiencing physical abuse in the last 30 days. Half of all participants reported a history of sexual abuse (51%), with 4% indicating an occurrence in the
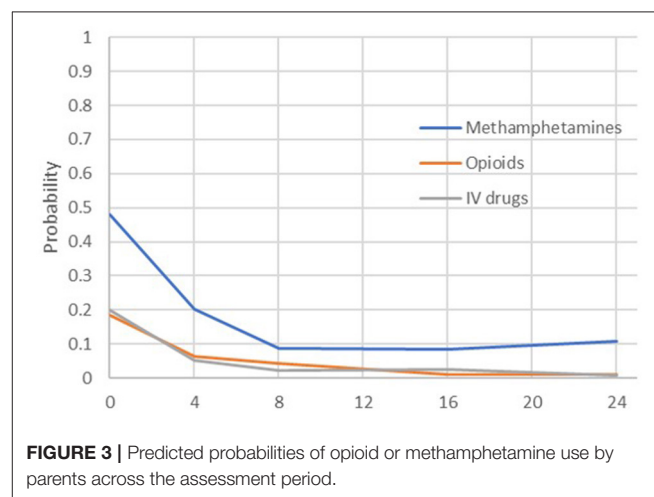
last 30 days. While 79% reported a lifetime history of emotional abuse, 28% reported an occurrence in the last 30 days. Of note, 74% reported having experienced recent emotional distress in the last 30 days related to one or more of these abusive experiences, with 33% reporting daily distress. However, only 22% reported a history of any mental health treatment.

Across mental health outcomes, and with only one exception, there were statistically significant decreases in symptoms between the FAIR baseline and each of the follow-up assessment occasions (see **Table 2**). Trauma symptoms, as measured by the TSI, indicated Anxiety T-scores decreased from 58.8 at the FAIR baseline to 53.6 at Month 4, 52.0 at Month 8, 50.4 at Month 16, and 50.1 at Month 24. Likewise, the predicted probability of a clinical-level Anxiety score decreased from 25% at baseline to 19% at Month 4 (OR = 0.70; the one non-significant effect), to 8% at Month 8 (OR = 0.27), and to 6% at Months 16 and 24 (ORs = 0.19). Similarly, for a clinical-level score on any TSI scale, the predicted probability decreased significantly from 64% at baseline to 38% at Month 4 (OR = 0.35), 38% at Month 8 (OR = 0.34), 31% at Month 16 (OR = 0.25), and 34% at Month 24 (OR = 0.29). Likewise, symptoms of depression as measured by the BDI decreased significantly across occasions, from 19.6 at baseline to 16.6 at Month 4, 13.6 at Month 8, 15.2 at Month 16, and 14.9 at Month 24. Finally, PDR ratings of emotional distress decreased significantly at Months 4 and 8.

Parenting Risk

Table 2 provides the mixed-effects regression outcomes regarding parents' self-reported parenting stress and beliefs as measured by the PSI and BCAP. As seen, parenting stress decreased significantly from 235.7 at baseline to 222.3 at Month 4, 221.3 at Month 8, and 217.7 at Month 16. On the other hand, risk for child neglect did not show significant reductions until Month 8, decreasing from the baseline score of 10.3 to 8.1, with the reduction maintained at 8.1 at Month 16 and 7.7 at Month 24. The PDR ratings of child problem behavior decreased significantly from 7.1 at baseline to 5.2 at Month 4, 4.1 at Month 8, 4.4 at Month 16, and 4.6 at Month 24. The level of stress reported by parents in response to these behaviors also decreased over time, from 10.0 at baseline, 6.9 at Month 4, 5.7 at Month 8, 6.1 at Month 16, and 6.9 at Month 24.

Parental Stability

At baseline, almost half of all parents reported their usual living arrangement as being with their partner and children (48%); the remaining parents reported living with family (18%), living alone with their children (13%), or without a stable arrangement (10%). Results for parental stability outcomes are reported in **Tables 1**, **2**. Housing stability did not change significantly at Months 4, 8, or 16, but it did increase significantly at Month 24. The level at Month 24, a predicted score of 1.87, indicates that parents were closer to having lived at their current residence for 7 to 12 months (i.e., a score of 2). For paid work, there were two versions of the outcome: any paid work and full-time work. At baseline, the probability of full-time work was 5%, and this increased significantly at Months 16 and 24 to 24% (OR = 6.71) and 25% (OR = 7.19) respectively. For any paid work, the

baseline probability was 30%, and at Month 24, this increased significantly to 53% (OR = 2.64).

Exploratory Correlations: Associations Across the Four FAIR Components

As shown in **Figure 3**, both opioid and methamphetamine use showed marked decreases between baseline and 8 months, with incremental decreases and maintenance over time, and the same pattern held for outcomes related to mental health and parenting risk. To understand these effects—specifically, the degree to which certain outcomes were meaningfully correlated at relevant points in the treatment process—correlations were computed between outcomes from each domain at Month 0 (baseline), Month 8 (around the time that treatment is completed), and Month 16 (∼8 months since treatment completion). The selected exemplary variables were methamphetamine use (ASI), depression symptoms (BDI), risk for parental neglect (BCAP), and paid work (Parental Stability). **Figure 4** illustrates each outcome across the full 24-month follow-up, and the correlations are reported in **Table 3**. At baseline, methamphetamine use was not significantly correlated with the other variables. Among the selected variables, the only significant correlation at baseline was between depression and risk for parental neglect. By Month 8, methamphetamine use was significantly associated with depression symptoms, and depression symptoms continued to be associated with parental neglect. By Month 16, methamphetamine use continued to be significantly correlated with depression symptoms, and there was also a significant and positive correlation with parental neglect. Also at Month 16, methamphetamine use, depression symptoms, and parental neglect all had significant, negative correlations with paid work. As shown in **Table 3**, a number of significant associations exist across all four FAIR treatment domains, highlighting the interrelated symptoms presentation.

Cost and Reimbursement of FAIR Service Delivery

Table 4 provides the average total cost of a client over the course of treatment. The FAIR team is comprised of a mix of Qualified Mental Health Associates (certified drug and alcohol counselors) and Qualified Mental Health Professionals (who hold a Master's degree or above). In the study's local Medicaid environment, QMHPs are allowed to conduct intake assessments and to complete the interim clinical assessments required by Medicaid. QMHAs are allowed to provide all non-assessment services delivered within the FAIR program, but are reimbursed at a reduced rate. The cost per clinician was calculated (i.e., salary/fringe, phone, mileage, session expenses; $5,680/month) and totaled to the fixed monthly program expenses (i.e., billings and software, supervision, rent, medical director, administrative support) for an average clinician cost of $7,938/month. These figures do not consider additional expenses such as training and turnover costs. Total cost per client estimates were calculated by using an average of true costs for 30 completed cases. Outcomes suggest a cost of $8,000–9,000 per client, over an average treatment length of 8.7 months. As shown in **Table 4**,
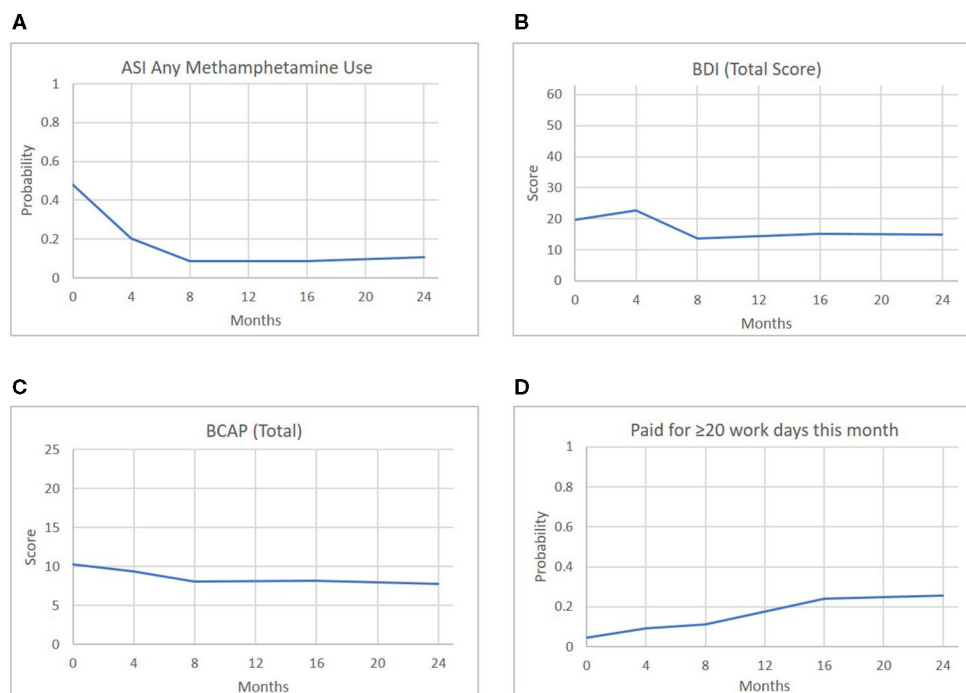
FIGURE 4 | Predicted scores of representative outcomes across the four FAIR domains over time.

monthly treatment costs decreased over the course of FAIR, as level of intervention intensity decreased over time.

The ability to recoup costs through Medicaid reimbursement changed over time due to changes in reimbursement fee schedules by the county insurer. Although at the start of the trial, a modifer was provided for offering services outside of the clinic, with an additional modifier for providing rural services, by the end of the trial both of these additional reimbursement credits were no longer allowable. Thus, to continue to provide services to parents in rural, outlying communities (i.e., nearly half of referred parents), the clinic was required to seek additional funding for 13% of program costs above Medicaid. **Table 5** shows an analysis of travel costs for FAIR, with figures adjusted for no-show appointments. As shown, counselors had to travel to settings no more than 20 miles away, 7–10 times, to cover the cost of delivering a single encounter in the most distant locations.

DISCUSSION

This trial examined the clinical effectiveness and financing required to sustain FAIR—an intensive community-based outpatient program for families involved in the CWS with parental opioid and/or methamphetamine use—when delivered in a real-world community behavioral health clinic.

FAIR Engagement

Although treatment engagement rates were high at 95%, only 72% completed the program. While this treatment completion

rate is less than found in the original randomized clinical pilot where 87% completed treatment (Saldana, 2015), it still exceeds the rates reported across residential (65%) and outpatient (52%) substance abuse treatments across the United States (Stahler et al., 2016) or Family Treatment Drug Courts with parents involved in the CWS (65%; Worcel et al., 2008). This is particularly significant considering the comprehensive and integrated benefits of the FAIR program, in addition to substance abuse treatment. Indeed, as shown throughout the results, parents who received FAIR showed significant improvements in areas related to mental health, parenting, and ancillary stability. Thus, the engagement strategies utilized by FAIR counselors as part of the defined intervention demonstrate strong potential to engage and retain a particularly difficult to engage population.

FAIR Effectiveness

The overall outcomes from this trial suggest the clinical effectiveness of the FAIR program in addressing all four treatment components targeting the needs of parents referred by the CWS for opioid and/or methamphetamine abuse (**Figure 2**). Of note, the average length of treatment was 8.7 months, with a 24-Month follow-up (i.e., 15.3 months post-average treatment completion). Therefore, parents who received FAIR were likely to maintain improvements in their substance abuse, mental health symptoms, and parenting risk for over a year after completing treatment. Although only 25% of participants were fathers, the probability of reducing opioid or methamphetamine use did not differ for mothers vs. this small sample of fathers, offering

TABLE 3 | Correlations between select outcomes from the substance abuse, mental health, parenting risk, and parent stability domains at FAIR baseline, Month 8, and Month 16.

Outcome	Methamphetamine		Depression		Risk for neglect	
	r	p	r	p	r	p
FAIR Baseline						
ASI any methamphetamine use						
BDI (depression total score)	0.14	0.172				
BCAP (risk for neglect total)	−0.01	0.959	0.74	<0.001		
Paid for ≥20 work days this month	−0.07	0.485	−0.19	0.066	−0.10	0.390
Month 8						
ASI any methamphetamine use						
BDI (depression total score)	0.47	<0.001				
BCAP (risk for neglect total)	0.19	0.139	0.65	<0.001		
Paid for ≥20 work days this month	−0.17	0.137	−0.22	0.050	−0.05	0.691
Month 16						
ASI any methamphetamine use						
BDI (depression total score)	0.59	<0.001				
BCAP (risk for neglect total)	0.32	0.018	0.67	<0.001		
Paid for ≥20 work days this month	−0.25	0.031	−0.28	0.018	−0.30	0.024

TABLE 4 | Average cost of treatment per client, per treatment month.

Month	Average client % of FTE	Monthly client cost
1	19%	$1,520
2	16%	$1,280
3	14%	$1,120
4	15%	$1,200
5	12%	$960
6	13%	$1,040
7	10%	$800
8	8%	$640
9	6%	$480
Total		$9,040

cautious promise of FAIR in providing an effective treatment for either parent referred by the CWS.

At baseline, the majority of parents referred to this study (74%) reported experiencing distress in the last 30 days related to a previous experience of abuse. Of these, 33% reported experiencing daily distress and yet, only 22% of parents reported any history of mental health treatment. Exploratory analyses highlighted the relationship between parental depression, methamphetamine use, risk for child neglect, and employment. These patterns are consistent with conceptualization of the logic behind FAIR (**Figure 1**), and underscores the need to address the interrelation of all treatment domains to achieve the goal of safe and stable families. Although only a sample of available correlations were detailed, significant non-reported associations were found across a range of variables including other substance use scales, mental health symptoms, and parenting risk indicators, highlighting the overarching need for comprehensive care for families involved in the CWS.

Waitlist

Although the adapted version of the dynamic wait-listed design was intended to accommodate the ethical concerns of not making an efficacious treatment available to a population in high need, the high rate of participants who accepted the invitation to receive FAIR once a slot became available was not expected. Given that participants initially randomized to WL were encouraged to seek alternative services and maintained the opportunity to receive compensation for their research participation, it was anticipated that a larger portion of the WL sample would have declined FAIR, providing greater opportunity to examine a no-treatment group in addition to waitlist effects. Of the 40 parents initially allocated to WL, 13 reported receiving some level of mental health and/or substance use treatment, but only 8 declined FAIR once it was offered. Thus, only 33% of parents initially randomized to WL engaged in services outside of FAIR, and 80% of parents referred elsewhere preferred to try FAIR even though its level of rigor and commitment was more intensive than traditional outpatient services. This secondary finding reinforces not only that the CWS has identified a need for services specific for families with opioid and methamphetamine abuse, but parents themselves who have open CWS treatment plans desire a needs-specific program. Although the original design failed in providing a large enough sample for rigorous comparisons between groups, this failure highlights the misalignment between the needs of parents and the services that are traditionally available.

Given the limited number of individuals remaining on the waitlist throughout their 24-months participation ($n = 8$), formal analyses were not conducted comparing this group against parents receiving FAIR. Yet, the WL data still offer some value. Across time, parents who remained on the waitlist, opting to receive services elsewhere, showed moderate reductions both in methamphetamine and opioid use at 8 Months, but use was close to baseline for both substances by 24 Months, with associated high levels of cravings and other substance-related problems. Although two individuals reported decreased mental health symptoms, the majority reported relatively unchanged mental health symptoms. One exception was anxiety, which showed a steady increase in severity from baseline to 24 Months. Parenting risk behaviors were inconsistent across this small sample. While these waitlist observations are limited, they offer a preliminary example of the potential

TABLE 5 | Travel costs for providing FAIR treatment throughout the catchment area of study clinic.

	Trip expenses			Average trip revenue			Profit	
	Round trip miles	Total travel cost	Clinical wage cost	Average units billed	Average revenue	Adjusted average revenue*	Adjusted revenue minus expenses	Breakeven % rate increase
QMHP[a]								
	84	$132.20	$86.00	6.3	$208.66	$146.06	−$72.14	49.39%
	45	$67.75	$90.11	6.6	$218.59	$153.01	−$4.85	3.17%
	20	$28.92	$51.88	3.8	$125.86	$88.10	$7.30	−8.29%
QMHA[b]								
	84	$114.20	$68.01	6.3	$169.79	$118.85	−$63.36	53.31%
	45	$58.75	$71.25	6.6	$184.49	$129.14	−$0.86	0.66%
	20	$25.17	$41.02	3.8	$108.00	$75.60	$9.41	−12.45%

*Includes the 30% no–show rate for trips made without any billable units.
[a]QMHP, Qualified Mental Health Professional (master's degree or above).
[b]QMHA, Qualified Mental Health Associate (bachelor's degree with experience).

trajectories for families with complex needs who do not receive integrated services.

Services for Families Involved in the Child Welfare System

As described in the results, the baseline functioning of parents referred to the study was notably poor. Parents described extensive periods of methamphetamine and/or opioid use. Less frequent, but still reported, was the use of other illicit drugs including benzodiazepines, cocaine, MDMA, and hallucinogens. In the original feasibility trial of FAIR, the average age of onset of any substance use was 16 years (Saldana et al., 2013). The average age of the current sample was 31.24 years, with a longer reported length of use reported for methamphetamines (7.38 years) than opioids (3.15 years). Several older parents reported up to 30 and 22 years of use for methamphetamine and opioids, respectively. Thus, families presenting to FAIR demonstrate the level of severity of parents who are referred to the CWS who are in need of an array of services.

The FAIR logic model (**Figure 1**) was developed over a decade ago from a series of qualitative interviews and focus groups with CWS-involved collaborators including workers, legal teams, and parents during the formative development work. The current trial shows that the need for programs like FAIR is as great now as it was at its inception, and also shows that if parents are able to access such services, they might be able to break out of a cycle of high ancillary need. Although indicators of parental stability initially did not change for parents receiving FAIR, by Month 16 they reported increases in days employed and, by Month 24, significant increases in full-time employment and housing stability.

Cost and Financing of FAIR

The current trial examined a free-standing FAIR program, functioning independently of the research study. As described, the average cost of treating a FAIR parent was ~$9,000 over the course of ~9 months. Though costly, the average cost

of methadone maintenance treatment for opioid use disorder alone is $4,700 annually (National Institute on Drug Abuse, 2018), and does not address the other complexities for long-term parental success. Likewise, inpatient addiction treatment costs range between $14,000 and $27,000 for a 30-day treatment (American Addiction Centers, 2021) and may not address the specific needs of parents involved in the CWS. Although a formal cost-effectiveness analysis was not feasible in the current trial, it is hypothesized that future research will find FAIR to be cost-effective relative to the combination of services received by parents as part of their CWS treatment plans.

Federal guidelines establish the base for reimbursement fee schedules and definitions of billable services; however, states and their contracted Medicaid providers operate independently of one another, making it difficult to determine a fixed expectation of costs and reimbursements available. Current CPT codes do not provide reimbursement for services such as FAIR and, as such, individual session activities are billed whenever possible, but unbillable time still remains. As shown in **Table 5**, these financing challenges limit the ability for programs like FAIR to serve families beyond a prescribed mileage radius without the assistance of additional funding. Thus, such programs also must consider factors such as the geographic range being served in their financial strategies. When such factors are considered, however, and with close financial monitoring, FAIR can be sustained within a community clinic setting.

Limitations

Despite the strong clinical effectiveness of FAIR found in the current trial, several important limitations should be noted. First, although the dynamic wait-listed design offered a rigorous alternative to traditional randomized clinical trials and was necessary to meet the ethical and CWS needs, it failed to provide the intended goal of having a reasonable sample of parents who remained on the WL for repeated measurement periods, and therefore limited the ability to draw firm comparisons between parents receiving FAIR and those who receive traditional services. This meant that the statistical tests, rather than focusing on

differences between groups, focused on within-group change over time, controlling for waitlist. Second, the statistical models tested for change between baseline and each later occasion. This provided targeted tests, but one consequence was that the model assumed all participants completed assessments at the intended timing of each occasion. Alternative formulations (e.g., linear slopes) could address uneven spacing of measurements across participants. Third, the FAIR program being evaluated was a single site, operating in the same county where it was developed. Therefore, the CWS was a part of the intervention development process and was familiar with the program. It is unknown how FAIR might be received in a new community under different CWS conditions. Fourth, due to challenges unrelated to the study at the state DHHS office providing administrative outcomes, data is not yet available to determine FAIR's effectiveness in achieving system-level outcomes such as rates of case closure and child permanency.

Future Directions

In addition to these outcomes offering promise as a treatment for adults with complex and interrelated problems, they demonstrate the effectiveness of an intervention for one of the most intractable issues facing the CWS, specifically, and public serving systems more generally. The FAIR program has been operating consistently since its inception in 2009, growing steadily from a feasibility trial to an independent program. Indeed, a recent analysis showed the ability for the FAIR program to sustain during the COVID-19 pandemic (Cruden et al., 2021) demonstrating the promise for FAIR to sustain and become recognized within a CWS and service system community.

To help facilitate the possibility of scale-up, implementation strategies were developed to implement FAIR in a new context. Strategies build from those used by the investigative team for implementing other interventions and include an operationalized implementation plan, cost calculator based on findings from the currently described trial, and a training and coaching process. An active effectiveness-implementation trial of an adapted version of FAIR to prevent parental opioid and/or methamphetamine use is evaluating the effectiveness of these strategies in implementing FAIR in nearby counties, as part of the Helping to End Addiction Long-Term initiative (PI: Saldana; UG/H3DA050193). These scale-up efforts, in combination with outcomes from the current trial, underscore the promise for FAIR to be implemented more widely.

As communities across the United States struggle to address the opioid and methamphetamine crises, the FAIR program might offer families access to evidence-based practice in a welcome style. Policy efforts are needed to focus on investing in reimbursement for programs that address the complexities of parental opioid and/or methamphetamine use, and in so doing focus on investing in future generations.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available but data might be made available upon request to be analyzed in collaboration with members of the investigative team. Requests to access the datasets should be directed to Lisa Saldana, lisas@oslc.org.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Oregon Social Learning Center Institutional Review Board. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

LS conceptualized and led this study, developed the intervention and hypotheses, and led the writing of the manuscript. JC developed the study design and data analytic plan, directed primary outcome analyses, and assisted in manuscript preparation including writing and editing. MC conducted all economic analyses and helped with manuscript preparation. ZA conducted primary data analyses under the direction of JC and assisted in manuscript preparation including writing analysis results. HS conducted all preliminary data preparation analyses and participated in manuscript preparation. CP oversaw study procedures and reviewed all study descriptions for accuracy. All authors contributed to the article and approved the submitted version.

FUNDING

ACKNOWLEDGMENTS

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Conflict of Interest: LS is the developer of the FAIR program and
initiated the implementation of FAIR at the ODI Clinic. She does not gain
financially from this implementation. Further, she was not involved in data
collection, management, or analyses or otherwise positioned to manipulate
study outcomes.

The remaining authors declare that the research was conducted in the absence of
any commercial or financial relationships that could be construed as a potential
conflict of interest.

The Family Check-Up Online: A Telehealth Model for Delivery of Parenting Skills to High-Risk Families With Opioid Use Histories

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Growing opioid misuse in the United States has resulted in more children living with an adult with an opioid use history. Although an abundance of research has demonstrated a link between opioid misuse and negative parenting behaviors, few intervention efforts have been made to target this underserved population. The Family Check-Up (FCU) has been tested in more than 25 years of research, across multiple settings, and is an evidence-based program for reducing risk behavior, enhancing parenting skills, and preventing the onset of substance use. It is designed to motivate parents to engage in positive parenting practices and to change problematic parenting and has been tested across a variety of ages including early childhood and adolescence. It is highlighted in NIDA's Principles of Substance Use Prevention for Early Childhood: A research-based guide as one of only three effective selective prevention programs for substance abuse among families with young children. Recently, we developed an online version of the FCU that has now been adapted for early childhood and families with opioid use histories. The online platform and telehealth model allow for wide-scale dissemination, ease of training with community providers, and increased public health reach for families in remote, rural areas. This is particularly important when targeting families with opioid misuse and addiction because there are high rates of addiction in remote areas, yet few services available. In this article, we describe the FCU Online and review new content in the model that targets a population of young adult parents with substance abuse histories, including opioid use. New modules include content focused on harm reduction for this high-risk population of parents, such as safety in the home, substance use while parenting, and managing conflict with partners and friends.

Keywords: prevention, family, telehealth, early childhood, parenting

INTRODUCTION

Misuse of opioids, including heroin, prescription pain relievers, and synthetic opioids, has been on the rise in the United States over the past decade, which has led to more than 400% increases in overdose death in the United States (Centers for Disease Control and Prevention, 2019). According to a 2018 national survey on drug use and health

(Substance Abuse and Mental Health Services Administration, 2019), over 10 million people 12 years of age or older misused opioids, approximately 2 million people were diagnosed with opioid use disorder. Bullinger and Wing (2019) estimate about 548,000 children lived with an adult with opioid use histories in 2017. Additionally, the number of children living with an adult who uses heroin doubled from 2002 to 2017 (Bullinger and Wing, 2019). The result is that an increasing number of children are living with substance abuse in the home and more parents are taking care of their children while using substances, yet few interventions specifically target this population of parents.

Similar to patterns observed in research with parents who use a range of substances, the past research has documented the link between opioid use and negative parenting behaviors. Risk factors for negative parenting practices associated with parents with opioid use histories include psychopathology, comorbidity, socioeconomic status, parenting style or parenting knowledge, emotion regulation, level of distress, and negative care-taking behaviors (Cioffi et al., 2019). The previous studies also suggest a high level of comorbidity between opioid dependence and other mental health disorders. Furthermore, individuals with mental health disorders are more likely to be prescribed opioids, which increases the risk of opioid misuse (Goesling et al., 2015). Additionally, parents with opioid use histories are likely to receive prescription medication for mental illness and have other mental health disorder diagnoses (Novak et al., 2019), such as personality disorder (Barry et al., 2016), anxiety-related disorders (Martins et al., 2012), and depressive disorders (Sanmartin et al., 2019). Given the co-occurrence of the aforementioned mental health disorders, parents with opioid use histories often face emotion regulation challenges and high levels of distress (Neger and Prinz, 2015; Wilcox et al., 2016). For example, parents with opioid use histories often experience stages between substance craving and withdrawal, which may induce emotion regulation challenges. As both a precursor and an outcome of opioid misuse, emotion dysregulation may also impede parents' ability to provide adequate childcare and responsive parenting (Mayes and Truman, 2002). Research also indicates that parents with opioid use histories often lack basic parenting information and utilize coercive, negative parenting strategies which exacerbate the risk of child abuse and neglect (Mayes and Truman, 2002; Cioffi et al., 2019).

Children living with an adult with opioid use histories are likely to grow up in a chaotic environment with low parental support, minimal monitoring, and high exposure to unsafe and illegal activities (Powis et al., 2000). Such settings may impede children's ability to develop complex regulatory skills, such as emotion regulation and autonomous decision making, and increase the likelihood of engaging in risky behaviors in adolescence and young adulthood (Bridgett et al., 2015; Cioffi et al., 2019). Some research suggests a direct impact of parental substance use on child developmental outcomes while other studies argue that parental and environmental factors mediate negative long-term outcomes (Barnard and McKeganey, 2004; Pajulo et al., 2006). Key parenting skills, including maternal

responsiveness and sensitivity, predict long-term positive outcomes for children even in the context of substance misuse (Lowe et al., 2017).

Parenting interventions that have been developed specifically for parents with opioid use histories focus on delivering emotional regulation skills and increasing parenting knowledge (Neger and Prinz, 2015). For example, Parents Under Pressure is a 12-session, home-based, and manualized program that aims to improve family functioning and decrease parental stress by delivering parenting skills and mindfulness techniques. The program demonstrated effectiveness in improving family functioning, reducing child problem behaviors, and preventing parental substance use relapse (Dawe et al., 2003). Niccols et al. (2012) conducted a systematic review of integrated substance abuse program that included a parenting component. While most integrated programs were associated with parenting skill improvement, reductions in maternal mental health problems, such as depression, were associated with higher levels of parenting competence.

Despite these successes, most parents with opioid use histories in the United States are not receiving any treatment, and they are rarely receiving treatment that links their substance misuse with parenting. Research shows that only 28% of adults with opioid use histories who live with a child received any type of substance use treatment within the past year (Feder et al., 2018). Additionally, parents with opioid use histories are more likely to identify barriers and stigma that prevent them from seeking proper treatment for their substance use compared to adults with opioid use histories who are not living with a child. Adults with opioid use histories who live with a child are more likely to be women than men. Historically, women are less likely to seek out substance use treatment due to unique risk profiles, such as comorbid mental health disorders and past traumatic experiences (Greenfield et al., 2007). Adults with opioid use histories who live with a child are also more likely to live in rural areas, where substance use treatment and resources focused on parenting are usually limited (Patrick and Schiff, 2017). Barriers related to accessibility, such as access to transportation and availability of childcare, are also twice as likely to be reported by parents with opioid use histories. Finally, parents with opioid use histories face a variety of stigmas that limit their ability to seek mental healthcare. Feder et al. (2018) reported that parents with opioid use histories are four times more likely to report stigma as a barrier to treatment for mental health concerns than parents without opioid use histories. Adults with opioid use histories feared being judged by neighbors or peers, removal of their children from the household, and developing a bad reputation as a parent, particularly in small rural communities.

The COVID-19 pandemic has placed additional and unprecedented barriers to treatment for parents with opioid use histories. Isolation, stress, and anxiety caused by the pandemic may increase the frequency and amount of opioid use, which can lead to exacerbation of symptoms and increased likelihood of overdose. For those who seek treatment, state and federal regulations on reducing face-to-face clinical

encounters may prevent them from seeking proper care (Priest, 2020). Huskamp et al. (2020) suggest that the percentage of individuals initiating medical treatment for opioid misuse decreased during the early months of the COVID-19 pandemic. Additionally, other organizations providing services to people with opioid use histories, such as syringe service programs, have also been impacted by the pandemic. For example, Glick et al. (2020) found that 43% of 173 interviewed syringe service programs reported decreasing service provision due to the pandemic. Additionally, one-quarter of syringe service programs had one or more sites closed due to COVID-19. For people already in treatment for opioid misuse, access to any medication-assisted treatment or opioid treatment program has become one of the biggest issues. For example, patients receiving methadone were required to visit their opioid treatment program daily prior to the pandemic. While some of the requirements have been modified to allow patients to take home doses of their medication during the pandemic, this option can be challenging for some populations (Cowan et al., 2021). Some recent efforts have been made to decrease barriers for parents with opioid use histories, which will increase accessibility to treatments. For example, the (Substance Abuse and Mental Health Services Administration, 2020) recently released new guidance for patients to engage in take-home methadone maintenance programs. Agencies that serve families have increased their use of telehealth support to parents. Parenting interventions are taking important steps to decrease face-to-face contact and building programs online that reach a wide range of families.

THE FAMILY CHECK-UP

The Family Check-Up (FCU) is a brief, cost-effective, and strengths-based intervention that focuses on parent management training and skill building. It relies on an ecological assessment where parents report on their current parenting strategies, child behaviors, family dynamics, and other important contextual factors including stress, social support, parenting self-efficacy, and health behaviors including substance use (Dishion and Stormshak, 2007). Following the norm-referenced assessment, parents receive a strengths-based feedback session using motivational interviewing delivered by a family consultant or coach where their assessment results are presented relative to normed data. Parents choose from a menu of options and can self-direct to additional support from their coach on topics including limit setting and monitoring, proactive parenting, positive parenting, and relationship building (Dishion and Kavanagh, 2003). The FCU is intended to be brief (three sessions) and delivered as a preventative intervention to at-risk families or it can be adapted to a tiered, targeted intervention with follow-up for high-risk families. Families engaged in the FCU experience reductions in child problem behaviors, family conflict, youth substance use, improvements in child self-regulation and academic outcomes, and increased use of parent use of positive behavior strategies. The FCU has been shown to be effective in multiple randomized control trials with a

range of age groups when delivered in a variety of settings including elementary school (Stormshak et al., 2020), middle school (Stormshak et al., 2010), and community mental health settings (Smith et al., 2015). The model is effective at reducing problem behavior and supporting parenting skills with parents of young children (Dishion et al., 2008), middle school children (Fosco et al., 2013), and late adolescents (Stormshak et al., 2019a).

The FCU has a long history of efficacy trials that support this model across multiple populations; however, this research was conducted using the in-person version of the FCU, which was delivered either in the home, at a community setting, or at school. A large-scale effectiveness trial conducted in 2009 was delivered across 41 schools in Oregon, and although the results of the study were positive, there were many barriers to participation and uptake (Smolkowski et al., 2017). First, the uptake by schools was poor, with some schools unable to use the model due to staffing issues. Second, many parents faced barriers to participation, such as transportation and childcare. This led to the adaption of the FCU for online delivery (FCU Online) for parents of middle school children (Danaher et al., 2018). Parenting interventions often suffer from issues of retention and engagement, and the FCU Online removed the barrier of having to physically attend sessions and engage with the intervention at specific times. Instead, parents could access the FCU Online from their home computers and received support from a coach over the phone. Additionally, the FCU Online reduced any potential burden on school staff or community providers and can be delivered with coaching or with no support at all.

The FCU Online was developed as part of a randomized controlled trial as an approach to reduce problem behavior in middle school children (funded by the National Institute on Drug Abuse: Stormshak et al., 2019b). In the trial, the FCU Online was delivered as a stand-alone program, or with supplemental coaching in a telehealth format that included at least three phone or video conferencing sessions to support parents in making behavioral change (Danaher et al., 2018; Stormshak et al., 2019b). The FCU Online was delivered to students across eight middle schools in Oregon (both rural and urban) with a high percentage of students and families who were at risk (more than 70% economically disadvantaged and fewer than 50% passing state testing with proficiency). Results suggest that the FCU Online with coaching support improved parents' self-efficacy ($d = 0.25$) and child emotional problems ($d = 0.32$) at 3 months post-test, with outcomes moderated by risk in the expected direction (e.g., higher risk was associated with greater improvements; Stormshak et al., 2019b). Furthermore, for children with higher levels of behavior problems, the FCU Online also showed intervention effects on effortful control and parenting confidence, key FCU mechanisms of change.

These results are promising and suggest that an online version of the FCU can be targeted at high-risk populations, such as parents who misuse opioids and other drugs. As such, we have adapted the FCU Online for parents with opioid use histories for delivery on smartphones. This will enable us to disseminate the FCU Online in rural communities—where

more adults have smartphones than computers—and to have a wider reach and impact on vulnerable populations that may not have access to parenting skills interventions, or who may have stigma associated with attending these support interventions in their communities. Rural areas, particularly in Oregon, are impacted simultaneously by high rates of opioid use and lack of services for parenting support, mental health, and substance use treatment. Rural areas have been hard hit by opioid use due to easier access to prescription medications coupled with high levels of socioeconomic stress and unemployment (Keyes et al., 2014). Research clearly suggests that enhancing parenting practices when children are young can ameliorate and protect against risk factors that impact development. Ample research supports the model whereby supportive and warm parenting mediates socioeconomic status and later child problem behavior from early childhood to adolescence (Odgers et al., 2012). By adapting the FCU to an eHealth model, we address a need in the community with a cost-effective, transportable intervention focused on building parenting skills in a vulnerable population to support healthy development of children and improve overall family functioning.

RATIONALE

Given the unique struggles that parents with opioid use histories face, it is important to address and support the needs of this population with evidence-based interventions. However, as outlined previously, many barriers exist in seeking treatment and parenting support. Treating substance use by integrating a family component to the intervention improves treatment engagement for substance use, as well as increases parenting skills (Sword et al., 2009; Milligan et al., 2011). Building upon our previous research and development of an eHealth version of the FCU (Danaher et al., 2018), we worked to develop an eHealth web-based mobile application of the FCU Online to allow for accessible parenting intervention within rural settings.

To ensure our intervention met the needs of our intended community, we utilized an iterative approach to intervention development, guided by family and community service focus groups, to ensure that the mobile application of the FCU Online would adequately address parenting needs. First, we conducted family focus groups of pregnant mothers with opioid use histories to identify needs of the population. Several themes emerged focused on lack of knowledge around child development, appropriate discipline practices, and behavioral routines. Additionally, difficulties in accessing services were a consistent theme throughout the focus group. Specifically, lack of knowledge navigating systems and available services, fear of judgment from providers and stigma of substance use challenges, lack of access to services, and concern about having children removed from their care. Finally, the focus group highlighted themes around flexibility in provided services, as many of the family struggled with economic instability.

Based on feedback from focus groups and community providers, we adapted the FCU model for this population of high-risk parents. First, we identified areas of content, including

parent wellness and parenting in the context of substance use, that were relevant to parents with substance use histories. Once the content was identified, we used evidence-based models to develop content in each modules. Once the modules were refined, each module was then reviewed by community partners and third-party content experts to ensure their clarity and suitability to the population.

THE FCU ONLINE FOR PARENTS WITH HISTORIES OF OPIOID MISUSE

The FCU Online is grounded in the original FCU model and includes an assessment, feedback, and curricula designed to support parents in improving their relationships with their children and building parenting skills that predict healthy long-term child adjustment. The FCU Online guides parents through an assessment, feedback, and skills training session for each module of content. At the start of each module, parents take a brief assessment where they receive feedback that identifies specific areas of strength and growth within the skill area. This assessment and feedback inform the content delivery, and the web-based or mobile application then highlights strength areas as well as areas for growth using a motivational interviewing framework.

FCU ONLINE MODULES

The FCU Online includes five different content modules: parent wellness, substance use and parenting, positive parenting, proactive parenting, and monitoring/limit setting. The content of these modules was adapted from the Everyday Parenting curriculum (Dishion et al., 2011) and includes additional support for parent wellness and substance use prevention, which support challenges that are often associated with parents with a history of substance use. In the next section, we will briefly describe the content and how each module was specifically adapted to support parents with opioid use histories.

Parent Wellness and Self-Care

Research suggests that individuals with opioid use histories are more likely to have higher incidences of mental health disorders, specifically anxiety and depression (Cioffi et al., 2019). Additionally, problems with self-regulation and emotional control have been shown to be both a precursor and outcome of opioid misuse, which has negative implications for parenting skills since self-regulation is needed to appropriately respond to children's behaviors (Rutherford et al., 2015; Cioffi et al., 2019). The aim of this module is to provide psychoeducation on the importance of parent mental health and promote self-care through skills that support their child's mental health and emotion regulation in the context of parenting.

The parent wellness and self-care module include psychoeducation and interactive activities to increase knowledge and build skills to support parent health. Specifically, the module

introduces the importance of building a self-care plan to improve health and manage stress, providing suggestions and examples to choose from, if needed. The module then turns to building skills to manage depression and cope with stress, acknowledging these as common experiences for parents that have been linked with child behavior problems and are amenable to change when parents participate in parenting training and skills development (Shaw et al., 2009). The skill sessions engage parents in stress management practice through interactive activities, including behavioral activation and mindfulness techniques. The module then turns to implementing healthy routines and supporting parent wellbeing and child development. Finally, the module provides tools to improve one's sleep routine and highlights the importance of sleep. By implementing these self-care habits and improving parent emotional control, parents can improve their ability to provide quality care for their children.

Substance Use and Parenting

This module was designed from a harm reduction perspective since the previous research has suggested that punitive-based interventions for adults with opioid use histories are often ineffective (Taplin and Mattick, 2015). Harm reduction approaches which incorporate comprehensive treatment to address substance use within the larger context of parenting have shown success in increasing the overall health of both mothers and their children (Pinkham et al., 2012; Wright et al., 2012). Furthermore, Niccols et al. (2012) found that integrated treatment of substance use and parenting intervention for mothers was associated with improved outcomes in parenting skills compared to addiction-only treatment. The substance use module utilizes this perspective to address substance use within the context of parenting in order to support parenting development.

The module starts by engaging individuals in psychoeducation about substance use and the physiological effects on the body. Participants then practice how to manage substance cravings, by identifying triggers of use and employing strategies when experiencing cravings to build awareness. Because individuals with opioid use histories often report social isolation (Sword et al., 2009; Pinkham et al., 2012), we discuss the importance of building support through healthy relationships. We explore communication with partners and family as an essential aspect of building positive relationships (Gottman, 2008). Activities provide practice with effective communication skills, such as practicing "I" statements. Finally, the module explicitly connects the effects of substance use to parenting and emphasizes important strategies to keep children safe when substances are present in the home.

Positive Parenting

The cornerstone of effective parenting is positive parenting, which refers to a set of skills that enable parents to guide their children using positive strategies, such as praise, incentives, and positive support. Research consistently suggests positive parenting strategies improve child behavior and mental health (Stormshak et al., 2017). Positive parenting is particularly important in early childhood, as harsh punitive parenting

practices have been shown to lead to a parent-child coercion cycle, which is associated with increased child problem behavior, and more extreme problem behavior in adolescence (Smith et al., 2015). Critical tools for parents of young children involve promoting healthy development by using praise, support, and positive attention to shape behaviors; structuring activities and requests to increase the likelihood of success; and providing parent-child interaction and playtime. The FCU has been shown to improve positive parenting in high-risk families, which, in turn, disrupts the trajectory of problem behavior in young children ages 2–5 years (Dishion et al., 2008). Additionally, the previous research has shown that maternal warmth and sensitivity predict positive mother-infant dyad relationships, beyond in utero exposure to opioids (Sarfi et al., 2011). While parents with opioid use histories have fewer sensitive and warm interactions with their children compared to those without opioid use histories, interventions like the FCU that focus on relationship quality, warmth, and positive behavior have the potential to mitigate risk to parent-infant relationship quality.

The positive parenting module in the FCU Online includes interactive activities to increase awareness and attention to positive skill development. The module begins with psychoeducation around positive reinforcement (e.g., rewarding the behavior you want to see, rather than focusing on punishment). It acknowledges the challenges of raising young children and encourages parents to focus on praising good behavior rather than attending to negative behavior. In addition to encouragement and praise, the module offers opportunities for parents to practice using specific praise. Specific praise gives children explicit information about what behaviors parents want to encourage. By making praise more specific rather than global, young children can learn the behaviors that parents want to reinforce. Building high-quality relationships with children is also an important aspect of positive parenting. This module emphasizes the importance of building parent–child relationships by focusing on child strengths and engaging in child-directed play. Specific skills for playing with children are reviewed and parents are encouraged to practice these skills. Another core component of positive parenting is giving clear, age-appropriate directions to guide children's skill development. Video examples demonstrate giving directions, praising children, and providing clear rules. Last, the module gives participants a chance to differentiate between incentives, rewards, and bribes. By identifying the differences between incentives and rewards, parents can practice implementing those skills with their children to support positive behavior at home.

Proactive Parenting

Proactive parenting refers to a parent's ability to plan ahead to avoid problem behaviors before they occur. Research suggests that parents' use of proactive strategies reduces child problem behaviors and may reduce the risk of future conduct problems (Gardner et al., 2007). By utilizing proactive techniques, parents provide structure and safety for children, adding stability to facilitate a child's success. Because parents with opioid use

histories can struggle with positive or warm interactions as well as creating behavioral routines (Cioffi et al., 2019), proactive parenting also incorporates the importance of planning ahead and anticipating child behaviors.

The proactive parenting content first provides structure to help a parent identify problem events and take steps to plan any adjustments needed to avoid problems in the future. Part of proactive parenting includes setting up expectations and scaffolding learning opportunities so that children can anticipate transitions. Similar to the parent wellness module, proactive parenting emphasizes the importance of healthy routines for a child. Setting up predictable routines can help promote consistency and support overall wellbeing. Research has shown that children with consistent routines also have improved behavioral control and coping skills (Dishion et al., 2011). The module helps parents build healthy routines throughout critical points of the day, such as in the morning routine, mealtime, and at bedtime. These routines also support a healthy lifestyle through sleep, meals, and exercise. Video examples demonstrate bedtime routines and play. By engaging in the proactive parenting skills, parents can begin to incorporate small changes to provide more structure to support child success.

Rules and Consequences

Finally, the rules and consequences module addresses how to manage behaviors by creating clear, reasonable rules with defined consequences. Adapted from the Everyday Parenting curriculum, the content focuses on limit setting and monitoring skills to keep children safe and to shape behavior. Parents who effectively implement these skills can decrease problem behaviors in children (Stormshak and Dishion, 2009). Because parents with opioid use histories may have unrealistic expectations about child behavior, incorporating skills in these areas can help parents to better understand developmentally appropriate expectations and consequences to improve parenting practices (Cioffi et al., 2019).

This module begins with clear expectations about appropriate supervision of children in early childhood. The content emphasizes the importance of consistent parenting practices, which include clear rules and directions so that children know what to expect. The module provides skills development for parents in how to create rules that are realistic and set effective limits and consequences that are developmentally appropriate for young children. These skills include content, such as ignoring and using logical consequences.

Conclusion

Opioid use in adolescents and young adults is rising at unprecedented levels and has reached epidemic proportions in some areas of the country, particularly in rural areas. Although research on the detrimental effects of opioid use on parenting and children is relatively new, it is clear that parents with opioid use struggle with a variety of parenting skills, including positive parenting, responsivity, and consistent limit setting. Substance abuse decreases parents' responsivity to their child,

increases the chances of neglect or abuse, and prevents parents from developing the relationships with their children that are necessary for healthy child development. Parents with substance abuse histories show deficits in knowledge related to parenting and reduced pleasure in parenting their children. Parents who use opioids or have a history of use display poor relationship-building skills with their children and engage in negative parenting that leads to a range of detrimental child outcomes that begin in early childhood.

As such, to have long-term sustained effects on preventing opioid misuse in parents and to help prevent substance use and related problem behaviors in the next generation, it is critical to provide support for parenting skills to this population of parents. We have developed a version of the FCU Online for families who have a history of opioid misuse to provide parenting skills training and support to this high-risk population. Our long-term goal is to facilitate the wide-scale dissemination of the FCU Online intervention to prevent opioid misuse (i.e., prescription misuse and use of heroin and illicit synthetics) across generations by targeting parents living in rural and hard-to-reach areas who have had a history of substance misuse. Our eHealth intervention focuses on supporting parents by increasing parenting self-efficacy, stress management skills, self-regulation skills, and sleep routines, which are hypothesized to lead to the prevention of opioid misuse as well as improve mental health and increase responsive, positive parenting skills.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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Social-Ecological Predictors of Opioid Use Among Adolescents With Histories of Substance Use Disorders

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Adolescent opioid misuse is a public health crisis, particularly among clinical populations of youth with substance misuse histories. Given the negative and often lethal consequences associated with opioid misuse among adolescents, it is essential to identify the risk and protective factors underlying early opioid misuse to inform targeted prevention efforts. Understanding the role of parental risk and protective factors is particularly paramount during the developmental stage of adolescence. Using a social-ecological framework, this study explored the associations between individual, peer, family, community, and school-level risk and protective factors and opioid use among adolescents with histories of substance use disorders (SUDs). Further, we explored the potential moderating role of poor parental monitoring in the associations between the aforementioned risk and protective factors and adolescent opioid use. Participants included 294 adolescents (M_{age} = 16 years; 45% female) who were recently discharged from substance use treatment, and their parents (n = 323). Results indicated that lifetime opioid use was significantly more likely among adolescents endorsing antisocial traits and those whose parents reported histories of substance abuse. Additionally, adolescents reporting more perceived availability of substances were significantly more likely to report lifetime opioid use compared to those reporting lower perceived availability of substances. Results did not indicate any significant moderation effects of parental monitoring on any associations between risk factors and lifetime opioid use. Findings generally did not support social-ecological indicators of opioid use in this high-risk population of adolescents, signaling that the social-ecological variables tested may not be salient risk factors among adolescents with SUD histories. We discuss these findings in terms of continuing care options for adolescents with SUD histories that target adolescents' antisocial traits, perceived availability of substances, and parent histories of substance abuse, including practical implications for working with families of adolescents with SUD histories.

Keywords: opioid misuse, adolescence, substance use recovery, social-ecological model, SUD treatment

INTRODUCTION

Opioid misuse, broadly defined as the intentional use of opioids not directed by a prescriber, is a major public health concern in the United States, particularly among adolescents. In 2018, an estimated 699,000 (2.8%) of U.S. adolescents aged 12–17 reported past year opioid misuse and 169,000 reported past month misuse (Substance Abuse and Mental Health Services Administration, 2019). In 2019, the Centers for Disease Control and Prevention's 2017 Youth Risk Behavior Surveillance Survey–a nationally representative survey that provides data of 9th through 12th grade students in public and private schools in the United States– found that approximately 14% of U.S. adolescents reported ever misusing opioids (Bhatia et al., 2020). Although U.S. adolescents aged 12–17 are less likely to report opioid use compared to older age groups (Back et al., 2010), adolescence represents a critical developmental stage for initiation of drug use, characterized by increased risk-taking as well as novelty and sensation seeking behaviors. Adolescents are at increased susceptibility to drug use and drug-related risks due in part to the salient influence of peers in conjunction with critical cortical development that occurs during this developmental period (Crews et al., 2007; Dayan et al., 2010; Romer, 2010; Winters and Arria, 2011). Further, early initiation of substance use and related risk behavior patterns increases risk for more progressive forms of substance use into adulthood (Chassin et al., 1999; DuRant et al., 1999; Lynne-Landsman et al., 2010; Van Ryzin et al., 2012). Thus, understanding salient risk factors associated with opioid use during this critical developmental period is paramount.

Adolescent opioid misuse has been associated with increased risk for negative outcomes into adulthood, including subsequent substance use disorders (SUDs) and more severe forms of drug misuse, including use of more potent opioids, such as heroin (Muhuri et al., 2013; Cerdá et al., 2015; Miech et al., 2015; Palamar et al., 2016b; McCabe et al., 2019). Compared to adolescents with cannabis or alcohol use disorders, those with opioid use disorders may also exhibit poorer long-term prognoses, including higher rates of school drop-out and multiple SUDs (Subramaniam et al., 2009; Godley et al., 2017). Among U.S. high school students, non-medical prescription opioid use is associated with increased odds of engaging in concurrent risky behaviors, including risky driving behaviors, violent behaviors, risky sexual behaviors, substance use, and suicide attempts (Bhatia et al., 2020). Given the wide-ranging short- and long-term consequences of adolescent opioid use, it is essential to identify the malleable risk and protective factors underlying early opioid misuse to develop more effective preventive interventions.

Adolescents with longstanding histories of excessive substance use or SUDs are considered a high-risk subpopulation who are particularly vulnerable to developing opioid use disorders and experiencing subsequent consequences. For instance, adolescents with histories of SUDs report high rates of comorbid mental health problems (Tanner-Smith et al., 2019) and high risk of relapse following SUD treatment (Cornelius et al., 2003; Chung and Maisto, 2006). Few existing studies have explored opioid-specific outcomes in this high-risk subpopulation, but there is some evidence that youth with SUDs who have received SUD treatment in the United States report high rates of opioid misuse (e.g., Osgood et al., 2012). Opioid misuse has been shown to be prevalent among adolescents in substance use treatment and was associated with an increased likelihood of having three or more co-occurring SUDs (Al-Tayyib et al., 2018). And among students who attended a recovery high school (RHS)–a form of continuing care for youth discharged from SUD treatment– 78% reported ever using opioids/narcotics, compared to 13% in a national sample of students who received SUD treatment in the United States who were not enrolled in an RHS (Tanner-Smith et al., 2018). Further, prior research on youth with SUDs attending RHSs reported that among those who use heroin, 80% identified prescription opioid misuse as a precursor to heroin use (Vosburg et al., 2016). These findings demonstrate the unique risk profiles of adolescents with SUD histories and underscore the importance of identifying social-ecological risk and protective factors for opioid misuse specifically for this vulnerable subpopulation.

Social-Ecological Predictors of Adolescent Opioid Misuse

The social-ecological model (Bronfenbrenner, 1979, 1994) is a comprehensive conceptual framework for understanding human development and is uniquely suited for examining risk and protective factors for adolescent opioid misuse (Twombly and Holtz, 2008; Jalali et al., 2020). The social-ecological model posits that human development and behavior are shaped by bidirectional relationships and interactions between an individual and five different environmental systems (microsystem, mesosystem, exosystem, macrosystem, and chronosystem). Particularly salient to identifying actionable mechanisms of adolescent substance use are those more proximal ecological systems, including individual characteristics (e.g., mental health, substance use history); microsystemic (e.g., peer/family substance use history, influence of family/peers); and exosystemic relationships (e.g., access and availability to illicit substances, school). Given the influence and importance of social contexts in adolescents' lives (e.g., school, parents, peers), as well as bidirectional influences of these factors, the current study uses this guiding framework to examine a range of social-ecological predictors of adolescent opioid use and their interactions with parenting behaviors.

Extending from the social-ecological model, prior empirical research has found strong evidence for diverse ecological factors predictive of substance use and other related behaviors in adolescence across diverse populations (Arthur et al., 2002; Bränström et al., 2008; Cleveland et al., 2008; Hemphill et al., 2011). Among individual-level predictors, prior tobacco, marijuana, and alcohol use have been consistently identified as salient indicators for subsequent opioid misuse among the general adolescent population (Sung et al., 2005; Back et al., 2010; Palamar et al., 2015; Vaughn et al., 2016; Barnett et al., 2019; Griesler et al., 2019; Bhatia et al., 2020; Bonar et al., 2020; Osborne et al., 2020). Specifically, the odds of reporting having ever misused opioids were three times higher among adolescents with histories of alcohol use (vs. those without), and two times

higher among those with histories of cigarette and marijuana use (vs. those without; Barnett et al., 2019). Additionally, specific mental health concerns, such as depression and anxiety (Schepis and Krishnan-Sarin, 2008; Young A.M. et al., 2012; Edlund et al., 2015; Monnat and Rigg, 2016; Chan and Marsack-Topolewski, 2019; Griesler et al., 2019; Bonar et al., 2020); post-traumatic stress (McCauley et al., 2010; Mackesy-Amiti et al., 2015); and antisocial behavior (Sung et al., 2005; McCauley et al., 2010; McCabe et al., 2012; Young A.M. et al., 2012; Edlund et al., 2015; Nargiso et al., 2015; Vaughn et al., 2016; Bonar et al., 2020) were associated with increased likelihood of adolescent self-reports of opioid misuse.

Within the microsystem, peers and parents are critical agents of socialization and influence in adolescents' lives. The peer context contains some of the most robust predictors of adolescent substance use (Bauman and Ennett, 1994). Specifically, peer attitudes favorable toward substances are a consistent predictor of opioid misuse in the general adolescent population (Ford, 2008; Conn and Marks, 2014, 2017; Ford and Rigg, 2015; Nargiso et al., 2015; Vaughn et al., 2016; Schaefer and Petkovsek, 2017). In a nationally representative sample of youth ages 12–17, adolescents who associated with peers that use drugs or had attitudes favorable of drug use were approximately 1.4 times more likely to endorse non-medical prescription drug use compared to peers without these peer associations (Ford, 2008). Although the influence of peers on substance use increases during adolescence, the role of parenting continues to serve as a salient factor in predicting adolescent substance use involvement. Parenting factors, including poor parental monitoring, lack of parental involvement, parental histories of substance use, and tolerant parental attitudes toward substance use are associated with adolescent substance use, including opioid misuse (Sung et al., 2005; Gilson and Kreis, 2009; Donaldson et al., 2015; Edlund et al., 2015; Nargiso et al., 2015; Vaughn et al., 2016; Griesler et al., 2019; Bonar et al., 2020). Although peers and parents serve as important risk and protective factors, prior research has documented complex interactions between peer associations and parental monitoring, such that the substance use risk associated with peers may be magnified when adolescents experience low levels of parental monitoring (Kiesner et al., 2010).

Prior research has also identified several influential school and community-level (i.e., exosystem) risk factors for adolescent opioid misuse. Relevant school-level risk factors include academic achievement (Young A.M. et al., 2012; Veliz et al., 2013; Nargiso et al., 2015; Vaughn et al., 2016; Schepis et al., 2018; Barnett et al., 2019; Bonar et al., 2020) as well as school bonding and negative attitudes toward school (Ford, 2009; Young A.M. et al., 2012; Ford and Rigg, 2015; Nargiso et al., 2015; Nicholson et al., 2016). In a systematic review of studies on youth non-medical prescription drug use, five of six studies assessing low academic performance, school dropout, or lack of school-bonding found a significantly higher prevalence of prescription drug use among youth with these risks (Young A.M. et al., 2012). Relevant community level risk factors for adolescent opioid misuse include (perceived) availability and access to drugs in the community (Nargiso et al., 2015; Monnat and Rigg, 2016). In a nationally representative study of adolescents,

perceived ease of access to illicit drugs was associated with 1.03 times greater odds of prescription opioid misuse (Monnat and Rigg, 2016). This body of literature thus demonstrates how diverse social-ecological systems can contribute to adolescent opioid use outcomes.

Parental monitoring is perhaps the most widely studied family risk factor for adolescent substance use. Prior research has found that low levels of parental monitoring moderate the associations between some community level risk factors (e.g., exposure to violence; Burlew et al., 2009; Udell et al., 2017), peer risk factors (e.g., substance using with peers; Kiesner et al., 2010), and individual characteristics including impulsivity (Haas et al., 2018) and depression (Geisner et al., 2018). Low levels of parental monitoring may thus exacerbate the relation between relevant social-ecological risk factors and substance use among adolescents. However, no research to date has examined parental monitoring as a moderator of the relationship between ecological risk and protective factors and opioid misuse among adolescents with SUD histories.

Despite the extensive body of evidence on risk and protective factors for adolescent opioid misuse, to date there has been limited evidence examining these associations in clinical samples of adolescents who may be at particularly high risk for opioid misuse (Bonar et al., 2020). Most prior research on this topic has analyzed data from large national surveys of U.S. adolescents, which can yield valuable insights on patterns in the general adolescent population; however, these findings may not be generalizable to high-risk adolescent subpopulations, such as those with SUDs. Among adolescents with SUD histories, the family environment, parental support, and involvement may be uniquely important for sustaining recovery and abstinence (Godley et al., 2005; White et al., 2009; Sussman, 2011; Fisher, 2014; Winters et al., 2018; Botzet et al., 2019). Given the important role of parents in adolescents' recovery from SUDs, further research is warranted to better understand parental risk and protective factors, as well as their interaction with other relevant social-ecological risk factors (e.g., peer and community factors). Identifying the contexts in which opioid misuse is likely to arise among adolescents with SUDs can inform targeted prevention efforts for this population.

Study Aims and Hypotheses

The current study examined risk and protective factors for opioid use in a sample of adolescents with histories of SUDs. Guided by ecological systems theory and prior research, we first examined associations between individual (mental health and substance use), microsystemic (peer perceptions of use, parent alcohol or drug [AOD] abuse history, and parenting behaviors), and exosystemic (academic performance, attitudes toward school, and perceived availability) risk factors and adolescent opioid use. We explored each risk and protective factor by assessing its unique association with opioid use within the broader social-ecology (individual, microsystem, and exosystemic domains). Second, to gain a better understanding of the role of parenting behaviors, we examined whether parental monitoring moderates any of the associations between these risk and protective factors and adolescent opioid use.

In line with these study aims, we hypothesized that each individual, microsystemic, and exosystemic risk factor would predict lifetime adolescent opioid use among a clinical sample of adolescents with SUD histories. We also hypothesized that parental monitoring would significantly moderate the associations between ecological risk factors and opioid use, such that greater levels of parental monitoring would buffer the relations between ecological risk factors and opioid use.

MATERIALS AND METHODS

Participants and Procedure

We analyzed existing data from a longitudinal study that used a quasi-experimental design to examine the effects of post-SUD treatment schooling attendance on student outcomes (Finch et al., 2018). Adolescents and their families were recruited upon adolescents' SUD treatment or continuing care programs (baseline assessment); a total of 294 adolescents and 323 parents enrolled in the study at baseline. Although the larger parent study included longitudinal follow-up assessments, the current manuscript analyzes data collected during only the baseline assessment to isolate study findings apart from any intervention effects. Adolescent participants identified as predominantly non-Hispanic white (74.9%) with ages ranging from 13 to 19 (M = 16.3 years, SD = 1.09) and were approximately equal in distribution by sex (50.2% male). For more information on sample characteristics, see Finch et al. (2018) and Tanner-Smith et al. (2018). All procedures followed were in accordance with the ethical standards of the University of Minnesota Institutional Review Board and with the Helsinki Declaration of 1975, as revised in 2000.

Measures
Primary Outcome
Opioid Use

The outcome of interest in this study was measured using a single self-reported dichotomous item about adolescents' lifetime opioid misuse at baseline–"Have you ever used any of these drugs: Opioids/Narcotics (heroin, smack, morphine, codeine, Demerol, methadone, opium, Vicodin, Oxycontin, and oxycodone)?" This outcome item was coded as *yes* (1) or *no* (0).

Individual-Level Predictors
Mental Health

Several mental health constructs were assessed as individual-level risk factors for the current study. We used the M.I.N.I. Structured Clinical Interview (M.I.N.I.-SCID), a brief structured diagnostic interview for major psychiatric disorders derived from the symptomology defined by the DSM-IV and ICD-10, to examine adolescents' self-reported mental health symptoms of major depressive disorder (MDD), generalized anxiety disorder (GAD), and post-traumatic stress disorder (PTSD), as well as antisocial traits (Sheehan et al., 1999). This measure assessed whether adolescents experienced any symptoms of each diagnosis in the 12 months prior to enrolling in the substance use treatment program (*yes/no*). Antisocial traits were assessed by whether

adolescents met the point-in-time clinical threshold of DSM-IV symptoms of antisocial personality disorder (*yes/no*). These measures do not represent a formal clinical diagnosis; rather, they assessed whether adolescents self-reported any symptoms for MDD, GAD, and PTSD, and whether adolescents reported antisocial traits at or above a clinically indicated threshold (i.e., at least three antisocial traits based on DSM-IV criteria).

Substance Use

Tobacco, marijuana, and alcohol use were examined as individual-level risk factors. Tobacco use was assessed through a single binary item (*yes/no*) asking, "in the past 12 months, have you used tobacco products, including cigarettes, cigars, a pipe, or chewing tobacco/snuff?" Marijuana and alcohol use were also measured with two binary items (*yes/no*) indicating whether adolescents reported using marijuana in the past year or using alcohol to the point of intoxication in the past year, respectively.

Familial- and Peer-Level Predictors
Parenting Practices

Parenting practices were measured using a shortened version (15 items) of the original 42-item parent-reported Alabama Parenting Questionnaire (PAPQ) (Frick, 1991). The PAPQ includes measures of three subscales of parenting practices: positive parenting (six items), poor parental monitoring (five items), and inconsistent discipline (four items). Response options used a five-point Likert scale ranging from *Never* (1) to *Always* (5), where parents rated the frequency of parenting in the past 12 months. An example item for poor parental monitoring was, "Your child fails to leave a note or let you know where he/she is going." Scores for the three subscales were determined by calculating the mean for each subscale. Higher mean scores on each subscale indicate higher levels of each parenting construct. The PAPQ subscales have shown strong concurrent and predictive validity in a prior study with this sample (Nichols et al., Under review). The current sample showed adequate internal consistency in the three subscales: positive parenting (α = 0.78), inconsistent discipline (α = 0.70), and poor parental monitoring (α = 0.74).

Parent With Alcohol or Drug Abuse History

One dichotomous (*yes/no*) adolescent-reported item was used to measure parents' alcohol or drug abuse history: "Do either of your biological parents have a history of an AOD abuse problem?"

Peer Attitudes Scale

Substance approving peer attitudes were assessed using 13 items from the Personal Experiences Inventory (Winters and Henley, 1989). Response options were measured on a four-point Likert scale, with responses ranging from *Strongly disagree* (1) to *Strongly agree* (4), where responses were anchored to the time in the adolescent's life when they were using drugs at their heaviest level. An example item was, "My friends think that using drugs or alcohol makes hanging out more fun." A mean score for peer attitudes was determined by calculating the mean of the 13 items, with higher scores indicating higher peer approval of substance use. This measure demonstrated good internal consistency in the analytic sample (α = 0.87).

School-/Community-Level Predictors

Academic Performance

Grade point average (GPA) was used to assess adolescents' academic performance. One continuous adolescent-reported item measured adolescents' most recent GPA, on a scale ranging from 0 to 4.

Perceived Availability of Substances

Perceived availability of alcohol, marijuana, prescription drugs, other illicit drugs, and over-the-counter drugs was measured using a modified version of Monitoring the Future's Perceived Availability of Drugs Scale (Bachman et al., 2001). Survey questions began with one question "How difficult do you think it would be for you to get each of the following drugs, if you wanted some?" and listed multiple substance types. Response options were measured on a five-point Likert scale ranging from *Probably impossible* (1) to *Very easy* (5). A mean score was computed for each participant, where higher values represent greater overall perceived availability of drugs and alcohol. This measure demonstrated adequate internal consistency in the current sample (α = 0.67).

Attitudes Toward School

Adolescents' attitudes toward school were measured using 10 items from the Behavior Assessment System for Children (BASC) (Reynolds and Kamphaus, 1992). Response options were *True/False* with the following prompt: "Thinking back to before you were in treatment, when you were using drugs the heaviest, click on the "True" option if you agree with the sentence or click on "False" if you don't agree." An example item was, "I can hardly wait to quit school." The 10 items were added together to create a sum score, with higher scores representing higher negative attitudes toward school. The BASC demonstrated adequate internal consistency among the current sample (α = 0.75).

Analytic Plan

To address the current study's aims, we estimated a series of logistic regression models to examine the magnitude of associations between the individual, interpersonal, and school/community risk and protective factors and the odds of adolescent opioid use. All models adjusted for adolescent's sex, race/ethnicity, whether they lived in a two-parent household, and whether they were enrolled in an RHS vs. a more traditional, non-RHS. First, a hierarchical logistic regression was conducted to examine the association between risk and protective factors of all the domains and adolescent opioid use. The first step of the hierarchical model examined associations between covariates and lifetime opioid use. The following step included all individual-level variables as predictors of adolescent opioid use. The third step in the model examined peer and parental risk and protective factors on opioid use while adjusting for individual-level predictors and covariates. The final step of the model examined the associations between school-/community-level predictors and adolescent opioid use, while adjusting for covariates and individual-, peer-, and parental-level risk and protective factors.

To address the second study aim, we added a multiplicative interaction term to test whether poor parental monitoring moderated the effect of each risk and protective factor on the odds of adolescent opioid use. When an interaction was tested (e.g., MDD symptoms and poor parental monitoring), all risk and protective factors were included in the model, as well as covariates. Results are presented as logit coefficients (*b*) from the logistic regression models, alongside corresponding odds ratio (*OR*) or adjusted odds ratio (*AOR*) effect sizes and their 95% confidence intervals. Model fit for each logistic regression tested was assessed using the Akaike Information Criterion (AIC).

There was a modest amount of missing data due to participant non-response and study attrition; missingness ranged from 5 to 24% among the variables of interest. Missing data were addressed using multiple imputation by chained equations (van Buuren and Groothuis-Oudshoon, 2011) to create 30 multiply imputed datasets with 30 iterations. All reported model estimates were obtained by pooling results across the imputed datasets using Rubin's (1987) rules. All analyses were conducted using R 4.0.3 (R Core Team, 2020).

RESULTS

Table 1 shows the descriptive statistics for study variables included in the analyses. About 50% identified as male and

TABLE 1 | Descriptive statistics for covariates, individual-, peer-, parental-, school-/community-level domains, and opioid use (*N* = 294).

Variable	M (SD)	Range	n (%)
Ever used opioids (1 = yes)			216 (66.9%)
Male (1 = yes)			162 (50.2%)
White (1 = yes)			242 (74.9%)
RHS enrollment (1 = yes)			153 (47.4%)
Two-parent household (1 = yes)			116 (35.9%)
MDD symptoms (1 = yes)			102 (31.6%)
GAD symptoms (1 = yes)			92 (28.5%)
PTSD symptoms (1 = yes)			35 (10.8%)
Antisocial traits (1 = yes)			126 (39%)
PY Tobacco use (1 = yes)			272 (84.2%)
PY Alcohol use (1 = yes)			223 (69%)
PY Marijuana use (1 = yes)			250 (77.4%)
Positive parenting	3.96 (0.59)	(1–5)	
Inconsistent discipline	2.70 (0.76)	(1–5)	
Poor parental monitoring	2.58 (0.81)	(1–5)	
Parent with past AOD abuse (1 = yes)			183 (56.7%)
Peer attitudes	3.05 (0.52)	(1–4)	
GPA	2.56 (0.87)	(0–4)	
Negative attitudes toward school	5.69 (2.60)	(0–10)	
Perceived availability	4.33 (0.59)	(1–5)	

RHS = Recovery High School; MDD = Major Depressive Disorder; GAD = Generalized Anxiety Disorder; PTSD = Post-traumatic Stress Disorder; PY = Past year; AOD = alcohol or drug; GPA = Grade point average; M = mean; SD = Standard Deviation; n = number of observations.
Standard deviations are in parentheses. Percentages of adolescents that stated yes for each variable is reported in parentheses.

approximately 75% identified as white. Less than one-half of the sample (47.4%) stated that they were enrolled in an RHS and approximately 36% of the adolescents in the sample stated they lived in a two-parent household. Approximately 67% of adolescents reported lifetime opioid use. Regarding mental health symptoms in the past 12 months, 31.6% of adolescents reported experiencing symptoms of MDD, 28.5 and 10.8% of adolescents reported experiencing symptoms of GAD and PTSD, respectively, and 39% of adolescents endorsed antisocial traits. Most adolescents reported at least some use of tobacco (84.2%), alcohol (69%), and marijuana (77.4%) in the past year. Approximately 57% of the sample reported a parent with past AOD abuse.

Table 2 presents the findings from the hierarchical logistic regression models. In the covariate model, there was no evidence of significant associations between being male, white, enrolled in RHS, and living in a two-parent household with engaging in opioid use. The inclusion of individual-level risk factors in the subsequent model indicated that adolescents who endorsed antisocial traits had three times the odds of engaging in opioid use than adolescents who did not (AOR = 3.01, p < 0.001, 95% CI [1.55, 5.86])[1]. Experiencing MDD symptoms, GAD

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[1]*Post hoc* analyses excluding non-significant covariates were conducted to increase statistical power. Results of these *post hoc* analyses yielded no substantial or meaningful changes in model fit, statistical significance, or conclusions.

symptoms, or PTSD symptoms in the last 12 months were not significantly associated with engagement in opioid use. Use of tobacco, alcohol, and marijuana in the past year were also not significantly associated with engagement in opioid use. After adding parent and peer risk and protective factors, the model showed that having a parent with past AOD abuse was associated with an 87% increase in the odds of engaging in opioid use (AOR = 1.87, p = 0.04, 95% CI [1.04, 3.39]) when adjusted for other individual, parent, and peer predictors. Other parental dimensions, including poor parental monitoring, inconsistent discipline, and positive parenting, were not significantly associated with engagement in opioid use. Similarly, peer attitudes did not show evidence of a significant association with engagement in opioid use. In the final model, including school-level and community-level predictors, the community-level predictor (perceived availability of substances) was significantly associated with ever using opioids (AOR = 1.90, p = 0.02, 95% CI [1.12, 3.20]). School-level predictors, including GPA and negative attitudes toward school, however, were not significantly associated with engagement in opioid use. A significant association was found for adolescents with a two-parent household having higher odds of engaging in engaging in opioid use (AOR = 2.09, p = 0.038, 95% CI [1.04, 4.20]) when including the school- and community-level predictors. As seen in **Table 2**, both parent with a past AOD abuse and antisocial traits remained significantly associated with engaging

TABLE 2 | Hierarchical logistic regression of individual-, parent- and peer, school-/community-level predictors of opioid use.

Variable	Covariates		Individual		Parent/Peer		School/Community	
	b (SE)	OR [95% CI]	b (SE)	AOR [95% CI]	b (SE)	AOR [95% CI]	b (SE)	AOR [95% CI]
Male	0.15 (0.30)	1.16 [0.64, 2.11]	0.21 (0.30)	1.23 [0.68, 2.23]	0.18 (0.31)	1.20 [0.65, 2.20]	0.11 (0.32)	1.12 [0.60, 2.09]
White	0.55 (0.41)	1.74 [0.76, 3.96]	0.68 (0.40)	1.97 [0.90, 4.31]	0.60 (0.40)	1.82 [0.82, 4.03]	0.64 (0.41)	1.89 [0.84, 4.27]
RHS enrollment	0.47 (0.28)	1.59 [0.81, 2.78]	0.39 (0.32)	1.48 [0.79, 2.77]	0.45 (0.32)	1.57 [0.83, 2.96]	0.33 (0.33)	1.38 [0.73, 2.63]
Two-parent household	0.52 (0.30)	1.69 [0.93, 3.05]	0.48 (0.32)	1.62 [0.87, 3.03]	0.62 (0.34)	1.86 [0.95, 3.63]	0.74 (0.35)*	2.09 [1.04, 4.20]
MDD symptoms			0.00 (0.35)	1.00 [0.50, 2.00]	0.02 (0.36)	1.02 [0.50, 2.07]	0.03 (0.37)	1.03 [0.50, 2.13]
GAD symptoms			0.48 (0.338)	1.62 [0.77, 3.41]	0.52 (0.39)	1.68 [0.78, 3.61]	0.51 (0.39)	1.67 [0.77, 3.63]
PTSD symptoms			0.27 (0.53)	1.31 [0.46, 3.71]	0.22 (0.53)	1.24 [0.43, 3.56]	0.09 (0.54)	1.10 [0.38, 3.18]
Antisocial traits			1.10 (0.34)**	3.01 [1.55, 5.86]	1.12 (0.35)**	3.05 [1.54, 6.04]	0.98 (0.35)*	2.65 [1.32, 5.32]
PY Tobacco use			0.47 (1.10)	1.61 [0.17, 15.20]	0.42 (0.35)	1.52 [0.14, 16.20]	0.27 (1.19)	1.31 [0.12, 14.9]
PY Alcohol use			0.27 (0.42)	1.31 [0.58, 2.99]	0.28 (0.42)	1.32 [0.57, 3.04]	0.15 (0.44)	1.17 [0.49, 2.76]
PY Marijuana use			0.08 (0.50)	1.08 [0.40, 2.91]	0.18 (0.50)	1.19 [0.44, 3.22]	0.24 (0.52)	1.27 [0.45, 3.54]
Positive parenting					0.09 (0.26)	1.09 [0.66, 1.81]	0.10 (0.26)	1.11 [0.66, 1.85]
Inconsistent discipline					0.10 (0.21)	1.11 [0.74, 1.66]	0.08 (0.21)	1.08 [0.72, 1.64]
Poor parental monitoring					−0.05 (0.20)	0.96 [0.65, 1.40]	0.03 (0.20)	1.03 [0.69, 1.54]
Parent with past AOD abuse					0.63 (0.30)*	1.87 [1.04, 3.39]	0.67 (0.31)*	1.95 [1.05, 3.59]
Peer attitudes					−0.09 (0.29)	0.91 [0.51, 1.63]	−0.30 (0.32)	0.74 [0.39, 1.40]
GPA							0.12 (0.20)	1.13 [0.76, 1.69]
Negative attitudes toward school							0.06 (0.06)	1.06 [0.94, 1.21]
Perceived availability							0.64 (0.27)*	1.90 [1.12, 3.20]
Likelihood ratio test statistic			χ2 = 1.45		χ2 = 0.92		χ2 = 2.10	
AIC	376.24		366.91		370.59		366.76	

RHS = Recovery High School; MDD = Major Depressive Disorder; GAD = Generalized Anxiety Disorder; PTSD = Post-traumatic Stress Disorder; PY = Past year; AOD = alcohol or drug; GPA = Grade point average; b = Unstandardized logit coefficient; SE = Standard errors; AOR = Adjusted odds ratio; OR = Odds ratio; CI = Confidence interval; AIC = Akaike Information Criterion.
Standard errors are in parentheses. All models adjusted for covariates.
*p < 0.05; **p < 0.01.

in opioid use when including additional ecological predictors in subsequent models.

Potential Moderating Effect of Poor Parental Monitoring With Individual-Level Predictors

As shown in **Table 3**, there was no evidence that poor parental monitoring significantly moderated the association between the individual-level predictors and opioid use. Indeed, the interaction between MDD symptoms and poor parental monitoring was not significantly associated with odds of adolescents ever using opioids (AOR = 1.25, p = 0.60, 95% CI [0.54, 2.90]). Similarly, there was no evidence that poor parental monitoring moderated the associations between other mental health constructs, including GAD symptoms (AOR = 2.24, p = 0.12, 95% CI [0.81, 6.20]), PTSD symptoms (AOR = 1.23, p = 0.74, 95% CI [0.35, 4.27]), and antisocial traits (AOR = 1.16, p = 0.69, 95% CI [0.55, 2.45]), with using opioids. Finally, there was no evidence that poor parental monitoring moderated the associations between other individual-level predictors and adolescents' opioid use: tobacco use (AOR = 0.82, p = 0.90, 95% CI [0.04, 15.60]), alcohol use (AOR = 1.17, p = 0.75, 95% CI [0.45, 3.02]), marijuana use (AOR = 1.92, p = 0.18, 95% CI [0.73, 5.05]).

Potential Moderating Effect of Poor Parental Monitoring With Parental-/Peer-Level Predictors

Table 4 shows that there was no evidence that poor parental monitoring significantly moderated the association between parental- and peer-level predictors and adolescent opioid use. Specifically, there was no evidence of a significant association between the interaction of positive parenting and poor parental monitoring with adolescents ever using opioids (AOR = 1.09, p = 0.77, 95% CI [0.61, 1.94]). Similarly, there was no evidence that poor parental monitoring moderated the associations

between the other parental constructs, including inconsistent discipline (AOR = 1.18, p = 0.46, 95% CI [0.76, 1.81]) and having parents with histories of AOD abuse (AOR = 0.94, p = 0.87, 95% CI [0.45, 1.97]) with opioid use. Lastly, the interaction between peer attitudes and poor parental monitoring was not significantly associated with odds of adolescents ever using opioids (AOR = 1.30, p = 0.48, 95% CI [0.62, 2.76]).

Potential Moderating Effect of Poor Parental Monitoring With School-/Community-Level Predictors

Table 5 shows the interaction findings between school-/community-level predictors and poor parental monitoring with adolescents ever using opioids. There was no evidence that poor parental monitoring significantly moderated the associations between GPA, negative attitudes toward school, and perceived availability with ever engaging in opioids. Specifically, there was no evidence that poor parental monitoring significantly moderated the association between GPA and adolescents ever using opioids (AOR = 0.95, p = 0.86, 95% CI [0.56, 1.62]), nor between negative attitudes toward school and opioid use (AOR = 1.14, p = 0.07, 95% CI [0.99, 1.32]). Finally, there was no evidence of a significant association between the interaction of perceived availability and poor parental monitoring with adolescents ever using opioids (AOR = 1.53, p = 0.18, 95% CI [0.82, 2.85]).

DISCUSSION

This study examined several social-ecological risk and protective factors associated with lifetime opioid use among a sample of adolescents with histories of SUDs. Our results suggest that opioids are a commonly used illicit substance among this clinical adolescent sample, evidenced by the 67% of adolescents reporting lifetime opioid use. This prevalence rate

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TABLE 3 | Moderation analyses of individual-level predictors and poor parental monitoring on opioid use.

	MDD symptoms		GAD symptoms		PTSD symptoms		Antisocial traits	
Effect	b (SE)	AOR [95% CI]	b (SE)	AOR [95% CI]	b (SE)	AOR [95% CI]	b (SE)	AOR [95% CI]
Main effect	0.04 (0.37)	1.04 [0.50, 2.16]	0.60 (0.42)	1.82 [0.80, 4.14]	0.11 (0.54)	1.12 [0.38, 3.27]	0.98 (0.35)*	2.66 [1.32, 5.33]
Poor parental monitoring	−0.05 (0.24)	0.95 [0.59, 1.53]	−0.13 (0.22)	0.88 [0.56, 1.36]	0.01 (0.21)	1.01 [0.67, 1.53]	−0.03 (0.26)	0.97 [0.58, 1.61]
Interaction	0.22 (0.43)	1.25 [0.54, 2.90]	0.81 (0.51)	2.24 [0.81, 6.20]	0.21 (0.63)	1.23 [0.35, 4.27]	0.15 (0.38)	1.16 [0.55, 2.45]
AIC	368.13		365.00		368.41		368.47	

	Past Year Tobacco Use		Past Year Alcohol Use		Past Year Marijuana Use			
Effect	b (SE)	AOR [95% CI]	b (SE)	AOR [95% CI]	b (SE)	AOR [95% CI]		
Main effect	0.09 (1.97)	1.09 [0.02, 58.90]	0.16 (0.44)	1.18 [0.49, 2.81]	0.34 (0.54)	1.41 [0.49, 4.06]		
Poor parental monitoring	0.10 (0.26)	1.11 [0.66, 1.85]	0.10 (0.26)	1.11 [0.66, 1.86]	0.12 (0.26)	1.13 [0.68, 1.89]		
Interaction	−0.20 (1.47)	0.82 [0.04, 15.60]	0.15 (0.48)	1.17 [0.45, 3.02]	0.65 (0.49)	1.92 [0.73, 5.05]		
AIC	367.86		368.22		366.37			

MDD = Major Depressive Disorder; GAD = Generalized Anxiety Disorder; PTSD = Post-traumatic Stress Disorder; b = Unstandardized logit coefficient; SE = Standard errors; AOR = Adjusted odds ratio; CI = Confidence interval; AIC = Akaike Information Criterion. Standard errors are in parentheses. All models adjusted for covariates.
p < 0.05.

is comparable to previous findings of opioid use rates among adolescents in recovery from SUDs (Vosburg et al., 2016; Tanner-Smith et al., 2018), highlighting the generalizability of opioid use characteristics among high-risk clinical populations of adolescents. Our hypothesis that risk factors at each social-ecological level would significantly predict lifetime opioid use was partially supported. Regarding the role of family and parenting contexts, our results demonstrated that adolescents whose parents have a history of AOD abuse were more likely to report ever using opioids compared to those who did not report a parental substance use history. As hypothesized, adolescents who endorsed antisocial traits also had greater odds of reporting lifetime opioid use compared to adolescents who did not meet this threshold. This finding is consistent with prior research linking antisocial behavior to adolescent opioid misuse (Sung et al., 2005; Nargiso et al., 2015; Vaughn et al., 2016; Griesler et al., 2019). Additionally, adolescents who reported greater perceived availability of substances had greater odds of reporting lifetime opioid use compared to adolescents with lower perceived availability of substances. We found no evidence that adolescents' past year substance use (tobacco, marijuana, or alcohol) was associated with their lifetime opioid use, nor any evidence that adolescents' prior mental health symptoms of MDD, GAD, or PTSD, nor peer attitudes favorable toward drugs, were predictive of lifetime opioid use. Given that previous studies have consistently reported significant associations between substance use and mental health histories and subsequent opioid use outcomes (Barnett et al., 2019; Griesler et al., 2019; Bhatia et al., 2020; Bonar et al., 2020), further research is warranted to replicate the null findings reported herein.

These results highlight the potentially impactful role of parental substance use histories on adolescent opioid use. The family context is incredibly influential during the developmental stage of adolescence, underlying the significance of understanding the development and progression of SUDs among adolescents, particularly among those with parents who have existing substance use-related concerns and histories (Chassin and Handley, 2006). Prior research has documented that parental SUDs increase the likelihood that their children will develop SUDs (Biederman et al., 2000). Moreover, effects of protective parenting behaviors on children's outcomes might be diminished among parents with SUDs compared to parents without substance use problems (Arria et al., 2012). Family and parenting characteristics therefore affect adolescents' behaviors both directly and indirectly, highlighting the complex nature of parenting when substance use is a factor within the family context. Growing behavioral genetics research suggests that substance use during adolescence is heavily influenced by environmentally mediated factors, including parent–child relationship problems and peer deviance, which influence adolescent phenotypes, over and beyond heritable biological influences alone (Walden et al., 2004). Although parental substance abuse was examined as a microsystemic predictor of opioid use, future research should consider examining this variable as a possible proxy of biological vulnerability for addiction or substance use among adolescents. Such an investigation may provide more nuance to the complex nature of substance use in the context of family and parents.

The hypothesis that level of parental monitoring would moderate associations between social-ecological risk factors

TABLE 4 | Moderation analyses of parental- and peer-level predictors and poor parental monitoring on opioid use.

Effect	Positive Parenting		Inconsistent Discipline		Parent with Past AOD Abuse		Peer Attitudes	
	b (SE)	AOR [95% CI]	b (SE)	AOR [95% CI]	b (SE)	AOR [95% CI]	b (SE)	AOR [95% CI]
Main effect	0.10 (0.26)	1.11 [0.66, 1.86]	0.05 (0.21)	1.06 [0.69, 1.61]	0.66 (0.31)*	1.94 [1.05, 3.59]	−0.29 (0.32)	0.75 [0.40, 1.42]
Poor parental monitoring	0.03 (0.20)	1.03 [0.69, 1.54]	0.03 (0.20)	1.03 [0.69, 1.54]	0.07 (0.31)	1.07 [0.58, 1.98]	0.04 (0.21)	1.05 [0.70, 1.57]
Interaction	0.09 (0.29)	1.09 [0.61, 1.94]	0.16 (0.22)	1.18 [0.76, 1.81]	−0.06 (0.38)	0.94 [.045, 1.97]	0.27 (0.38)	1.30 [0.62, 2.76]
AIC	368.47		368.07		368.58		368.04	

b = Unstandardized logit coefficient; SE = Standard errors; AOD = alcohol or drug; OR = Odds ratio; CI = Confidence interval; AIC = Akaike Information Criterion. Standard errors are in parentheses. All models adjusted for covariates.
*p < 0.05.

TABLE 5 | Moderation analyses of school-/community-level predictors and poor parental monitoring on opioid use.

Effect	GPA		Perceived Availability		Negative Attitudes Toward School	
	b (SE)	AOR [95% CI]	b (SE)	AOR [95% CI]	b (SE)	AOR [95% CI]
Main effect	0.13 (0.20)	1.14 [0.76, 1.70]	0.61 (0.27)*	1.84 [1.08, 3.13]	0.07 (0.07)	1.07 [0.94, 1.22]
Poor parental monitoring	0.03 (0.20)	1.03 [0.69, 1.54]	0.06 (0.21)	1.07 [0.70, 1.61]	0.04 (0.21)	1.04 [0.68, 1.58]
Interaction	−0.05 (0.27)	0.95 [0.56, 1.62]	0.42 (0.32)	1.53 [0.82, 2.85]	0.13 (0.07)	1.14 [0.99, 1.32]
AIC	368.17		366.33		364.65	

b = Unstandardized logit coefficient; SE = Standard errors; AOR = Adjusted odds ratio; CI = Confidence interval; AIC = Akaike Information Criterion. Standard errors are in parentheses. All models adjusted for covariates.
*p < 0.05.

and opioid use was not supported in the current study. We found no evidence that parental monitoring levels significantly moderated associations between social-ecological risk factors and adolescents' lifetime opioid use. These null results could be due to limited statistical power using our analytic sample of 294 adolescents. Future research should thus attempt to replicate this effect in larger samples of adolescents with SUD histories and similar risk profiles as the current sample. These null findings might also reflect a lack of nuance and sensitivity in our measure of parental monitoring (see Kerr and Stattin, 2000; Stattin and Kerr, 2000; Kerr et al., 2010), despite its demonstrated predictive validity among other samples of adolescents (Elgar et al., 2007; Zlomke et al., 2014, 2015; Gross et al., 2017). Historically, parental monitoring has been conceptualized as an active attempt by parents to monitor and follow the whereabouts of their children. However, this parental management strategy has been found to be most effective in the context of positive parent-adolescent relationships that would evoke adolescent self-disclosure of information and risk behaviors (Stattin and Kerr, 2000; Fletcher et al., 2004; Keijsers et al., 2009; Rusby et al., 2018). Indeed, adolescent self-disclosure is an important component of parental monitoring (Kerr and Stattin, 2000; Stattin and Kerr, 2000; Rusby et al., 2018), supporting the need to understand the relationship quality alongside factors such as conflict and communication. Thus, family focused interventions with adolescents with SUD histories may need to consider the way in which parental monitoring is being assessed. This may be an important area for prevention among adolescents with histories of SUDs.

Our results demonstrate the applicability of studying adolescents' perceived availability of substances (at the exosystem level), parent's substance use (microsystem level), and antisocial traits (individual level) among students in recovery from SUDs. Some theoretical frameworks, such as the recovery capital framework (Granfield and Cloud, 1999; Hennessy, 2017), highlight how access to and accumulation of resources across multiple ecological levels can aid the substance use recovery process. Continuing care options that address the multiple social-ecological needs of youth in recovery, are therefore likely to successfully support youths' recovery needs. For example, RHSs, which aim to support students' social and community capital by fostering social connectedness with sober peers, supportive school staff, and family members, have shown positive effects in prolonging abstinence from substance use during recovery (Finch and Karakos, 2014; Finch et al., 2018; Tanner-Smith et al., 2019, 2020). Other approaches drawing on integrated and holistic care models providing tailored therapeutic services to adolescents in recovery from SUDs (e.g., Latimer et al., 2000) may thus be similarly effective in addressing the numerous issues facing these adolescents.

Limitations

The findings from the current study should be considered alongside several study limitations. First, because we relied on existing data, we were only able to study the outcome of interest–opioid use–using one binary item. This item inherently limited our ability to examine predictors of the frequency or severity of adolescent opioid use. Future research

studies in samples of adolescents with SUDs should collect more nuanced data about opioid misuse to better understand predictors of both the likelihood and extent of opioid use (e.g., Boyd et al., 2006). There were additional limitations due to measures used in the current study that are important to note. It is possible that there was insensitive measurement bias if the measures were not developmentally appropriate for this sample of adolescents. Additionally, it is possible that opioid use was under-reported in the present sample, as well as other national samples of adolescents (Palamar et al., 2016a); a possible source of attention bias. Given that adolescents had recently been discharged from SUD treatment, it is possible that some participants felt pressure to respond favorably to the questionnaire items regarding drug use. Second, given the small and relatively homogenous sample (in terms of race/ethnicity and socioeconomic status), future research should aim to study these ecological risk and protective factors in larger clinical samples of adolescents from more diverse backgrounds. Finally, given our reliance on previously collected data, there were several potential confounding variables highlighted in the literature that were not included in our final analytic models, such as adolescents' sensation-seeking and self-medication motives (Khantzian, 1997; Boyd et al., 2006, 2009; Young A. et al., 2012; Romer et al., 2017). Similarly, the scope of this study did not include examining potential mediators; however, prior research suggests these associations may hold additional complexity that should be further explored. For instance, prior studies have demonstrated that positive parental involvement may act as a mediator between parent characteristics such as SUD history on youth psychosocial outcomes, which may include adolescent opioid and other substance use (Bijttebier et al., 2006; Burstein et al., 2006). Future research is thus warranted to examine possible differences in motivations for opioid use among adolescents with SUD histories as well as potential mediators that may elucidate the mechanisms underlying the link between various risk factors and adolescent opioid misuse.

CONCLUSION

This study adds to the empirical evidence base on adolescent opioid misuse in several important ways. First, this is the first study to our knowledge that uses a social-ecological framework to study risk and protective factors of opioid use among adolescents with a history of SUDs. Examining these associations in this understudied clinical population is critical for promoting positive outcomes among adolescents after they are discharged from formal substance use treatment. High school students with histories of SUDs represent a high-risk clinical subpopulation for problematic substance use and relapse. More research is needed on the social epidemiology of substance use–and opioid use, more specifically–in this population, which can be used to inform efficacious and targeted preventive and continuing care interventions for these adolescents. Continuing care programs that offer individualized treatment plans should concentrate on

the important roles that families, peers, and school environment have in promoting positive outcomes among adolescents with histories of SUDs and opioid misuse.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: Sensitive data that cannot be publicly shared. Requests to access these datasets should be directed to ET-S, etanners@uoregon.edu.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Minnesota Institutional Review Board. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

LN: conceptualization, writing—original draft, writing—review and editing, and project administration. JP: conceptualization,

methodology, formal analysis, and writing—review and editing. CF: conceptualization, methodology, and writing—review and editing. KO'B: conceptualization and writing—review and editing. ET-S: conceptualization, investigation, resources, writing—review and editing, and supervision. All authors contributed to the article and approved the submitted version.

FUNDING

ACKNOWLEDGMENTS

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Stakeholder Perspectives on Advancing Understanding of Prenatal Opioid Exposure and Brain Development From the iOPEN Consortium of the Healthy Brain and Child Development Study

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Introduction: There is a dire need for research regarding the implications of opioid use during pregnancy on fetal and childhood development to better inform both medical practice and policy. The Healthy Brain and Child Development Study will examine brain and behavioral development from birth through the first decade of life. Due to large scope and anticipated complexity of this initiative, an 18-month planning phase was implemented across 28 sites across the nation. A core element of the Phase I initiative involved the development of Stakeholder Advisory Committees to inform the next phase of the initiative.

Methods: Phase I stakeholder meetings were conducted at Oregon Health and Science University, New York University Langone Medical Center, the University of Pittsburgh, and the University of Vermont to better understand perspectives and inform upcoming research. Despite differences in the structure of the stakeholder meetings by site, the overarching goals for the meetings included establishing relationships, gathering input, and learning about research engagement. Documents from each meeting were reviewed for location, duration, attendees, common research themes, and pertinent suggestions for improving research approaches.

Results: All stakeholders had high levels of interest in research for pregnant people with substance use disorders and agreed on research priorities including collaboration, connection, communication, and support. Different stakeholders offered

unique perspectives on various aspects of study design and themes that emerged through meetings.

Discussion: Overall, there was excitement about the research, especially the opportunity to include the voices of people with lived experience; collaboration between providers, peer support specialists, patients, and others; and excitement around contributing to research that could elucidate new and pertinent findings in the realm of addiction medicine and child development. Sites also found that there is mistrust between people with substance use disorder and the medical system, and this could be addressed by including people with lived experience on the research team, forming connections, communicating clearly, training the research team in implicit bias, and practicing trauma-informed care. In conclusion, these stakeholder meetings provided valuable information for structuring upcoming studies; however, researchers would have benefitted from more time and more opportunities for in-person connection.

INTRODUCTION

The increased prevalence of opioid use during pregnancy and the subsequent potential effects of *in utero* opioid exposure on children represent a dual maternal-child health epidemic in the United States. Between 1999 and 2014 the prevalence of perinatal opioid use disorder (OUD) increased from 1.5 to 6.5 per 1,000 deliveries (Goodman et al., 2020). The number of infants diagnosed with neonatal abstinence syndrome (NAS) grew ∼5-fold (Krans and Patrick, 2016), currently accounting for about 50% of all NICU hospital days in some communities and $1.5 billion in hospital charges (Tolia et al., 2015; Patrick et al., 2017). These numbers demonstrate a dire need for research regarding the immediate and long-term implications of opioid use during pregnancy on maternal outcomes and fetal and childhood development to better inform both medical practice and policy.

The National Institute of Drug Abuse, in partnership with multiple other NIH institutes, has issued a request for proposals to conduct the Healthy Brain and Child Development (HBCD) Study, a groundbreaking project that would examine brain and behavioral development from birth through the first decade of life (Volkow et al., 2021). The study will establish a national consortium of ∼25 research sites across the country and will involve 7,500 children and their families, oversampling for infants who were exposed to opioids *in utero*. This study has the potential to substantially impact scientific understanding of early brain development and mental health in the context of environmental influences beginning *in utero*, and even prior to conception. Importantly, there is an emphasis on capturing a wide range of domains and exposures, with understanding that many of the circumstances that accompany substance use, such as poor maternal nutrition and unstable housing, also have the potential to influence neurodevelopment. Co-occurring factors such as maternal trauma and psychiatric history, experiences of discrimination, and variation in socioeconomic conditions will be investigated as well.

An important consideration in an undertaking such as this is how to effectively engage and support people using substances during pregnancy in longitudinal research, many of whom have historically and traditionally been underserved and stigmatized in multiple medical, support, and research domains. There is a growing awareness in the field of intervention research of the need for a paradigm shift away from academic, top-down, clinical trials toward the development of interventions informed by patients, providers, and real-world implementation settings (Schindler et al., 2017). Exclusion, or limited inclusion, in research of patients or people with lived experience of substance use during pregnancy marginalizes their voices in academia (i.e., research), science and health policy. The current opioid epidemic has highlighted the negative impacts of this pervading paradigm on pregnant people who use substances and their infants as evidenced by the persistence of punitive vs. treatment-oriented policies across many states (Krans and Patrick, 2016). Existing data also indicates that gaining patient perspectives can increase engagement in both research and clinical care (Brett et al., 2014). Thus, gaining input from people with lived experience using substances during pregnancy (current or past) has significant potential to improve research in the realms of study design, innovation, recruitment and retention, ethical standards, and real-world translation potential.

Due to the large scope and anticipated complexity of the HBCD initiative, an 18-month planning phase, known as HBCD Phase I, was implemented across 28 sites across the nation. Sites were tasked with both preparing local infrastructure and piloting activities anticipated to feature centrally in Phase II. A core element of the Phase I initiative involved the development of Stakeholder Advisory Committees to inform the next phase of the HBCD initiative. Key to the Stakeholder Advisory Committees was involvement of people with lived experience of using substances during pregnancy and care providers. The overarching goals of these committees were to: (1) obtain input regarding the best ways to ethically and

Site	Stakeholders Represented
Oregon Heath and Science University (OHSU)	People with lived experience (2), peer support specialists (2), people affiliated with an OUD treatment program specializing in pregnancy (3), people affiliated with local non-profits (2), state/local health authority representatives (2), family medicine physicians (2), an OB/GYN (1), nurse-midwife (1), doula (1), developmental psychologist (1), child and adolescent psychologist (1), neuroscience researcher (1), and OB research associate (1)
University of Pittsburgh Medical Center (UPMC)	Mother with lived experience (1), RN (1), physician researcher (1), OUD treatment provider specializing in the care of pregnant and parenting persons (1), PhD investigator (1), and research coordinator (1)
New York University Langone Medical Center (NYU)	People affiliated with OUD treatment program specializing in pregnancy (three agencies), child welfare representatives (6), addiction medicine physicians (2), and a young mother with lived experience (1)
University of Vermont (UVM)	Person affiliated with OUD treatment program specializing in pregnancy (1), child welfare representative (1)

sustainably conduct research with pregnant people, parents, infants and children impacted by substance use and other sources of adversity; (2) learn what engagement, partnership and collaboration with researchers means to different communities and organizations; (3) examine research attitudes and priorities among different communities. Research guided by community insights and perspectives is more likely to translate into meaningful interventions going forward.

MATERIALS AND METHODS

iOPEN Sites

As part of Phase I of the HBCD initiative, one of the consortiums established was the Investigation of Opioid Exposure and Neurodevelopment (iOPEN). The iOPEN consortium consisted of a set of linked sites that participated in HBCD Phase I, including Oregon Health and Science University, New York University Langone Medical Center, the University of Pittsburgh, and the University of Vermont. Stakeholder meetings were conducted at these iOPEN sites from 2019 to 2020 to better understand stakeholder perspectives and inform upcoming research. The iOPEN Phase I study was approved by the Institutional Review Board (IRB) at New York University.

Stakeholders

In the context of this project, the following people were considered stakeholders: (1) people with lived experiences of substance use during pregnancy, including opioid use; (2) medical providers or other care providers for pregnant people using substances and their infants; and (3) people making decisions at the individual or policy level with direct impacts on pregnant people who use substances and their infants. See **Table 1** for a detailed description of stakeholders involved at each site.

Stakeholder Meetings

Meeting Goals

Despite differences in the structure of these meetings by site, the overarching goals for all sites were as follows:

1. Establish a dialogue and build relationships with key organizations and stakeholders to support the ultimate goal of conducting a large-scale study of early brain development with families facing multiple sources of adversity, and particularly experiences of substance use during pregnancy.
2. Get input regarding the best ways to ethically and sustainably conduct research with pregnant people, parents, infants and children impacted by substance use and sources of adversity.
3. Learn about what engagement, partnership, and collaboration means to different stakeholders.
4. Learn about stakeholder attitudes toward research and the medical community more broadly.

Individual Sites

Oregon Health and Science University

Two group meetings each lasting 60 min were structured with a list of questions designed to elicit information and discussion about research attitudes and priorities. Prior to the second meeting, a survey and email were sent to all attendees of the first meeting to gather input on the topics and potential additional attendees for the second meeting. Notes were taken during meetings to capture elements of discussion. Participants were also invited to submit written responses to questions to increase inclusiveness of preferred communication style. The first meeting included 14 attendees and was in-person, while the second meeting included eight attendees and was virtual.

University of Pittsburgh Medical Center

One in-person group meeting lasting 60 min was conducted in a free discussion format with six attendees including treatment providers and a peer navigator from the Pregnancy and Women's Recovery Center, an outpatient OUD treatment program for pregnant and parenting women.

New York University

Twelve meetings, each ∼60 min in duration, were held with community organizations and medical centers including the Odyssey House (a residential treatment facility for pregnant mothers with OUD), Administration for Children's Services (Department for Child Welfare), Cooper University Healthcare (outpatient OUD treatment program), and Montefiore Medical Center (hospital OUD treatment program for mothers). Four of these meetings were held in-person, and the other eight were virtual.

University of Vermont

Two 30-min, in-person one-on-one meetings were held in a free discussion format. The first meeting included a child welfare representative, and the second meeting included a person who was affiliated with a treatment program specializing in pregnancy.

Analysis of Meeting Notes

Documentation from each site's meeting(s) in the form of a template were reviewed (JD) for location, duration, and attendees. See **Appendix A** for the template. After gathering basic details on the meeting formats and attendees, free form notes were further reviewed to identify common research themes and pertinent suggestions for improving research approaches. Common themes across the sites and implications for future research were identified and summarized.

RESULTS

Across all four sites, researchers were asked to record themes that emerged from meetings. All identified themes have been summarized and divided by category below. Themes are intended to inform planning and development of Phase II of the HBCD study. Implementation (e.g., practical, ethical) and measurement of outcomes would be a part of the evolving Phase II process, with site-specific considerations (e.g., geographic location, demographics).

Strong Interest in Research

All stakeholders had high levels of interest in the proposed research, and there is a desire across sites to work collaboratively with existing systems of care for pregnant people with substance use disorders (SUD). At the OHSU site there was excitement about the potential for research to address questions about the effects of substance use during pregnancy on child development as well as the opportunity for people with lived experience to have a voice in research. Involvement in research could increase connection between participants and bring a sense of meaningful contribution. People with lived experience and peer support specialists shared experiences of mistrust and frustration with prior research as these studies did not account for key potential confounding factors, such as socioeconomic status. Additionally, both people with lived experience and providers were frustrated about the lack of clear and consistent communication from providers and different agencies about what might be harmful to a developing fetus and the potential implications for child development.

Research Priorities: Collaboration, Connection, Communication, and Support

Priorities discussed by the NYU site included a desire to work collaboratively in order to fund research and treatment initiatives, decrease undue family separation related to substance use, and effectively connect participants to research opportunities. OHSU stakeholders, specifically people with lived experience and peer support specialists, stated that their priorities were to: improve the design of future research studies so they can disentangle the effects of co-occurring factors, like prenatal stress, trauma history, and food security, from the potential effects of substance use during pregnancy; address the fear, guilt, and shame often experienced by parents who have used substances during pregnancy by initiating studies with larger sample sizes with the ability to better understand potential effects of substance use on offspring; address conflicting information provided

to pregnant people using substances or in treatment during pregnancy by providing communications that are informed by the current evidence base; and study protective factors for parents and children instead of solely focusing on adverse outcomes. Providers at these meetings stated priorities such as decreasing fear and discrimination among medical providers through providing a more solid research base on pregnancy and SUD, and creating a structure for research projects that allows providers and policy makers to gain information, feel supported, and reduce bias against pregnant people using substances. Lastly, all stakeholder groups at the OHSU site meetings spoke to the importance of creating a structure for research projects that gives participants the opportunity to feel connected to others with lived experience and to the medical community, and to feel that they are making a valuable contribution—essentially using research participation as a way to decrease isolation and shame and also contribute to synthesizing current information and recommendations regarding effects of substance use during pregnancy and treatment options for patients and providers.

Barriers and Challenges

Sites agreed that institutional barriers and the COVID-19 pandemic could pose challenges for research, along with limited funding opportunities and access to data. The UVM site stakeholders specifically mentioned the potential challenge of facilitation of consent for infant participation in the study if birth parents temporarily or permanently lose guardianship. Stakeholders at the UPMC site discussed concerns about how willing pregnant people might be to complete an MRI and logistical barriers that might make completing the MRI difficult, such as transportation to and from the MRI location and childcare during the MRI. They also made points about the use of language when discussing the research—for example, not implying that there is a problem with opioid use or participants' infant's brain or making people feel like they will be experimented on during this study. OHSU site stakeholders brought up a few challenges pertaining to participants having prior negative experiences with the medical system and research; additionally, participants could be concerned about the study results indicating negative impacts of OUD on child outcomes, which could deter participation.

Achieving Research Priorities

General suggestions included: meeting patients "where they are" without any expectations; practicing trauma-informed care; demonstrating an understanding of the social determinants of health; forming relationships with study participants; providing remote support; frequent check-ins to gauge population needs; and understanding participants' motivations for participation. OHSU site stakeholders suggested implicit bias training so that researchers are cognizant of inherent bias that can exist at different points of the research process. NYU site stakeholders discussed data sharing and networking between providers and investigators in partnerships. The UVM site has a coordinated care group for all pregnant people who are in substance use treatment, and researchers at that site have been invited to participate in these meetings that include clients.

Research Strategies

Inclusion and Exclusion Criteria

Stakeholders at the OHSU site discussed the importance of considering factors that co-occur with substance use in study design, data analysis, and contextualization of interpretation, including low socio-economic status, trauma, mental health disorders and symptoms, poor nutrition, and experiences of discrimination. NYU site stakeholders suggested expanding the scope of the study to pregnant people with all substance use disorders as opposed to focusing solely on OUD.

Recruitment Strategies

Sites agreed that including people who have lived experienced with substance use during pregnancy on the research team and community advisory board would be an important way to form personal connections with research participants and better communicate information about research, with the added potential of decreasing mistrust in the healthcare system. The UVM site planned to recruit participants by having team members present at coordinated care meetings that help plan for pregnancy for people in SUD treatment. NYU site stakeholders mentioned a preference for in-person recruitment at the facility, however, with COVID-19 restrictions that might not be possible for 2022. In lieu of in-person recruitment, participants could be recruited through hospital system medical record data. Lastly, the UPMC site discussed how providing pregnant people with the MRI imaging taken of their baby could be seen as recruitment incentive, but that teams should also consider incentives such as money, food, diapers, or transportation.

Retention Strategies

UPMC site stakeholders suggested obtaining multiple contacts from participants, such as family members and friends, and gaining permission to contact those people throughout the study. NYU site stakeholders spoke to the importance of feeling a partnership between the study participants and stakeholders, and potentially forming a partnership with housing authorities in the local jurisdiction as well. Similar to recruitment strategies, OHSU site stakeholders emphasized having people who have lived experience with substance use during pregnancy on the team to promote retention and engagement with the study. Additionally, it is important for researchers to understand the motivation behind participation—understanding their reasons for joining the study could make their participation more meaningful and promote retention.

Frequency of Study Visits

The UPMC site was the only site to raise discussion of the frequency of study visits; discussion was broad, with no specific visit timeline suggested. Stakeholders thought that telehealth/virtual visits would be most ideal for this study, especially if study visits were tied to treatment program visits.

Composition and/or Role of Community Advisory Board

Sites agreed that the community advisory board should include people with lived experience of substance use during pregnancy,

peer support specialists, healthcare providers from different disciplines, policy makers, and child welfare representatives. This variety of different perspectives will be important for shaping research and also creates the opportunity to further communication between these groups. Multiple sites mentioned high levels of interest in supporting ongoing dissemination of findings with relevant service sectors and the community advisory board.

Key Ethical and Legal Considerations

Some important ethical considerations that emerged from the meetings included ensuring that participants would indeed benefit from the study, and that their experiences with the study would not cause further mistrust of the healthcare system. It will be important to consider the implications of parental rights in the event of guardianship changes that might result in retention of the parent or child in the study.
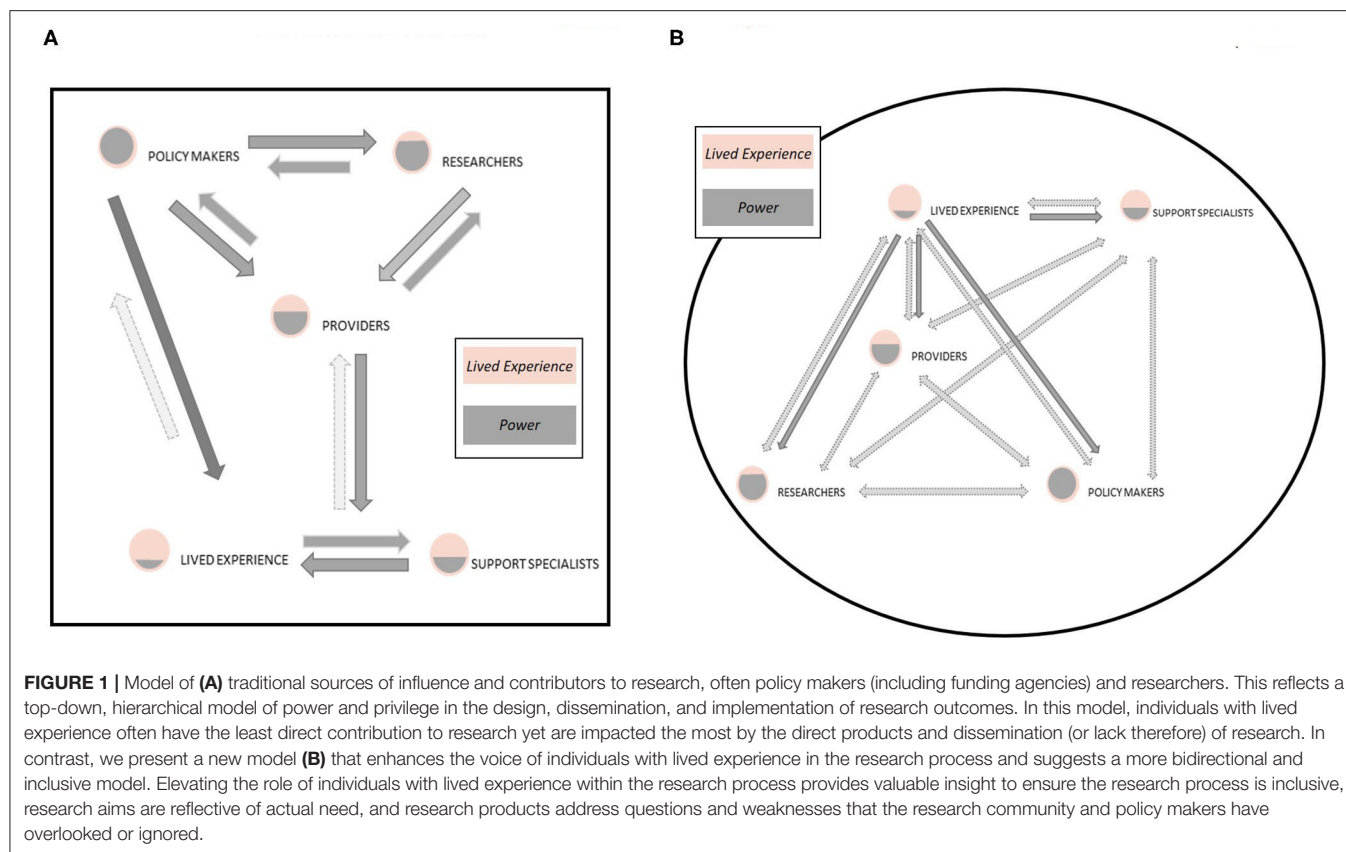
Individual Stakeholder Contributions

Different stakeholders offered unique perspectives on different aspects of study design and themes that emerged through meetings. People with lived experience and peer support specialists offered firsthand experiences with difficulties navigating healthcare, including perspectives on judgment from providers, and general distrust of the system based on past trauma. They emphasized the importance of including people with lived experience on the research team to create a welcoming atmosphere and reinforce trust in the research mission. Healthcare providers spoke to the lack of information and knowledge about impacts of opioids on fetal brain development, and the need for concrete evidence to give patients during treatment. Child welfare representatives were able to highlight legal considerations regarding custody changes, while policy makers offered perspectives on how information gathered from future research could improve the quality of patient education and legislation.

Figure 1 illustrates a conceptual framework informed by stakeholder meetings, which places patients and individuals with lived experience at the center, and demonstrates the concentric levels of contact between stakeholders including peer support specialists, healthcare providers, child welfare, and policy makers. In practicing patient-centered research, patients occupy the center space, with peer support specialists in immediate contact with them, as those who assist patients firsthand in navigating the healthcare system and advocating for their needs. Healthcare providers represent the next layer of the concentric model, as those who care for patients in the medical setting, both in prenatal and SUD capacities. Child welfare and policy makers represent the final layers of the model, as they have less direct contact with patients, but are important in making guardianship and custody decisions and crafting legislation that impacts pregnant people with SUD and their infants.

DISCUSSION

As HBCD focuses on understanding the brain and behavioral development of children exposed to opioids *in utero* and their

FIGURE 1 | Model of **(A)** traditional sources of influence and contributors to research, often policy makers (including funding agencies) and researchers. This reflects a top-down, hierarchical model of power and privilege in the design, dissemination, and implementation of research outcomes. In this model, individuals with lived experience often have the least direct contribution to research yet are impacted the most by the direct products and dissemination (or lack therefore) of research. In contrast, we present a new model **(B)** that enhances the voice of individuals with lived experience in the research process and suggests a more bidirectional and inclusive model. Elevating the role of individuals with lived experience within the research process provides valuable insight to ensure the research process is inclusive, research aims are reflective of actual need, and research products address questions and weaknesses that the research community and policy makers have overlooked or ignored.

parent's ability to effectively provide care for their child, it is essential that stakeholder input, especially from people with lived experience, inform the study design. In an effort to understand the patient voice in HBCD, stakeholder meetings were conducted across iOPEN consortium sites to aide in HBCD formation and design. Despite each site taking a different approach to the stakeholder meetings, common themes and implications emerged. Specifically, there was excitement about the research, especially the opportunity to include the voices of people with lived experience, and the ability to contribute to a broader evidence base pertinent to addiction medicine and child development in the context of *in utero* exposure to opioids. All types of stakeholders suggested research priorities should include collaboration between providers, peer support specialists, patients, and others.

There were also a significant number of strategy suggestions coming out of the stakeholder meetings. Sites found that there is mistrust between people with SUD and the medical system, and this is something that could be addressed by including people with lived experience on the research team, forming connections, communicating clearly, training the research team in implicit bias, and practicing trauma-informed care. There was a strong emphasis on the need for rigorous research designs that could effectively delineate the effects of factors that frequently co-occur with SUD during pregnancy from the effect of SUD on fetal, infant, and child development, such as low socioeconomic

status or poor nutrition. Another unanimous priority was that providers and participants should all feel supported in providing/receiving care in the research structure, and have an understanding of the social determinants of health. Research teams should include people with lived experience to improve both recruitment and retention of participants, and researchers should understand what is motivating participants to join the study. There should be ample incentives for participation, such as money, food, or transportation. It would likely be most feasible to recruit from medical record data and conduct remote study visits when possible, due to restrictions secondary to the COVID-19 pandemic. Community advisory boards should include stakeholders from a wide array of backgrounds, including people with lived experience, peer support specialists, providers, policy makers, and child welfare organizations, to promote connectedness and collaboration, and bring different perspectives to the table.

Through conducting these stakeholder meetings, several challenges emerged, including the rapid timeline of grants limiting the time for relationship building, COVID-19 limiting in-person meetings and increasing daily challenges for providers, patients, and policy-makers, and academic/research-focused language in presenting and writing up the study. Multiple sites shared that in-person stakeholder meetings were more effective in fostering community and keeping people engaged, while virtual meetings were more accessible and could increase

collaboration. These challenges posed important questions to consider for future stakeholder meetings. First, is there a best format for meeting or does it vary greatly depending on the site and on current conditions (for example, the COVID-19 pandemic)? Are group or one-on-one stakeholder meetings more effective for gathering input? Additionally, how can we more effectively involve stakeholders at every stage of the research process, from meeting planning through interpretation of results?

Figure 1 demonstrates a concentric model of the layers of contact and intersection between the stakeholders involved in this process. It is critical to have the patient perspective informing our research goals and strategies, and incorporation of stakeholders across the levels of the concentric model further strengthen recommendations and translatability of research. However, there is limited data on the patient experience of pregnant people with OUD, specifically how pregnant people with OUD perceive information provided by medical professionals about the effects of *in utero* drug exposure on their developing infants, during pregnancy, infancy, and into childhood. Existing data indicates a significant lack of trust, and many barriers to interacting with medical care providers for substance use treatment and by extension, researchers operating in medical settings (Goodman et al., 2020). Barriers include lack of insurance, high costs of care, long waiting lists to obtain care, and a lack of transportation (Goodman et al., 2020). During pregnancy, accessing treatment can be particularly difficult due to the stigma surrounding substance use during pregnancy and the threat of the legal system intervening through Child Protective Services (Goodman et al., 2020). Despite the condemnation of punitive treatment for drug use during pregnancy by national associations such as the American Academy of Pediatrics (Patrick et al., 2017), 18 states still classify substance use during pregnancy as criminal child abuse, which can result in termination of parental rights (Krans and Patrick, 2016). This represents a lost opportunity, as pregnancy is a turning point for many people during which they decide to seek help for substance use, both for the health of themselves and their infants, and engage with the healthcare system (Goodman et al., 2020).

Qualitative research has shown that pregnant people with OUD need to have access to "gender-specific, family-friendly addiction treatment programs, psychosocial services, and mental health treatment" due to high rates of trauma and abuse (Patrick et al., 2017). Unfortunately, trials of mental health interventions during pregnancy often exclude pregnant people using substances (Seghete et al., 2020), limiting the evidence base for selecting appropriate interventions addressing mental health in this population. Addressing logistical barriers also appears to be critical, as an important factor contributing to continuation of treatment is the availability of on-site childcare and services (Patrick et al., 2017). Those who attended substance use treatment program support groups cited their peers as "significant source(s) of support and information," and many people found comfort in hearing the stories of other births following treatment for OUD (Goodman et al., 2020). One-to-one clinical support to assist patients in navigating the healthcare system and other sources of assistance has also been cited as

a way to help people engage with medical providers, overcome barriers, and set goals for themselves and their newborns (Cochran et al., 2019).

Peer support specialists are the next level out in the concentric model, as they are closely associated with patients and focus specifically on supporting pregnant people with OUD in the process of seeking treatment and navigating the healthcare system. They are uniquely positioned to ensure that a patient's needs are being met and that their voices are heard. Peer support specialists are often also people with lived experience with substance use during pregnancy and parenting. Medical providers are the next level out from patients and peer support specialists, as they provide direct care to pregnant people with OUD and their children. In the research context, they provide unique perspectives on how research is interpreted, what information is shared with patients, and directly influences care for this population. They can additionally provide insights on barriers to research participation and factors that may facilitate research engagement. Lastly, they can give voice to what data and evidence is missing that might help them better care for pregnant patients with OUD.

Next, child welfare agencies are stakeholders in research regarding substance use during pregnancy since they theoretically rely on this research to determine safety of infants and families, and make critical decisions about child guardianship and custody. Child welfare agencies become involved with pregnant people in OUD treatment in states that require intervention, and often work with families both during and after treatment to assure that newborns are in safe home environments. Lastly, policy makers are those responsible for developing and implementing legislation that impacts pregnant people with OUD and their newborns. They, too, rely on research and research dissemination to inform legislation. Policies then impact the care given by healthcare providers and the extent to which child welfare agencies become involved during and after pregnancy.

As these stakeholder meetings were conducted at the iOPEN consortium sites as part of the Phase I initiative of the HBCD study, stakeholder meetings were limited in scope to support the aims of planning and development of Phase II of the HBCD study. Therefore, stakeholders with lived experience were most representative of individuals with lived experience of using opioids during pregnancy. Phase II of the HBCD study will provide an opportunity to expand stakeholder groups that will evolve with the needs of the study over time at each site. For example, membership could expand to include other individuals with lived experience as appropriate (e.g., partners of pregnant people with OUD, adult children of parents that used opioids during pregnancy). Of note, there is an ethical responsibility to ensure the make-up of the stakeholder group allows all individuals with lived experience to feel their voice is able to be heard. It may at times be appropriate to establish different types of advocacy boards.

In conclusion, these stakeholder meetings provided very valuable information for structuring upcoming studies; however, researchers would have benefitted from more time and more opportunities for in-person connection. Additionally, ongoing

dialogue and relationship building with stakeholders is needed, particularly people with lived experience. Research and funding agencies must be flexible in timelines and methods to allow for incorporation of stakeholder input.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by New York University Institutional Review Board. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

FUNDING

ACKNOWLEDGMENTS

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.698766/full#supplementary-material

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Adapting an Evidence-Based Home Visiting Intervention for Mothers With Opioid Dependence: Modified Attachment and Biobehavioral Catch-up

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Infants born to mothers who are dependent on opioids often have difficulty regulating behavior and physiology at birth. Without sensitive maternal care, these infants are at risk for ongoing problems with self-regulation. Mothers who are dependent on opioids may experience challenges related to their substance use (e.g., unsupportive and/or risky environment, impulse control and reward system problems) that increase the likelihood of insensitive parenting in the absence of effective intervention. In this paper, we describe a home-visiting intervention we have adapted to enhance sensitive, responsive caregiving tailored to the specific needs of mothers with opioid dependence. The original intervention, Attachment and Biobehavioral Catch-up (ABC), was designed for mothers of infants aged 6–24 months who were exposed to early adversity. ABC has been shown to enhance sensitive parenting as well as children's behavioral and biological functioning, with positive outcomes extending into at least middle childhood. Mothers who are opioid dependent need earlier support than provided by ABC because opioid-exposed infants are often vulnerable at birth. The adapted intervention (modified ABC or mABC) includes one prenatal session and one early postnatal session, followed by 10 sessions every 2–3 weeks. In the initial two sessions in particular, mothers are helped to anticipate the challenges of caring for a baby who may be difficult to soothe while nonetheless providing sensitive care. mABC is intended to help mothers see the importance of responding sensitively so as to help infants overcome the developmental risks associated with opioid exposure. Additionally, mABC is structured to support mothers with the challenges of early parenting, especially if the mother herself was not parented sensitively. Throughout, the focus is on helping the mother nurture the distressed infant, attend to the infant's signals, and avoid behaving in overstimulating or intrusive ways. Case examples are presented that highlight both the challenges of working with this population as well as the gains made by mothers.

Keywords: home visiting program, parenting intervention, parenting sensitivity, attachment, prenatal opioid exposure, neonatal opioid withdrawal syndrome (NOWS)

INTRODUCTION

Opioid abuse is a public health emergency of historic proportions, affecting thousands of pregnant and parenting mothers (Clemans-Cope et al., 2019). Infants exposed to opioids prenatally are at risk for difficulty regulating physiology and behavior, particularly in the vulnerable neonatal period when many infants experience symptoms of withdrawal (Conradt et al., 2018). Sensitive caregiving is critical for helping substance-exposed infants thrive; however, mothers with opioid use disorders may struggle to parent sensitively in the context of substance-related risk factors including poverty, trauma exposure, alterations in reward processing, and emotional dysregulation. There is an urgent need for evidence-based parenting interventions to support mothers with opioid use disorders, especially in the peripartum period when infants experiencing withdrawal may be difficult to soothe. The current paper reviews existing interventions designed to enhance parenting quality among opioid-dependent mothers of infants, in addition to reviewing the evidence base of Attachment and Biobehavioral Catch-Up (ABC), a home-visiting intervention model for parents of infants exposed to early adversity. We then describe modified Attachment and Biobehavioral Catch-Up (mABC), an adaptation of ABC tailored to the needs of this population, designed to enhance parenting sensitivity and in turn promote attachment organization and self-regulation among infants with prenatal opioid exposure.

In 2017, an estimated 2.129 million American adults met criteria for opioid use disorder (Florence et al., 2021), including more than 600,000 parents living in households with their children (Clemans-Cope et al., 2019). The impact of parental opioid use begins in utero: opioids are known to cross the placenta and have been implicated in a wide range of adverse fetal outcomes (Yazdy et al., 2015). Despite these concerns, a growing proportion of American women report using opioids during pregnancy (Epstein et al., 2013; Ailes et al., 2015; Patrick et al., 2015a), with the prevalence of maternal opioid use disorder documented at delivery more than quadrupling between 1999 and 2014 (Haight et al., 2018).

The rising rate of prenatal opioid exposure is linked to a corollary increase in neonatal opioid withdrawal syndrome (NOWS), a constellation of withdrawal symptoms affecting 50–80% of opioid-exposed newborns (Patrick et al., 2015b; Conradt et al., 2019). NOWS is characterized by hyperreactivity of the central nervous system and difficulty regulating gastrointestinal, respiratory, and autonomic functions (Jones et al., 2010; Patrick et al., 2015b). Symptoms of NOWS include irritability, high-pitched cry, tremors, feeding difficulty, and disrupted sleep (Jansson et al., 2009). Even among infants without overt withdrawal symptoms, a history of prenatal opioid exposure confers risk for biological and behavioral dysregulation (Minnes et al., 2011; Nygaard et al., 2016; Reddy et al., 2017). Thus, compared to infants without prenatal opioid exposure, infants exposed to opioids in utero are at heightened risk for medical complications and broad-based difficulties with self-regulation.

Importantly, prenatal opioid use is often accompanied by exposure to other substances, both prescribed (e.g., antidepressants, sedatives) and non-prescribed (e.g., alcohol, marijuana, cocaine), many of which are known to have adverse effects on fetal development (Singer et al., 2020). For example, rates of cigarette smoking among pregnant women in treatment for opioid use disorder have been estimated at 95% (Jones et al., 2013). Prenatal opioid exposure thus occurs in the broader context of polysubstance use, with the potential for additive and/or synergistic effects on infants' outcomes (Singer et al., 2020). Co-occurring substance exposure may exacerbate risks associated with prenatal opioid use, heightening infants' vulnerability to dysregulation.

A limited body of evidence suggests that social-environmental factors, including rearing environment, may offset or moderate effects of substance-related risk on developmental outcomes (Marcus et al., 1984; Hans and Jeremy, 2001; Ornoy et al., 2001). A broader literature on risk and resilience has identified parenting as a powerful predictor of child outcomes across a wide range of adversities, including poverty and exposure to trauma (Masten and Labella, 2016). Relatedly, parenting interventions have been shown to promote resilient functioning, including healthy physiological and behavioral regulation, in the context of early adversity (Fisher et al., 2007; 2016). Taken together, the evidence suggests that sensitive parental care may be especially important for buffering effects of early vulnerability and promoting healthy development among infants prenatally exposed to opioids and other co-occurring substances (Reddy et al., 2017; Conradt et al., 2018; Finger et al., 2018).

Challenges for Sensitive Parenting

Unfortunately, prenatal substance exposure is associated with multiple challenges that interfere with sensitive parenting. Maternal opioid use often co-occurs with poverty (Han et al., 2017; Metz et al., 2018), which in turn is associated with a range of sociodemographic risk factors (e.g., low parental education, inadequate resources) and adverse experiences (e.g., family conflict, community violence) known to undermine parenting sensitivity and healthy child development (Conger and Donnellan, 2007; Simons et al., 2016). In addition to current psychosocial stressors, pregnant and parenting women with opioid use disorders often report prior history of trauma, including physical and sexual abuse (Saia et al., 2016; American College of Obstetricians Gynecologists, 2017; Gannon et al., 2020). Early traumatic experiences confer risk for both problematic substance use and parenting dysfunction, perhaps in part by disrupting attachment processes across the lifespan (Alvarez-Monjaras et al., 2019; Labella et al., 2019; Preis et al., 2020).

The social-environmental context of maternal opioid use is thus characterized by current and historical adversity, as well as limited access to resources and social supports (American College of Obstetricians Gynecologists, 2017; Conradt et al., 2018; Peisch et al., 2018). In addition to cumulative contextual risk, women with opioid use disorders often have individual vulnerabilities that may further challenge their ability to provide sensitive care. At a physiological level, opioid dependence alters the reward system, potentially interfering with normative neurobiological processes that make parenting inherently rewarding (Kim et al., 2017; Rutherford and Mayes, 2017; Alvarez-Monjaras et al., 2019). Substance use disorders may also disrupt neural processes

involved in executive function, undermining emotion regulation and impulse control (Alvarez-Monjaras et al., 2019; Peters and Soyka, 2019). The neurobiological sequelae of opioid dependence may thus impinge on skills required for effective parenting.

Relatedly, women with opioid use disorders are frequently diagnosed with a range of psychiatric comorbidities characterized by dysregulation of affect and behavior, including anxiety, depression, bipolar disorder, borderline personality, and post-traumatic stress disorder (Whiteman et al., 2014; Arnaudo et al., 2017; Preis et al., 2020). Conradt et al. (2018) propose maternal emotion dysregulation as a key vulnerability factor for psychopathology in general and substance use in particular among women using opioids during pregnancy. Maternal emotion dysregulation may function to exacerbate substance use and/or disrupt parenting directly. Difficulty regulating negative emotions may impair mothers' ability to inhibit a prepotent response (e.g., expressing anger or withdrawing from a crying infant) in order to provide sensitive care. Thus, behavioral dysregulation associated with substance use may pose additional threats to childrearing.

Prenatal opioid exposure is thus associated with a constellation of parenting risk factors at the social-environmental, behavioral, and neurobiological levels. Difficulties with sensitive parenting are multiply determined and may be compounded by infants' symptoms of NOWS. Opioid withdrawal symptoms—including fussiness, shrill cries, and disrupted sleep—may be particularly taxing for peripartum parents, contributing to frustration and fatigue (Jansson et al., 2009). Mothers of infants with severe NOWS may struggle to persist in providing comfort to an infant who is difficult to soothe. Early insensitive interactions may become entrained over time, developing transactionally into a pattern of suboptimal care that extends across infancy and beyond. Indeed, relative to community samples without prenatal opioid exposure, mothers prescribed opioid treatment medications during pregnancy interact less positively and more negatively with their opioid-exposed children during infancy, preschool age, and middle childhood (Hans et al., 1999; Salo et al., 2009; Sarfi et al., 2011). Notably, variations in observed parenting quality predict social-emotional adjustment among children prenatally exposed to opioids (Bernstein and Hans, 1994; Sarfi et al., 2013; Finger et al., 2018), illustrating the importance of sensitive parenting in this vulnerable population.

A Review of Interventions to Promote Sensitive Care

There is an urgent need for evidence-based parenting interventions to support mothers with opioid use disorders and their infants (Peisch et al., 2018). Our review of the literature identified just four parenting programs that have been empirically evaluated with opioid-dependent mothers of infants younger than 1 year (**Table 1**). Two interventions (Circle of Security and patient-centered educational support groups) were tested with small pilot samples and focused primarily on feasibility and acceptability (Coleman, 2014; Kahn et al., 2017).

No measures of observed parenting behavior were included, and no inferential statistics were reported, limiting evaluation of their effectiveness. A third intervention (Mothering from the Inside Out) was evaluated using a randomized clinical trial following a promising pilot (Suchman et al., 2010, 2011, 2017). This intervention was found to enhance reflective functioning among predominantly opioid-dependent mothers of infants and toddlers, although results for observed parenting behaviors were mixed (Suchman et al., 2011, 2017). Another intervention targeting mindfulness-based parenting showed promise using a pre-post design: opioid-dependent mothers of children aged 3 months through 3 years demonstrated post-intervention improvements in self-reported mindful parenting and observed parenting quality, although causal inference was limited by the lack of a comparison group (Gannon et al., 2017, 2019).

Importantly, none of these interventions are specific to early infancy. They are intended to serve a broader population of parents with children up to 3, 5, or 8 years, and as such, are not explicitly targeted to the challenges of caring for a vulnerable newborn. Additionally, only one parenting program was evaluated using a randomized clinical trial, the gold standard for assessing treatment efficacy. There remains a need for rigorous research evaluating parenting programs, particularly those that begin during the peripartum period and those that target specific parenting behaviors known to enhance self-regulation among vulnerable infants. Cioffi et al. (2019) recommend accelerating translational research aimed at supporting parents with opioid use disorder by adapting existing parenting interventions with established evidence of effectiveness in other populations.

A Review of Attachment and Biobehavioral Catch-Up

One promising model is Attachment and Biobehavioral Catch-Up (ABC), a ten-session home-based intervention designed to enhance parenting sensitivity, with cascading effects on parent–child attachment and child self-regulation among infants and toddlers exposed to early adversity (Dozier and Bernard, 2019). Drawing on insights from attachment theory, the ABC intervention anticipates children's innate need to seek proximity and comfort from a caregiver under conditions of threat (Bowlby, 1969/1982). Despite this need, children exposed to early adversity may have difficulty seeking out caregivers directly when they are distressed and may struggle to soothe when comfort is provided, making it more challenging for parents to provide consistent nurturing care (Stovall-McClough and Dozier, 2004). Helping young children manage distress is an important parental task, as infants rely on their parents for co-regulation of their emotions, behavior, and physiology (Hofer, 2006). Responding sensitively to children's cues when they are not distressed—and avoiding insensitive behavior that may be frightening or overwhelming—further support children's emerging self-regulation (Feldman, 2007). Sensitive parenting is especially important for infants and toddlers exposed to early adversity, who are at heightened risk for behavioral and biological dysregulation. Unfortunately, parents of vulnerable children may struggle to interact sensitively for a variety of reasons, including their own experiences of

TABLE 1 | Interventions targeting parenting among opioid-dependent mothers of infants.

Intervention	References	Sample	Study design	Description of parenting findings
Circle of Security	Coleman (2014)	8 parents enrolled in opioid treatment (children aged 6 months to 8 years)	Pre-post	Qualitative feedback indicated that the parenting program was helpful and informative.
				Self-reported caregiver reflectiveness and empowerment did not show evidence of improvement.
Educational support groups	Kahn et al. (2017)	23 pregnant and parenting women on MAT (children aged 0–5 years)	Focus groups	Qualitative feedback indicated that focus groups were perceived as helpful and supportive.
Mindfulness-Based Parenting	Gannon et al. (2017)[a]	160 pregnant and parenting women on MAT (children aged 0–3 years)	Pre-post	Observed-rated parenting quality showed large increases and self-reported mindful parenting showed small increases pre- to post-intervention.
	Gannon et al. (2019) [a]	120 pregnant and parenting women on MAT (children aged 0–3 years)	Pre-post	Qualitative descriptions of parenting changes reported in Gannon et al. (2017) suggested increased sensitivity to child cues and supportiveness during play
	Short et al. (2017) [a]	59 pregnant and parenting women on MAT (children aged 0–3 years)	Pre-post	Self-reported parental distress (but not parenting stress related to child difficulty or dysfunctional interactions) declined pre- to post-intervention
Mothering from the Inside Out (MIO)/Mothers and Toddlers Program (MTP)	Suchman et al. (2010)[b]	47 mothers in substance use treatment (children aged 0–3 years); predominantly opioid users (72%)	Randomized clinical pilot	At post-intervention, mothers randomized to MTP showed small advantages over mothers in the comparison group on reflective functioning and large advantages in observed parenting sensitivity; no *p*-values reported
	Suchman et al. (2011)[b]	47 mothers in substance use treatment (children aged 0–3 years); predominantly opioid users (72%)	Randomized clinical pilot	Six weeks post-intervention, mothers randomized to MTP showed medium advantages over mothers in the comparison group on reflective functioning and observed parenting sensitivity; no *p*-values reported.
	Suchman et al. (2017)	87 mothers in substance use treatment (children aged 11 months-5 years); predominantly opioid users (89%)	Randomized clinical trial	At post-intervention, the MIO group showed significantly better maternal reflective functioning (but not parent–child attachment security or observed parenting) than the comparison group
				At 3-month follow up, the MIO group showed significantly better maternal reflective functioning (but not observed parenting) than the comparison group.
				At 12-month follow-up, the MIO group showed significantly better observed parenting than the comparison group

[a]*Results drawn from overlapping samples.*
[b]*Results drawn from overlapping samples.*
MAT, medication-assisted treatment for opioid use disorder.

adversity, their attachment history, and/or their child's difficulty communicating emotional needs.

To support parents of vulnerable infants and toddlers in serving this crucial co-regulatory function, ABC targets three aspects of parenting behavior: (a) nurturing the child when he or she is distressed, (b) responding sensitively when the child is not distressed (i.e., following his or her lead with delight), and (c) avoiding intrusive or frightening behavior. Parent coaches deliver manualized intervention content in each of 10 weekly sessions, which are attended by parents and children. Intervention targets are illustrated using video clips of other parents and children, as well as clips of the family's interactions in previous sessions. Most

importantly, parent coaches provide frequent feedback in the form of "in-the-moment" comments, which are designed to help parents recognize and engage in targeted parenting behaviors (Dozier and Bernard, 2019). In-the-moment comments have been identified as the intervention mechanism leading to changes in parenting behavior (Caron et al., 2016).

ABC was initially developed for parents and caregivers of infants aged 6–24 months and subsequently adapted for use with parents of toddlers (24–48 months). Its efficacy has been established through large RCTs with families of infant and toddlers involved in the child welfare system, as well as with families of children adopted internationally (Dozier and Bernard,

2019). Intervention effects on parenting behavior, parent–child attachment, and children's self-regulation are reviewed in **Table 2**. In comparison with a control intervention focused on healthy development, ABC has been shown to enhance parenting sensitivity among birth parents referred to Child Protective Services (CPS) due to concerns about child maltreatment (Yarger et al., 2016; Lind et al., 2020), as well as among foster caregivers (Bick and Dozier, 2013) and internationally adoptive parents (Yarger et al., 2020). The intervention has shown benefits for parent–child attachment in families involved with CPS: ABC has been linked to reduced attachment avoidance among infants and toddlers in foster care (Dozier et al., 2009), and to enhanced attachment security and organization among CPS-referred infants remaining in their birth parents' care (Bernard et al., 2012). When the latter sample was followed into middle childhood, children in the ABC group reported feeling more secure in their relationships with their parents than children in the comparison group, suggesting impressive longevity of effects (Zajac et al., 2020).

The benefits of ABC extend past the parenting relationship to enhance child outcomes. In particular, ABC has been found to support emerging self-regulation of biology and behavior in infants and toddlers at risk for dysregulation. Among CPS-referred families participating in a foster care diversion program, children whose parents received ABC showed more normative diurnal regulation of the hormone cortisol than children whose parents received a control intervention, an advantage that persisted in toddlerhood (Bernard et al., 2015a) and preschool (Bernard et al., 2015b). This is promising because the disruption of healthy cortisol production is believed to be one mechanism by which early stress undermines adaptive functioning and physical health across the lifespan (Gunnar and Quevedo, 2007; Fisher et al., 2016). Restoring a healthy pattern of diurnal cortisol through responsive caregiving may confer powerful protection against risks associated with early adversity (Fisher et al., 2016).

ABC's benefits for physiological regulation persist into middle childhood. In a follow-up study with the same sample, nine-year-old children whose parents received ABC during infancy showed higher respiratory sinus arrhythmia across tasks than children whose parents received a control intervention (Tabachnick et al., 2019). Respiratory sinus arrhythmia indexes parasympathetic activation, an aspect of autonomic nervous system functioning involved in maintaining homeostasis while flexibly responding to environmental demands (Beauchaine, 2001; Porges, 2007). Higher parasympathetic activation at rest is believed to reflect greater capacity for physiological and emotional regulation (Beauchaine, 2001). Thus, children in the ABC group showed enhanced self-regulation a remarkable 7–8 years after the intervention took place.

Self-regulatory benefits of ABC are also evident at the behavioral level. Relative to children in the comparison group, toddlers whose foster parents received ABC showed better self-regulation skills as preschoolers, as indexed by caregiver-reported attention problems and child performance on the Dimensional Change Card Sort, a measure of cognitive self-control skills known as executive functions (Lind et al., 2017). Furthermore, among CPS-referred families participating in a foster care diversion program, ABC was linked to less emotion dysregulation during a frustrating task in toddlerhood than seen among children in the control condition (Lind et al., 2014; Labella et al., 2020). In a follow-up study with the same sample, preschoolers whose parents received ABC were more likely to comply with a behavioral directive (i.e., not to touch forbidden toys) than those whose parents received the control intervention (Lind et al., 2020).

ABC is associated with similar positive changes in parenting when delivered by community clinicians. In community-based RCTs, parents who received ABC were more sensitive and less intrusive than parents in comparison groups (Berlin et al., 2014, 2018). Furthermore, in a sample of 108 parents seen across five community dissemination sites, parents showed large increases in sensitivity from pre- to post-intervention ($d = 0.83$), comparable to effect sizes observed in university RCTs (Roben et al., 2017). These findings build confidence that ABC is feasible and effective when delivered in the community, a prerequisite for a large-scale public health intervention.

ABC for Mothers in Treatment for Opioid Use Disorder

The evidence base for ABC has established its efficacy and effectiveness for families exposed to multiple types of early adversity, including CPS involvement. This is relevant for mothers with opioid use disorders, many of whom become involved with CPS if their infants test positive for opioids (including opioid treatment medications) at birth (Child Welfare Information Gateway, 2020). Prior research on ABC has included parents with substance use disorders. For example, in the RCT with families participating in foster care diversion, a subset of birth parents had been referred to CPS because of concerns about parental substance use (Bernard et al., 2015a). Furthermore, a small community-based RCT demonstrated enhanced parenting sensitivity among mothers in residential substance abuse treatment randomized to receive ABC vs. treatment as usual (Berlin et al., 2014). This provides preliminary evidence that ABC may be successfully used with parents in treatment for substance use, including opioid dependence. ABC has been successfully delivered in community settings, suggesting promise as a large-scale public health intervention, and targets areas of vulnerability for families affected by prenatal opioid exposure. ABC's focus on concrete parenting behaviors may help opioid-dependent mothers respond to their infants in nurturing and sensitive ways, with downstream benefits for parent–child attachment and children's self-regulation.

ABC thus shows promise as a treatment model for parents of infants with prenatal opioid exposure. However, ABC is designed to be delivered with older infants (6–24 months) and toddlers (24–48 months) and is not well suited to support mothers during the vulnerable peripartum period, when infants may be experiencing challenging opioid withdrawal symptoms including inconsolable crying and disrupted sleep. Mothers of infants with prenatal opioid exposure may need additional early support focused on providing nurturance to newborn infants who are difficult to soothe, as well as assistance reading infant cues to avoid overstimulation.

TABLE 2 | Review of ABC effects on parenting, parent–child attachment, and child self-regulation.

References	Intervention sample	Outcome	Description of findings
Parenting			
Bick and Dozier (2013)	96 foster mother-infant dyads (infants aged 0–2 years)	Parenting sensitivity	At post-intervention, mothers randomized to ABC showed greater increases in sensitivity than mothers in the comparison group.
Berlin et al. (2014)	21 mothers in residential substance abuse treatment and their infants (infants aged 0–2 years)	Parenting sensitivity	At post-intervention, mothers randomized to ABC showed marginally more parenting sensitivity, consistent with a medium effect size
Yarger et al. (2016)	24 birth mother-infant dyads referred to CPS (infants aged 6 months−2 years)	Parenting sensitivity, intrusiveness	Relative to comparison mothers, mothers randomized to ABC showed greater increases in parenting sensitivity and decreases in intrusiveness across 10 sessions
Caron et al. (2016)	78 parent–infant dyads (most CPS-referred) (infants aged 0–2 years)	Parenting sensitivity, intrusiveness	Parents receiving ABC in a community setting showed increased parenting sensitivity and decreased intrusiveness from pre-to post-intervention
Roben et al. (2017)	108 parent–infant dyads (infants aged 6 months−2 years)	Parenting sensitivity	Parents receiving ABC across five community sites showed increased parenting sensitivity from pre-to post-intervention
Berlin et al. (2018)	208 low-income mother-infant dyads (most Latinx; infants aged 6–20 months)	Parenting sensitivity, intrusiveness, positive regard	At post-intervention, mothers randomized to EHS + ABC showed greater sensitivity, lower intrusiveness, and greater positive regard than mothers receiving only EHS
Lind et al. (2020)	101 birth mother-infant dyads referred to CPS (infants aged 0–2 years)	Parenting sensitivity	One month post-intervention and at a follow-up assessment 1.5 years later, mothers randomized to ABC showed more sensitivity than mothers in the comparison group
Yarger et al. (2020)	120 internationally adopted infants and toddlers and their adoptive parents (children aged 6 months−4 years)	Parenting sensitivity, intrusiveness, positive regard	Relative to comparison mothers, adoptive parents randomized to ABC showed greater increases in parenting sensitivity, decreases in intrusiveness, and increases in positive regard pre-to post-intervention. Effects persisted at a 2-year follow-up
Raby et al. (2021)	94 birth mother-infant dyads referred to CPS (infants aged 0–2 years)	Parenting sensitivity	Receiving ABC (vs. a comparison intervention) during infancy had an indirect effect on parenting sensitivity during middle childhood through parents' secure base script knowledge
Parent–child attachment			
Dozier et al. (2009)	46 foster mother-infant dyads (infants aged 0–3 years)	Attachment avoidance	Relative to comparison children, children whose parents received ABC showed less avoidance during distress-eliciting situations reported in a daily diary.
Bernard et al. (2012)	120 birth mother-infant dyads referred to CPS (infants aged 0–2 years)	Attachment security, disorganization	Relative to comparison children, children whose parents received ABC showed higher rates of attachment security and lower rates of disorganization in the Strange Situation
Zajac et al. (2020)	100 birth mother-infant dyads referred to CPS (infants aged 0–2 years)	Perceived attachment security	Relative to comparison children, children whose parents received ABC reported greater perceived attachment security approximately 8 years later.
Child self-regulation: Biological			
Bernard et al. (2015a)	100 birth mother-infant dyads referred to CPS (infants aged 0–2 years)	Diurnal cortisol	Post-intervention, children whose parents received ABC showed more normative diurnal cortisol production (higher wake-up value, steeper slope) than comparison children
Bernard et al. (2015b)	96 birth mother-infant dyads referred to CPS (infants aged 0–2 years)	Diurnal cortisol	At a three-year follow-up, preschool-aged children whose parents received ABC during infancy showed more normative diurnal cortisol production (higher wake-up value, steeper slope) than comparison children
Tabachnick et al. (2019)	96 birth mother-infant dyads referred to CPS (infants aged 0–2 years)	Respiratory sinus arrhythmia	Relative to comparison children, children whose parents received ABC showed higher respiratory sinus arrhythmia (suggesting better physiological regulation) approximately 8 years later

(Continued)

TABLE 2 | Continued

References	Intervention sample	Outcome	Description of findings
Child self-regulation: Behavioral			
Lewis-Morrarty et al. (2012)	37 foster parent–infant dyads (infants aged 0–2 years)	Executive function	Relative to comparison children, children whose parents received ABC during infancy showed better executive function as preschoolers
Lind et al. (2014)	117 birth mother-infant dyads referred to CPS (infants aged 0–2 years)	Negative affect expression	Relative to comparison children, children whose parents received ABC during infancy showed less negative affect during a frustrating task in toddlerhood
Lind et al. (2017)	121 foster parent–toddler dyads (toddlers aged 2–4 years)	Attention problems; executive function	Relative to comparison children, children whose parents received ABC in toddlerhood had fewer parent-reported attention problems and showed better executive function as preschoolers
Lind et al. (2020)	101 birth mother-infant dyads referred to CPS (infants aged 0–2 years)	Inhibitory control	Relative to comparison children, children whose parents received ABC were more likely to comply with a behavioral directive (inhibit the urge to touch forbidden toys) as preschoolers

ABC, Attachment and Biobehavioral Catch-Up; CPS, Child Protective Services; EHS, Early Head Start.

MODIFIED ATTACHMENT AND BIOBEHAVIORAL CATCH-UP

Modified Attachment and Biobehavioral Catch-Up, or mABC, builds on the principles of ABC, tailored to address the specific needs of mothers in treatment for opioid use disorder. The first session of mABC is designed to occur during the third trimester in order to help pregnant mothers anticipate their crucial role in providing nurturance, even when their infant is difficult to soothe. A second session is intended to take place as soon as possible after birth and may be delivered in the hospital if the infant is being monitored or treated for NOWS. Following these initial sessions, the intervention proceeds with ABC targets, developmentally adapted for early infancy. In contrast to ABC, which meets weekly, mABC is intended to meet every 2–3 weeks. This extended schedule allows the parent coach to be available for postpartum support while also ensuring that parents have adequate opportunity to practice parenting behavior targets that are developmentally appropriate in older infancy.

Similar to ABC, mABC is a manualized intervention designed to be delivered in the home. Everyone who lives in the home is invited to participate in sessions, and parent coaches are encouraged to comment on parents' interactions with siblings as well as the target child. This intervention strategy is designed to help mothers practice targeted parenting behaviors in the context of their everyday lives, while navigating distractions, feedback from other family members, and the attentional demands of caring for other children. We believe this increases the likelihood that behavior change will generalize outside of intervention sessions and produce lasting benefits.

The manual provides a framework for introducing session content but is not intended to be treated as a script. Instead, parent coaches are encouraged to present material in a natural and conversational manner, soliciting mothers' input and ensuring understanding. Parent coaches simultaneously pay close attention to parent–child interactions unfolding in real time, interspersing content discussion with frequent feedback in the form of in-the-moment comments.

In-the-Moment Commenting for mABC

Consistent with their role in ABC, in-the-moment comments are believed to be an important mechanism of parenting behavior change in mABC, drawing parents' attention to opportunities to engage in parenting targets and praising their efforts to do so. For the first several sessions, in-the-moment comments are exclusively positive, with the goal of cultivating a supportive and trusting relationship between the mother and parent coach. Parent coaches may "spotlight" positive aspects of problematic interactions in order to provide ample positive feedback while shaping mothers' behavior in the direction of parenting targets. When mothers follow their child's lead or behave in nurturing ways, parent coaches make in-the-moment comments containing at least one of the following components: (a) a specific behavior description (e.g., "She made a surprised face, and you made a face right back"), (b) the name of the relevant intervention target ("What a good example of following her lead!"), and (c) an associated developmental outcome ("You are helping her learn she has an effect on the world"). This timely feedback provides parents with concrete instantiations of the intervention targets discussed in session and emphasizes the importance of the behaviors for child outcomes. Through the parent coach commenting upon such behaviors at least once per minute, parents receive feedback on their intervention-relevant behaviors at least 60 times in an hour session.

As the intervention progresses, parent coaches introduce advanced comments designed to redirect problematic behaviors. Parent coaches may scaffold engagement in parenting targets by providing suggestions and gentle corrections. Toward the end of the intervention, parent coaches may encourage mothers to reflect on their behavior by asking, "What could you do to nurture right now?" or "Are you following or leading?" Consistent with procedures developed for standard ABC, the frequency and quality of parent coaches' comments are assessed using a 5-mins self-coding procedure reviewed during in-the-moment supervision.

Modifications to in-the-moment commenting procedures were developed to address the challenges of maintaining an

adequate commenting rate when intervening with mothers of newborns. Frequent and unpredictable napping make it difficult to schedule sessions when a young infant is likely to be awake, and very young infants show fewer spontaneous behaviors, limiting opportunities to follow their leads. To ensure that mothers receive frequent positive feedback during early sessions, two categories of in-the-moment comments were added to mABC. "Pre-following" comments acknowledge approximations of following the lead behaviors in the absence of clear infant cues. For example, a parent coach may praise a mother for periodically looking down at her baby during conversation, reciprocating eye contact, and/or talking to the baby about what is happening around them. For example, a parent coach might say, "Even while you and I are talking, you keep checking in to see if he is awake and interested. You are so tuned in to his cues!" Similarly, "pre-nurturance" comments highlight approximations of nurturance—that is, gentle physical comfort in the absence of infant distress. For example, a parent coach might say, "You are rocking her so gently in your arms while she sleeps."

As infants get older, their daytime sleep consolidates, and it becomes easier to schedule sessions when they are alert. At the same time, they begin to show more spontaneous behaviors, such as vocalizing and reaching, which serve as opportunities for following the lead. As this transition occurs, parent coaches make fewer "pre-following" and "pre-nurturance" comments, focusing as much as possible on the ABC parenting targets of nurturance, sensitivity, and delight. Parent coaches help mothers navigate the transition to more complex ways of following as infants progress developmentally: a parent might follow a 1-month old's lead by talking about what she is looking at, follow a 3-month old's lead by handing him the toy he is reaching for, and follow a 5-month old's lead by imitating her shaking a rattle.

Session-by-Session Summary of mABC

The sequence of mABC sessions is intended to match the infant's developmental progress and the mother's level of receptivity (**Table 3**). Sessions that are more likely to elicit resistance are reserved for later in the intervention, when the relationship with the parent coach is well-established. If resistance does arise, parent coaches are encouraged to validate the mother's perspective, avoiding direct confrontation or minimization of the mother's beliefs. As the therapeutic relationship develops, parent coaches gently challenge developmentally inappropriate expectations and help each mother take her child's perspective. Hesitant mothers are encouraged to experiment by trying out parenting targets and seeing how their child responds. This experimentation is reinforced by frequent in-the-moment comments that praise the mother's efforts and draw attention to positive effects.

The prenatal session (m1) introduces parents to the importance of nurturing their baby. Mothers are asked to reflect on how it may feel to provide comfort to a baby who is easy vs. difficult to soothe. Feelings of helplessness and frustration are normalized, and mothers are encouraged to persist in providing comfort even when their infants are unable to settle. Parent coaches ask mothers to practice providing nurturance by caring for an infant simulator (or, more simply, any doll or

stuffed animal) while an audio track of infant crying is played. Although some parents may find this experience unusual, it provides hands-on practice with concrete nurturance behaviors and with the format of future mABC sessions, which include ample opportunities for in-the-moment commenting on parent–child interactions. Parent coaches provide frequent positive feedback throughout the nurturance activity, with the goal of helping mothers feel accepted, supported, and motivated for the parent coach to return. Finally, mothers are introduced to infants' engagement and disengagement cues, with the goal of helping them avoid overstimulating their vulnerable infants. They practice recognizing these cues in videos and photographs and reflect on how they may feel when their infants communicate a need to disengage.

The early postnatal session (m2) occurs as soon as possible after the infant's birth and often takes place in the hospital. This session is more flexible than most and is intended to help the parent coach connect with the mother and her infant during a potentially vulnerable time. The parent coach reinforces content introduced at the prenatal session while commenting as much as possible on the mother's observed interactions with her infant. Mothers are asked to describe a time they tried to comfort their baby and are praised for their efforts to nurture their infant, whether or not the infant was easily soothed. Mothers are also asked whether they have observed any times that their baby became overstimulated or signaled a need to disengage. The parent coach reinforces the importance of attending to infants' cues and lays the foundation for later discussion of following the child's lead by encouraging responsive interactions when the infant gives cues for engagement.

In some cases, families are unable to start the intervention prenatally—perhaps because they were not referred for services until after the infant was born, or because they gave birth before a planned prenatal session could occur. The latter scenario is not uncommon given elevated rates of preterm birth among mothers in treatment for opioid dependence (Stover and Davis, 2015). In these cases, the early postnatal session marks the parent's introduction to mABC. The parent coach should seek to communicate novel intervention content clearly without overwhelming the mother during a potentially challenging time. The primary focus should be on building a positive relationship and motivating the mother to engage in treatment. This is accomplished primarily through frequent in-the-moment comments, which have the added benefit of reinforcing session content without lengthy discussion or video review.

Following the early postnatal session, mABC continues with session content from standard ABC. Sessions one and two reinforce the importance of nurturing children when they are frightened or distressed. In session one, mothers are asked to reflect on common beliefs about parenting—for example, the idea that babies become spoiled if parents pick them up when they cry. Parent coaches validate mothers' perspectives while presenting research evidence that challenges these ideas. For example, mothers learn that babies whose parents respond quickly to their distress tend to cry less later in infancy (Bell and Ainsworth, 1972). Nurturance is described as a powerful way to build infants' trust and security in the parent–child relationship.

TABLE 3 | Overview of mABC topic area by session.

Session Sequence	Topic Area	Session goals
Session m1	Providing nurturance and recognizing cues	Prenatal session: introduce mABC; emphasize the value of providing nurturance; discuss infant engagement and disengagement cues
Session m2	Providing nurturance and avoiding overstimulating behaviors	Early postnatal session: celebrate baby's birth; encourage persistence in nurturance; lay the foundation for sensitive responding to infant cues
Session 1	Providing nurturance	Reinforce the importance of nurturing the baby when distressed, even when difficult to soothe
Session 2	Providing nurturance when children do not elicit it	Encourage nurturance even when children do not provide clear cues that they need comfort
Session 3	Following the child's lead with delight (part 1)	Help the mother follow the child's lead and show delight during interactions, even when tempted to teach or set unnecessary limits
Session 4	Following the child's lead with delight (part 2)	Scaffold practice of following the lead with delight
Session 5	Attending to the child's signals and avoiding intrusive behavior	Help the mother resist the urge to engage in intrusive behavior
Session 6	Reducing frightening behavior	Discuss the drawbacks of parenting in ways that may be frightening; help parents develop alternative ways of interacting
Session 7	Recognizing voices from the past	Help the mother identify automatic ways of responding that make it difficult to provide sensitive, nurturing care
Session 8	Providing sensitive care even when you hear voices from the past	Develop strategies to "override" automatic responses in order to parent in sensitive, nurturing ways, even when it does not come naturally
Session 9	Consolidating gains	Review progress, practice behaviors still in need of improvement
Session 10	Consolidating and celebrating change	Consolidate gains, celebrate progress, and anticipate challenges ahead

Parent coaches also help mothers recognize times that children's behavior make it challenging to provide nurturance. Mothers are shown video clips in which children do not clearly signal their need for comfort—infants turn away from their parent, appearing not to need them, or fuss and push them away. Mothers learn how this behavior may elicit "in-kind" responses: parents may be tempted to turn away from infants who appear not to need them (Stovall-McClough and Dozier, 2004). Parent coaches acknowledge how confusing these unclear signals can be and emphasize children's ongoing need for nurturance, even when their behavior does not elicit it. Mothers are praised for all their efforts to comfort their infants, especially when they do not directly seek nurturance or settle easily when soothed.

Sessions three and four focus on responding sensitively when the child is not distressed by following his or her lead with delight. This type of responsive interaction, which was introduced briefly in the first postnatal session, is described as a powerful way to help children learn to regulate their behavior and develop a sense of personal mastery. Mothers are shown video clips of parents following their children's lead by narrating, imitating, and/or physically assisting their play, as well as counterexamples of parents taking the lead by teaching, correcting, and setting unnecessary limits. Sessions include hands-on activities that give mothers' practice following their children's lead, even under circumstances that often tempt parents to take charge (e.g., by insisting the infant hold a baby book correctly or not allowing splashing during water play). Activities were adapted from those included in ABC to be appropriate for younger infants and include adaptations for developmental level. For example, in session four of mABC, parents are coached to follow their child's lead while exploring a play mat or engaging in water play.

Session five builds on the importance of following the child's lead to address intrusive parenting. Mothers are asked to reflect on their own childhood experiences with intrusive behavior, such as roughhousing and tickling. Parent coaches help mothers to take the perspective of their infants, who may feel overwhelmed and dysregulated despite appearing to enjoy intrusive play. Video examples are shown of parents playing with puppets in ways that are dysregulating to their infants, as well as in ways that are responsive to infant cues. Mothers are asked to play with their own children using puppets, stuffed animals, or other toys that can easily become overwhelming. Parent coaches use in-the-moment comments to support mothers in following their children's lead despite the potential to engage in intrusive behavior.

Session six extends insights from the previous session to address frightening behavior. Mothers are asked to recall experiences from childhood when they may have been frightened by caregivers and to reflect on how those experiences affected them. Parent coaches gently challenge responses that downplay or endorse frightening experiences, providing research evidence that harsh discipline tends to elicit more rather than fewer behavior problems in children over time (e.g., Lansford et al., 2005). Mothers are asked to consider times they may have frightened their own children (perhaps without meaning to) and to identify strategies that could help them avoid frightening behavior in the future. If parent coaches have observed frightening behavior during prior sessions, those observations may be discussed and/or illustrated with video examples. To avoid shaming mothers, coaches should take care to normalize parental frustration and provide ample counterexamples of times that they did not behave in frightening ways. Mothers are encouraged to minimize frightening behavior as much as possible

in order to avoid sending mixed messages about the safety of the parent–child relationship, which would undermine their progress in providing nurturance and following their children's lead.

Sessions seven and eight address automatic ways of responding that arise from mothers' past experiences and challenge their current parenting. Parent coaches prepare for these sessions by identifying the parenting target the mother struggles with most. The parent coach presents a video clip of the mother showing strength in that domain, followed by a video clip illustrating a weakness. The parent coach helps the mother to reflect on past experiences, especially their childhood experiences with caregivers, that may contribute to their current difficulty. For example, a mother whose own parents responded dismissively to her childhood distress may struggle to provide nurturance to her infant. The mother's automatic style of responding is discussed in terms of "voices from the past"—for example, the mother who downplays her child's distress may be echoing her own mother's voice saying, "Get up, you're not a baby." "Voices from the past" are described as a universal experience, and the ability to recognize one's "voices" is framed as a strength, enabling parents to make their own decisions about how to respond to their children in the present. Mothers are encouraged to identify strategies to help them "override" voices from the past, bypassing their automatic responses in order to parent in sensitive, nurturing ways.

As might be expected, sessions seven and eight often involve emotionally vulnerable discussions about the mother's caregiving history. In such cases, the parent coach must take care to respond supportively to the mother's disclosures while remaining attentive to parent–child interactions in the present moment. The primary focus remains on identifying and overriding "voices from the past" that interfere with parenting in the present, rather than processing potentially traumatic childhood experiences. Skillful in-the-moment commenting can help mothers continue to parent sensitively even while discussing painful "voices from the past."

Finally, sessions nine and ten help mothers to consolidate gains from previous sessions. Parent coaches select activities that will help mothers celebrate progress while practicing skills that remain problematic. Mothers are asked to reflect on what they have learned and anticipate how they will apply mABC parenting targets as their children grow older. In the final session, parent coaches share video clips that illustrate mothers' progress over the course of the intervention. Mothers are given video montages highlighting moments from earlier sessions in which they engaged in the targeted parenting behaviors of nurturance, following the lead, and delight. Jointly viewing the montage provides a powerful opportunity to celebrate change and reinforce parenting targets that mothers can apply in the months and years to come.

Putting mABC Into Practice

mABC is currently being evaluated through a RCT based at the University of Delaware, enrolling pregnant and recently postpartum mothers on medication-assisted treatment for opioid dependence. Although robust effectiveness data for mABC will not be available until the RCT concludes, clinicians serving peripartum mothers with opioid use disorder have identified an urgent need for appropriate parenting services. To address this need while contributing to mABC's developing evidence base, community partners in Maine and a growing number of other dissemination sites have begun to implement mABC and evaluate its effectiveness using a pre-post design. mABC is being implemented in Maine through a hospital-based healthcare system at MaineGeneral Medical Center, with frequent supervision and consultation provided by the University of Delaware. Funding from the John T. Gorman Foundation supported the training and time of two local parent coaches, who recruited mothers dependent on opioids through family practice obstetrics offices. The parent coaches in Maine—the first to train in mABC outside of the RCT—have been crucial in further refining communication strategies with mothers in the perinatal period, identifying challenges in recruitment and retention, and creating supervision and dissemination tools for pre-nurturance and pre-following comments. mABC is currently being implemented in multiple states and settings, with early fidelity and parental sensitivity data supporting community effectiveness.

Because of the unexpected challenges of a global pandemic, mABC is being delivered through telehealth in addition to home visiting. Transitioning mABC to telehealth has felt remarkably successful. To date, most mothers have had access to Internet-connected devices (primarily smartphones, but also computers and tablets), which are used to videoconference with their parent coaches. In the RCT, a minority of mothers have needed assistance obtaining appropriate devices. The research team has purchased two WiFi-enabled tablets and two smartphones with prepaid data plans for participating mothers to use during telehealth sessions; these devices cost approximately $50 each, and the data plans cost $35–$45 monthly for the duration of the intervention. Mothers are also supplied with inexpensive phone stands that allow them to prop up phones or tablets during sessions. They are encouraged to set up their devices so both they and their children are visible on screen, facilitating in-the-moment commenting. Given that parent coaches' in-the-moment comments are key to intervention fidelity and to effectively engaging the intervention mechanism of parental sensitivity, making such comments was critical to success. We have found through data collected in our dissemination sites that parent coaches maintain high rates of in-the-moment comments when implementing ABC through telehealth (Roben et al., 2021).

MABC CASE EXAMPLES

Emily

Emily was a 35-year-old single mother pregnant for the fifth time when she enrolled in mABC. Her two oldest children had been born while she was in the midst of active addiction to prescription opioids and her parental rights with these children had been terminated. Emily then enrolled in a methadone maintenance program and began abstaining from illicit opioid use. When she enrolled in mABC, Emily had been taking methadone for 3 years, during which time she had given birth to Ben (age two) and Grace (age one). She had not intended to become

pregnant again so quickly and felt overwhelmed at the prospect of having 3 children under 3 years. Familiar with reporting rules from previous pregnancies, Emily was anxious about coming to the attention of CPS if her baby tested positive for methadone at birth.

At the prenatal session, Emily appeared insecure in her parenting. She seemed anxious to impress the parent coach, encouraging her son to show off his counting skills, repeatedly correcting his play ("No, not like that, you know how to hold the book!"). Emily apologized to the parent coach when her daughter cried ("I don't why she's so fussy, she's never like this! She only ever cries when she's hungry!") before shushing her and trying to distract her with a bottle of juice. The parent coach capitalized on a brief moment of nurturance, when Grace rested her head on her mother's lap and Emily briefly touched her back. "Look at that—even more than the juice, your gentle touch is helping her feel better! That is exactly what we're going to talk about today— how important it is to show your children nurturance when they are upset." Emily lit up. When the parent coach encouraged her to practice soothing the infant simulator, Emily pulled Grace close with one arm while she rocked the doll in the other. The parent coach praised her for gently "comforting" the crying infant simulator and added a pre-nurturing comment about Grace: "Great job sticking with it—you just kept rocking the baby even she didn't settle right away. And at the same time, you cuddled Grace close you—I can tell, being next to mom is her favorite place in the world!"

When her new baby Evie was born, Emily invited the parent coach to meet them at the hospital. She whispered to the parent coach that hospital staff had alerted CPS when the infant tested positive for both methadone and marijuana. She would be permitted to take the baby home from the hospital if she followed a plan of safe care developed with a CPS caseworker and remained consistent with substance use treatment. During the postnatal session, Emily nervously deferred to the NICU nurses, especially after one criticized her for letting Evie fall asleep before she finished her bottle. Emily was hesitant to pick Evie up after feeding, not wanting to disrupt the tangle of monitor wires. With the encouragement of the parent coach, however, she picked Evie up when she fussed and rocked her gently in her arms. The parent coach praised Emily for giving Evie the nurturance she needed from her mother, even while her medical needs were met by hospital staff. Emily gazed down at her baby proudly.

Evie was hospitalized for the next 6 weeks while she was treated for opioid withdrawal. Emily felt worried and guilty. Her older children, although also exposed to methadone, had less severe symptoms of NOWS than Evie and were home within 2 weeks. During the hospitalization, Emily struggled to balance Evie's needs with the needs of her young children at home. The parent coach checked in supportively by phone, reminding Emily that even though she could not be with all her children all the time, she was letting them know she was there for them every time she comforted them.

When Evie was discharged, mABC sessions resumed at home with all three children present. Emily responded well to in-the-moment comments focused on following her children's lead and showing delight. She became less inclined to correct and

teach, instead narrating her children's play and imitating Evie's cooing and babbling. Encouraged by pre-following comments, she moved toys closer to Evie's reach, rather than putting them directly in Evie's fist. Despite her initial progress, Emily continued to struggle with nurturance. Evie had more difficulty soothing than her older siblings had, which Emily attributed to her more severe NOWS symptoms. "I just feel like the worst mom, because it's my fault," she told her parent coach. Overwhelmed by Evie's crying, Emily would go down a list of potential problems to fix— offering a bottle, giving baby Tylenol, changing and re-changing her diaper. With the older children, Emily was more irritable, tersely telling them to stop crying— "I just fed you, you're okay." With scaffolding from her parent coach, Emily was able to show nurturance, but providing comfort was rarely her first reaction.

During session seven, the parent coach showed Emily video clips of times that she offered nurturance right away, as well as times that she was slow to comfort, focusing instead on problem-solving. She drew Emily's attention to Evie turning around to reach for her mother while Emily distractedly hunted for a pacifier, missing her baby's bid for physical comfort. With her parent coach's help, Emily identified the automatic thought, "My children need something else—I am not enough." She connected this thought to feelings of shame about her opioid use: Emily blamed herself for their symptoms of NOWS, a message that was reinforced by family members who saw her as a drug addict and judged her parenting. With her parent coach's help, Emily began the process of "overriding" this automatic thought, telling herself, "I know my children need me." For the remaining sessions, Emily worked with her parent coach on "nurturing first" —picking up her children and asking them gently if they were okay before offering other solutions. She was astonished how often they settled without needing anything more.

Monique

Monique was 8 months pregnant with her second child when she enrolled in mABC. She lived with her older sister Frances, who had legal custody of Monique's 3-year-old daughter Amaya due to ongoing concerns about parental substance use. Monique had been actively using heroin when she discovered she was pregnant again at 4 months' gestation. At Frances's encouragement, she sought out medication-assisted treatment and temporarily moved into a sober living home, where the prenatal session took place. As the session began, Monique appeared skeptical and closed off, responding monosyllabically as the parent coach sought to engage her in conversation about comforting an infant who is difficult to soothe. When encouraged to practice nurturance with the infant simulator, Monique was initially awkward, stiffly holding the doll on her lap. As the parent coach praised her efforts with a series of in-the-moment comments, Monique appeared to soften, smiling and gently jiggling the baby in her arms. She shifted the infant simulator to a more comfortable position against her chest, commenting, "This is how my daughter always liked to be held." The parent coach praised her, "You play such an important role in helping Amaya settle down when she's upset. You'll do the same thing for your new baby, just like you are doing with this pretend one! He's crying and crying, and you just keep gently rocking him, smoothly

moving him to a more comfortable position. That's really going to let him know you're there for him - you can stick with it when he is upset."

Monique gave birth to baby Elijah a few weeks later. After being treated briefly for mild NOWS, he was discharged home. Because children were not allowed in the sober living facility, Monique and Elijah moved back in with Frances and Amaya, and mABC sessions resumed in the home. Frances declined the parent coach's invitation to join the intervention but was often present for several minutes at the beginning or end of sessions. During the first few sessions, Monique appeared exhausted and emotionally flat, rarely smiling or interacting spontaneously with baby Elijah, who lay listlessly on her lap. She was visibly overwhelmed by Amaya, an energetic child who became easily dysregulated when her mother's attention was focused elsewhere. During the first session, Amaya picked up her aunt's embroidered cushions and threw them across the room. Monique grabbed her arms roughly and yelled sharply at her— "You know auntie don't let you touch those!" Amaya yelled and kicked, tears welling up in her eyes. The parent coach commented, "This is really challenging—you know Amaya is upset but it's so hard to provide comfort when she's pushing you away." When Amaya had an outburst several minutes later, Monique sighed deeply. The parent coach said gently, "It would be so easy to yell at a time like this, but you're working really hard to stay calm." Monique looked at the parent coach gratefully and replied, "I'm so tired. Elijah barely slept at all last night." The parent coach built on this moment of connection using a pre-nurturance comment: "That makes staying calm even more impressive. And even though you're totally exhausted, you're holding Elijah so gently in your arms—look how comfortable he looks nestled against you!" Monique looked down at Elijah with a hint of a smile. The parent coach immediately commented on this flicker of delight, "Aww, look at you smiling down at him. That's going to let him know how much you love and enjoy him."

The next few sessions proceeded in a similar way. When the parent coach arrived, Elijah was often lying passively in his car seat. With encouragement, Monique would pick him up and hold him, but she often appeared preoccupied with Amaya's behavior. When Amaya became upset and acted out, Monique responded with frustration that bordered on being frightening. The parent coach framed these difficult moments as examples of "unclear cues" —when a child needs comfort but has difficulty seeking it directly. Monique's sister Frances, passing through the living room, expressed skepticism: "Amaya knows exactly what's she's doing." The parent coach did not directly confront this resistance, responding, "It can be hard to tell! And sometimes what they need most is just to know that a parent is there for them when they're upset. I know it's so challenging, but what if you experimented with offering comfort when Amaya seems frustrated?" Frances snorted but Monique agreed to try.

Monique's initial efforts were awkward and stilted, but she persisted with encouragement from her parent coach. Gradually the tone of her responses to her children changed. Monique became far more likely to respond with physical comfort, rubbing Amaya's back or picking her up when she started to cry and yell. Instead of acting out, Amaya began to seek out comfort by climbing on Monique's lap and cuddling with her mother and brother. The parent coach took care to praise Monique's parenting of both children: "Look at that, you were holding Elijah and Amaya wanted to join in. Now you're holding them both at the same time—it's not easy to meet everyone's needs at once, but you're doing it!"

After the introduction of following the lead, Monique became more animated and interactive with both children. She had a strong tendency to take the lead during play—for example, shaking Elijah's arm while he held a rattle, and instructing Amaya how to build with blocks. With scaffolding from her parent coach, Monique was able to observe that behaving intrusively upset Elijah and worsened Amaya's behavior. Over time, she adjusted her approach. She began following their leads—saying "yum, yum, yum" when Elijah put toys in his mouth and joining in when Amaya sang Baby Shark. As their interactions became easier, Monique smiled and laughed more readily, showing her children she delighted in them. She looked like a different person from the exhausted, frustrated parent at the first postnatal session.

Frightening behavior still emerged from time to time, usually directed at Amaya. Monique was able to see that yelling and threatening escalated tense interactions with Amaya and caused Elijah to startle. While discussing voices from the past, Monique recalled that her mother pushed her to be "tough," often yelling at Monique to stop crying and spanking to enforce rules. Monique described becoming less open, hiding her feelings and concealing problems from her mother so she wouldn't get in trouble. Monique realized that she did not want the same thing for her own children—she wanted them to feel safe and secure in her love for them. Remembering her own early entry into substance use, Monique said she wanted her children to feel comfortable coming to her with problems so she could help. The parent coach praised these insights and highlighted Monique's progress: "You've been working so hard to show them you're always there for them when they're upset. You want them to know you're always a safe person to come to." Monique agreed that she did not want frightening behavior to send a mixed message to her children and committed to working on overriding her frustration by saying "I want my kids to know they're safe and loved." Monique continued to make progress and consolidate gains during her final few sessions. Although at times she was slightly intrusive or spoke with annoyance, she worked hard to stay calm, offer comfort, and follow her children's lead. Monique became emotional watching the video montage presented in the final session. Turning to the parent coach, she said, "I don't always feel like I do enough as a mom. This makes me feel like enough."

CONCLUSION

Modified Attachment and Biobehavioral Catch-Up, or mABC, was designed to address limitations in prior intervention research and meet the needs of mothers and infants affected by prenatal opioid exposure. mABC is adapted from Attachment and Biobehavioral Catch-Up, a home-visiting intervention shown to enhance parenting sensitivity, parent–child attachment,

and children's self-regulation among families of infants and toddlers affected by early adversity. As such, mABC has a strong theoretical and empirical foundation. Consistent with the original intervention, mABC targets areas of potential vulnerability for mothers with opioid use disorder—namely, nurturing an infant who is difficult to soothe, responding sensitively by following the child's lead with delight, and avoiding intrusive or frightening behavior. As with ABC, mABC is targeted in focus, tailored to the individual, and supportive in tone. To address the specific needs of peripartum mothers with opioid use disorders, mABC is designed to begin prenatally or shortly after birth, with an expanded emphasis on soothing a fussy newborn and avoiding overstimulation. This adapted intervention is currently being implemented in the context of a university RCT and community practice. Flexible implementation via telehealth amid the COVID-19 pandemic represents an additional strength of this approach.

Because research is ongoing, there is not yet published data directly supporting the effectiveness of mABC, which is a limitation of this review. Important future directions include establishing evidence of the efficacy and effectiveness of mABC in both university and community settings. We anticipate direct effects of mABC on parenting sensitivity, with downstream benefits for children's self-regulation at both biological and behavioral levels. Once such evidence has been established, future research may fruitfully evaluate the impact of delivery method (i.e., in-person vs. telehealth vs. hybrid delivery) and identify moderators of treatment effectiveness in order to tailor therapeutic approach for the needs of individual families. Additionally, mABC may be tested among other populations at risk for early parenting difficulties and child dysregulation. For example, families affected by perinatal depression, parental emotion dysregulation, and/or premature birth may benefit from

mABC's focus on sensitive parenting during early infancy in the context of risks to healthy self-regulatory development.

Much more research is needed to inform and evaluate parenting interventions designed for families affected by prenatal opioid exposure. Drawing from decades of research demonstrating the effectiveness of Attachment and Biobehavioral Catch-up, modified ABC shows strong promise for enhancing parenting sensitivity and children's self-regulation in families affected by maternal opioid use.

AUTHOR CONTRIBUTIONS

MD developed the mABC intervention in collaboration with RE and CR. All authors contributed to the conception of the manuscript. ML wrote the first draft of the manuscript. All authors contributed to manuscript revision and approved the submitted version.

FUNDING

ACKNOWLEDGMENTS

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The Value of Mechanistic Experiments to Target the Shared Neural Circuitry of Parenting and Addiction: The Potential for Video Feedback Interventions

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Certain neural processes that underlie addiction are also central to parenting, notably stress and reward. Parenting interventions that incorporate the unique context of caregivers with addiction have demonstrated some success: However, real-world implementation of evidence-based interventions can be difficult with this population. Video feedback interventions are an especially promising approach to reach parents who experience barriers to participation, particularly caregivers with addiction. A translational neuroscientific approach to elucidating the mechanisms of change in these interventions will aid the delivery and success of this method and advance theory surrounding parenting in the context of addiction. Along these lines, we provide an example of one video feedback intervention, Filming Interactions to Nurture Development, that will serve as such a mechanistic experiment.

Keywords: parenting, addiction, translational neuroscience, intervention, mechanisms of change

INTRODUCTION

Caregivers of young children constitute a notable proportion of the population of individuals with substance use disorders. Increasing rates of substance use, particularly opioid use, in this subgroup reflect an already-emergent public health concern (Terplan, 2020; Goetz et al., 2021; National Institute on Drug Abuse, 2021) that has been amplified by the impact of the COVID-19 pandemic (Mota, 2020; Ornell et al., 2020; Rogers et al., 2020; Sun et al., 2020). The negative intergenerational consequences of substance use problems are well documented, reflected by an increased vulnerability to addiction and psychopathology (Merikangas et al., 1998; Clark et al., 2004; Knight et al., 2014). Concomitant consequences for offspring of caregivers with substance use disorders are evident throughout development; during childhood, this may include difficulties with temperament, attachment, aggression, cognition, and speech and language (Shulman et al., 2000; Barnard and McKeganey, 2004).

The significance of these consequences has fueled research examining the intersectionality of substance use and parenting (Niccols et al., 2012; Moreland and McRae-Clark, 2018). Parental involvement is hypothesized to be the primary route through which addiction impacts parenting and subsequent parent and child wellbeing (Suchman and Luthar, 2000). Intrusive or disengaged

parenting styles often co-occur with substance use problems (Burns et al., 1997; Hans et al., 1999; Jacques et al., 2020), and the extremes of these styles result in child maltreatment which is associated with caregiver substance use (Freisthler and Kepple, 2019). Recently, a greater focus on how parenting might impact addiction suggests that parenting itself confers a unique form of stress that may increase risk of substance use (Rutherford and Mayes, 2019).

Understanding the mechanisms underlying the interaction between parenting and addiction provides useful knowledge for identifying intervention targets that promote healthy parent and child outcomes. Although those mechanisms can be studied at multiple levels (e.g., cognitive or behavioral), investigating the neurobiological correlates of parenting processes that mediate responsive caregiving in the context of addiction draws upon the wealth of knowledge provided in these separate literatures (i.e., neurobiology of parenting and neurobiology of addiction; Rutherford et al., 2020). Notably, and with some important exceptions that we describe below, there is limited extant research in this area.

In this paper, we provide rationale for applying a translational neuroscientific approach to intervention research aimed at helping parents struggling with addiction. Translational neuroscience necessitates a conceptual model of disorder that identifies specific processes supported by neurobiological systems with respect to any relevant moderators (Fisher and Berkman, 2015). Interventions can engage these systems to promote desired outcomes. This approach has the potential to increase the specificity or direction of proposed intervention targets, elucidate individual differences in intervention response at the neurobiological level, and lead to the application of precision interventions based on biobehavioral markers. Parents with addiction remain a particularly difficult population to engage in parenting interventions. Our goal is to draw upon the growing knowledge of the shared neural circuitry of parenting and addiction to advance these efforts. To explicate our perspective, we discuss a neurobiological mechanistic experiment with the potential to address barriers to engagement with opioid-using mothers.

Neural Intersection of Parenting and Addiction

Certain cognitive and affective processes, such as those related to stress and reward, are central in both addiction and parenting. For example, in the context of addiction, non-medically used psychoactive substances (hereafter referred to as drugs) elicit reward responses, and stress often precedes subsequent use (Sinha et al., 2005). In the context of parenting, children elicit reward responses in caregivers (Ferrey et al., 2016), and parenting stress influences family interactions and function (Deater-Deckard, 1998).

Activation of stress and reward neural circuitry across these contexts plausibly induces a mutually informed interaction wherein system responses in one context impact the response in another (Rutherford et al., 2011). Although the overlapping neurobiology of these two contexts has not yet been widely studied, researchers have investigated neural changes in these contexts separately. During the development of drug dependence, neural reward systems are highly activated in response to drug use, and this positive reinforcement maintains drug-seeking behavior (Koob and Volkow, 2010). As addiction becomes reinforced primarily through withdrawal and anticipation, stress-related neural systems generate negative reinforcement when a substance provides relief.

The dysregulation of these stress and reward systems associated with addiction must be considered alongside the neuroendocrine changes elicited by the onset of parenthood. Research on the maternal brain suggests that rising levels of hormones (e.g., oxytocin and cortisol) correspond with stress and reward circuit activation central to sensitive caregiving (Atzil et al., 2011; Swain et al., 2019). This circuitry, which includes subcortical (amygdala, insula, and ventral striatum) and cortical (anterior cingulate cortex, prefrontal cortex, and precuneus) regions, supports emotion regulation and executive function (Swain and Ho, 2017). Many of these regions overlap with those impaired in addiction, indicating that regional disruption can echo throughout connected circuits (Rutherford et al., 2011).

In addition to the impact of general addiction processes, the type of drug used can impart unique physiological changes. While there is little research on the effect of extended opioid use on parental brain circuitry, the role of endogenous opioids in maternal stress and emotion regulation and reward processing highlights the importance of investigating that effect (Benarroch, 2012; Swain et al., 2019).

As shown in **Figure 1** (adapted from Rutherford et al., 2011), we highlight a "reciprocal influence model" characterizing the bidirectional effects of parenting and addiction. Reward system dysregulation may decrease saliency of social or relational
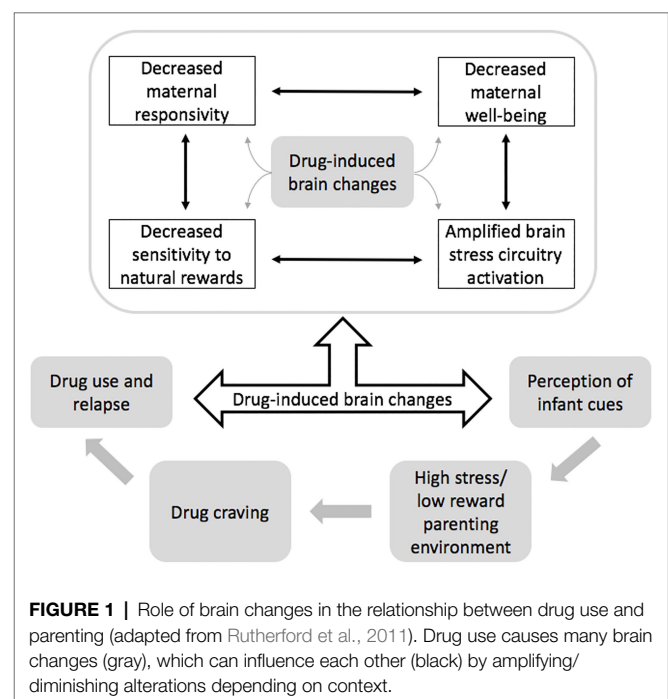

FIGURE 1 | Role of brain changes in the relationship between drug use and parenting (adapted from Rutherford et al., 2011). Drug use causes many brain changes (gray), which can influence each other (black) by amplifying/diminishing alterations depending on context.

rewards that are pervasive in parenting and underlie secure parent-infant attachment. Additionally, stress and emotion dysregulation in caregiving roles could intensify craving and drug-seeking behaviors. Parents with addiction might find caring for infants less rewarding and more stressful than parents without addiction, creating a cycle that maintains substance use.

A reward-stress dysregulation model of addiction and parenting proposed by Rutherford and Mayes (2017) incorporates these dynamic neural interactions. Implicated brain regions include the prefrontal cortex, ventral tegmental area, and nucleus accumbens within reward circuitry and the hypothalamic-pituitary-adrenal axis and extended amygdala within stress circuitry (Rutherford et al., 2011). Studies examining parental reactions to infant cues provide evidence for this model. Altered neural activity in response to infant stimuli suggests that positively valenced infant cues may be less salient and negatively valenced cues may be more stressful for parents with addiction, corroborating observations of parental disengagement (Landi et al., 2011; Kim et al., 2017; Rutherford et al., 2017, 2020).

Interventions at the Intersection of Responsive Caregiving and Addiction Treatment

Instances of household instability and child neglect along with co-occurring mental health difficulties underscore the need for effective interventions for parents with addiction (Barnard and McKeganey, 2004; Barlow et al., 2019). Despite the significant social costs of this problem, complications to intervening within this population persist (Daley, 2013). These stem from additional comorbidities and social problems including time constraints, affordability, transportation difficulties, mistrust in clinicians, fear of losing children, and shame (Acevedo et al., 2012; Guerrero et al., 2015; Matsuzaka and Knapp, 2020).

Although dual treatment for substance use and parenting results in improvements in both domains (Neger and Prinz, 2015), directing substance-using caregivers to optimal interventions remains difficult. Different interventions target multiple and varying mechanisms of change, and effectiveness may depend on parenting stage or the substance of abuse (Neger and Prinz, 2015; Cioffi et al., 2019). Rigorous randomized clinical trials can help determine the influence of specific hypothesized mechanisms on outcomes, thereby establishing causal evidence which allows the identification of effective strategies to improve outcomes and advances theory.

Many interventions for parents with substance use disorders are based on attachment and relational theories, integrating varying aspects of caregiver responsivity, mentalization, emotion and stress regulation, and mindfulness to improve parent and child outcomes. Examples include Relational Psychotherapy Mothers' Group (Luthar and Suchman, 2000), Practicing Safety Mindfulness Project for Mothers in Drug Treatment (Short et al., 2017), Mothers and Toddler Program (MTP; Suchman et al., 2010), Parenting under Pressure (PuP; Barlow et al., 2013), Attachment and Biobehavioral Catch-Up (ABC; Berlin et al., 2014), and a modified ABC (mABC) specifically for mothers using opioids (Labella et al., 2021). One promising

component of many of these interventions is the inclusion of video feedback, where clinicians or instructors provide mothers feedback about their interactions with their child, based on recorded interactions.

Video Feedback Design

Video feedback has been employed in parenting interventions where caregiver-child interactions are filmed. Videos are useful for capturing the reciprocal influence parents and children exert on each other. Trained therapists use recordings to replay and personalize feedback to parents. This method allows researchers to highlight parenting skills in a naturalistic environment, often in participants' homes. Although the specificity of this intervention approach varies, many video feedback interventions aim to encourage supportive interactions between parents and their children. A review of 29 experimental studies revealed that video feedback interventions successfully resulted in a change of maternal sensitivity and more positive parent and child behaviors (Balldin et al., 2018).

Given the disruption of maternal sensitivity in many parents with addiction, this style of intervention might be especially well suited for substance-using parents. However, the true measure of intervention effectiveness does not end within a research context but extends to the feasibility of disseminating and evaluating that intervention in community settings for those who could benefit most. Barriers to accessing treatment are a primary concern for parents with addiction and often have roots in systemic inequalities and racism prevalent in society (Acevedo et al., 2012; Guerrero et al., 2015; Matsuzaka and Knapp, 2020). The natural environment context of these parenting interventions provides an avenue to partially address inequity by increasing availability to caregivers. Furthermore, the salient personalized stimuli present in video feedback could both increase participant interest and facilitate the transition from in-session learning to home integration. Still, the relative utility of video feedback in comparison with other interventions in real-world settings remains an open subject that necessitates the scrutiny of future research.

Research on video feedback interventions containing proposed mechanisms of change helps discern employable components to further explore and integrate into interventions for caregivers with substance use disorders. Although there is overlap among hypothesized mechanisms, distinct interventions have not targeted mechanisms uniformly. A cursory comparison of different video feedback interventions illustrates this. PuP uses psychoeducation and mindfulness skill building to target the proposed mechanisms of change: parental emotion regulation, representation quality, and mentalization about own and child's emotions (Dawe and Harnett, 2007; Barlow et al., 2019). Similarly, MTP hypothesizes that changes in maternal mentalization, representations of one's child, and the therapeutic alliance lead to positive outcomes (Suchman et al., 2010, 2011, 2012). Mechanisms in ABC and mABC include changing nurturing behaviors during child distress, improving synchronous interactions, and reducing frightening behavior (Dozier and Bernard, 2017).

These video interventions have yielded improvements in parenting and substance use behaviors (Dawe and Harnett, 2007; Suchman et al., 2011, 2012; Barlow et al., 2013, 2019; Dozier and Bernard, 2017). However, targeting multiple mechanisms makes it difficult to identify which are most effective and for whom. Furthermore, these interventions have been predominantly tested among pregnant and postnatal mothers, limiting generalizability across other caregivers. There may be a significant benefit to interventions founded on a specific process of change and inclusive of a range of caregivers. To illustrate these considerations, we describe the Filming Interactions to Nurture Development (FIND) intervention.

Filming Interactions to Nurture Development

Filming Interactions to Nurture Development is a strength-based video feedback intervention with a clearly proposed conceptual model, protocol, and potential to achieve notable impact at scale. FIND was designed to primarily target responsive caregiving and consequently improve caregiver and child outcomes. This design is informed by research on serve and return interactions that are critical to healthy development, a process where caregivers provide contingent, supportive responses to child-initiated cues (Dozier et al., 2002; Fisher et al., 2006; Shonkoff and Bales, 2011). Almost all parents—even those at highest risk—engage in responsive caregiving to some extent. Thus, the goal of FIND is not to teach responsive caregiving but to highlight the occurrence of caregivers' own responsiveness with video clips.

Across 10 sessions with a family (five filming sessions and five coaching sessions), coaches share video compilations of positive micro-social interactions between parent and child to encourage parents to identify and increase the frequency of specific serve and return components (e.g., Sharing the Child's Focus, Supporting and Encouraging, Naming, Back and Forth, and Ending and Beginnings). Further details of the program can be found in Fisher et al. (2016).

Emerging evidence suggests that FIND is particularly effective for high-adversity families. A preliminary study with low-income fathers provides support for FIND's conceptual model that caregiver and child improvements occur through increases in responsive parenting (Schindler et al., 2017). Fathers with high levels of childhood adversity also experienced an increase in parental self-concept and a decrease in their child's behavioral problems. Another preliminary study suggests that FIND participation alters brain functioning in regions related to inhibitory control for low-income mothers, which is noteworthy given the relatively small intervention dose (Giuliani et al., 2019).

CURRENT PERSPECTIVE

Parents with opioid addiction tend to experience difficulty understanding and reacting to child cues, exhibiting greater irritability and decreased responsiveness compared to other parents (Romanowicz et al., 2019). Gaps in the literature highlight the need to identify whether parenting interventions engage the neural circuitry that is implicated in such parenting difficulties and influenced by addiction. The conceptual model of FIND (see **Figure 2**) proposes a testable mechanism through which FIND might serve mothers recovering from opioid misuse. In recognition of this shared neural circuitry, future research on FIND will test mediating roles of brain changes related to parental self-concept, executive function, and reward. Following principles of translational neuroscience, this model targets the drug-induced brain changes that impact maternal responsivity and wellbeing identified by Rutherford et al. (2011). This line of research not only identifies process-level mechanisms, but also may elucidate why intervention effects might persist in some caregivers but not others.

Currently, a randomized clinical trial of FIND is being conducted with 200 mothers in opioid use treatment or recovery with children aged 0–36 months. Half the parents are assigned to a control

FIGURE 2 | FIND conceptual model.
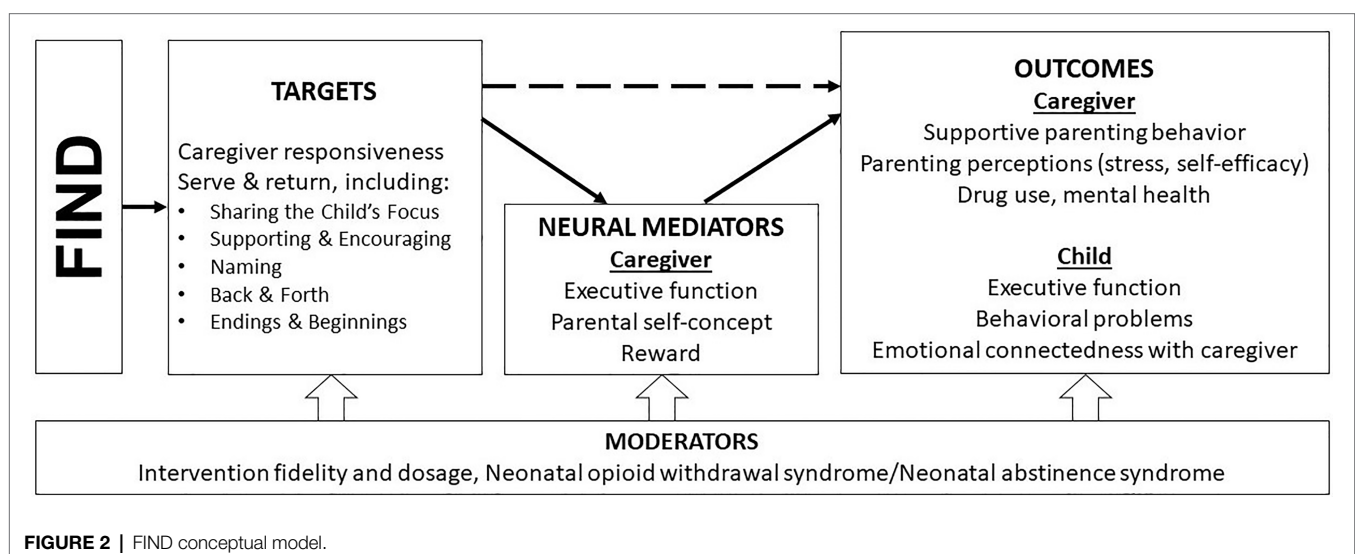
condition, which includes alternating child development information sessions and supportive observations of caregiver-child interaction. This study will both evaluate the effect of FIND on responsive caregiving and test whether observed changes in parenting and addiction circuitry, which have considerable overlap (Rutherford et al., 2011), accompany behavioral improvements. Regions that underlie parental self-concept (e.g., medial prefrontal cortex) and inhibitory control (e.g., insula and inferior frontal gyrus) will be examined before and after intervention. Tasks will also be employed that allow for the disaggregation and assessment of motivation and reward, known to be affected by drug addiction (Kelley and Berridge, 2002), at behavioral and neural levels. This will illuminate whether specific phenotypes exist in mothers with opioid use issues (e.g., low motivation-high reward; high motivation-low reward), whether these phenotypes respond differently to the intervention, and how sensitive these processes are to change in this context. We expect that, across all neurocognitive functions under investigation, intervention effects may be moderated by intervention delivery variables (e.g., fidelity and dosage) and infant opioid exposure/withdrawal.

Investigating the neurocognitive mediators of responsive caregiving improvements and subsequent outcomes allows for more informed intervention alteration and adaptation in real-world contexts. Many evidence-based interventions fail to achieve impact when delivered at scale, and others only yield modest effects and fail to support families at highest risk (Shonkoff, 2010). For substance-using parents of young children, the effectiveness of the intervention in real-world community settings is of heightened concern.

The design process employed in developing FIND was intended to proactively tackle large-scale dissemination concerns of both scalability and real-world efficacy for high-risk populations. FIND's descriptive, as opposed to analytical, coaching delivery permits more people (rather than only those with specialty knowledge or degrees) to implement the program, enhancing scalability. Parents of addiction may respond particularly well to the specific, strength-based nature of the program which directly addresses non-drug reward hypo-responsivity by increasing the inherent rewards of parenting without imposing feelings of shame or guilt that might accompany skill-learning present in other interventions. Previous research suggests that participation increases responsive caregiving at lower doses than many existing interventions (Schindler et al., 2017), possibly due to the exclusive practice of showing caregivers positive instances of their own responsive caregiving. This avoids the trap of including too many untested components within a single intervention, enhancing efficacy. Given these

implementation considerations and preliminary findings, evidence suggests that FIND may be especially effective for caregivers who are traditionally difficult to reach.

DISCUSSION

The need for effective resources and interventions for caregivers with addiction necessitates carefully planned research that acknowledges their shared and unique contexts. The reciprocal influence model posits that drug-induced brain changes are implicated in a cluster of cognitive, behavioral, and affective caregiver changes that directly impact child interactions and consequently create a high-stress parenting environment that increases risk for further drug use. Such models, informed by the neurobiology of shared processes, have potential to be more efficient and scalable than those without a clearly proposed and tested mechanism.

Building, testing, and disseminating effective interventions for this population are complicated by ongoing challenges. Individuals come in with varying skills and may be experiencing concurrent and related stress or adversity. One intervention cannot be made to suit all caregivers and some caregivers may need more or less support. Continued research that connects the growing knowledge of neurobiology related to caregiving and substance use with mechanistic intervention evaluation will allow scientists to investigate what works, why, and for whom.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, and further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

PF and A-MB conceived the idea. A-MB and KM wrote the manuscript. All authors contributed to the final version of the manuscript.

FUNDING

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Service Needs for Corrections-Involved Parents With a History of Problematic Opioid Use: A Community Needs Assessment

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The incarceration of a parent is often a continuation of a challenging family situation marked by poverty, unstable housing, trauma, and abuse. These challenges make it difficult for incarcerated parents reentering their communities to raise their children effectively and, thus, increase the likelihood of poor outcomes for their children. Children whose parents are also battling opioid misuse have an even higher risk for long-term problems. This study uses survey data from 48 community service providers to better understand the service needs of parents with histories of problematic opioid use who are reentering their communities after incarceration. Community service providers recommended implementing intervention programs that cover critical information related to basic needs, supportive community resources, drug treatment programs, and parenting to help individuals thrive in their communities and meet their children's needs. The services most frequently identified by providers as important for reentering parents included housing, mentors or peer counselors, mental health support, group therapy and other support programs. Key topics to address in parenting programs included problem-solving techniques, the effect of parent's addiction on children, and strategies for connecting with and meeting children's needs. Suggestions are made for future research and intervention development.

Keywords: incarceration, reentry, parenting, opioid use, parental incarceration

INTRODUCTION

Over the past four decades, the United States has led the world in both the rate and number of incarcerated individuals (Walmsley, 2018). More than half of the inmates held in U.S. state or federal prison are parents to minor children (Glaze and Maruschak, 2009). On any given day, ~4% of U.S. minors have an incarcerated parent (Sykes and Pettit, 2014), with millions more experiencing parental incarceration at some time during their childhood (Glaze and Maruschak, 2009; Murphey and Cooper, 2015). This prison boom has not only affected the incarcerated parents, but also their children and families who were left behind to struggle with family disruption, diminished financial resources, and emotional strain. Disproportionately impacted are populations of color and other marginalized populations (Tucker, 2014). Nearly all incarcerated parents will return to their communities (Carson and Anderson, 2016). When they do, many face a host of complex and long-term challenges, including substance abuse, mental illness, poverty,

discrimination, unemployment, physical health problems, and eroded family and social networks (Arditti and Few, 2006; Brown and Bloom, 2009; Kjellstrand and Eddy, 2011b).

Reentry into their communities can be particularly challenging for the nearly 20% of corrections-involved parents meeting the criteria for an opioid use disorder (OUD) before incarceration (Joudrey et al., 2019). When incarcerated, these individuals are forced to detox—often without medical intervention—and typically do not receive any substance use treatment during prison (Nunn et al., 2009). Without proper rehabilitation, many struggle with opioid use after reentering their communities. In fact, in the period immediately after release from prison, individuals with histories of problematic opioid use are at high risk of overdosing due to their lower drug tolerance after forced abstinence during incarceration, combined with inaccessibility to treatment (Nunn et al., 2009; Binswanger et al., 2013). When the individuals are parents, the misuse of opioids can lead to poor outcomes for their children (Geller et al., 2009; Kjellstrand and Eddy, 2011a; Murray et al., 2012b; Peisch et al., 2018).

Although research continues to grow about the effects of parental incarceration and parental opioid misuse on children, little is known regarding how to best support corrections-involved parents with a history of problematic opioid use (CIO parents), their children, and their families during incarceration and after release. This study seeks to understand the service needs of CIO parents by soliciting views from community service providers who work with CIO parents during reentry.

BACKGROUND

Reentry from prison back into the community can be difficult for those who have been incarcerated (Hughes and Wilson, 2003; Morenoff and Harding, 2014). Many struggle with problems they faced before incarceration, such as low education levels, poverty, discrimination, underemployment, and dysfunctional relationships (Mumola, 2000; Petersilia, 2003; Glaze and Maruschak, 2009). Moreover, some return to social networks that endorse the commission of criminal and harmful behaviors (e.g., Dodge et al., 2007; Boman and Mowen, 2017), are strained and conflictual (e.g., Greene et al., 2000; James and Glaze, 2006; Kjellstrand and Eddy, 2011a; Wallace et al., 2016), or have eroded due to time apart (Rabuy and Kopf, 2015). Because of their criminal records, the reentering adults often face new challenges related to securing employment; finding safe, affordable housing; and dealing with marginalization, biases, and disadvantage (Travis, 2005; Brazzell et al., 2009; Hamilton-Smith and Vogel, 2012). For CIO parents, the challenges are even greater. As parents attempt to reconnect with their children and family members from whom they have been separated during incarceration (Travis, 2005), all will face potential relapse due to difficulties accessing treatment during and after incarceration (National Institute on Drug Abuse, 2018; World Health Organization, 2018), and many will deal with issues related to their past problematic substance use, including damaged familial, intimate partner or peer relationships (Daley et al., 2018).

The effect of parental incarceration and parental substance misuse on child development has been well-documented. Children with parents who have been incarcerated are more likely to experience poverty and unstable housing (Geller et al., 2009), have insecure attachments (Murray and Murray, 2010), exhibit antisocial and delinquent behaviors (Kjellstrand and Eddy, 2011a,b; Murray et al., 2012a), suffer from internalizing problems and psychopathology (Foster, 2012; Kjellstrand et al., 2020), have antisocial peers (Cochran et al., 2018), and, as adolescents, misuse drugs, and participate in criminal activities (Geller et al., 2009; Wildeman, 2009; Kjellstrand and Eddy, 2011a,b; Foster and Hagan, 2013). Children of parents who misuse drugs are more likely to incur injuries, experience poor physical and mental health (Raitasalo and Holmila, 2017), exhibit externalizing problem behaviors, and engage in substance use as adolescents (McGovern et al., 2020). Both parental incarceration and parental opioid misuse have been linked to harsh, inconsistent, and disapproving parenting strategies (Kjellstrand and Eddy, 2011b; Peisch et al., 2018). Opioid use, specifically, can negatively affect parental responsiveness and ability to exercise empathy (Richter and Bammer, 2000; Hogan, 2007; Rizzo et al., 2013). These problematic parenting strategies, on top of contextual issues, can worsen child outcomes. Despite past findings on the effect of parental incarceration and parental opioid misuse, few parents receive adequate treatment or support during incarceration or after they are released (Feder et al., 2018; National Institute on Drug Abuse, 2018).

Research on supportive interventions for corrections-involved adults who struggle with opioid use is becoming more prevalent (e.g., Parmar et al., 2016; Marsden et al., 2017; Friedmann et al., 2018). The majority of intervention research points to the importance of medication-assisted treatments (MAT), such as naltrexone at reentry (Gisev et al., 2015; McDonald et al., 2016; Parmar et al., 2016; Marsden et al., 2017; Friedmann et al., 2018; Waddell et al., 2020). Evidence also supports the benefits of individualized treatment and case management for reentering individuals with substance use disorders (Miller et al., 2016; Kendall et al., 2018). However, results are mixed on exactly which interventions are most beneficial (Bitney et al., 2017; Moore et al., 2020).

Unfortunately, research on interventions to support corrections-involved parents—specifically CIO parents—and their families is minimal. Numerous interventions have been implemented in correctional facilities and the community, including such programs as parenting classes, family visitation, prison nurseries, and alternatives to incarceration (Kjellstrand, 2017). However, the effects of these interventions are still largely unknown (Kjellstrand, 2017; Eddy et al., 2019). To the best of our knowledge, no research has focused specifically on how to support CIO parents and their families. Given the immense variation in and complexity of these families, it is unlikely that a "one-size-fits-all" model will provide sufficient support. More research is warranted to better understand the specific needs of CIO parents as well as the most effective ways to support this high-risk population.

Our community assessment of the service needs of CIO parents is a first step toward (1) addressing some of these critical gaps in our knowledge and (2) laying the foundation to build a supportive intervention strategy for CIO parents and their families. By soliciting information from community service providers who work with CIO parents, we take a community-based participatory research approach. Such an approach not only addresses power dynamics and promotes reciprocal knowledge translation (also referred to as 'knowledge hybridity'), but also allows underrepresented voices a place in research. All of these can help increase the likelihood of successful intervention implementation (Wallerstein and Duran, 2010) and systemic change generation (Collins et al., 2018). In our community needs assessment, we were interested in three specific issues related to service provision: (1) what community service providers see as the most needed services and programs for reentering CIO parents; (2) what community service providers feel CIO parents need to know upon reentry in order to be successful; and (3) what community service providers feel would be most beneficial for CIO parents to learn and practice in a brief parenting intervention to help support them with parenting and reentry challenges.

METHOD

Participants

Sampling and Recruitment

After receiving IRB approval, our research team used three distinct methods to recruit primarily Oregon-based social service providers who are familiar with the service needs of CIO parents (e.g., parole and probation officers, mental health, and medical professionals). First, we used snowball sampling where we contacted community service providers with whom we had prior relationships. They, in turn, were asked to suggest other colleagues familiar with our population of interest who might be interested in participating in our study. Community partners were provided an overview and goals of the project and then invited to complete an online Qualtrics survey (see **Appendix A**). This approach yielded 26 respondents.

Second, we sent out individual emails and website queries to additional service providers identified using internet search engines, county websites, and online community resource sheets. All emails and website queries included information on the project, a link to the survey, and a request to forward the email to other colleagues who worked with this population. A total of 53 agencies were invited to participate via an agency online website query form, and an additional 196 individuals were invited via email using the contact information found online. We received 29 automated responses informing us that those email addresses were invalid. Twelve individuals responded to the email but declined to participate. Follow-up emails were sent to the remaining 88 individuals ~1 week after the initial email to remind them of the survey. Last, we posted a link to the survey on Twitter and Facebook and invited service providers familiar with the population to participate. In the end, a total of 48 service providers completed the survey.

TABLE 1 | Demographic information.

Variable	Mean	SD	%
Age	47.98	11.57	
Race/Ethnicity			
White			85.11
Hispanic, latino, or Spanish Origin			8.51
American indian or alaska native			8.51
Black or African American			4.26
Other			4.26
Asian			2.13
Native Hawaiian or other Pacific Islander			0.00
Gender			
Female			63.83
Male			34.04
Decline			2.13
Education level			
Some college credit with no degree			4.26
Associates degree			10.64
Bachelor's degree			31.91
Master's degree			38.30
Professional degree			4.26
Doctorate degree			10.64

Sample

Table 1 displays demographic information for the respondents.

Respondents worked in a variety of fields and positions including addiction support (e.g., addictions clinical supervisor, alcohol and drug prevention coordinator), health care (e.g., community health worker, psychiatrist), the corrections system (e.g., parole and probation officers, judge), and mental health (e.g., clinical social worker, clinical director). Additionally, one researcher, one licensed minister, and one author completed the survey. The majority of participants had worked in their respective fields for over 15 years.

Survey Instrument

An online Qualtrics survey was used to gather input from the respondents. The survey contained five main sections. In the first section, participants were asked to provide basic demographic information (e.g., education level, race, ethnicity, occupation). Participants were then asked open-ended questions regarding what they viewed as needs or gaps in services for CIO parents. Following this section, participants were invited to review a set of potential topics and activities for a parenting intervention program and indicate which they felt would be beneficial for CIO parents. These topics were derived from a previously developed intervention for a similar population (see Eddy et al., 2019). In this section of the survey, they also indicated what they felt were the three most important parenting topics to address as well as the three most important activities to include in a brief intervention. Participants were able to suggest topics and activities that were not listed on the survey. Finally, participants were given the option to elaborate on any of the topics or

activities they desired in an open-ended short answer format. Responses to all questions were optional; most participants chose to skip at least some of the questions. On average, participants took 10–30 min to complete the brief survey.

Analysis

All data were exported from Qualtrics to IBM SPSS Statistics 26. Descriptive analyses were run on all the quantitative questions. The open-ended short answer questions were coded manually—grouping similar themes into categories and calculating the respective frequencies. Responses were collaboratively discussed among research team members to ensure the reliability of the codes (see Sweeny et al., 2012 for information on this consensus-building approach).

RESULTS

Needed Services and Programs

Participants identified eighteen different supports that they felt CIO individuals needed to successfully reenter the community. The services and supports tended to address three specific needs: *basic reentry needs*, *needs related to problematic opioid use*, and *parenting specific needs* (see **Table 2**). Some of the most frequently identified services included: housing, mentors or peer counselors, mental health support, treatment services, additional MAT facilities, parenting education or programs, advocates to help navigate Department of Health and Human Services (DHS)/ child custody/ reunification, childcare, and resources for the child.

Important Knowledge for CIO Parents

When asked what CIO parents needed to know upon reentry, community service providers identified eighteen unique topics, which—similar to the previous section—tended to fall in three specific areas: basic reentry needs (e.g., information on positive social networks, housing, employment, and general resources); problematic opioid use (e.g., information on treatment programs, recovering from addiction, and developing a recovery plan); and parenting (e.g., information on parenting, childcare, and family counseling). See **Table 3** for a complete list of the items mentioned.

Parenting Intervention Knowledge and Activities

The next section of the survey examined topics and activities that service providers felt would be important to present in a parenting intervention (see **Table 4**). Participants were provided a list of twelve potential topics and eight potential activities and asked to mark any items on the list they felt would be important to include in a parenting intervention. They were also given the opportunity to identify other parenting topic and activities they deemed important. Out of the topics and activities that they had marked as important, they were then asked to identify the three most important topics and the three most important activities. We utilized a technique in Qualtrics so that participants could only select the top three most important topics and activities from those that they had already marked as important. Topics that

TABLE 2 | Needed supports for CIO parents.

Type of support	Percent of participants that listed each type of support
Supports to address basic re-entry needs	
Housing	39.58
Mentors or peer counselors	12.50
Mental health support	10.41
Group therapy or support programs	8.33
Employment resources	8.33
Additional case management	8.33
Additional resources during incarceration	6.25
Social support	6.25
Additional collaboration between programs	6.25
Transportation	4.17
Cell phone for reentering individuals	2.08
Early intervention for children with CIO parents	2.08
Additional research to better understand issues faced by CIO parents	2.08
Trauma-informed care for CIO parents	2.08
Adult Education	2.08
Supports related to problematic opioid use	
Treatment services	18.75
Additional MAT facilities	6.25
Supports to address parenting specific needs	
Parenting education/programs	10.41
Advocates to help navigate DHS/ child custody/reunification	6.25
Childcare	4.17
Resources for the child	2.08

CIO, corrections-involved with a history of problematic opioid use; MAT, medication-assisted treatments; DHS, Department of Health and Human Services.

were most likely to be identified by service providers as one of the three most important included: problem-solving techniques ($n = 26$), the effect of parental addiction's on children ($n = 22$), specific strategies for connecting with and meeting children's needs ($n = 20$), appropriate self-care management techniques ($n = 19$), and strategies for managing the effects of trauma ($n = 19$). Activities listed by service providers as one of the three most important for CIO parents included: working with a parent coach to develop a plan for solving problems ($n = 35$), working with a parent coach to implement specific strategies for connecting with and meeting children's needs ($n = 31$), and role-playing difficult conversations with child, partner, or others ($n = 27$).

Finally, we asked participants in an open-ended format to list other activities they felt were important for CIO parents who are exiting the prison system to either learn or do in an intervention program. Participants identified seventeen different topics and activities. The most frequently identified items related to basic reentry needs included gaining access to resources, learning and practicing self-care strategies, connecting with peers or peer support, and accessing mental health support. Items connected to problematic opioid use included learning

TABLE 3 | Needed knowledge for CIO parents.

Type of Knowledge	Percent of participants that listed each type of knowledge
Knowledge to address basic re-entry needs	
Positive social networks	35.42
Information or case management for general resource connection	25.00
Housing resources	25.00
Job resources	14.58
Mental health services or individual therapy resources	14.58
Peer support resources	12.50
Relationship skills training and resources	6.25
Positive relationships with probation officer	6.25
Skills and strategies for self-care	4.17
Transportation resources	2.08
Physical health resources	2.08
Knowledge related to problematic opioid use	
Treatment program resources	27.08
MAT resources	20.83
Understanding of the time and work necessary to recover from addiction	10.42
Developing a recovery plan	6.25
Knowledge to address parenting specific needs	
Information about parenting resources	12.50
Information about childcare resources	6.25
Family counseling resources	2.08

CIO, corrections-involved with a history of problematic opioid use; MAT, medication-assisted treatments.

about and practicing strategies related to addiction recovery, accessing addiction or other types of support, engaging in a 12-step program, and accessing in-prison substance use treatment. Finally, two items related to parenting that were not mentioned in the earlier list of potential topics included learning more about child needs and learning how to advocate for their child. In these short, open-ended responses, most participants did not provide extensive details on what they envisioned for these topics or activities.

DISCUSSION

Reentry can be a difficult time, fraught with economic difficulties (Mumola, 2000; Petersilia, 2003; Glaze and Maruschak, 2009), strained social networks (Greene et al., 2000; James and Glaze, 2006; Wallace et al., 2016), and societal stigma and disadvantages (Alexander, 2020). Some of the most reported challenges facing incarcerated parents concern securing employment, finding quality affordable housing, maintaining good physical and mental health, and developing healthy relationships (Gaes and Kendig, 2003; Kjellstrand, 2017). CIO parents face additional difficulties as they manage issues related to problematic substance use (Winkelman et al., 2018; Gannon et al., 2020) and navigate

strained relationships with their children and families (Mirick and Steenrod, 2016; Stulac et al., 2019).

The purpose of our study was to gain a better understanding of the reentry needs of CIO parents from the perspectives of community service providers who work with this population and/or are familiar with the population's needs. Such perspectives are essential in guiding the development of effective and relevant interventions for these parents and families. To our knowledge, this is the only study that has examined the needs of reentering CIO parents from the perspective of community service providers.

Our findings underscore the multiple challenges CIO parents encounter in three central areas related to (1) reentry, (2) problematic opioid use, and (3) parenting. Further, our findings point to some of the topics and activities in each of these areas that community service providers feel would be most beneficial for CIO parents as they return to their families and communities after incarceration.

Community service providers in our sample showed a deep understanding of the issues that CIO parents faced during reentry. They described a variety of basic reentry needs and stressed the importance of CIO parents knowing where to turn to obtain critical information and support in the areas of housing, transportation, physical and mental health, and prosocial relationships. Such information and support can significantly improve outcomes for individuals post-incarceration in multiple areas and can help promote successful reentry (Visher, 2006; Bahr et al., 2010; Morenoff and Harding, 2014). Without the knowledge of and access to such resources, reentering individuals may struggle, relapse, or recidivate.

In terms of problematic opioid use, community service providers suggested many evidence-based supports and treatments. For example, several of our participants listed the importance of MAT for CIO parents, echoing research demonstrating the value of such treatment for reentering individuals in preventing use and potential overdose (Gisev et al., 2015; McDonald et al., 2016; Marsden et al., 2017; Friedmann et al., 2018; Waddell et al., 2020). Additionally, community service providers stressed the importance of specific individualized treatment, consistent with findings that such treatment can be beneficial for reentering individuals struggling with problematic opioid use (Miller et al., 2016). However, community service providers in our sample had vast opinions on what specific treatment would be most helpful for CIO parents (e.g., group therapy or support programs, mentors or peer counselors, trauma-informed care). Given that research is mixed on which types of individualized treatment are most beneficial (Bitney et al., 2017; Moore et al., 2020), more research is warranted in this area.

Lastly, the community service providers discussed parenting needs and endorsed or identified potential topics and activities they felt would be beneficial to CIO parents for parenting and reentry. Some of the most common topics that participants indicated as important to address in a parenting program included problem-solving techniques, the effects of a parent's

TABLE 4 | Important topics and activities for reentering parents with opioid addiction.

Learning topic for parenting	Percent of participants indicating topic is important to address	Percent of participants ranking topic as one of three most important to address
Problem-solving techniques.	89.58	54.17
Parental addiction's effect on children.	89.58	45.83
Strategies to connect with or meet children's needs.	87.50	41.67
Managing effects of trauma.	87.50	39.58
Appropriate self-care management techniques.	85.42	39.58
Family strengths and challenges during reentry.	85.42	25.00
Basics of mindfulness (e.g., deep breathing, fully present, meditation).	81.25	31.25
Appropriate routines to engage in with children.	77.08	16.67
Age appropriate activities to engage with children.	70.83	10.42
Issues related to domestic violence.	70.83	6.25
Building a relationship with the child's caregiver.	60.42	12.50
Personal parental hopes.	60.42	2.08
Hands-on Activity for Parenting	**Percent of Participants Indicating Activity is Important to Do**	**Percent of Participants Ranking Activity as One of Three Most Important to Do**
Practice strategies to connect with or meet children's needs.	91.67	64.58
Develop plan to solve problems.	87.50	72.92
Role-play difficult conversations with child, partner, or others.	77.08	56.25
Role-play difficult situations around opioid use.	68.75	41.67
Work on age-appropriate routines to engage in with child.	62.50	22.92
Practice age-appropriate activities to engage with children.	60.42	8.33
Engage in mindfulness meditation.	47.92	14.58
Engage in mindfulness meditation with child.	41.66	2.08
Additional topics or activities suggested by participants for intervention	**Percent of participants suggesting this item**	
Topics or activities to address basic re-entry needs		
Learn how to access resources	20.83	
Self-care and practice	12.50	
Connect with peers/peer support	12.50	
Availability and access to mental health support	12.50	
Learn criminogenic risk/need	8.33	
Learn communication skills	6.25	
Learn self-advocacy	4.17	
Learn about trauma	4.17	
Learn financial management or job search skills	4.17	
Topics or activities related to problematic opioid use		
Addiction recovery knowledge or support	14.58	
Engagement in a 12-step program	4.17	
In prison addiction treatment	2.08	
Topics or activities to address parenting specific needs		
Learn child needs	10.42	
Learn child advocacy	4.17	

addiction on children, strategies for connecting with and meeting children's needs, ways to manage the effects of trauma, and appropriate self-care strategies and management. Activities to support this learning and promote improved parenting and family dynamics included developing a family plan to address problematic issues, practicing strategies to connect with and meet children's needs, role-playing difficult family conversations, developing parenting routines, and practicing mindfulness meditation. Many similar topics and activities arose in a recent study by Kjellstrand (2017) in which incarcerated parents were asked what they needed most to support them in parenting their children both during incarceration and after they returned to their communities. The combined findings highlight the importance and relevance of the identified topics regardless

if the parents are struggling with problematic opioid use. Notably, participants tended to mention the need of providing support and knowledge on parenting for CIO parents less frequently than support and knowledge focused on basic reentry needs (e.g., housing, case management, employment, general resources) and opioid use (e.g., treatment programs, MAT, support groups). While parenting is important, based on our results, it might be best to address the topic of parenting as part of a multi-modal program which provides support around critical basic and medical needs of CIO parents or, alternatively, after reentering parents have first attended to their basic needs and secured medical treatment and programming for their opioid use.

LIMITATIONS

Our findings were in line with much of the existing research on supports for individuals who are reentering their communities from prison, providing us with more confidence regarding our results. Although our study provides additional insight into the service needs of CIO parents from the perspective of community service providers, a few limitations must be considered. First, our sample of community service providers was recruited from a specific region of the U.S. Hence, the results may not be generalizable to other geographic regions. Second, our data was collected during the spring and summer of 2020—a time when the world was entering a global pandemic. Many individuals, including community service providers, were navigating difficulties both at work (e.g., shutdowns, agency protocol changes) and at home (e.g., childcare, illness of family members, financial strain). This situation may have biased our sample toward those who were easier to contact or who were experiencing fewer time constraints due to the pandemic. Third, our research does not examine outcome differences by type of provider who might be inclined to stress certain needs over others. Because there were seven different types of providers within our sample of 48, we did not have sufficient numbers of each type to examine statistical differences. A more robust sample could show patterns by type of provider. Fourth, our sample gathered perspectives from a particular group of key stakeholders (i.e., community service providers). Perspectives from other key stakeholders (e.g., individuals and families with lived experience, additional professionals in the corrections system) could provide further insight into the needs of CIO parents as they return to their communities after prison. Last, because our study was meant to inform an intervention for a particular population, the survey was made specifically for this study and did not use validated measures.

IMPLICATIONS

Despite these limitations, our findings provide valuable insight for the development of a supportive strategy to meet the needs of CIO parents and their families. The community service providers highlighted the importance of addressing parenting but with an eye toward each individual's reentry needs

and context. Successful reentry will look different depending on the circumstances of the parent and family. Ideally, a reentry program would begin supporting parents while they are still incarcerated, providing key information, treatment, and transitional planning to ensure that each parent and their family have relevant tools and knowledge as well as a strong comprehensive support system in place before the parent leaves prison. Such support would then continue as the parents returned and reintegrated into their communities and families. Reentry is a long process, and, given limited community resources, it can be challenging for a single program or organization to address the complex needs faced by CIO parents during reentry. Creating a multi-modal strategy that links relevant programs might be the most economical and efficient way to provide thorough support for individuals. Key programs to include in such a system would provide support around three critical areas identified in our study: general reentry needs, substance use, and parenting. Establishing such organized systems of care could streamline the process for reentering CIO parents and enable these individuals to more easily access the knowledge and support they need. In respect to parenting specifically, a program that addresses basic parenting strategies, the effects of parental incarceration and opioid use on child development, and self-care management techniques could be especially valuable and relevant for CIO parents. Providing supplemental activities that afford parents the opportunity to develop plans and practice specific skills could help improve parents' understanding, retention of the content, and likelihood of implementing the parenting strategies.

CONCLUSION

Reentry from prison to the community can be challenging for everyone, but particularly for CIO parents. In our study, community service providers highlighted the importance of providing CIO parents with the knowledge and skills needed to navigate this difficult period especially in terms of addressing their basic needs, handling problematic substance use, and parenting their children effectively. Given the complex needs facing CIO parents and their families, this might be done most effectively through a collaborative approach across systems and at different points during incarceration and reentry. We believe that such a strategy will lead to better outcomes not only for reentering parents, but for their children and families as well.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the University of Oregon's Institutional Review Board. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

FUNDING

ACKNOWLEDGMENTS

SUPPLEMENTARY MATERIAL

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An Integrated Mechanistic Model of Mindfulness-Oriented Recovery Enhancement for Opioid-Exposed Mother–Infant Dyads

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A growing body of neurobiological and psychological research sheds light on the mechanisms underlying the development and maintenance of opioid use disorder and its relation to parenting behavior. Perinatal opioid use is associated with risks for women and children, including increased risk of child maltreatment. Drawing from extant data, here we provide an integrated mechanistic model of perinatal opioid use, parenting behavior, infant attachment, and child well-being to inform the development and adaptation of behavioral interventions for opioid-exposed mother–infant dyads. The model posits that recurrent perinatal opioid use may lead to increased stress sensitivity and reward dysregulation for some mothers, resulting in decreased perceived salience of infant cues, disengaged parenting behavior, disrupted infant attachment, and decreased child well-being. We conclude with a discussion of Mindfulness-Oriented Recovery Enhancement as a means of addressing mechanisms undergirding perinatal opioid use, parenting, and attachment, presenting evidence on the efficacy and therapeutic mechanisms of mindfulness. As perinatal opioid use increases in the United States, empirically informed models can be used to guide treatment development research and address this growing concern.

Keywords: pregnancy, parenting (MeSH), opioid misuse, mindfulness, savoring

INTRODUCTION

In the United States, from 1999 to 2014, the prevalence of maternal opioid use disorder (OUD) at delivery increased four-fold from 1.5 per 1,000 births to 6.5 per 1,000 births (Haight et al., 2018). This dramatic shift has led to adverse consequences for mothers and babies. Pregnant and postpartum women with OUD experience a higher risk of maternal death due to opioid overdose (Haight et al., 2018; Schiff et al., 2018; Smid et al., 2019). For newborns, *in-utero* opioid exposure can result in neonatal opioid withdrawal syndrome, a group of symptoms that occurs when a neonate withdraws from opioids on which they were physiologically dependent (Kocherlakota, 2014). Though the quality of parenting behaviors varies among

individuals, opioid use during pregnancy has also been associated with higher risk for neglect and abuse (Smith et al., 2007) and has been cited as a risk factor for child protective services involvement (Leventhal et al., 1997; Burke, 2007; Hafekost et al., 2017; Prindle et al., 2018). Despite these risks, pregnancy is a unique opportunity to provide support to families through medical and behavioral health care (Krans et al., 2015; Mascola et al., 2017). Indeed, many women are motivated to seek substance use treatment during pregnancy (Asta et al., 2021) and enter and maintain recovery postpartum (Frazer et al., 2019; Goodman et al., 2020).

In response to this opportunity for treatment engagement, there has been a call for a comprehensive and compassionate response to address contextual factors contributing to OUD and support families impacted by the ongoing opioid crisis (Hand et al., 2021). A comprehensive approach to prenatal opioid use (2021) emphasizes the role of poverty, adverse childhood experiences, historical trauma, and stigma on the understanding of the context of perinatal OUD. The model describes a treatment model which includes: medication for OUD, behavioral health care, patient navigation prenatal/well-child care, psychiatric care, education and employment, parenting development, and other services.

Though this paper will emphasize the role of biobehavioral mechanisms in opioid use, it is essential to consider this in the context of a comprehensive treatment approach and to knowledge the role of poverty, trauma, and stigma in perinatal opioid use and parenting behavior. In particular, pregnant women with OUD have high rates of adverse childhood experiences. One study conducted by Gannon et al. (2021) found treatment-seeking pregnant women with OUD ($N = 152$) self-reported an average of 4.3 adverse childhood experiences (SD 2.3; range 0–8). These high rates of adverse childhood experiences require compassionate, trauma-informed care. Black and Hispanic women with OUD may encounter even more barriers to completing substance use treatment compared to White counterparts (Suntai, 2021) due to the intersections of racism and stigma. Stigma in many healthcare, criminal justice, and child welfare systems (Stone, 2015) has led to punitive policies and practices towards pregnant women with OUD which can deter women from seeking and continuing with treatment September 5, 2021 10:19:00 PM. Though outside of the scope of this article, the impacts of poverty, trauma, and stigma are essential to understanding the experiences of pregnant women with OUD and any proposed intervention and we ask readers to keep this context in mind.

The current opioid epidemic presents a dire need for effective interventions to address perinatal opioid use and promote wellbeing among opioid-using mothers and their infants. There are several existing interventions demonstrating promise in promoting attachment and positive parenting behaviors in substance-exposed mother–infant dyads, including Attachment and Biobehavioral Catchup Project (Berlin et al., 2014), Mom Power (Muzik et al., 2015, 2016), the Mothers and Toddlers Program (Suchman et al., 2012), and Mothering from the Inside Out (Suchman, 2016) and Mindfulness-Based Parenting (MBP; see below; Duncan et al., 2009). Though a comparison of

these interventions is outside the scope of this article, we would like to identify one limitation of these approaches. Specifically, they target women and children in the postpartum period. Focusing on attachment and parenting behavior during pregnancy may capitalize on enhanced motivation for change in the prenatal period. In this manuscript, we address this limitation, present a conceptual model of the mechanisms underlying perinatal opioid use and child well-being, and consider how the use of a MBI, Mindfulness-Oriented Recovery Enhancement (MORE), may address the mechanisms outlined in the proposed model during pregnancy.

A DYADIC MODEL LINKING MATERNAL STRESS, COPING, AND OPIOID USE TO PARENTING BEHAVIOR AND CHILD WELL-BEING

Neurobiological and psychological models shed light on the mechanisms underlying the development and maintenance of OUD and interactions between opioid use and parenting. Here we provide an integrated model (depicted in **Figure 1**) of perinatal opioid use, parenting behavior, infant attachment, and child well-being that unites Lazarus and Folkman's transactional model of stress and coping (Lazarus and Folkman, 1984), Garland, Boettiger, and Howard's model of the risk chain linking stress to addictive behavior (Garland et al., 2011), Koob and Volkow's model of the neurocircuitry of addiction (Koob and Volkow, 2016), Rutherford and Mayes' reward-stress dysregulation model of addicted parenting (Rutherford and Mayes, 2017), and Bowlby's attachment theory (Bowlby, 1988). For this paper, we define child well-being in relation to five distinct domains: physical, psychological, cognitive, social, and economic (Pollard and Lee, 2003).

Our model highlights biobehavioral processes linking negative stress appraisals to parenting behavior and child well-being. Negative stress appraisals may lead to negative affect, stress sensitization, reward dysregulation, and ultimately opioid craving and use. Over time, recurrent opioid use may lead to reduced engagement and passive/disengaged parenting behavior, and subsequently, insecure attachment and decreased child well-being. Altogether, opioid use may set off a reciprocal relationship wherein some mothers and infants negatively impact one another. Proposed mechanisms to target with intervention may include negative stress appraisals, stress sensitization, reward dysregulation, substance craving, and parenting behavior. The ultimate goal of developing this model is to inform the development and adaptation of behavioral interventions for opioid-exposed mother–infant dyads.

Stress and Cognitive Appraisal

The initial stages of our model are informed by Lazarus and Folkman's (1984) transactional model of stress and coping. Lazarus and Folkman define stress as "a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or
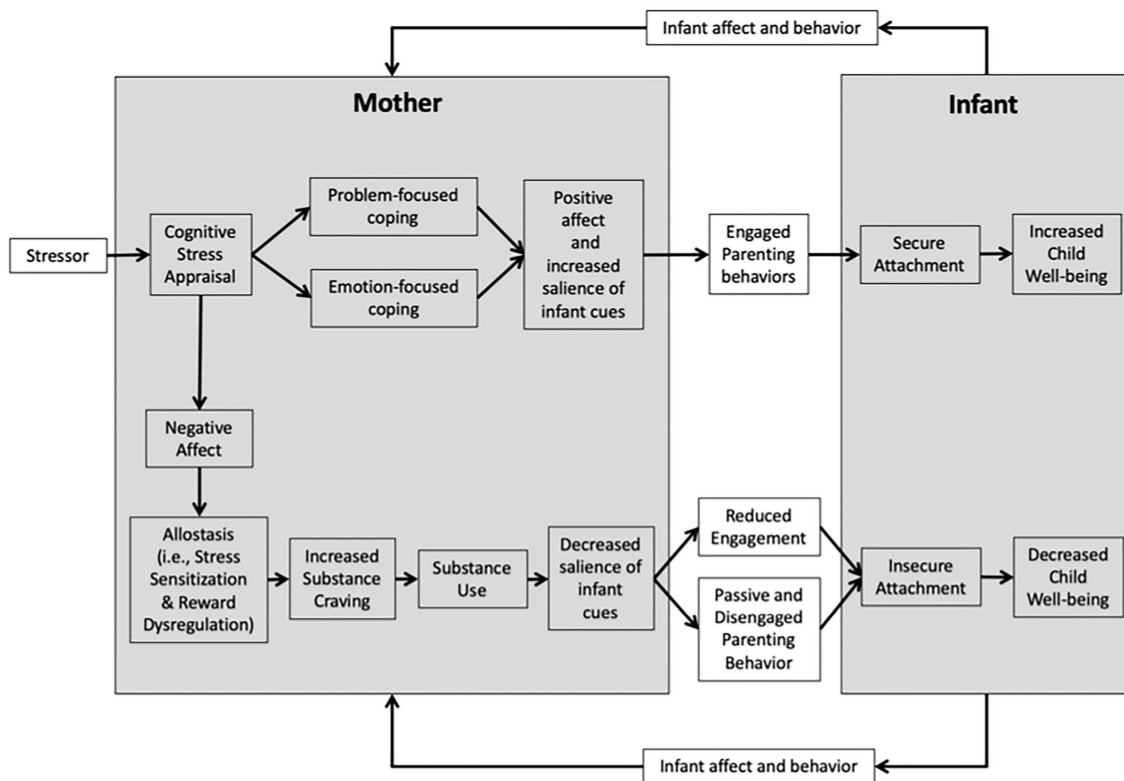
FIGURE 1 | Mechanisms of maternal substance use and child well-being model. This process model represents the connections between perinatal opioid use, parenting behaviors, and infant attachment development. As a mother encounters a stressor, her cognitive appraisal of the situation can drive adaptive coping, leading to positive affect, and engaged parenting behaviors. Alternatively, a negative cognitive appraisal may result in negative affect, promoting the process of allostasis—resulting in increased sensitivity to stress and dysregulation of reward processes. Allostatic load may lead to increased substance craving and substance use, which, over time, results in a decreased salience of infant cues, reduced engagement with the infant, and passive and disengaged parenting behavior. Gradually, the infant may develop an insecure attachment, being unable to rely on his mother's response. Insecure attachment may then lead to an overall decrease in the child's well-being. This model also highlights the process of dyadic synchrony. The infant's affect and behavior also influence the mother's affect and behavior. As the child learns that the mother's behavior is unreliable, she may reach out to her mother through behavior that can be interpreted as stressful by her mother, which may reinforce her mother's cycle of substance craving and use.

her resources and endangering his or her well-being" (Lazarus and Folkman, 1984, p. 19). This process of appraisal refers to the evaluation of meaning or significance and is shaped by individual commitments (e.g., what is important to individuals, what has meaning for them, and what is at stake). These commitments motivate individual choices and behavior in an attempt to maintain or achieve goals. When an individual appraises an encounter with a stressor as exceeding their resources, the stress reaction results. Stress can be defined as any situation that requires an individual to respond and adapt. An individual's response to stress is determined by their appraisal of the situation. If a person appraises the circumstances as harmful and overwhelming their capacity to cope, this can result in distress (i.e., "bad stress"). Alternatively, if the person appraises the circumstances as manageable, this can result in eustress (i.e., "good stress"), which can lead to increased resilience, or the ability to weather hardships. It is important to note here that mothers with OUD report higher perceived parenting stress compared to mothers without OUD (Bagner et al., 2009).

Problem-Focused and Emotion-Focused Coping

In response to appraising a situation as stressful, a person may then engage in coping—that is, cognitive and/or behavioral efforts to manage or resolve the stressor. Coping may be problem-focused or emotion-focused (Lazarus and Folkman, 1984). Problem-focused coping involves problem-solving and drawing on resources (e.g., social, financial) to resolve the problem or improve the situation. Alternatively, or in addition to problem-focused coping, the person may utilize emotion-focused coping to address emotional distress. One emotion-focused coping skill is *reappraisal*—reinterpreting the meaning of the stressor to reduce emotional distress. We will discuss reappraisal at greater length below. Successful problem-focused or emotion-focused coping may lead to positive affect (Aldwin and Revenson, 1987). When coping fails, an individual may experience increased negative affect, which fuels allostasis, the biological process which occurs as the body responds to stress to regain homeostasis, leading to allostatic load (see below; Sterling and Eyer, 1988).

Allostatic Load Leads to Stress Sensitization, Reward Dysregulation, and Craving

As a result of a negative stress appraisal, the sympathetic nervous system (SNS; i.e., the branch of the autonomic nervous system that coordinates the "fight/flight" response) is engaged. When an individual negatively appraises a situation, leading to emotional distress, the adrenal glands release epinephrine and norepinephrine, activating the sympathetic-adrenal-medullary and the hypothalamic-pituitary-adrenal (HPA) axes, and increasing heart rate and respiration. This physiological stress response can be adaptive in the short term, motivating a person to engage in activity leading to homeostasis, or a more stable equilibrium. However, over time, chronic stress can result in allostatic load (i.e., "wear and tear" on the body) that can then lead to increased vulnerability to disease and developmental disorders (McEwen and Wingfield, 2003; McEwen and Gianaros, 2011). How individuals appraise these stressors can lead to adaptive coping, which can reduce stress-induced negative affect and improve SNS recovery (Larsen and Christenfeld, 2010). However, an individual's ability to regulate their emotions through adaptive coping is influenced by the neurobiological effects of recurrent opioid use.

Recurrent opioid use produces neurobiological effects on reward and stress circuitry in the brain (Volkow et al., 2016; Koob, 2019). Koob and Volkow's (2010, 2016) model of the neurocircuitry of addiction divides the process of drug addiction into three recurring stages: (1) *binge/intoxication*, (2) *withdrawal/negative affect*, and (3) *preoccupation/anticipation*. The binge/intoxication stage is accompanied by neuroadaptations in the basal ganglia that impact the perceived salience of drug-related versus natural rewards. These neuroadaptations are a result of intoxication caused by an increase in several neurotransmitters and neuromodulators (Koob and Volkow, 2016), including dopamine in the ventral striatum and ventral tegmental area, which produce euphoric effects and positively reinforce drug use (Caine et al., 2007). Over time and with recurrent use, mesocorticolimbic brain systems become sensitized to drug cues (e.g., a needle, a pill bottle, a specific place; Schultz et al., 1997; Robinson and Berridge, 2008; Berridge, 2012), and these cues (as opposed to the drug itself) begin to activate *wanting* without *liking*, which propels compulsive behavior (Robinson and Berridge, 2001). Drug cues are thought to activate drug use action schemas, or conditioned responses that initiate a series of unconscious, automatic drug use behaviors (Tiffany, 1990). Over time, drug use action schemas and automatic, or habitual, drug use behavior lead to attentional bias toward drug cues, during which attentional resources are drawn toward drug-related cues (Field and Cox, 2008). Individuals then develop tolerance and begin to increase use, which leads to the second stage of the development of addiction.

The second stage of Koob and Volkow's (2010, 2016) model, withdrawal/negative affect, is associated with changes in the extended amygdala and negative emotional states, including increased sensitivity to stress and loss of interest in natural rewards. When not using the drug, individuals experience intense emotional and physical discomfort, or symptoms of withdrawal. As addiction dysregulates the neural circuitry implicated in reward processing, it decreases the salience or perceived value of nondrug rewards (Garavan et al., 2000; Volkow et al., 2010). During the perinatal period, these neurobiological changes may interfere with the neurocircuitry responsible for maternal bonding behaviors (Wallin et al., 2021). Prolonged drug use also affects stress circuitry, activating the HPA axis to release molecular mediators of antireward (Koob and Le Moal, 2008), including cortisol, corticotropin-releasing factor, and adrenocorticotropin hormone, producing aversive states during withdrawal or extended abstinence. This overproduction of the stress response systems leads to the final stage of Koob and Volkow's (2010, 2016) model—craving, or a preoccupation with obtaining and using opioids as a means of allaying the resultant dysphoria.

The third and final stage of Koob and Volkow's (2010, 2016) model, preoccupation/anticipation (i.e., craving), is a result of changes in the prefrontal cortex that lead to deficits in executive functioning. Tiffany's model suggests that substance craving is triggered when a drug use action schema is initiated and the person is hindered from engaging the automatic drug use behavior. When craving is triggered by a drug cue and a drug use action schema is triggered, the prefrontal cortex is activated (Lee et al., 2005; Risinger et al., 2005; Volkow et al., 2005; Jasinska et al., 2014; Kober et al., 2016). Craving, stress sensitization, and reward dysregulation can lead to increased opioid use, which fuels this cycle. Reward dysregulation, in particular, may affect the perceived salience of infant cues and, in turn, influence parenting behavior (Brancato and Cannizzaro, 2018; Cataldo et al., 2019; Swain and Ho, 2019).

Salience of Infant Cues and Parenting Behavior

Decades of animal and human research on parenting has revealed an "intricate interplay of numerous neural, mental, and behavioral processes of perception, motivation, affect, cognition, … and motor performance in shaping the mother's behavior to engage in a selective and enduring reciprocal emotional relationship with [her child]" (Pereira and Ferreira, 2016, p.72). This dynamic, interactive process occurs within the dyad, with reciprocal influences between infants and mothers. Sensitive mothering requires mothers to attend to, interpret, and respond appropriately to infant cues. Although mothering is impacted by genetics, mothers' childhood experiences, and culture (Keller et al., 2008), here we will focus primarily on the motivational, affective, and cognitive processes that affect the mother–infant relationship.

Coordination between motivational, affective, and cognitive processes rely on hormones (Bridges, 2015). Changes in hormones during pregnancy and after birth affect brain functioning (Featherstone et al., 2000; Keyser-Marcus et al., 2001; Shingo et al., 2003; Rasia-Filho et al., 2004; Leuner and Gould, 2010; Larsen and Grattan, 2012) and are responsible for early bonding between mothers and infants (see Bridges, 2015). Specifically, oxytocin and prolactin are thought to increase the salience of

infant cues (i.e., their value or motivating quality), increase reward experience from interacting with the infant, and induce positive affect (Numan et al., 2006). Higher oxytocin levels have been found to be associated with mothering behaviors such as shared gaze, vocalizations, positive affect, and affectionate touch (Feldman et al., 2007, 2010). Oxytocin levels were also found to correlate with activation in these parts of the brain when mothers were exposed to photos of their babies (Feldman, 2015). Findings from experimental studies are mixed. In one study, when depressed postpartum mothers were given internasal oxytocin, it did not increase the sensitivity of their interactions with their babies, but it did improve their protective behavior (Mah et al., 2017). In a study of brain activation, oxytocin administration was found to be associated with reduced activation in stress systems of the brain (i.e., amygdala, insula, and inferior frontal gyrus) when exposed to infant crying (Riem et al., 2011). Oxytocin administration was also found to be associated with increased salience of infant laughter (Riem et al., 2012).

In addition to oxytocin, cortisol plays a role in mothering behavior. During the first week after birth, hormones (specifically cortisol) originating in the HPA axis also appear to be associated with maternal responsiveness. Corter and Fleming (1990) hypothesize that in this first week, activation of the HPA axis may enrich the perception of salience of infant cues and, as a result, attention to cues. Though, continued heightened activity in the HPA axis later in the postpartum period may be inversely associated with mothering behaviors (Krpan et al., 2005). Oxytocin and cortisol impact the activation of brain networks implicated in mothering behavior.

Human and animal studies have revealed that mothering is influenced by the coordination of multiple brain structures known as the Maternal Brain Neurocircuit (MBN; see Swain and Ho, 2019 for an extensive review of the model). The MBN includes orbitofrontal and prefrontal cortices, bed nucleus of the stria terminalis, amygdala, hippocampus, medial preoptic area, nucleus accumbens, and ventral tegmental area (Kendrick et al., 1997; Numan et al., 2006; Atzil et al., 2011; Barrett and Fleming, 2011; Olazábal et al., 2013; Moses-Lolko et al., 2014). This neural network is thought to subserve a mother's capacity to perceive and respond to her infant's needs by coordinating multiple neurocognitive processes, including attention, memory, empathy, decision-making, and stress reactivity (Pereira and Ferreira, 2016). The medial preoptic area, in particular, is critical to effective parenting, as it integrates and coordinates the mothering behavior according to the age of the child (Numan, 1974; Jacobson et al., 1980; Gray and Brooks, 1984; Cohn and Gerall, 1989; Lee et al., 2000; Arrati et al., 2006; Perrin et al., 2007; Pereira and Morrell, 2009). In the context of parenting, the medial preoptic area communicates with nucleus accumbens to regulate motivation; amygdala, bed nucleus of the stria terminalis, and medial prefrontal cortex to regulate affect and cognitive functions (e.g., attention, behavioral flexibility, and working memory; Pereira and Ferreira, 2016). These same neurocognitive processes are also impacted by recurrent opioid use.

Swain et al. (2014) suggest that to the extent that opioid use and mental health disorders dysregulate reward circuitry

in the brains of mothers, this process may impact the salience of infant-related rewards, leading to challenges in emotion regulation, maternal responsiveness, attachment, and infant development. In support of this hypothesis, a recent pilot functional magnetic resonance imaging (fMRI) study of resting state function in mothers receiving buprenorphine for OUD ($n=32$) compared to mothers without OUD ($n=25$) found an association between problems with maternal bonding (measured by the Postpartum Bonding Questionnaire) and connectivity in the MBN (Swain and Ho, 2019). They also found buprenorphine treatment may mitigate this risk of bonding deficits.

Rutherford and Mayes (2017) have outlined a model explaining the overlapping brain circuitry involved in the neurobiology of parenting behavior and the etiology of addiction. Research indicates that viewing infant faces is rewarding for both parents and nonparents, activating the nucleus accumbens (Glocker et al., 2009) and other reward circuits in the brain (Rutherford et al., 2011, 2013), seemingly as a way to attract potential caregivers (Kringelbach et al., 2016). They identify brain regions associated with reward (i.e., prefrontal cortex, ventral tegmental area, and nucleus accumbens) and stress (i.e., HPA axis and extended amygdala) that are implicated in the development of addiction, as well as the perception of infant cues and interaction with infants (Rutherford et al., 2011). Their model posits that as substance use dysregulates reward circuitry in the brain of a mother, she experiences a decrease in the salience of infant-related rewards (i.e., she becomes less responsive and less motivated by her infant's crying and/or smiling).

Findings from three fMRI studies support this hypothesis. Landi et al. (2011) found that mothers using substances demonstrated less brain activation in the prefrontal and limbic regions of the brain compared to mothers not using substances when presented with images of unfamiliar infant faces. Kim et al. (2017) utilized a similar paradigm, but with images of women's own babies along with photos of unknown infants. They found reduced reward responses in hypothalamus, ventral striatum, and ventromedial prefrontal cortex among women enrolled in inpatient substance use programs compared to women without SUD. Finally, Rutherford et al. (2020) utilized a similar paradigm as Kim et al. (2017)—and found that compared to non-substance-using mothers, mothers using substances demonstrated greater activation in superior medial frontal, inferior parietal, and middle temporal regions when viewing their own infants' faces rather than unknown infant faces. As such, for substance-using parents, caregiving is less rewarding and more stressful (Rutherford et al., 2011, 2013). We have integrated the reward-stress dysregulation model into our model and expanded on these ideas to consider how parenting behaviors impact attachment.

Attachment and Child Well-Being

A mother's ability to attune to her infant, regulate her own physical and emotional experience, and respond appropriately to her infant influences the quality of an infant's attachment

(Bowlby, 1988; Sroufe, 1988). Bowlby's (1988) attachment theory states that humans are wired to connect within intimate relationships and that infant relationships with caregivers are particularly influential on development and future relationships. There are four types of attachment: secure, avoidant, resistant, and disorganized. Secure attachment develops as a result of consistent, sensitive caregiving, (i.e., providing physical care, emotional communication, and affection in response to infant cues; Ainsworth et al., 1978). In response to attentive, engaged caregiving, infants learn to trust their caregivers, operationalized as children seeking proximity to attachment figures when they experience distress (Ainsworth et al., 1978). Parenting quality can lead to epigenetic changes that influence the brain systems underlying children's ability to regulate stress and emotion (McGowan et al., 2009). Since infants are unable to self-regulate, a secure attachment with a trusted caregiver can result in co-regulatory stress regulation, buffering the infant's HPA axis in response to stressors (Schore, 2005). One method of measuring HPA axis activation is salivary cortisol. Nachmias et al. (1996) found elevations in cortisol among insecurely, but not securely attached toddlers when both groups were exposed to a series of stressors. Ahnert et al. (2004) also found significantly greater increases in cortisol responses of insecurely-attached toddlers compared to securely attached toddlers when visiting a new child care center. As children develop, they use attachment figures as a "secure base" from which they can explore the world and take risks. Children with secure attachments are more resilient and self-reliant than their insecurely attached peers (Sroufe, 2005). Avoidant attachment and altered HPA axis function have been found to be associated with impaired social, psychological, and neurobiological functioning (i.e., behavior problems; Snoek et al., 2004; Van Bokhoven et al., 2005a,b; Fearon and Belsky, 2011), anxiety, depression, and post-traumatic stress disorder (Heim et al., 1997; Nemeroff, 2004; Gunnar and Quevedo, 2008), as well as negative outcomes related to childhood school achievement and peer social status (Schore, 1994, 2001).

These findings have implications for perinatal opioid use. As discussed in the introduction, studies have found an association between adverse childhood experiences and illicit substance use in pregnancy (Chung et al., 2010; Leeners et al., 2014; Currie and Tough, 2021; Racine et al., 2021). Given the increased likelihood of experiencing abuse and neglect in childhood, mothers who struggle with OUD may be more likely to exhibit insecure attachment relationships, but research on this topic is limited.

Infant Affect and Behavior

In addition to considering the impact of parenting behaviors on attachment, we have modeled the reciprocal relationship between infants and mothers. An infant's symptoms of opioid withdrawal (e.g., inconsolable crying) can be particularly challenging for caregivers, requiring caregivers to regulate negative emotions stemming from caring for the infant in distress. Emotion regulation has been defined as the capacity

to control the experience or expression of positive and negative emotions (Gross, 1998, 2015). Children learn emotion regulation strategies from interacting with their caregivers (Fox, 1998), and children's behavior and affect similarly affect their caregivers' responses. This dynamic dyadic system is known as emotion co-regulation and is operationalized as the dyad's shared gaze, complementary affective states, verbal turn-taking, and interactive behavior (Tronick et al., 1977; Dumas et al., 1995; Cole et al., 2003; Deater-Deckard et al., 2004; Lavelli and Fogel, 2005). Co-regulation (e.g., a mother vocally soothing her infant) is a component of sensitive caregiving that promotes resilience among children (e.g., Gerwitz et al., 2008). Dyadic synchrony can help a child learn to self-regulate through the mechanisms described above (Harrist and Waugh, 2002).

Behavioral interventions for perinatal opioid use should address the aforementioned mechanisms that connect opioid use to child well-being. As described above, MBIs are demonstrating promise in addressing these mechanisms. Below, we present evidence supporting the use of one MBI, MORE, with women who are pregnant and have been diagnosed with OUD.

MBIS ADDRESS SUBSTANCE USE AND PROMOTE ATTENTIVE CAREGIVING

Mindfulness is conceptualized as a *practice*, a *state*, and a *trait*. The two primary practices of mindfulness are focused attention and open monitoring (Lutz et al., 2008). Focused attention practice involves a repeated process of first sustaining attention on an object, then acknowledging distractions, and finally, redirecting attention to the object. During open monitoring practice, an individual attends to passing thoughts, emotions, and physical sensations as well as the field of awareness in which mental contents occur. These practices can induce the state of mindfulness (e.g., Lau et al., 2006), a state of awareness during which one cultivates an attitude of acceptance, openness, curiosity, and detachment. Overtime, invoking the state of mindfulness through mindfulness practice leads to the development of the trait of mindfulness (Kiken et al., 2016), or the propensity to act mindfully in everyday life (e.g., Baer et al., 2006). Increases in trait mindfulness as a result of participating in MBIs have been found to be associated with psychological health benefits (Carmody and Baer, 2008; Shapiro et al., 2008; Shahar et al., 2010).

MBIs are demonstrating promise in treating SUDs broadly and OUD specifically. Interventions include Mindfulness-Based Relapse Prevention and MORE. Randomized controlled trials (RCTs) support the use of MBIs to treat alcohol use disorder (Garland et al., 2010; Kamboj et al., 2017; Cavicchioli et al., 2018), stimulant use disorder (Glasner-Edwards et al., 2017), and opioid misuse/OUD (Garland et al., 2014c). A (Li et al., 2017) meta-analysis of RCTs of MBIs for substance use found mindfulness treatment significantly reduced substance use post-treatment [−0.33, 95% CI (−0.88, −0.14)] compared to control conditions.

There is a growing body of evidence supporting the role of mindfulness practices in reducing anxiety, depression, and

stress during pregnancy (Duncan et al., 2009; Dhillon et al., 2017; Babbar et al., 2021). This research is expanding to focus on the unique context of perinatal substance use. A research team based in the Division of Maternal Addiction Treatment Education and Research are leading in the field of MBIs for mothers with OUD. In an observational study ($N = 160$), Gannon et al. (2017) evaluated the impact of a trauma-informed MBP intervention on parenting quality as measured by the Keys to Interactive Parenting Scale (Comfort and Gordon, 2006). The MBP intervention is based in the model of mindful parenting (Duncan et al., 2009), which emphasizes the role of attention, nonjudgment, compassion, self-regulation, and awareness. The team found that the MBP intervention led to clinically significant improvements in the quality of parenting behaviors. The team also found that the MBP intervention resulted in a significant decrease in general stress (as measured by the Perceived Stress Scale-10; Cohen et al., 1983), parental distress [as measured by the parenting stress index-short form (Abiden, 1995; Short et al., 2017)], and depression symptoms (Alexander et al., 2019).

The model of mindful parenting on which the MBP intervention is based (Duncan et al., 2009) hypothesizes how mindfulness may promote adaptive parenting behaviors. In early infancy, caregivers must be attentive to cries and other behavioral signs of distress or discomfort. This is particularly important for mothers of infants experiencing withdrawal symptoms who require more extensive care. The second dimension of mindful parenting, nonjudgmental acceptance of self and child, is relevant to mothers who are prescribed medication for OUD (e.g., buprenorphine) or used opioids while pregnant due to frequent reports of shame and self-judgment regarding substance use (Covington, 2008). Emotional awareness of self and child involves being able to identify emotions within self and child and regulating strong negative emotions. Finally, compassion has been described as the "desire to alleviate suffering" (Lazarus and Lazarus, 1994). Through heightened compassion, parents who practice mindfulness may be more responsive to their infants' needs. We will now describe the components of one MBI, MORE, and how MORE may address the mechanisms of perinatal opioid use.

MORE AND THE MMT

Mindfulness-Oriented Recovery Enhancement is a sequenced treatment made up of three primary components—mindfulness, reappraisal, and savoring. MORE is based on the *mindfulness-to-meaning theory* (MMT), which provides a dynamic causal model of the mechanisms by which mindfulness promotes positive emotions and the sense of meaning in life (Garland et al., 2015). This promotion of positive emotions is relevant to pregnancy, which for many, can be a time of reprioritizing values and meaning-making (Prinds and Hvidt, 2014). Garland et al. (2015) argue that mindfulness research has been myopically focused on the study of attention regulation as a means of eliminating maladaptive behaviors, emotions, and cognitions, while neglecting the historical purpose of these

practices—namely, fostering eudemonic states through positive emotion regulation and the development of prosocial behavior. The MMT posits that mindfulness practice can promote metacognition, altering the quality of awareness and thereby enabling positive reappraisal, positive affect, and adaptive behavior (Garland et al., 2015).

In MORE, participants engage in mindfulness practices like the body scan, mindful breathing, and open-monitoring to strengthen executive functioning and attentional networks in the brain. Participants then apply this enhanced cognitive control capacity to the process of reappraisal, a form of emotion-focused coping utilized to restructure maladaptive cognitions and decrease stress. Finally, participants utilize these mindfulness skills to practice savoring, the intentional process of focusing on and enhancing responses to naturally rewarding experiences in life (Bryant and Veroff, 2007; Garland, 2016).

Mindfulness-Oriented Recovery Enhancement has demonstrated efficacy across multiple RCTs of chronic opioid users and opioid misusers, as well as patients with OUD. In the first Stage 2 RCT of MORE ($N = 115$) for opioid misuse (Garland et al., 2014c), MORE significantly decreased opioid misuse behaviors indicative of OUD ($\downarrow$ occurrence of OUD by 63%) relative to a supportive group psychotherapy (SG) control condition. A second Stage 2 RCT ($N = 95$; Garland et al., 2019c) replicated these results, demonstrating again that MORE opioid misuse ($p = 0.027$, $d = 0.64$), and opioid use ($p = 0.006$, $d = 1.07$; Garland et al., 2020). In a third Stage 1 RCT of people with OUD ($N = 30$), combining MORE with methadone maintenance therapy decreased days of heroin and other drug use ($F = 4.72$, $p = 0.04$) to a greater extent than methadone plus usual care (Cooperman et al., 2021). Finally, in a new, full-scale RCT ($N = 250$), MORE reduced opioid misuse by 46% at the 9-month follow-up. Taken together, findings from these trials (total $N = 490$) demonstrate MORE's efficacy for decreasing addictive use of opioids. In light of MORE's efficacy, below, we expand on these mechanisms by which MORE may address perinatal OUD and review the supporting evidence (see **Figure 2**).

MORE Addresses Attentional Bias, Cue-Reactivity, and Craving

Evidence from mechanistic studies and RCTs support the hypothesis that MORE reduces attentional, physiological, and subjective reactivity (i.e., craving) to drug cues. In a pilot RCT ($n = 53$) with alcohol-dependent adults in an inpatient setting, MORE significantly reduced attentional bias to alcohol-related cues during a dot probe task compared to a support group (SG) control condition (Garland et al., 2010). In the same group, less alcohol attentional bias predicted a lower rate of return to alcohol use (Garland et al., 2012). MORE may decrease attentional bias to drug cues by promoting attention regulation and disengagement from stimuli (Garland et al., 2017a). In support of this theory, MORE was found to significantly reduce opioid attentional bias in a sample ($n = 115$) of opioid-treated chronic pain patients compared to a SG (Garland et al., 2017a); and MORE was shown to be associated with reduced opioid
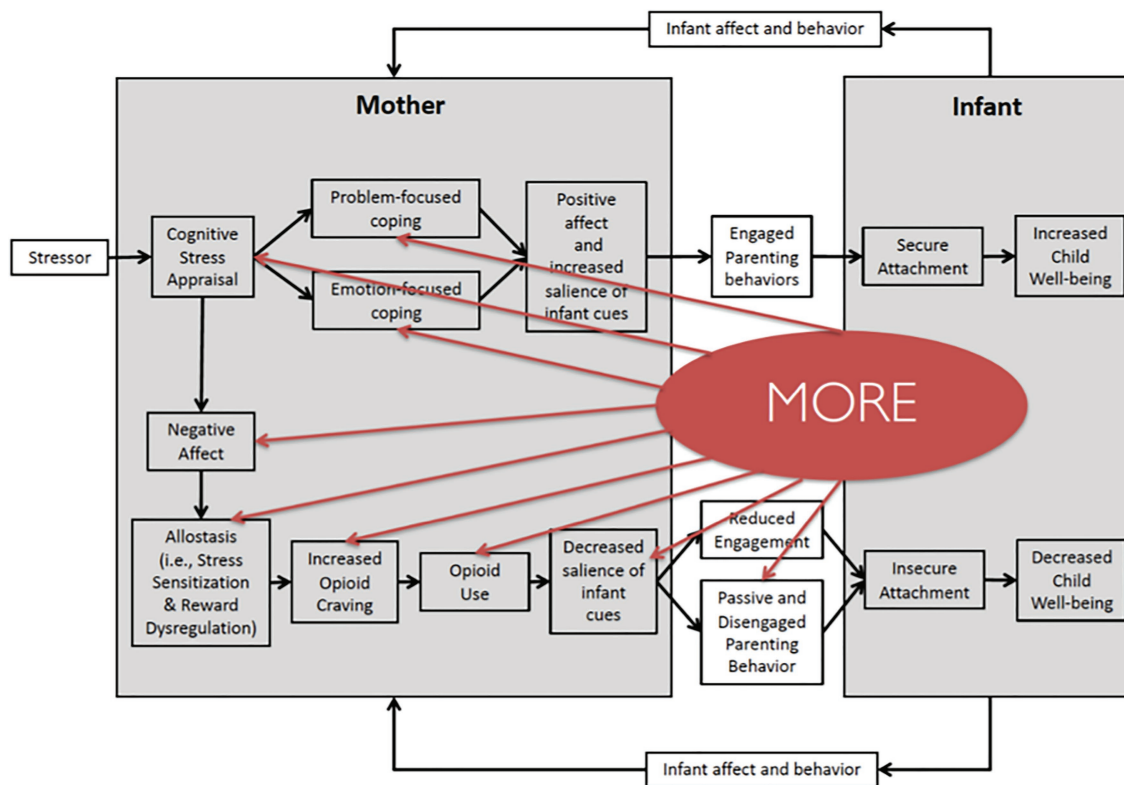
FIGURE 2 | Mindfulness-Oriented Recovery Enhancement (MORE) targets mechanisms of maternal substance use and child well-being. MORE may interrupt several key processes in the proposed model of perinatal opioid use and child well-being. MORE promotes the process of *mindful reappraisal*, whereby a mother can change her perspective on a stressor to decreased her negative affect. MORE also fosters problem-focused and emotion-focused coping, during which a mother uses mindfulness practices to cope with emotional distress. MORE also targets the process of allostasis, reduces sensitization to stress, and increases sensitization to reward. MORE also provides strategies to cope with substance craving, decreasing the likelihood of substance use. Finally, *mindful savoring* may help women increase the salience of infant cues and promote engaged parenting behavior.

cue-reactivity as evidenced by decreased salivation during *in vivo* opioid cue-exposure (Hanley and Garland, 2020).

With regard to subjective craving, mechanistic studies have found that MORE decreases cue-elicited craving (Garland et al., 2014a; Hanley and Garland, 2020). In a study of opioid-misusing chronic pain patients ($n = 115$), MORE was found to significantly decrease opioid craving ($p = 0.027$; Garland et al., 2014c). Similarly, a pragmatic RCT of men diagnosed with co-occurring disorders ($n = 180$) found that MORE led to significantly greater decreases in craving than cognitive-behavioral therapy or usual care (Garland et al., 2016). Finally, analysis of a stage 1 RCT of MORE with methadone-maintained individuals ($N = 30$) revealed that MORE significantly reduced craving ($p < 0.001$) compared to methadone maintenance as usual control condition (Garland et al., 2019b).

Garland et al. (2014b) argue that mindfulness enhances functional connectivity between prefrontal-parietal metacognitive attentional control networks and subcortical limbic-striatal circuits involved in emotional habits and responses. For pregnant women with OUD, mindfulness practice may decrease attentional bias to opioid-related cues, decreasing cue-reactivity and craving, and thereby allowing for disengagement from automatic, habitual opioid use.

MORE Enhances Stress Recovery and Reduces Stress Reactivity

In addition to reducing substance attentional bias, MORE may capitalize on increased cognitive control to reduce stress through mindful reappraisal and parasympathetic activation, circumventing stress-induced relapse. The *mindful reappraisal hypothesis* (Garland and Fredrickson, 2019) states that as individuals learn to regulate attention through mindfulness practice, they increase their ability to widen their attention in order to disengage from momentary thoughts, feelings, and sensations and become aware of contextual information that they previously ignored. By widening attention from solely being focused stressful thoughts, feelings, and sensations, individuals can identify more helpful ways of thinking, which then decreases negative emotional reactions. The mindful reappraisal hypothesis as it relates to MORE is supported through findings from mechanistic studies and RCTs. One study found that compared to a SG, participation in MORE was associated with decreases in perceived stress (as measured by the Perceived Stress Scale; Cohen et al., 1983) and increased parasympathetic recovery when exposed to stress-primed alcohol-related stimuli (Garland et al., 2010). In a study of opioid-misusing chronic pain patients ($n = 115$),

MORE was found to significantly increase reappraisal while decreasing stress arousal (as measured by the Calgary Symptoms of Stress Inventory; Carlson and Thomas, 2007; $p = 0.034$) compared to a SG (Garland et al., 2014c). A recent study of MORE compared to a SG found MORE significantly reduced stress (measured by ecological momentary assessment, 0–10 numeric scale in response to the question "How stressed are you right now?") among a sample ($N = 30$) of individuals receiving methadone maintenance treatment compared to a TAU control condition (Garland et al., 2019b). As described above, stress plays a central role in perinatal opioid use, which can prime a return to use and inhibiting attentive mothering behavior. Given the significance of stress, interventions like MORE may improve opioid use and parenting behavior.

MORE Restructures Reward

The *mindful savoring hypothesis* (Garland and Fredrickson, 2019) posits that mindfulness practice may boost positive emotions and amplify natural reward processing in the brain by facilitating savoring – the process of attending to the pleasurable features of a positive object or event while appreciating one's own emotional and somatic response to the pleasant event. For example, a parent may savor the experience of rocking their child to sleep The parent may focus on the physical sensation of pressure and warmth, the sound of their child's breathing, the look of relaxation on their child's face, or the smell of their child's hair. They may then focus on the emotions that arise—feelings of calm, closeness, and love for their child. Finally, they would focus on these feelings with the intention of amplifying and absorbing those feelings. Savoring is the focus of a growing body of evidence supporting the use of MORE as a way to address reward dysregulation caused by recurrent substance use. High-frequency heart rate variability (HRV), the beat-to-beat change in heart rate, represents parasympathetic nervous system regulation of the heart (Berntson et al., 1997) and is often used as a measure of central and autonomic nervous system activity (e.g., prefrontal and cingulate cortices and vagus nerve), which are associated with reward responsiveness, attention, and emotion regulation (Thayer et al., 2009; Thayer and Lane, 2009). Among a sample ($n = 115$) of chronic pain patients prescribed opioids, MORE, compared to a SG, was found to increase HRV in response to natural rewards, which mediated reductions in craving (Garland et al., 2014a).

In an EEG study of opioid-treated chronic pain patients ($n = 29$), MORE was associated with enhanced late positive potential (LPP) toward photos of natural rewards, which was associated with reductions in opioid craving (Garland et al., 2015). Participation in MORE relative to SG was also found to be associated with a shift in relative HRV response towards drug versus natural rewards, with participants demonstrating a decreased response towards drug rewards and a greater response towards natural rewards in an affective picture viewing task (Garland et al., 2017c). This decrease in HRV responsivity to drug rewards and increase in HRV responsivity to natural rewards predicted decreases in opioid misuse in a 3-month follow-up (Garland et al., 2017c). A recent EEG study (Garland et al., 2019a) of opioid-treated chronic pain patients ($n = 135$) found MORE (relative to a SG) decreased neurophysiological reactivity to drug-related cues and increasing responsiveness (i.e., LPP) to natural reward cues. This enhanced regulatory capacity was associated with reductions in craving and opioid misuse. Analysis of ecological momentary assessment found that those who participated in MORE were 2.75 times more likely than those in SG to maintain or increase positive effect in day-to-day life, which predicted reductions in opioid misuse (Garland et al., 2017b). Finally, ecological momentary assessment findings from a recent Stage 1 RCT of MORE with individuals ($N = 30$) receiving methadone maintenance treatment indicate that MORE significantly increased positive affect ($p = 0.017$) compared to a TAU control condition (Garland et al., 2019b).

Here, we would like to highlight two parenting interventions which are demonstrating promise in addressing dysregulation in the MBN—Attachment and Behavioral Catchup (Berlin et al., 2014) and Mom Power (Muzik et al., 2015, 2016). A recent study found greater enhancement of ERP response (N170 and LPP) to viewing emotional faces of children in participants (mothers referred to child protective services) randomly assigned to ABC ($n = 30$) compared to a control group ($n = 21$) of child protective service-referred women. These findings support the hypothesis that short-term attachment-based parenting interventions may target dysfunction in the MBN (in particular, processing of emotional faces). A pilot study of Mom Power—an attachment-based parenting intervention targeting maternal empathy, reflective functioning and stress reduction—found the intervention to be feasible and acceptable among a group of women with OUD ($N = 68$; Muzik et al., 2015, n.d.) to reduce depression, symptoms of posttraumatic stress disorder, and caregiving helplessness among high-risk mothers. A larger community-based RCT ($N = 122$) found improvements in mental health and parenting stress for high-risk mothers after participating in MOM Power, in contrast to negative parenting outcomes (i.e., increase parent–child role-reversal) for the control group (Rosenblum et al., 2017). The effects of MOM Power on MBN have been examined with two fMRI studies utilizing a Child Facing Mirroring Task and fMRI (Ho et al., 2020). The authors found that participation in MOM Power led to decreased parenting stress which may have been mediated by changes in left superior-temporal-gyrus, peraqueductal gray, and left amygdala. Altogether, these studies support the hypothesis that attachment-based parenting interventions can address dysregulation of the MBN.

Mindfulness may be one such intervention for women who are pregnant and using opioids to help them cope with aspects of addiction, manage stress, and facilitate savoring and appreciation of pleasant experiences of connection with their children during pregnancy and early parenthood. For instance, using mindfulness to savor the touch of the hand of one's infant may produce a sense of abiding pleasure, love, and deep interconnectedness that comes to outweigh the pull of drug-related reward.

Mindfulness practice during and after pregnancy may lead to positive mental states, positive behaviors, and ultimately the cultivation of a sense of meaning and purpose in life.

DISCUSSION

Opioid use among pregnant women is a complex issue that warrants increased attention from the scientific community. There appears to be a spectrum of risk stratified by variables such as polysubstance use, tobacco use, low socioeconomic status, trauma history, and comorbid physical and mental health disorders. More research is needed to learn about perinatal opioid use and develop targeted treatments. Mechanistic research indicates that prolonged nonmedical opioid exposure modulates the neurocognitive and neuroaffective processes underlying addiction and produces adverse neurobiological consequences during pregnancy and after birth. As described in the introduction, a compassionate and comprehensive approach is recommended for all women with prolonged exposure to opioids during pregnancy to reduce the risk of a reoccurrence of use. Overall, there is a need for pregnant women to be included in RCTs of integrated interventions.

Our proposed model builds upon the Rutherford and Mayes' (2017) *reward-stress dysregulation model of addicted parenting* by including processes that can be targeted for intervention (e.g., cognitive appraisal, problem- and emotion-focused coping, and allostasis). This model outlines the underlying mechanisms leading from negative stress appraisals to maternal substance use and decreased child well-being. Appraisals of stressful or perceived stressful circumstances lead to substance craving and use. Recurrent substance use may lead to increased sensitivity to stress and dysregulation of reward, resulting in decreased perceived salience of infant cues, disengaged parenting behavior, and decreased child well-being. As substance use increases in the United States overall as well as with pregnant women, more research is needed to learn the best ways to support women, as well as their infants, in the context of their environments. Clinical trial MORE is one such MBI that may be utilized to address opioid use and psychological distress among mothers during the perinatal period.

AUTHOR CONTRIBUTIONS

SR developed the model and wrote the manuscript with support from EC, MR, and EG. All authors contributed to the article and approved the submitted version.

FUNDING

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Prevention Adaptation of an Evidence-Based Treatment for Parents Involved With Child Welfare Who Use Substances

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Background: Parental substance use, especially opioid misuse and/or methamphetamine use, is a key driver for recent increases in family involvement with child welfare and foster care placements in the United States. There is an urgent need for programs that prevent parental substance use disorders, yet few prevention programs exist that target parents' unique needs and strengths. Adapting evidence-based treatment approaches for prevention might be an efficient, effective way to address this gap. The current study informed the rigorous adaptation of an evidence-based treatment that supports families involved with child welfare due to substance use, Families Actively Improving Relationships (FAIR), to a prevention-oriented intervention: "PRE-FAIR." FAIR entails four treatment domains: substance use, parenting, mental health, and ancillary services (e.g., housing, medical care, and food). FAIR significantly improved parenting and reduced parental substance use in three rigorous treatment trials, but FAIR's effectiveness in preventing the initiation or escalation of opioid misuse and/or methamphetamine use is untested. To inform adaptation, particular attention was paid to operationalizing strategies underlying a key hypothesized mediator of successful parent outcomes—engagement.

Methods: Graduated FAIR parents ($n = 9$) and FAIR administrators, clinical supervisors, and clinicians ($n = 11$) participated in semi-structured interviews. Content analysis was used to identify key variables driving FAIR engagement and parent outcomes. Causal loop diagramming, a qualitative systems science method, was employed to operationalize emergent themes, and describe how causal links between key variables interrelated dynamically over time.

Results: Themes reinforced the value of FAIR's treatment domains for supporting parent's sobriety and parenting skills within a prevention orientation. Ancillary supports and strong relationships were particularly crucial for helping parents cope with stressors leading to substance use. Five engagement strategies were identified as essential to parent success: 24/7 clinician availability, in-person clinician advocacy, in-home delivery, strengths-based interactions, and urinalysis. Implications for PRE-FAIR engagement strategies and dosage were identified.

Discussion: Traditional qualitative analyses and qualitative analyses based in systems science can inform rigorous adaptations of evidence-based treatment programs for prevention. Future research will explore additional required, fidelity-consistent prevention adaptations to FAIR, and the impact of PRE-FAIR on parental substance use and child welfare case outcomes.

INTRODUCTION

Approximately, 7.9 million children were referred to child welfare in 2019 (U.S. DHHS and ACYF, 2020). Child foster care placements had been steadily declining for over a decade until rates began to rise in 2012, increasing over 10% through 2016 (U.S. DHHS and ACYF, 2020). Parental substance use was attributed as a leading cause of increased placements (Ghertner et al., 2018). Experiencing child maltreatment or unstable child welfare placements due to parental substance use can have both immediate and lifelong impacts on children's mental health, physical health, and economic and social well-being (Ford et al., 2011; Jonson-Reid et al., 2019; Vanderminden et al., 2019; Strathearn et al., 2020).

Parental substance use is a prevalent, pressing public health concern. Based on the most recent national survey of non-institutionalized US adults, over 1.5 million are estimated to have experienced opioid use disorder (OUD) in the past year and over one million are estimated to have experienced methamphetamine use disorder (MUD) (SAMHSA, 2020). The co-occurrence of OUD and MUD is rising (Volkow, 2020).

Recognizing the urgent need for interventions to prevent and treat OUD and/or MUD across diverse populations, the National Institutes of Health launched the Helping to End Addiction Long-Term (HEAL) Initiative in 2017 (U.S. NIH, 2021). The HEAL Prevention Initiative, launched in 2018, aims to prevent opioid initiation or escalation of misuse among older adolescents and young adults aged 16–30 (U.S. NIH, 2021). Individuals in this age range experience the highest risk for opioid initiation, misuse, disorder, and death from overdose (Lloyd, 2018). The highest rates of opioid-related overdose fatalities in 2016 were among young adults aged 25–35, (Lloyd, 2018); individuals in this age range often are parenting and fall within the age demographic most likely to perpetrate child maltreatment (U.S. DHHS and ACYF, 2020). Indeed, recent federal statistics and a systematic literature review showed significantly increased odds of child maltreatment and child welfare involvement when parents use substances (Neger and Prinz, 2015; U.S. DHHS and ACYF, 2020). Parents at risk of OUD and MUD might best benefit from evidence-based programs (EBPs) that support their role as parents. Yet, among 52 EBPs recently reviewed for potential federal reimbursement to prevent child maltreatment among families facing high risk of maltreatment and child removal from the home, only four were found to have substantial effectiveness or likelihood of effectiveness on parental substance use (Abt Associates, 2020).

Given the limited number of EBPs for preventing substance use among parents at risk for involvement with child welfare, adapting an existing child welfare focused EBP that integrates substance use treatment is a promising, efficient, and effective approach to developing a base of prevention-oriented EBPs. One such promising program is the Families Actively Improving Relationships (FAIR) program. FAIR was developed to fill a need identified by child welfare services key informants over a decade ago. Their greatest challenges related to parental substance abuse and child neglect, and the lack of associated services accessible for parents with this profile (Saldana, 2015). Thus, an intensive outpatient treatment program was rigorously designed to address the interplay among parental: (1) substance use, (2) parenting skills, (3) mental health, and (4) ancillary needs (e.g., housing, employment, nutritious food, and medical care) (Saldana, 2015). FAIR is designed to treat parental OUD or MUD, and is delivered through an outpatient clinic supported by Medicaid (i.e., fee-for-service) (Cruden et al., 2021). Building on a decade of rigorous development, evaluation, and implementation, FAIR consistently has yielded positive and sustained effects for referred parents tracked up to 24-months (ACF 90CA1816-01-00; Saldana et al., 2013; Saldana, 2015; Cruden et al., 2021; Saldana et al., 2021). In a recently completed effectiveness trial, parents receiving FAIR showed clinical and statistical reductions in opioid and/or methamphetamine use, mental health symptoms, and parenting deficits (Saldana et al., 2021). Per FAIR clinic records from January through July 2020, over 70% of enrolled parents successfully graduated; by comparison, a recent systematic review found that only 20% of mothers involved with child welfare attend 50% or more of treatment sessions (Neger and Prinz, 2015). Although developed and tested as an intensive outpatient-treatment program, FAIR holds promise as a preventive solution for parents who are at high risk for opioid and/or methamphetamine initiation or escalation to disorder, thereby reducing risk of children's exposure to parental substance use and neglect.

Phase one focused on building from the positive treatment effects found with FAIR to guide its adaptation to a prevention-oriented approach (PRE-FAIR). The premise was to identify ways to achieve the same high level of engagement FAIR; PRE-FAIR parents might not present with the same level of high need during treatment initiation, and therefore a different opportunity for relationship building. PRE-FAIR is hypothesized to operate more similarly to the second half of FAIR treatment, when parents are functioning with greater

stability and have fostered protective factors such as strong relationships, yet still experience risk factors for substance misuse. PRE-FAIR can be conceptualized as a selective preventive intervention (Mrazek and Haggerty, 1994; Jones and Kaltenbach, 2013; Maguire-Jack et al., 2018), where PRE-FAIR parents are anticipated to respond to similar level of intervention intensity as parents experienced in the second half of FAIR treatment. Thus, the current analysis sought to understand, from the perspective of FAIR parents and clinicians, what program characteristics influenced engagement and increased stability for parents to prevent substance use during a less intensive phase of intervention. This analysis informed the adaptation to PRE-FAIR.

The goal throughout adapting FAIR to PRE-FAIR was to maintain fidelity to FAIR and anticipate strategies that could increase parents' acceptability of PRE-FAIR (Proctor et al., 2013; Castro and Yasui, 2017). Parental engagement was selected as the initial focus of adaptation efforts because FAIR's unique engagement strategies are hypothesized to be the key pathways through which parents agree to participate in and are retained in treatment until graduation, and through which they actively participate in setting and meeting their treatment goals (Saldana, 2015). Engagement is not just a set of activities to initiate treatment, but an ongoing set of strategies for maintaining treatment engagement and supporting graduation. Engagement can include discrete, short gestures such as encouraging text messages, as well as tangible treatment incentives such as offering a favorite beverage during treatment sessions. The level and type of engagement changes over the course of treatment, with clinicians meeting with parents daily for the first 3 weeks of treatment, and then titrating to weekly meetings over the course of 9 months. Thus, a primary objective of the current study was to characterize FAIR engagement strategies to explore whether they might need to be adapted for parents not involved with child welfare and for whom substance use is not a key driver for seeking clinical support.

A secondary objective of the current study was to explore whether and how FAIR's four major treatment domains (substance use, parenting, mental health, and ancillary needs) would need to be modified in terms of emphasis or sequencing of delivery for PRE-FAIR, while maintaining attention to the mechanisms of core treatment components (Rotheram-Borus and Duan, 2003; Castro et al., 2010). This objective was pursued by identifying which strategies helped graduated FAIR parents maintain engagement when substance use frequency was reduced to levels similar to those expected among PRE-FAIR parents.

Two methods were used to address these objectives: traditional qualitative methods (i.e., coding semi-structured interviews), and a qualitative approach based in systems science known as causal loop diagramming.

Qualitative methods have been proposed as integral to EBP adaptation efforts (Castro et al., 2004; Castro and Yasui, 2017; Duggleby et al., 2020). They are ideally suited to validate the conceptual framework of the EBP, understand the experiences of EBP recipients and those who deliver EBPs in order to identify adaptations likely to be acceptable to these users, and to classify adaptations (Escoffery et al., 2019; Duggleby et al., 2020).

Similar to thematic qualitative analysis, causal loop diagramming identifies key variables and causal pathways that characterize behaviors. Causal loop diagrams (CLDs) shape understanding of how variables interact to produce an outcome or behavior over time through visual representation of variable interconnections and accompanying narratives (Sterman, 2000; Meadows, 2008). CLDs visually demonstrate how changes in one variable can cause changes in a second variable, and how changes in the second variable might or might not provide "feedback" into the behavior or value of the first variable (Sterman, 2000; Meadows, 2008). Feedback processes either can be reinforcing or balancing. Reinforcing feedback processes that "loop" around to continuously facilitate positive outcomes or behaviors are known as "virtuous feedback loops" or "virtuous cycles" (Sterman, 2000). In contrast, reinforcing feedback processes that perpetuate or exacerbate negative outcomes or behaviors are known as "vicious feedback loops" or "vicious cycles." Reinforcing loops thus "enhance whatever direction of change is imposed on it" (Meadows, 2008). Balancing loops serve as checks on reinforcing loops and stabilize a system (Sterman, 2000). Understanding the key feedback processes that lead to successful intervention delivery and sustainment is a foundational step during successful EBP adaptation, with CLDs allowing for an assessment of strategies that both facilitate and hinder success (Baumann et al., 2017; Castro and Yasui, 2017; Stirman et al., 2019). Understanding both what "to do" and what "not to do" can provide a path more likely to lead to success. After laying this foundation, practitioners are better able to identify which EBP components and pathways can and should be prioritized for adaptation while maintaining fidelity to the EBP (Lich et al., 2012; Stirman et al., 2019). Further, because CLDs articulate *why* change is perceived to occur, they can be particularly helpful for specifying hypothesized mediators or mechanisms of change for an EBP, such as engagement.

Systems science methods, including the quantitative counterpart to CLDs, system dynamics simulation models, have been used as an implementation planning strategy (Leeman et al., 2017) to generate consensus among frontline workers on the policies and processes that might facilitate successful implementation of mental health and substance use EBPs (Zimmerman et al., 2016), and to address gaps in health services continuity (Huz et al., 1997). The potential of systems science methods to support other aspects of implementation planning (e.g., EBP adaptation) has yet to be fully realized. To address this gap, the current study exemplified how a systems science approach can operationalize the implementation strategy to "promote adaptability," which focuses on identifying how an EBP can be modified to meet local needs (Powell et al., 2015).

A systems science approach was deemed appropriate to guide prevention adaptations for two reasons. First, systems science is well-suited to articulate the inherent complexity of factors elevating risk for substance use behaviors (Lich et al., 2012), similar to the complexity detailed in the FAIR logic model (Saldana et al., 2021). Second, these methods can identify dynamic feedback processes that lead to self-perpetuating positive behaviors and outcomes, such as sobriety, that should be

maintained in a prevention adaptation (Galea and Vlahov, 2002; Lich et al., 2012; Mabry et al., 2013; Dasgupta et al., 2018).

In Phase 2 of this HEAL Prevention Initiative project, PRE-FAIR will be rigorously compared to standard care across parent and child outcomes using a Hybrid I effectiveness-implementation evaluation design (Curran et al., 2012). Families eligible for PRE-FAIR will be those involved in public family serving systems, including child welfare and Self-Sufficiency, with parents who are at risk for but do not have current OUD or MUD diagnoses, yet experience current risk factors for OUD and MUD similar to those experienced by the FAIR sample, including unmet ancillary needs, a history of trauma, exposure to individuals who misuse substances, and untreated mental health disorders (Saldana, 2015; Saldana et al., 2021).

MATERIALS AND METHODS

Procedures

Key informant interviews elicited the perspectives of graduated FAIR parents and FAIR clinicians and administrators (Israel et al., 2005). Queries emphasized gaining an understanding of the strategies used to facilitate and maintain clinical engagement, and which strategies might be improved or modified to serve a prevention-focused population. Interviews were qualitatively analyzed to inform the design of CLDs describing how FAIR treatment components and engagement strategies led to positive parent outcomes. CLDs thus informed how treatment components and engagement strategies might be maintained or modified to support effective FAIR prevention adaptations.

Semi-Structured Key Informant Interviews

Semi-structured interviews with graduated FAIR parents ($n = 9$) and current or previous FAIR clinicians and administrators ($n = 11$) were conducted. Graduated FAIR parents were included because they experienced treatment during the phase of session frequency similar to the expected level of contact for PRE-FAIR parents. A multi-stage process was used to identify eligible parents in order to protect parent confidentiality and well-being. First, FAIR clinicians were asked to recommend parents who had graduated at least 1 year prior. Referred parents were contacted by their FAIR clinician to obtain permission for the study's Principal Investigator and FAIR developer (Saldana) to contact them. The clinicians were not involved further or told if their referral participated. The Principal Investigator contacted parents directly, explained the study purpose, and introduced the parent to the interviewer (Cruden). Upon agreeing to participate, parents were mailed consent documents and instructions for joining the interview on a video conferencing platform. Interviews lasted approximately one-hour each. Parents were compensated $50 for their time via their choice of a personal check or gift card to a local store, where they could obtain daily necessities (e.g., food and gas). Throughout recruitment, consent, and the interviews, parents were reminded that the interviewer was not involved with the FAIR clinic or team and that their responses would be kept confidential.

All current FAIR clinicians ($n = 7$) and administrators ($n = 2$) were invited and agreed to participate. Previous clinicians who worked with FAIR recently were invited and consented ($n = 2$). Clinicians were compensated $50 via a personal check. Similar to parents, clinicians were given instructions for joining the video conferencing platform and consent documents prior to their interview.

Interview scripts were co-created by the interviewer and FAIR developer. Graduated parent interviews focused on the parents' perception of the services they received through FAIR, services that parents accessed with the support of their FAIR clinician, current strategies for maintaining sobriety, and suggestions for adapting FAIR to PRE-FAIR or generally improving FAIR. Clinician and administrator interviews focused on the ancillary services that they helped parents to access, barriers in connecting parents to services, suggestions for adapting FAIR to PRE-FAIR, and engagement strategies. Interviews were recorded and professionally transcribed for qualitative analysis in Dedoose™ (Dedoose, 2016). Study procedures were reviewed and approved by the Oregon Social Learning Center Institutional Review Board.

Qualitative Analysis

Content analysis was employed to derive key variables for the CLDs (Mayring, 2015; Marçal et al., 2021). A hybrid approach with both inductive (data-driven) and theory-driven coding was applied across a multi-stage process (Fereday and Muir-Cochrane, 2006). First, a codebook was drafted based on the FAIR logic model (Saldana et al., 2021) and study goals (e.g., prevention adaptation implication) by the interviewer and Principal Investigator. Next, the interviewer added initial codes based on interview memos (e.g., parent feels seen, dosage, and value of FAIR). The interviewer then trained two independent coders who were naïve to detailed participant characteristics beyond the fact that participants had graduated from FAIR or work as a clinician/administrator for FAIR. The independent coders were aware that the study purpose was to derive feedback loops and adapt FAIR for prevention, as these study goals were deemed important to focus the coding and derive rich information about feedback behaviors. To test the reliability of the codebook, coders applied the initial codes and identified additional emergent codes across representative transcripts ($n = 4$) (Creswell and Zhang, 2009; Crowe et al., 2015). The three coders met to discuss discrepancies and converge emergent codes. The codebook then was refined and independently applied by all three coders to all transcripts. Codes were not mutually exclusive. Each coder kept detailed coding memos and reviewed other coders' memos before peer-debriefing; coders met two additional times for peer-debriefing to reach consensus (Patton, 2001; Levitt et al., 2018). Codes then were compared and contrasted to cluster them into meaningful groups in a computer spreadsheet (Patton, 2002; Ritchie and Spencer, 2002). The frequency with which codes had been applied and coding memos guided identification of salient themes. A theme for each group was created to characterize the content represented by code clusters and reviewed during a final peer-debriefing (Glaser, 1965; Patton, 2001). Themes were operationalized through CLD narratives (section "Deriving Causal Loop Diagrams").

Coding consistency was validated by comparing the overall frequency of applied codes using the coding matrix available within Dedoose™. Coders applied proportionally equivalent codes across transcripts. To support the dependability of results (Crowe et al., 2015), the FAIR manual and developer were consulted to validate the codes and associated definitions for each code.

Deriving Causal Loop Diagrams

Causal loop diagrams were created to visually depict how salient themes interrelated, with a focus on how key FAIR treatment and engagement strategies related to parent outcomes. A table was created to identify the variables within each loop (with variables often drawn from a qualitative code), tell a story describing the loop based on qualitative themes and causal links identified in coding memos, and include representative quotes for each story (Hovmand, 2014; Baugh Littlejohns et al., 2018; Marçal et al., 2021). Particular attention was given to explaining the pathways (i.e., intervention strategies) through which engagement in FAIR was achieved and maintained in order to identify those to replicate or modify in PRE-FAIR. Engagement was broadly conceptualized as parent attendance in treatment sessions and service appointments. The two trained coders reviewed the table and CLDs for accuracy and consistency with qualitative data. CLDs were designed in Stella Architect v 1.9.4 (ISEE Systems, 2019).

RESULTS

Sample Characteristics

One dad and eight moms were interviewed. Due to the sensitive nature of the interview topic and small sample size, additional parent demographic data was not collected. To protect clinicians' and administrators' confidentiality, limited demographics are presented. The sample consisted of nine clinicians and two administrators (who did not interact directly with parents). One current clinical supervisor and one previous clinical supervisor participated. The majority of clinicians were licensed as Qualified Mental Health Associates (QMHA) and the minority were licensed as Qualified Mental Health Professionals (QMHPs). QMHPs hold a minimum of a Master's degree and experience. Clinicians' experience with FAIR ranged from less than 1 year to approximately 10 years.

Operationalizing the Engagement Strategies in Families Actively Improving Relationships and Strategy Links to Parents' Sobriety

Key feedback loops driving the causal theory of how FAIR engagement leads to parents achieving and/or maintaining sobriety are presented individually (**Figure 1**) and in a more comprehensive CLD (**Figure 2**) showing how feedback loops interrelate. A loop describing how engagement drives treatment quality is first presented. Next, detailed loops that explain the dynamics driving engagement are presented. For each loop, the qualitative themes that characterized each loop are first presented, followed by descriptions of how loops relate to parent treatment goals.

The comprehensive CLD (**Figure 2**) shows feedback loops that are important for appropriately characterizing how FAIR and PRE-FAIR dynamically operate to help parents make positive choices about their health and parenting practices. Given the study purpose of informing a prevention adaptation, this CLD does not entail the full extent of dynamic complexity related to the original FAIR treatment program, designed for a high-needs population. The **Supplementary Material** contains examples of these more complex feedback loops, including loops that demonstrate the endogeneity or interconnectedness of FAIR's four treatment domains (substance use, parenting skills, mental health, and ancillary needs).

Central Reinforcing Feedback Loop: Engagement and Treatment Quality (Figure 1A)

Engagement emerged as a key virtuous feedback loop driving treatment quality. Emergent themes suggested that clinicians engaged parents through five key strategies: 24/7 clinician availability, in-home delivery, in-person advocacy, strengths-based dialogue or interaction, and urinary analysis (UA). Each strategy is detailed below [section "Engagement Strategy Feedback Loops: 24/7 Clinician Availability (**Figure 1B**)" to section "Engagement Strategy Feedback Loops: Urinalysis Administration (**Figure 1D**)"]. As parents received high-quality, consistent engagement strategies from clinicians, they were more likely to increase participation in FAIR (i.e., engagement) through honest communication and regular attendance, leading to high-quality treatment (**Figure 1A**). High-quality treatment increased parents' sense of empowerment and confidence due to strengths-based treatment delivery [section "Engagement Strategy Feedback Loops: Strengths-Based Interactions (**Figures 1A,C**)"] of evidence-based, manualized treatment components such as parenting skills training and positive coping strategies. As parents felt empowered and progressed toward their treatment goals, they increased their desire to engage with their clinician, and this engagement helped parents continue making positive choices about their health and sobriety. Demonstrating the strength of the therapeutic relationships and engagement quality, several parents reported wanting to continue engaging their clinicians after graduating FAIR. The following quote illustrates this: "I reach out to her because I really, I enjoyed the program. I've been through multiple A&D (alcohol and drug) programs, and so this was—I like the bonding."

Engagement Strategy Feedback Loops: 24/7 Clinician Availability (Figure 1B)

Components and causal pathway(s) to engagement

Parents could reach their clinician or another FAIR clinician at any time of day on any given day (i.e., 24/7). This consistent availability was made feasible through team-based clinical coverage, with a designated clinician on-call should the parent's primary clinician be unavailable (e.g., vacation and sick leave), and weekly team meetings. These meetings helped ensure
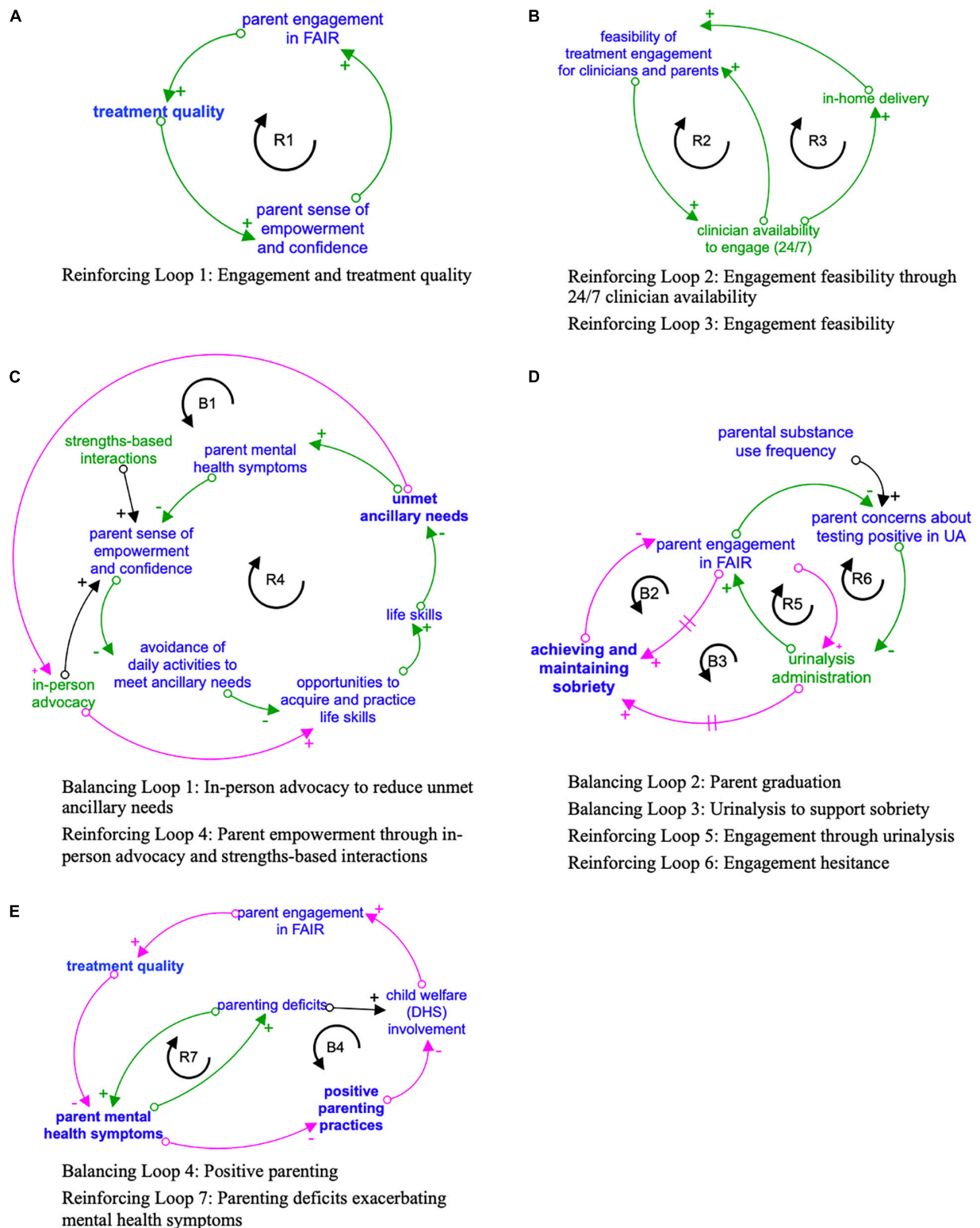
FIGURE 1 | (A-E) Key feedback loops driving the causal theory of how FAIR engagement strategies impact parent engagement and treatment goals. Engagement strategies designated in green. Outcomes related to the four primary FAIR treatment domains designated in bold. Reinforcing loops indicated in green with R clockwise arrow, and Balancing loops in pink with B counter-clockwise arrow. Arrows with a + sign indicate that the variables either both increase or both decrease when there is a change. Arrows with a – sign indicate that as one variable increases, the other decreases, or vice versa. A hashmark (two parallel lines) on an arrow represents a delay in the effect of the first variable on second variable.

FIGURE 2 | Composite causal loop diagram: FAIR engagement strategies and impact on parent treatment goals. Arrows with a + sign indicate that the variables either both increase or both decrease when there is a change. Arrows with a – sign indicate that as one variable increases, the other decreases, or vice versa. A hashmark (two parallel lines) on an arrow represents a del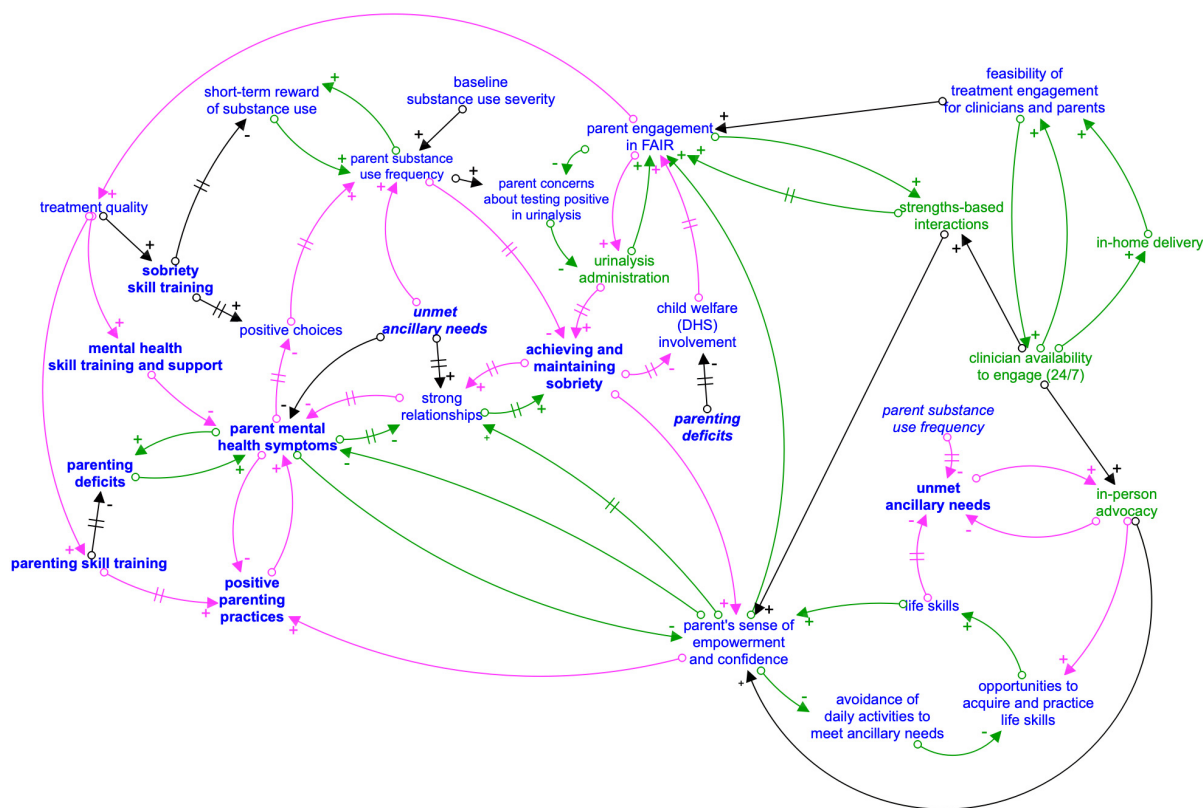ay in the effect of the first variable on second variable. Foodback loops are indicated with like colored arrows (green for reinforcing and pink for balancing). Variables in green represent engagement strategies. Outcomes related to the four primary FAIR treatment domains designated in bold. Italicized variables are repeated from another part of the causal loop diagram for visual simplicity.

that all clinicians were aware of pertinent details related to other clinicians' parent treatment plans. Clinicians used clinic-provided phones to frequently and directly communicate with parents. These strategies increased the feasibility for clinicians to consistently engage with parents (**Figure 1B**). As part of 24/7 engagement, FAIR clinicians reached out to parents between formal treatment sessions to let parents know they were thinking about them, provide strengths-based support [see section "Engagement Strategy Feedback Loops: Strengths-Based Interactions (**Figures 1A,C**)"], and to reinforce that parents can reach out at any time if they need support, including if they were considering using substances. Both clinicians and parents reported that this consistent engagement helped build rapport. One parent gave an especially clear example of how 24/7 availability helped them engage in FAIR and make positive choices about their sobriety and children's well-being (of note, parents and clinicians both normally refer to child welfare services as "DHS" because the child welfare department is housed within the Department of Human Services):

I mean I even called [counselor] at 11:00 one night and just told her that I was 99% sure my boyfriend was high and that they had said they'd come if it was an emergency.

They were 24/7. She said, "I think maybe we can wait until morning. It's 11:00." I said, "No, it's an emergency, and if DHS were to show up for any reason right now, they would take the kids." [Another FAIR clinician], was my boyfriend's counselor, so he came over at 11:30 at night and he [unintelligible], and took him to a motel to get him out of here because he was dirty. Just no other treatment would do that.

Link(s) to treatment goals

As parent-clinician rapport grew, parents increased their belief that clinicians would help them meet their treatment goals. Increased rapport thus increased parents' willingness to consistently and honestly engage. Increased parent engagement improved treatment quality by providing more opportunities for the parent to acquire sobriety skills, which in turn increased the likelihood that parents consistently made positive choices about their substance use. As one parent reported: "I mean any time of day if I needed to text or call, I could call or text. It wasn't a 2-day waiting period. They'd get back to me instantly even if it came down to, 'Well, I just had a dream about using and now I want to use.'"

Engagement Strategy Feedback Loops: In-Home Clinician Availability (Figure 1B)

Components and causal pathway to engagement

Because clinicians were available 24/7, they were better able to accommodate parents' schedules and meet them where they live, even if unhoused, and otherwise spend their time. In-home engagement increased the feasibility of clinician engagement and parent engagement, thereby increasing opportunities to engage in FAIR, receive high-quality treatment, and achieve treatment goals (**Figure 1B**). Straightforwardly, it was more feasible for a parent to engage because they do not have to obtain independent transportation or commute. Parents appreciated this accessibility: "It just made it easier. I think I was first starting to become a manager in the middle of us meeting so I was starting to work a lot of hours, and a lot of long hours so that was really hard on me to begin with so [counselor] would just meet me here which was really nice too. It's easy. A lot of the times, I would be feeding the baby breakfast when he came or whatever." Further, having clinicians in their home sometimes helped parents to honestly engage: "I just think I felt more comfortable in my home anyway... I mean, that was really nice for him to see me in my own personal setting I think. It's harder to lie and hide in those kinds of settings."

Link(s) to treatment goals

In-home engagement directly facilitated parents' treatment goals through at least two pathways. First, in-home engagement provided a comfortable environment for parents to honestly engage and to collaboratively identify individualized treatment goals and potential challenges to reaching those goals with their clinicians.

> A big part of it was – a lot of treatment facilities, you get thrown into a group setting with a whole bunch of people. So, the thing that helped a lot was the flexibility of being able to meet in different locations. If you can't make it, then they would come to you. Sometimes we'd meet at parks or we go out to lunch for our meetings. Different things like that to make me feel comfortable, and that made it a lot easier to open up.

Second, in-home engagement offered the opportunity for clinicians to deliver highly personalized, and at times non-traditional, treatment or engagement strategies that increased parents' desire to engage with FAIR. A small, creative gesture through in-home delivery can provide long-lasting support and eventually increase engagement through encouraging the parent to engage rather than choosing to discontinue treatment, as demonstrated by the following reflection:

> Most of the time, we met at my house, but she'd meet me wherever I was at. There was a few times that I was trying to get out of meeting her because I didn't want to take the UA, and she was just telling me, "It doesn't matter where you are, I'll meet you there. I'll drive to you. Just tell me the spot." It was one of those couple of times that I didn't show up to the house, and she left me a note, and I actually still have the

note. It just said, "I know you're having a hard time. You can do this. Hang in there. Please call me." She even made me a Superhuman Mom Strength Award that she cut out and made herself, and I still have it on my board on my wall.

From the clinician's perspective, in-home engagement provided opportunities to practice skills discussed during treatment sessions (such as positive parenting skills), directly observe parents' environment and interpersonal interactions (such as with their children or partners), and identify treatment strategies that might not otherwise have been identified. A clinician reflected:

> Whereas, one of the advantages of what we have is we meet parents literally where they're at, and going into their home turf and seeing what it is that they have to deal with. That can provide a lot of advantages when we get eyes on the situation. Maybe we notice something that they maybe don't notice because they've just become accustomed to it. That just helps everything run a little bit better. Whether it's like "Hey, what if we rearrange your furniture so that it felt like this was a different room instead of being stuck in the room where you used to use?" . . .It doesn't cost anything to do that. Just time.

Engagement Strategy Feedback Loop: In-Person Advocacy (Figure 1C)

Components and causal pathway(s) to engagement

When providing in-person advocacy, clinicians assisted parents with completing a range of daily life activities, such as navigating ancillary services (e.g., medical care, long-term mental health treatment, housing, employment, and child care) and completing DHS case management and legal sessions (e.g., court). Similar to in-home engagement, in-person advocacy was a standard FAIR treatment component that was tailored to parents in a key balancing feedback loop (**Figure 1C**) that helped disrupt vicious feedback loops that might lead to parental substance use, such as increased mental health symptoms. For example, parents reported sometimes experiencing negative interactions with ancillary service providers, such as physicians. These experiences caused parents to have anxiety when accessing these services and to believe that they will not be successful obtaining services. As a result, parents were less likely to access services. When parents faced challenges accessing services, the resulting unmet needs increased parents' stress and anxiety, leading to a decline in their mental and physical health and sobriety. This vicious cycle of parental mental health symptoms increasing due to unmet ancillary needs could be disrupted through in-person advocacy by the clinician. One parent reflected on how in-person advocacy disrupted this vicious cycle:

> I got an amazing counselor. She was able to help me through pretty much everything. Because at the time, I still had a DHS case going, and she was able to help me with the problems I was having as far as – she was able to help me with everything from taxes to finding other treatment facilities that could help me for when I was finished working

with FAIR. Pretty much anything that I had wrong in my life, she went out of her way to make sure that I had some sort of resource to help me get through it so I wasn't just up in the air, stressing about anything.

Further, in-person advocacy provided opportunities for clinicians to support parents as they worked toward meeting DHS (i.e., child welfare) requirements. Parents often discussed relying upon clinicians to "interpret" DHS requirements and advocate for them to ensure that DHS understood the progress parents were making. These parents reported that DHS would at times adjust expectations and DHS treatment goals accordingly. This advocacy helped parents "feel seen" and supported by the clinician, and thus more willing to engage with their FAIR clinician and DHS caseworker. The impact of in-person advocacy can be seen in the following parent quote:

> For one, the biggest help was like another voice. Someone who could communicate between the two, be it a worker, me, and the kid's attorney. Just to help get information to people that maybe the case worker wouldn't say it in the correct way because I wanted it translated. And then, being someone with that firsthand knowledge of what was going on, being able to communicate to those people.

By advocating for parents directly to those who provide ancillary services, clinicians helped parents feel supported and directly increased parents' access to ancillary services through changing the interpersonal dynamics between parents and ancillary service providers (**Figure 2**):

> I've seen it where I'll go with parents, just having another professional there, having an advocate who can say that "No, this person is trying to go legit. This person is working a program. There's an accountability piece here. This is not like the other folks that you may have seen." Sometimes, that can be a huge game changer. I've seen it even to the point where someone like a doctor who starts the first appointment and they got kind of an attitude toward the parent. Having not even met them before, just because of whatever preconceived notions they have about what they're coming in for and what to expect with that. By the third appointment, they've got a completely different attitude and they're asking them about what all is going in with life and now they're treating them like a human.

Parents' experiences directly mirrored this clinician's perspective:

> It was helpful. [counselor] was my FAIR counselor, but he went with me to a lot of the doctor's appointments which I'm glad because the doctor – I mean I get it. He sees many people, who are in there, just trying to get things to get high on. I was there because I was trying to do it the right way, I guess. At first, it was rough. He was kind of mean, but – [counselor] would talk about it and things got smoother from there. The doctor knew I was serious. It just got better from the first appointment on.

Link(s) to treatment goals

In-person advocacy created a balancing loop by increasing opportunities for clients to access ancillary services and practice life skills, such as advocating for themselves, eventually reducing the need for in-person advocacy as ancillary needs were met. This balancing loop strengthened the virtuous reinforcing loop in which parent empowerment led to reductions in parent mental health symptoms and unmet ancillary needs, thereby further empowering parents (**Figure 1C**). One clinician described this link as follows:

> So, if they've got a DHS case and the DHS case workers are able to provide some of those resources but maybe the parent doesn't know how to ask for that or has had some trouble with the relationship between them and the case worker, so then accessing that feels awkward... But we also try in the same sort of area of their DHS cases or things along those lines, if it's meeting with the parole officer, we'll try and support them in that. Maybe go to one or two of those meetings just to let them know they're okay, they're doing a program and this is the program, and of course, we get our allies and everything up and running before we actually make that meeting happen. But sometimes that can be a big game changer as far as not only making the access of that resource go better, but then moving forward, what that relationship looks like can be quite different.

From the parent's perspective, in-person advocacy was essential to feeling supported in the moment (empowered), but also for increasing opportunities for learning and applying life skills that can serve them over the long-term, such as emotion regulation and positive coping techniques. These skills then served parents in both the short-term (e.g., DHS case) and long-term (e.g., ongoing positive interpersonal relationships and accessing ancillary services). The following quote demonstrates how essential in-person advocacy was for one parent to practice some life skills:

> Sometimes, they DHS would say stuff that you don't understand or just to have that one support person saying that you are doing what you're supposed to be doing and you have that one person in your background. That helped a lot because then, they weren't just listening to what I was saying. They had someone else backing me up that I was actually doing what I was supposed to be doing... I'm one of those people that if I feel like you're attacking me, I get defensive very much. It's a fight or flight thing. I either fight back. That's my thing. I just fight back. I get angry or I get upset. I cry. I shut down. Having [clinician] there, he was there to bring me back like down and ground me and show me grounding tricks and how to do it in the moment instead of just telling you how to do it.

Relatedly, graduated FAIR parents reported that meeting their ancillary needs was integral to preventing substance misuse, as demonstrated in the following quote:

> A lot of substance abuse problems come from stress and people trying to deal with stress in their own way, and a

lot of that comes from people who just need help. Whether they're going through financial troubles or anything like that, it's like a lot of the things that they helped me with, at the core, solves my addiction problem too. It can help a lot of people that aren't even going through addiction but just need help learning how to cope with different problems in their life.

Engagement Strategy Feedback Loops: Strengths-Based Interactions (Figures 1A,C)

Components and causal pathway(s) to engagement

Strengths-based interactions emphasized communicating parent's positive choices and behaviors. Similar to in-home delivery and in-person advocacy, strengths-based interactions are a standard FAIR treatment strategy. The use of strength-based interactions increases with increased parental engagement because there are more opportunities for such interactions. As parents felt supported and not judged by the clinician, they were more likely to share their experiences honestly and increasingly engage with FAIR. High-quality, increased parent engagement provided opportunities for the clinician to understand what types of treatment the parents were receptive to and could benefit from, parents' treatment goals, and challenges parents faced. Clinicians could then tailor engagement and treatment strategies instead of taking a one-size-fits-all approach. For example, one parent characterized themselves as unorganized, and described how their therapist brought them a notebook to organize their paperwork as they collaboratively worked toward meeting the parent's ancillary needs and other treatment goals. The strengths-based, tailored strategies helped parents feel supported and empowered. As one parent reflected: "It's just a great place to help. Instead of your life being controlled and put in place by somebody else and you just following orders, they teach you how to put your life in order."

Further, hearing positive comments about their choices and unique strengths helped parents to see value in their skills, experiences, and emotions, which also increased their sense of empowerment and confidence. Parent empowerment was so integral to positive parent treatment outcomes that it is present in multiple reinforcing and balancing feedback loops (**Figures 1A,C, 2**). One parent described how strengths-based engagement empowered them: "Well, he [clinician] explained it in a way where it didn't feel like it was "I'm better than you" type of thing. It's like "I'm teaching you these coping tricks. I'm teaching you these things so you can have a better life." It wasn't just "I'm teaching you these as a paycheck." It was "I'm teaching you these so you can do better because I know you can do better." As parents felt empowered, they saw how they could make positive choices about their health with the support of FAIR, which made them want to initiate and maintain engagement. Several clinicians explained how strengths-based engagement helped them identify treatment goals with parents in a manner that parents could positively internalize, such as the following:

> I always try to do the sandwich approach when I'm talking with families and just really start it off with like praise and

kudos. . . and then I kind of go on to the hard topic because sometimes I'm able to – depending on the rapport I have with somebody, I'll hit him with just transparency and call on them on their behavior, but then I'll follow it up with like more positives and praise and clients are – they receive it.

Link(s) to treatment goals

Empowerment was not only a key pathway to FAIR engagement (i.e., short-term positive outcome), but also a key pathway to supporting parents as they built a long-term sense of confidence and similar internal supports. Several parents honed in on this pathway when asked about the value of FAIR, such as the following:

> When there are so many steps that they do with you that you get your own self-worth back. It's to know that you are actually worth something or that you do have potential. Do you know what I mean? It's like they build your confidence up as well. It's not just like. . .they're just there. Like I said, not a lot of people have people that are just actually there. They were just there and I needed that.

Strengths-based interactions thus facilitated a key virtuous feedback loop in which parents maintain sobriety and parent's sense of empowerment. Notably, the importance of receiving positive (i.e., strengths-based) support was the most commonly applied code among FAIR treatment strategy implications for parent outcomes.

Engagement Strategy Feedback Loops: Urinalysis Administration (Figure 1D)

Urinary analysis is administered regardless of severity of substance use or a parent's time in FAIR (Saldana, 2015). While UA contributes to both engagement and thus treatment, creating a reinforcing loop (**Figure 1E**), UA administration also declines as parents achieve sobriety and graduate from FAIR, introducing a balancing loop. A second reinforcing loops describes how some parents avoided engaging in FAIR initially because they were concerned about a positive UA. These concerns can be mitigated through treatment and engagement strategies, described below.

Components and causal pathway(s) to engagement

UA administration is a recurring opportunity to engage parents in a discrete treatment activity (i.e., monitoring substance use). It is coupled with a strengths-based interaction and evidence-based strategies such as contingency management (Saldana, 2015). Contingency management in FAIR is operationalized through "FAIR Bucks" that can be redeemed at the FAIR Store for everyday household items, clothes, toys, and other items of interest to parents and their families. Parents might have been offered FAIR Bucks for providing a UA early in treatment when they were more likely to provide a positive sample. Parents reported that the consistency of UA administration, coupled with strengths-based interactions regarding UA results, helped them to feel accepted by clinicians and realize that they could honestly engage: "I appreciate the positive reinforcement

and how they didn't degrade me if I did have a dirty UA."

Link(s) to treatment goals

Some parents reported that UA administration directly supported them in achieving and maintaining sobriety by providing a consistent, unbiased, tangible source of accountability and measure of treatment progress. As one parent described: "I mean, the accountability was really nice too. Some people might be mad about or are like negative feeling I guess about being drug-tested, but I've enjoyed it because I liked the accountability behind it. I mean at first, you almost don't trust yourself to stay clean and stuff, so just knowing that you're going to have to take those, it helps you as well to get over that hump."

Moderating Variable of Substance Use Feedback Loop: Baseline Substance Use

Not all parents immediately engaged with FAIR. Parents who had more severe substance use at baseline reported delayed engagement in FAIR. While not a focus of the current study, parents in this sample reported behaviors consistent with previous research indicating that substance use can provide short-term positive reinforcement for parents, which causes them to continue using (**Figure 2**; Han et al., 2018; Volkow et al., 2019). FAIR treatment strategies aim to interrupt this vicious feedback loop. Baseline substance use can thus moderate FAIR engagement timeliness and quality until a parent has experienced sufficient consistent clinician engagement strategies, or external stressors such as involvement with child welfare. Through engagement and high-quality treatment, parent substance use frequency declines over time in FAIR (Saldana, 2015; Saldana et al., 2021). Note, parental substance use is included in the CLD as "substance use frequency" to emphasize that substance use frequency can dynamically change over time, regardless of baseline severity, which includes frequency and dosage of use.

> I think we [FAIR counselor] worked together for almost a year. The first part of it, I wasn't ready to get clean and so I'm just trying to push him away but he would not leave me alone. [Laughter] So, then finally – I was pregnant during this time too, and so I gave birth to my son, and they took him right away and so we had court a couple of days after that and he showed back up. I told him I was ready and so he stuck it with me until I got [into detox].

Clinicians reported the importance of engagement strategies to reduce or overcome parents' initial rejection of FAIR. For example, one clinician reflected on the importance of being consistent and persistent:

> The most important thing for me in FAIR is engagement. You have to engage with those parents. I've had parents fire me, and then I say, "Well, I'll see you tomorrow," and they'll say, "Okay." [Laughter] They'll get mad at me for whatever reason. Sometimes it's not my fault. They're mad at me because I'm the one there, and they'll say, "I hate

FAIR, I don't want to be part of FAIR anymore," and I'll say, "Well, we can talk more about it tomorrow."

Interconnections Between Engagement and Treatment Strategies to Support Parents' Positive Choices

Families actively improving relationships engagement strategies, while planned as part of families actively improving relationships manualized approach, can be delivered more or less intensely as parent engagement varies over time (i.e., parents must engage to receive some treatment and experience further engagement strategies). Further, interview themes pointed to the endogeneity of parent's success—improvement in one domain, such as reduced mental health symptoms, led to improvements in other domains such as positive parenting practices. As the current study was focused on specifying potential adaptations to FAIR for PRE-FAIR, and the phenomenon of parental improvement in one treatment domain affecting another domain has been observed in previous FAIR trials as well as systematic reviews of the literature (Neger and Prinz, 2015; Saldana et al., 2021), detailed presentation of these results can be found in the **Supplementary Material**. **Figure 2** represents how the individual feedback loops presented in section "Operationalizing the Engagement Strategies in Families Actively Improving Relationships and Strategy Links to Parents' Sobriety" and depicted in **Figure 1** are interconnected and situated within the larger system of FAIR treatment strategies and parent outcomes.

DISCUSSION

Table 1 offers an overview of how key engagement strategies and treatment component feedback loops relate to prevention adaptations. Results suggest that PRE-FAIR clinicians should maintain fidelity to the FAIR model of synergistically delivering all four treatment domains (substance use, parenting practices, mental health, ancillary needs; **Table 1** and **Supplementary Material**) and using engagement strategies such as a strengths-based approach to support virtuous cycles of parent success (e.g., improvements in mental health and positive parenting, **Figure 1E**). However, engagement strategies directly and indirectly affected parent success across each of these domains, highlighting the need to consider how any engagement adaptations for PRE-FAIR might have cascading effects on parent engagement and treatment outcomes (section "PRE-FAIR Engagement Timeline Variation by Baseline Substance Use"). Thus, adaptation effects will be tracked carefully in the PRE-FAIR trial.

The current study offers three primary implications for PRE-FAIR: (1) the need to continue employing creative, multi-strategy engagement; (2) the role of baseline parental substance use on expected PRE-FAIR treatment duration and dosage; and (3) the need for prioritizing ancillary needs earlier in PRE-FAIR treatment compared to FAIR. These lessons could be generalized to guide adaptations for treatment programs similar to FAIR and testing or implementing adapted programs in new settings or locations.

TABLE 1 | Key feedback loops for parental engagement in FAIR: Implications for prevention adaptation to PRE-FAIR.

Key feedback loops	Causal link to core FAIR treatment domains and outcomes (substance use/sobriety, parenting, mental health, and ancillary needs), FAIR engagement, and treatment quality	Implications for prevention adaptation
FAIR engagement increases **treatment quality** (**Figure 1A**)	Direct: Treatment quality Indirect: Parent empowerment	Emphasize importance of engagement and creative, multi-pronged approaches to engagement when training new FAIR clinicians (section "Maintain and Track Creative, Multi-Strategy Engagement")
Engagement feasibility increases with **24/7 clinician availability** and **in-home delivery** (**Figure 1B**)	Direct: FAIR engagement Indirect: Treatment quality; achieving or maintaining sobriety; parenting practices; mental health; and ancillary needs	Emphasize importance of engagement and creative, multi-pronged approaches to engagement when training new FAIR clinicians (section "Maintain and Track Creative, Multi-Strategy Engagement")
In-person advocacy reduces **parent mental health symptoms** (**Figure 1C**)	Direct: Ancillary needs; Mental health Indirect: Achieving or maintaining sobriety; parenting practices; FAIR engagement; and strong relationships	Prioritize meeting parents' ancillary needs (section "Prioritizing Ancillary Needs Treatment Component")
Strengths-based engagement increases **parent empowerment** to reduce **unmet ancillary needs** (**Figure 1C**)	Direct: Life skills, ancillary needs Indirect: Parenting practices; mental health; and FAIR engagement	Emphasize importance of engagement and creative, multi-pronged approaches to engagement when training new FAIR clinicians (section "Maintain and Track Creative, Multi-Strategy Engagement") Prioritize meeting parents' ancillary needs (section "Prioritizing Ancillary Needs Treatment Component")
Increased **baseline substance use** severity delays high-quality **parent engagement** in FAIR (**Figure 1D**)	Direct: FAIR engagement Indirect: Treatment quality; achieving or maintaining sobriety; parenting practices; mental health; and ancillary needs	Modify treatment dosage and titration for PRE-FAIR (section "PRE-FAIR Engagement Timeline Variation by Baseline Substance Use")
Child welfare involvement increases **parent engagement with FAIR** (**Figure 1E**)	Direct: FAIR engagement Indirect: Treatment quality; achieving or maintaining sobriety; parenting practices; mental health; and ancillary needs	Modify treatment dosage and titration for PRE-FAIR (section "PRE-FAIR Engagement Timeline Variation by Baseline Substance Use")
Ancillary supports (**unmet needs**) increase likelihood of **achieving or maintaining sobriety** (**Figure 2**)	Direct: Achieving or maintaining sobriety Indirect: Parenting practices; mental health; ancillary needs; and FAIR engagement	Prioritize meeting parents' ancillary needs (section "Implications for Prevention Adaptations and PRE-FAIR Trial" to "Future Research")

Loop variables are indicated in bold.

Implications for Prevention Adaptations and Prevention-Oriented Approach Trial
Maintain and Track Creative, Multi-Strategy Engagement

The first key implication for PRE-FAIR is the importance of parent-centered, multi-strategy engagement. FAIR engagement strategies increased the likelihood of parents successfully achieving proximal treatment goals and led to the creation of long-term supports. Clinicians reflected on how they appreciated the ability to be creative, such as bringing a parent's favorite drink to a treatment session, in order to build rapport and increase parents' honest engagement. Findings around clinicians' engagement strategies are consistent with recent studies that report the need for off-business hours clinician availability and persistent engagement to develop therapeutic relationships with parents involved with child welfare (Yoon et al., 2021). Based on the current study, it is evident that creative, consistent engagement strategies also will be used for a prevention-oriented

intervention, but qualitatively different creatives strategies might emerge during PRE-FAIR. Thus, PRE-FAIR trial procedures will be designed to capture this creativity and identify potential new strategies unique to PRE-FAIR. In particular, strengths-based engagement still will be essential for PRE-FAIR, as illustrated by a clinician's reflection: "Prevention really comes from, in my mind, just an overall sense that there is somebody out there to help and that choice to reach out to those people if they even know that they exist, right? Then, feeling at least, hopefully, the confidence to be able to reach out."

Of note, PRE-FAIR parents might be at risk for involvement with child welfare, but might not yet have an active case. Some of the interviewed graduated parents in FAIR reported that child welfare involvement was an impetus for their engagement in FAIR (**Figure 2**). Consistent, creative engagement by PRE-FAIR clinicians might be even more important in PRE-FAIR to build rapport and parent engagement in the absence of service system-level consequences such as removal of one or more children from the home.

Prevention-Oriented Approach Engagement Timeline Variation by Baseline Substance Use

The second key implication for prevention is the potential appropriateness of PRE-FAIR and therefore duration of PRE-FAIR engagement given a parents' baseline substance use. Baseline substance use was reported to potentially moderate parents' engagement in FAIR, as parents with higher levels of substance use often had a longer period of initial engagement in FAIR. Clinicians reported that parents with higher baseline levels of substance use often have more complex ancillary needs, requiring additional time to help parents meet those needs. Thus, parents in PRE-FAIR, who by definition will have lower levels of baseline substance use than those in FAIR, are hypothesized to have shorter overall treatment duration. This insight led to modifying the planned treatment dosage for FAIR, given that the five engagement strategies (i.e., 24/7 availability, strengths-based approach, in-person advocacy, in-home delivery, and UA) might be delivered more immediately (i.e., shorter delay from initial parent engagement to high-quality engagement) and less frequently (i.e., less frequent parental substance use, thus less need to engage and disrupt that vicious cycle) in PRE-FAIR.

The PRE-FAIR dosage schedule was modified from FAIR to be 3 days per week in the first month of parent participation instead of 5 days per week, with planned titration to 2 days per week in months two through three, and 1 day per week in month four, upon which parents are anticipated to be graduating from PRE-FAIR. This is a notable, yet fidelity-consistent adaptation (Stirman et al., 2019) from the FAIR titration that typically occurs over 8–9 months. The planned PRE-FAIR trial will explicitly examine whether parents' needs align with this titration schedule.

Prioritizing Ancillary Needs Treatment Component

Some parents reported that reduced stress due to meeting ancillary needs also reduced their desire to use substances. Meeting parents' ancillary needs is thus a key potential mechanism for preventing substance use and might be emphasized earlier in PRE-FAIR compared to FAIR. Of note, tradeoffs or variation in how clinicians and parents spend their time focusing on each FAIR domain (substance use, parenting, mental health, and ancillary needs) will be modeled in a future simulation study and tested in the PRE-FAIR trial.

Practically, as PRE-FAIR clinicians expand services to new counties and new system partners, careful attention should be paid to the time and skills clinicians need for generating relationships with community partners that can help meet parents' ancillary and other treatment component needs, such as mental health providers that can provide mental health support to parents after they graduate PRE-FAIR. Clinicians often reflected on how they relied upon their network of community partners and fellow clinicians to identify resources, which helped mitigate the balancing loop impact of low service availability on meeting parents' ancillary needs (**Figure 2**). The PRE-FAIR partnership with Self-Sufficiency will provide an excellent opportunity to leverage existing resources. For example, a clinician reported leveraging their relationship with community partners to navigate waitlists: "Sometimes I've talked

to community partners and I've said, 'Can you guys start another class? Can there be another night that you guys do respite care?' Because a lot of my parents need that." Another clinician succinctly described their ingenuity and perseverance in establishing relationships: "We work closely with DHS to see what community partners DHS has, especially in rural communities. We call around. We learn from those other community members too what else is – because I get a lot of my information from other people." However, as clinicians spend more time fostering community partnerships, they will have less time to engage parents (**Supplementary Figure 2**). The tradeoff between demands to clinicians' time also will be examined in the simulation study and PRE-FAIR trial.

Limitations

This study should be interpreted within the context of its limitations. First, the parent sample size might have been insufficient to extract all potential considerations for FAIR adaptation to PRE-FAIR, and insights might be specific to the current study sample. For example, interviews initially revealed few balancing loops, requiring consultation with the FAIR developer to clarify dynamics such as how parent mental health symptoms related to positive parenting practices (e.g., appropriate developmental expectations) and parenting deficits (e.g., limited parenting skills, neglectful parenting) (**Figure 1E**). Additional parent and clinician interviews could increase robustness of the CLD. However, there was consistency in the variables that operationalized FAIR engagement and the stories that operationalized the interconnectedness of these intervention strategies (i.e., feedback loops).

Second, the recruitment of only graduated FAIR parents might have led to bias in parent reports and limitations in the scope of insights. Parents shared overwhelmingly positive comments about FAIR when probed for critiques and suggestions, limiting insights on what might be improved for parents who graduated FAIR and what engagement strategies helped or hindered engagement for parents who discontinued. Of the suggestions that were offered, responses were not negative, but rather, for example, a request for more frequent and intensive training in life skills. Other suggestions tended to focus on factors outside of the clinician's control, such as more funding for federal programs that support parents (e.g., SNAP/EBT). A particularly relevant suggestion for PRE-FAIR was to have FAIR provide additional services that might only be available to parents with an open DHS case, such as extra parenting classes or child care. Similar to previous trials of FAIR, which have extensively probed FAIR's acceptability to parents, the PRE-FAIR trial will carefully examine whether PRE-FAIR is meeting parents' needs or could be improved. Including only a sample of successfully graduated FAIR parents also might have limited insights around potentially necessary prevention adaptations. PRE-FAIR parents might have unique treatment goals, existing supports, or desired supports compared to the parents interviewed in the current study. Thus, the PRE-FAIR trial will be designed to capture these differences.

Relatedly, several interviewed parents did not graduate FAIR during their first enrollment in FAIR. They reflected on the more intensive treatments that were required for them prior

to returning to FAIR. Because of the current study's focus on making adaptations for a prevention model for parents with less severe baseline substance use, this theme was not highlighted in the current set of CLDs. The converse might be true in the PRE-FAIR parent population; parents might not quickly see the need for PRE-FAIR. As identified in this study, clinicians can apply flexible, creative engagement strategies to understand what aspects of PRE-FAIR parents might be most effective and best meet their needs. Alternatively, clinicians can refer parents to FAIR for a more intensive treatment. To address these potential limitations, attention will be paid to identifying additional feedback loops and engagement strategies during the PRE-FAIR trial.

Future Research

Immediate next steps include understanding whether: (1) engagement strategies with PRE-FAIR parents differ from successful strategies with FAIR parents; (2) PRE-FAIR is acceptable to parents and results in positive parent and child outcomes, such as reductions in the initiation or escalation of parental opioid and/or methamphetamine use, or DHS outcomes such as removal of children from the home or new reports; and (3) PRE-FAIR implementation costs are sustainable. Adaptations made during PRE-FAIR implementation that were not identified in the current study will be recorded in order to inform future adaptation planning methods.

As noted above, a system dynamics simulation model also will be pursued. This model will support PRE-FAIR clinics in anticipating how PRE-FAIR dynamics, such as more frequent caseload turnover due to a shorter treatment duration, might affect clinical dynamics, such as how quickly new clinicians reach competency in PRE-FAIR clinical strategies and, consequently, how much time clinicians spend with parents. The simulation will be used to learn about potential tradeoffs in how clinicians spend their time, and how these tradeoffs might impact caseload size and claims reimbursement. Insights could thus guide training activities for new PRE-FAIR clinicians and clinic administrators.

Broadly, future research should explore the use of similar systems science-based approaches for planning intervention adaptation and implementation planning efforts. Studies should examine whether such strategies sufficiently identify requisite EBP component and implementation adaptations, and whether EBPs adapted with systems science strategies lead to improved population health outcomes as expected.

CONCLUSION

Given the deleterious effects plaguing the child welfare system and families caused by the opioid and methamphetamine epidemics, there is an urgent need to develop preventive interventions that can address the myriad needs of parents at risk for substance abuse. Drawing on the limited EBPs available to address the treatment of this problem once the symptoms are severe, effective preventive interventions might be possible. Rigorous adaptation of EBPs can support efficacy of the interventions in new settings (e.g., community and

school), geographic regions, and populations (e.g., prevention). Previous studies have noted the importance of carefully planning adaptation to reduce the likelihood of reduced efficacy or acceptability of the intervention by participants (Baumann et al., 2017; Rabin et al., 2018; Stirman et al., 2019). This study presented an innovative application of systems science methods to rigorously identify treatment components that should be maintained or modified, as well as implementation processes that might be affected by prevention adaptations. Insights from the current study will help investigators anticipate what EBP components might be adapted to better support prevention intervention efforts, while also anticipating which treatment components need to be carefully monitored and adapted at subsequent stages of prevention intervention implementation. Future research will evaluate the impact of prevention adaptations on key parent outcomes. Although parental opioid and/or methamphetamine use are leading public health concerns, effective preventive interventions, and the engagement of parents in these interventions, is possible. Future policy must support these efforts for a public health impact to be realized.

DATA AVAILABILITY STATEMENT

De-identified qualitative data is not readily available but might be made available upon request to be analyzed in collaboration with members of the investigative team. Causal Loop Diagram data will be made available by the authors. Requests to access the datasets should be directed to LS, lisas@oslc.org.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Oregon Social Learning Center Institutional Review Board. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

GC conducted all interviews, led all analyses, and drafted the initial manuscript. SC co-coded qualitative analyses, validated causal loop diagrams, and provided substantive edits to the manuscript. LS obtained funding, provided FAIR materials, and served as a validation source for manualized FAIR treatment components, and provided substantive edits to the manuscript. All authors agreed to be accountable for the content of the work.

FUNDING

the Official views of the National Institutes of Health or its NIH HEAL Initiative.

ACKNOWLEDGMENTS

The authors extend their sincere gratitude to the parents, clinicians, and administrators who shared their time and experiences, Caroline Dennis, who supported qualitative coding and provided helpful, thoughtful feedback on the manuscript draft, and the reviewers, who provided insightful and strengthening comments.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg. 2021.689432/full#supplementary-material

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Reduced Child-Oriented Face Mirroring Brain Responses in Mothers With Opioid Use Disorder: An Exploratory Study

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While the prevalence of opioid use disorder (OUD) among pregnant women has multiplied in the United States in the last decade, buprenorphine treatment (BT) for peripartum women with OUD has been administered to reduce risks of repeated cycles of craving and withdrawal. However, the maternal behavior and bonding in mothers with OUD may be altered as the underlying maternal behavior neurocircuit (MBN) is opioid sensitive. In the regulation of rodent maternal behaviors such as licking and grooming, a series of opioid-sensitive brain regions are functionally connected, including the ventral pallidum (VP). In humans, these brain regions, interact with the supplementary motor area (SMA) to regulate maternal behaviors and are functionally dysregulated by opioids. It is unclear how these brain regions respond to the emotions of their child for mothers receiving BT. In this functional magnetic resonance imaging (fMRI) pilot study in 22 mothers within the first postpartum year, including six mothers receiving BT and 16 non-OUD mothers as a comparison group (CG), we devised a child face mirroring task in fMRI settings to assess maternal responses to pictures of facial expressions of own child and an unknown child in an empathic mirroring condition (Join) and a non-mirroring observation condition (Observe). In each condition, faces of neutral, ambiguous, distressed, and joyful expressions of each child were repeatedly displayed in a random order. The response of SMA during empathic mirroring (Join) vs. non-mirroring (Observe) of own child was reduced among BT/OUD vs. CG. Within MBN, the left VP, critical for parental sensitivity, had a similar deficit. This study outlines potential mechanisms for investigating the risks of deficits in the neural responses to actual maternal sensitivity and parenting behavior in mothers with OUD, and potential targets for interventions that reduce stress and augment maternal behavior and child outcome.

Keywords: opioid, maternal behavior neurocircuit, face mirroring, intersubjectivity, empathy, supplementary motor area (SMA), magnetic resonance imaging (MRI), ventral pallidum (VP)

INTRODUCTION

Every day in the United States, approximately 200 people die after overdosing on opioids (CDC/NCHS, 2021). The incidence of pregnant women with opioid use disorder (OUD) quadruped from 1999 to 2014 (from 1.5/1,000 delivery hospitalizations to 6.5) (Haight et al., 2018). In this epidemic, 2.5% of pregnant women use opioids chronically (Krans and Patrick, 2016) such that about 100,000 postpartum women and their families are afflicted with OUD every year. However, pregnant women with OUD may receive "gold standard" buprenorphine treatment (BT) for withdrawal (Jones et al., 2012; Nanda et al., 2015; Krans et al., 2016; Rosenthal et al., 2016; Zedler et al., 2016). Buprenorphine is a semisynthetic morphine-derived opioid used to treat OUD and chronic pain with very high affinity for the μ-receptor as a partial agonist and high affinity for the κ-receptor as an antagonist. Despite withdrawal reduction with BT, pregnant and postpartum women remain at high risk for problems, for which treatment is lacking. Indeed, relapse is common, with comorbid high stress, depression, polysubstance use, and maladaptive parenting behaviors (Rutherford et al., 2011; Rutherford and Mayes, 2017; Swain and Ho, 2019; Swain et al., 2019) risking child maltreatment and costly foster care utilization (Conway et al., 2006). Thus far in humans, however, there is still little research on mother and child bonding and health with buprenorphine treatment for OUD (Salihu et al., 2019).

Of additional concern to mothers with OUD, exogenous opioid-induced deficits have been shown for maternal behaviors in animal models (Bridges and Grimm, 1982; Grimm and Bridges, 1983; Slamberova et al., 2001). At least in part, these effects appear to be mediated by the activation of μ-opioid receptors in the hypothalamic (HYP) medial preoptic area (mPOA) (Rubin and Bridges, 1984; Mann et al., 1991; Stafisso-Sandoz et al., 1998). As part of the opioid-sensitive brain, the mPOA regulates a series of neurocircuits in the regulation of many salient behavioral outputs (Berridge and Kringelbach, 2015). For rodent maternal behaviors, the HYP normally activates the nucleus accumbens (NAc) and ventral pallidum (VP) (Numan and Young, 2016). Human mothers have a homologous and adaptable maternal behavior neurocircuit (MBN) as outlined by functional magnetic resonance imaging (fMRI) and responses to infant stimuli (Swain et al., 2007, 2019; Swain and Lorberbaum, 2008; Kim et al., 2016; Swain and Ho, 2017).

The MBN regulates mother–infant bonding, balances sensitive caring vs. aggressive defensive maternal behaviors in humans and other mammals, and adapts to a variety of circumstances (Swain and Ho, 2019). In addition to the mPOA and VP, many other MBN areas are sensitive to exogenous opioids (Wallin et al., 2021), including the NAc, VTA for parental care, and PAG for parental defensive behavior. In brain models extended to include substance use, the VP has previously been proposed as a common pathway for drug seeking initiated by stress, drug-associated cues, or the drug itself (Kalivas and Volkow, 2005). In fact, normal function in the VP is extremely important for discriminating between natural and exogenous drug-related rewards (Root et al., 2015). In preclinical animal models, natural offspring

stimuli cause maternal brain activation of the NAc-VP circuit (via dopamine and oxytocin) to facilitate selective offspring recognition, behavioral reactivity, and lasting social attraction. This can occur when NAc-GABAergic efferents to the VP are suppressed (via cortical dopamine-induced disinhibition), releasing the VP from NAc inhibitory control and enhancing VP response to pup stimuli (Hansen et al., 1993; Numan and Insel, 2003; Champagne et al., 2004; Numan, 2007; Ikemoto, 2010). The MBN is modulated by the opioid-sensitive extended amygdala, including the bed nucleus of the stria terminalis (Klampfl and Bosch, 2019), insula, and orbitofrontal cortex (Gholampour et al., 2020) with connections to motor cortical regions for maternal behavioral output (**Figure 1**), such as the supplementary motor area (SMA) (Zhang et al., 2012). The SMA is activated by infant crying sounds, for which picking up, holding, and talking to their infants are behaviors common to mothers across multiple cultures (Bornstein et al., 2017). Thus far, however, there is little research on mothers with buprenorphine treatment for OUD (Salihu et al., 2019), and just a few studies recently reviewed on the underlying MBN among mothers with OUD (Swain and Ho, 2021).

In our first report, BT mothers with OUD compared with a control group (CG) showed greater HYP and PAG responses to own vs. other baby-cry and differential functional connectivity between the HYP and PAG associated with parenting stress, suggesting that BT may dysregulate the normal balance between maternal caregiving and defensive/aggressive circuits (Swain et al., 2019). In another study of the same cohort, BT vs. CG differences in resting-state functional connectivity (rs-FC) between the PAG and HYP were studied at 1 month (T1) and 4 months postpartum (T2) (Swain and Ho, 2019). The authors found that BT mothers differed from CG mothers in PAG-dependent rs-FC with the HYP, amygdala, insula, and other brain regions that regulate caring at T1, with many of these differences not evident at T2. Furthermore, the authors also found that the PAG-dependent rs-FCs were related to maternal bonding problems as evidenced by the fact that "rejection and pathological anger" subscale of the Postpartum Bonding Questionnaire (PBQ) at T2 was associated with the increases from T1 to T2 in PAG-dependent rs-FC with the HYP and amygdala. This suggests that possible maternal bonding problems for mothers with BT OUD in the early postpartum may be linked to connectivity differences between specific care and defense maternal brain circuits, which may also be modulated by buprenorphine treatment. More work is required to elucidate how the MBN regulates specific parenting behaviors in OUD mothers such as maternal sensitivity that relate to infant outcome.

Parent–child interactions involving sensitively sharing joy and coping with distress are crucial for child development (Swain et al., 2017). Parental intersubjectivity has been identified as a key resilience factor against the adverse effects of parental stress and depressive moods on parent–child relationships (Camoirano, 2017; Bernard et al., 2018). Intersubjectivity is defined here as the understanding of the internal models of self and others, intentions, and feelings underlying overt behaviors. Parental intersubjectivity enables a parent to feel what the inner experience of a child *is like*, without diminishing the
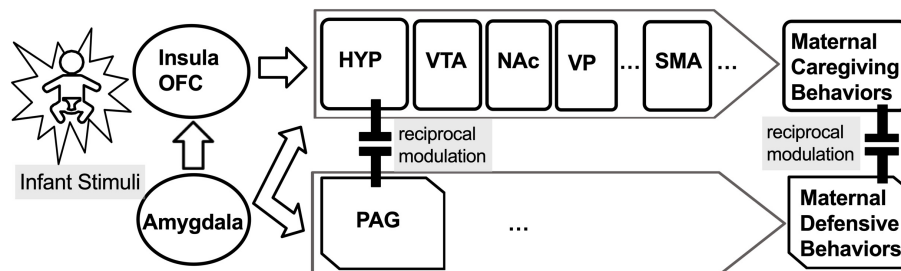
FIGURE 1 | The maternal behavior neurocircuit (MBN) is comprised of two reciprocally inhibiting subsystems for: (1) maternal care, mediated by the medial preoptic area (mPOA) of hypothalamus (HYP), ventral tegmental area (VTA), nucleus accumbens (NAc), and ventral pallidum (VP), which is functionally connected to the supplementary motor area (SMA), and (2) maternal defense, mediated by periaqueductal gray (PAG). These opposing subsystems are regulated by the amygdala (AMY), insula, and orbitofrontal cortex (OFC).

distinction between the inner experiences of the parent and the child. Parental intersubjectivity is embedded in several parenting-related constructs, such as parental sensitivity (Ainsworth et al., 1978; Bernard et al., 2013), parental reflective functioning (Fonagy et al., 1991; Slade, 2005), parental empathic attunement (Rowe and MacIsaac, 2004), and parental embodied mentalizing (Shai and Belsky, 2011). These constructs commonly point to the capacity of a parent to rely on dyadic interactions to understand the child and provide sensitive care to foster healthy development.

A key attribute underlying intersubjectivity is face mirroring, i.e., spontaneous mimicry or voluntary imitation of the facial expressions or manual gestures of others. The rudimentary capacity of intersubjectivity is innate (Trevarthen and Aitken, 2001). Indeed, infants can spontaneously mimic facial expressions soon after birth (Meltzoff and Moore, 1977). While mothers with secure parent–child bonding show greater child-oriented face mirroring (Kim et al., 2014), unfortunately, maternal intersubjectivity may be impaired in mothers exposed to excessive parenting stress (Shai et al., 2017), interpersonal violence (Dayton et al., 2016), or depressive mood disorders (Bernard et al., 2018). We have previously demonstrated that a parenting intervention delivered a few years postpartum reduced parenting stress with associated increases in parent–child intersubjective function in the MBN (Ho et al., 2020). Specifically, we found that SMA and other MBN regions were differentially activated during the condition in which the mothers empathically mirrored the facial expressions and emotions of the child. In this study, we contributed data from a pilot project on mothers with BT mothers with OUD using an empathic mirroring fMRI task described below. We hypothesized that the MBN required for mothers to empathically mirror the emotions of their child in infant-oriented sensitive behaviors may be altered for mothers under the stressful conditions of OUD receiving BT.

MATERIALS AND METHODS

The research reported in this study was approved by the Institutional Review Board (IRB) at the University of Michigan,

Ann Arbor, MI, United States. All research was performed in accordance with relevant IRB guidelines and regulations.

Participants

All participants (N = 22) were recruited from University of Michigan Health System. There were six participants in the buprenorphine replacement treatment group (BT) and 16 participants in the comparison group (CG) who underwent the fMRI task within 1 year postpartum. The participants in BT and CG groups were not different in age [BT: M = 30.67, s.e. = 2.68; CG: M = 29.63, s.e. = 1.64, $F_{(1,20)}$ = 0.11, MS_{error} = 43.154, p = 0.74], the age of their youngest child [BT: M = 0.25, s.e. = 0.06; CG: M = 0.20, s.e. = 0.04, $F_{(1,20)}$ = 2.47, MS_{error} = 0.024, p = 0.13], and the number of offspring [BT: M = 1.83, s.e. = 0.24; CG: M = 1.50, s.e. = 0.15, $F_{(1,20)}$ = 1.42, MS_{error} = 0.34, p = 0.25] (refer to **Table 1** for other demographics). The BT OUD mothers were monitored with urine screens and interview as part of clinical care during pregnancy, such that the only exogenous opioid was prescribed buprenorphine. As recorded every 2 weeks postpartum and during our study, it was 12.67 $\pm$ 1.63 mg (mean $\pm$ SD) daily with all mothers stabilized between 12 and 16 mg daily. We have reported fMRI studies using different tasks completed in the same cohort including a baby-cry task (Swain et al., 2019) and resting-state task (Swain and Ho, 2019).

Child Face Mirroring Task

In Child Face Mirroring Task (CFMT), as described previously (Ho et al., 2020) and illustrated in **Figure 2**, the participants were presented repeatedly with the same pictures of their own child and of an unknown child in three task conditions, namely, Observe, React, and Join. By design, the Observe task should elicit the unresponsive observation of face-like visual objects of participants; the React task should elicit the usual, voluntary responses of participants to the presented child, and the Join task should elicit the empathic mirroring of participants of the presented child. The React condition was designed for a pre- and post-treatment study (Ho et al., 2020) and thus was not included in the analysis of this study. The task instructions, design, and stimuli have been described elsewhere (Ho et al., 2020).

TABLE 1 | Demographics.

	BT	CG
Age		
Mean	30.67	29.63
s.e.	2.68	1.64
Infant age		
Mean	0.25	0.20
s.e.	0.06	0.04
Number of child		
Mean	1.83	1.50
s.e.	0.24	0.15
Race		
European American	5	12
African American	0	3
Native American	1	0
Bi-racial	0	1
Socioeconomic status		
Low	4	11
Middle	2	5

BT, buprenorphine treatment for opioid use disorder; CG, comparison group.

Magnetic Resonance Imaging Procedures

The magnetic resonance imaging (MRI) procedures, image acquisition, and data preprocessing have been described elsewhere (Ho et al., 2020). No head movements.

First-Level Analysis

Following image preprocessing described elsewhere (Ho et al., 2020), we constructed a first-level fixed effect general linear model (GLM) to examine condition-dependent responses. The first-level model consisted of a matrix of regressors modeling six trial types (3 Tasks × 2 Child Identities: Observe Own, React Own, and Join Own and Observe Other's, React Other's, and Join Other's Child), in addition to a regressor for Cue periods (seven regressors total). In this study, we focused on the contrast of the Join vs. Observe contrast of Own Child. Handedness and possible functional lateralization of brain function in the participants were not considered in this study.

Second-Level Analysis

Due to the small sample size, we focused on one contrast of interest, i.e., Join vs. Observe of the Face of Own Child, pooling across facial expressions in this study. This contrast of interest from the first level GLMs was submitted to a second-level random effect GLM, testing BT vs. CG effects on several regions of interest (ROIs), with Bonferroni family-wise small volume corrections (s.v.c.) in each ROI. The ROIs were identified as the subcortical regions known to modulate maternal behaviors (Numan and Woodside, 2010; Swain and Ho, 2017, 2019), with their masks derived from the wfu_pickatlas toolbox (Maldjian et al., 2003), including amygdala [as defined in wfu_pickatlas' AAL domain (Tzourio-Mazoyer et al., 2002)], periaqueductal gray (PAG) (an 8 mm × 6 mm × 8 mm box centered at [0, −28, −12] in MNI coordinates), hypothalamus (as defined in wfu_pickatlas' TD Brodmann areas+ domain; Maldjian et al., 2003), midbrain (as defined in wfu_pickatlas' TD Lobes domain; Maldjian et al., 2003), nucleus accumbens (NAc) (a 18 mm × 8 mm × 10 mm box centered at [0, 10, −14] in MNI coordinates), and pallidum (as defined in AAL; Tzourio-Mazoyer et al., 2002). In addition, as from an independent sample of late postpartum mothers ($N = 45$), reported previously (Ho et al., 2020), we found that SMA (MNI coordinates: [0, 6, 58], 76 voxels, $Z = 5.28$, $p < 0.001$ whole-brain corrected) was the only cluster surviving the whole brain family-wise Bonferroni correction in the main effect of the contrast of interest (Join vs. Observe Own Child). We, therefore, selected SMA as another ROI in this study and created a mask defined by this cluster (682 voxels) as found in that independent sample at a threshold of $p = 0.005$, uncorrected.

RESULTS

Main Effect of Join Versus Observe of Own Child

We focused on the contrast of Join vs. Observe of Own Child in this study. As hypothesized, we found that, pooling across BT and CG groups, the SMA showed significant Join > Observe differential neural responses in this contrast (MNI coordinates: [0, 2, 58], 65 voxels, $Z = 3.53$, $p = 0.014$ Bonferroni family-wise s.v.c., **Figure 3**). There were no other ROIs that showed significant differential neural responses in this contrast.

Buprenorphine Treatment Versus Comparison Group Contrast

We examined the group differences in the contrast of Join vs. Observe of Own Child. We found that BT showed lesser differential neural responses than CG in the SMA ([2, 8, 60], 222 voxels, $Z = 3.13$, $p = 0.045$ Bonferroni family-wise s.v.c., **Figure 4A**) and the left pallidum ([−16, −4, −6], 23 voxels, $Z = 4.26$, $p = 0.001$ Bonferroni family-wise s.v.c., **Figure 4B**).

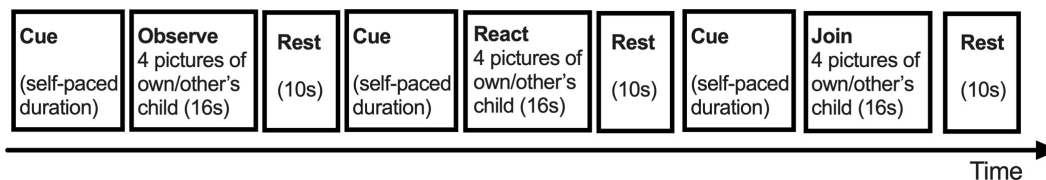| Cue (self-paced duration)	Observe 4 pictures of own/other's child (16s)	Rest (10s)	Cue (self-paced duration)	React 4 pictures of own/other's child (16s)	Rest (10s)	Cue (self-paced duration)	Join 4 pictures of own/other's child (16s)	Rest (10s)

Time

FIGURE 2 | The design of child face mirroring task [adapted from Ho et al. (2020)]. Note that the task order in this figure did not represent the actual order.
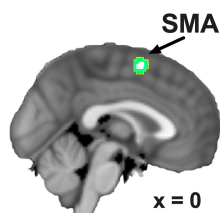
FIGURE 3 | The SMA showed Join > Observe of Own Child differential neural response, pooling across groups. The statistical map is presented with an activation threshold of *p* = 0.005, uncorrected.

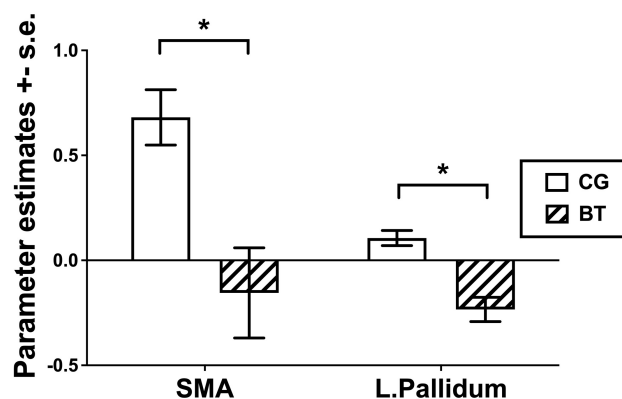FIGURE 5 | The bar charts for the Join vs. Observe of Own Child differential responses of BT and CG groups (mean ± s.e.) in the SMA and left pallidum. *indicates that significant group difference in the fMRI analysis.

As depicted in the bar chart (**Figure 5**), in the SMA and left pallidum both, the CG group showed significant Join > Observe differential responses, but the BT group showed Join < Observe differential response. These results suggested that BT mothers may have altered emotional mirroring responses in brain regions important for parenting behaviors.

DISCUSSION

In the midst of an unprecedented opioid overdose crisis (CDC/NCHS, 2021), many peripartum women with OUD are successfully treated with opioid replacement treatment that reduces withdrawal yet poses potential concerns for the psychology of parenting (Salihu et al., 2019). Animal model research has raised substantial concerns that opioids may disrupt maternal behavior by acting on opioid-sensitive maternal brain circuits including the hypothalamus and VP (Bridges and Grimm, 1982; Grimm and Bridges, 1983; Slamberova et al., 2001). Although allied research in humans has suggested that opioids like buprenorphine might reduce separation distress and offer treatment for some forms of depression (Panksepp and Yovell, 2014; Yovell et al., 2016), there have also been concerns that opioids may usurp healthy parent–infant separation distress and reward circuits that may be critical to mother–infant bonding (Swain et al., 2005). Indeed, "high opioid tone" has

been recently discussed as a concern in the development of autism spectrum disorder (Anugu et al., 2021), which is arguably one of several developmental disorders showing impaired intersubjective function (Trevarthen and Aitken, 2001). Thus, although BT is highly effective for reducing withdrawal, intersubjectivity-dependent face mirroring may be adversely influenced. By examining the multifaceted psychosocial effects of BT in the early postpartum on the maternal brain, this article begins to address the potential risks and benefits of buprenorphine beyond the basic relief of withdrawal in OUD.

An emerging human neuroimaging literature supports specific mechanisms at work in mothers with BT/OUD for maternal response to the baby cry and functional connectivity in care and defense brain systems (Swain and Ho, 2021). In this pilot study, we tested the MBN for BT vs. CG group differences in child-oriented face mirroring, a foundational aspect of parental intersubjectivity, that may have long-term consequences for infant development (Feldman, 2012), using the contrast of Join vs. Observe of Own Child in CFMT. Pooling across both
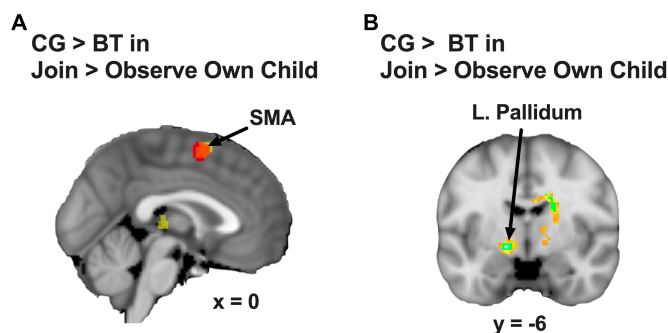

FIGURE 4 | **(A)** The SMA (the red area indicates the overlap with the **Figure 2**) and **(B)** the left pallidum showed CG > BT group difference in Join > Observe of Own Child differential neural response. The statistical map is presented with an activation threshold of *p* = 0.005, uncorrected.

groups, the SMA showed significant differential activation in this contrast, replicating the results from an independent sample of healthy mothers scanned at a later postpartum timepoint with the same task (Ho et al., 2020). We also found preliminary effects of BT/OUD on the differential neural responses during child-oriented mirroring, i.e., BT/OUD mothers, as compared to CG, showed altered differential neural responses in the SMA and left VP, an opioid sensitive part of the MBN. While the CG showed Join > Observe differential responses, the BT/OUD group showed little differential response in the SMA and in the opposite direction for Observe > Join differential responses in the VP.

The results suggested that, as related to the comparison group, BT/OUD mothers showed impairments in the own-child-oriented face mirroring responses in brain areas that are critical to maternal intersubjectivity including the VP and SMA. The VP is an important part of the MBN in the regulation of maternal caregiving (Swain et al., 2019) and reward processing in addictions (Kalivas and Volkow, 2005; Root et al., 2015). In animal models, the VP has been demonstrated to be a target of maternal brain motivational output of the NAc (Numan and Woodside, 2010; Numan, 2014) and involved in primate models of cued reaching (Jaeger et al., 1995) and other motivated movements (Hegeman et al., 2016). Among human mothers, the VP has been activated in fMRI studies of mothers observing salient own vs. other baby stimuli (Swain, 2011) and increased for mothers viewing the feeding behavior of their own vs. other children at 2–3 years of age (Noriuchi et al., 2019). Furthermore, VP and SMA responses correlated with maternal caregiving behaviors (Hipwell et al., 2015) and responded in a face mirroring task similar to that used in this article (Ho et al., 2020) for non-OUD mothers. Across continents and cultures, the SMA was highlighted in response to own vs. other baby-cry for infant-oriented preparation for movement and vocalization (Bornstein et al., 2017) and also demonstrated to be important for child-oriented empathy in a parent decision-making fMRI task (Ho et al., 2014). Finally, SMA connectivity to amygdala was reported to be heightened during maternal responses to infant distress according to maternal childhood maltreatment and decreased maternal intrusive behaviors, suggesting the potential for transgenerational adaptations to early life adversity that could include brain responses and infant-oriented behaviors to increase maternal sensitivity (Olsavsky et al., 2021). Perhaps plasticity in the SMA could be a future target for interventions to address maternal health from early childhood maltreatment to OUD such as transcranial magnetic stimulation.

This study on responses to a face mirroring task for mothers with BT OUD is preliminary and with notable limitations. First, an optimal comparison group of OUD mothers without BT is neither feasible nor ethical because of the practical impossibility of recruiting subjects with untreated OUD and the medical imperative to treat the suffering of any subject with OUD, respectively. Thus, our CG mothers were not affected by OUD, related stress, or the possible influence of previous opioid use. Future research may need to adopt approximate controls according to the measures of stress or longitudinal designs in which subjects may be their own controls at different doses and time points. Second, replication with larger sample sizes is needed

to confirm these findings and include full characterization of participants with OUD, including the quantity and frequency of all prescription, licit and illicit drug using, cravings, withdrawal, and the gold standard "time-line follow back" interview with calendar prompts and other memory aids to facilitate comprehensive and accurate recall of drug use (Sobell et al., 1988, 1998; Carey, 1997). These data in future studies will allow us to test the assumption of it for a range of critical factors. Indeed, the effects of childhood adverse experiences, sociodemographic factors, and other medical conditions constitute important areas of future research on intersubjective parental function, since we already know that parental stress, poverty, anxiety, and postpartum depression affect the parental brain (Moses-Kolko et al., 2014; Kim et al., 2015; Ho and Swain, 2017; Guo et al., 2018). Currently lacking studies of deficits and resiliencies in addition to possible lateralization in maternal brain function connected with mother–child bonding, parenting behavior and child outcome may contribute insights into the long-term consequences of OUD toward improved prophylaxis and treatment (Moningka et al., 2019).

CONCLUSION

Although preliminary, this study probes potential buprenorphine effects on intersubjective child face mirroring responses in mothers affected by OUD. These preliminary results strengthen the hypotheses that specific MBN regions that are required for mothers to empathically mirror the emotions of their child in infant-oriented sensitive behaviors may be altered for mothers with the stressful condition of OUD receiving BT. With replication and converging research on parental interventions that affect the same regions and correlate with inexpensive and convenient questionnaires, it may be possible to maximize intervention effects on specific neural targets for mothers to augment maternal intersubjectivity and reduce transgenerational mental health risks. Perhaps future interventions will be tailored according to neural targets as needed just as other treatments in medicine target-specific physiological systems that may be malfunctioning. This report calls for more attention to parental intersubjectivity and the roles of SMA and VP in the MBN as possible underlying brain mechanisms to better assess opioid-sensitive parental brain functions in the context of parent–child bonding and parenting.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Institutional Review Board of the University of Michigan. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

FUNDING

ACKNOWLEDGMENTS

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