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# Pedagogical interventions in augmentative and alternative communication (AAC): therapeutic benefits in healthcare and quality of life. A systematic review

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**Introduction:** The scientific literature was reviewed with the aim of to identify and synthesize empirical studies reporting the application of AAC strategies in hospital-based educational and healthcare environments for individuals with communication impairments.

**Methods:** The article search was carried out in the WOS, Scopus and PubMed databases, and it was limited to studies published in the last 10 years. The study was registered in the International Prospective Register of Systematic Reviews (PROSPERO), and its quality was evaluated with the Effective Public Health Practice Project (EPHPP) instrument.

**Results:** Among the 256 articles that were initially selected, only a total of 10 studies met the established eligibility criteria after performing a more exhaustive analysis with abstract and full text reading. The results show a positive relationship between the use of AAC and improvements in communication skills in the identified populations.

**Discussion:** Different AAC strategies can be applied and employed in people with communication difficulties, thereby improving their quality of life and that of their environment. Educational centres can be true learning scenarios to favour the maximum psychosocial potential of their students. Moreover, these resources can also be used with clinical and/or therapeutic purposes in healthcare.

## KEYWORDS

pedagogy, augmentative and alternative communication, healthcare, public health, education, quality of life

# 1 Introduction

## 1.1 AAC

Communication is a human right, as is clearly established in Article 19 of the Universal Declaration of Human Rights on Freedom of Expression (ONU, 1948). Every person has the right to freedom of opinion and expression. This right includes the freedom to have opinions, search and receive information, and transmitting the latter by any means without borders (Reaño, 2022).

People with disabilities that affect communication may feel impotent, frustrated and unsatisfied. Feelings of despair and loneliness are also frequent (Nicola-Jolleff et al., 1992). The effects of bad communication may manifest in the short or long term, and they are associated with the presence of anxiety and depression. This population may experience different states of irritation or nervousness in urgent situations, in cases where their problem cannot be resolved immediately. In addition, long term feelings of incomprehension can lead to deep sadness (Berruecos-Villalobos, 1983).

For these people, the use of AAC can be very useful. Specifically, in the field of healthcare, it can be employed by care givers, healthcare professionals and patients. AAC includes a set of tools and strategies to overcome communication barriers when verbal communication is blocked or deteriorated. This involves any type of intervention that helps improve people's communication, from more conventional methods such as sign language, to more innovative strategies such as assisted communication. It can be used through different means of communication, such as: voice, text, gestures, sign language, symbols, images and voice generating electronic devices (Pina et al., 2020).

AAC methods and tools are diverse and must be adapted to the needs and characteristics of the population to which they are applied. They can be customised according to the characteristics of each individual or professional team that utilises them. Although the needs of individuals can vary as a function of their situation, the professional team can initially adapt to them, taking into account, for instance, the learning level of the individual (Deliyore-Vega, 2018).

AAC systems are available to professionals such as speech therapists, educators and nurses. Their main aim is to develop or recover the communication and language capacity when the latter is altered by sensory, physical or psychic causes (Regalado-Chamorro and Medina-Gamero, 2022).

Furthermore, there are situations or groups of people who need to use some type of AAC. These are characterised by the type of disorder they present: physical functional diversity; intellectual, cognitive or psychic disorders; sensory functional diversity; or other groups of people who need to use AAC systems temporarily. The latter is the case of people who have undergone surgery, injury in organs involved in speech or need to use a language they do not know (Regalado-Chamorro and Medina-Gamero, 2022).

The use of a specific type of tool depends on factors related to the people that present communication problems, the professionals involved, the technology required, and the costs implied. It is important to take into account that AAC is easier to use when it is intuitive and simple and requires little training (Cusihamán-Sisa et al., 2023).

Lastly, it is important to listen to and consider the opinions of children with disabilities. In many cases, this population presents

important limitations in communication. It is difficult for children with language problems to attain an effective interrelation. In this sense, the Convention on the Rights of Persons with Disabilities (Naciones Unidas, 2006) establishes that the use of technology can be a solution to protect the rights of people with disabilities and special communication needs. The different professionals who work with this population can implement specific evaluations and interventions to help these children to exercise their right to communication and social participation. Viera-Gómez and Real-Arcos (2021) established a series of recommendations for the successful application of AAC in paediatric populations: (a) collaboration and coordination within the work teams; (b) making adjustments to ensure that the members of the team receive adequate training in operations and communications; (c) offer continuous educational support; and (d) provide access to different types of appropriate resources for people with communication needs.

## 1.2 Paediatric healthcare environments and AAC

A hospital classroom is defined as a resource of the educational system to satisfy the needs of students who do not regularly attend school due to a disease (Romero and Alonso, 2007). This is an educational space with a series of adequate characteristics to prevent children from suffering negative psychosocial consequences (Alonso and Romero, 2006). Hospital classrooms provide cognitive, emotional and social benefits for the paediatric population (Bagur and Verger, 2022). It is important to highlight that hospitals must include comprehensive psychosocial care for children. Thus, children in a hospital classroom can live in a normalised and playful space in which they can collaborate with their classmates (Dote, 2021).

Moreover, the treatment of the hospitalised paediatric population must be carried out by a multidisciplinary team in order to provide a comprehensive response that satisfies social, biological and psychological needs. Parents and healthcare professionals have positive perceptions toward the purpose of hospital classrooms. These professionals play a fundamental role in the communication of information when a child is admitted to a healthcare centre. Therefore, they must be familiarised with the educational adaptations that are offered by this service (Hita-Fernández et al., 2022).

In some cases, the paediatric population may present, in addition to their physiopathological diagnosis, some type of communication problem due to different casuistries. In this type of situation, in addition to the application of the usual clinical treatment and teaching methodologies, it is fundamental to implement AAC. The aim is to humanise care and pedagogy in healthcare, train and involve the entire multidisciplinary team, and guarantee the quality of the service, as well as the quality of life of the patient. This requires the interdisciplinary collaboration of different groups, such as teachers, educators, social workers and healthcare professionals (e.g., nurses and physiotherapists) (Asensio-Ramón, 2022).

Hospital classrooms also aim to normalise the lives of hospitalised minors and help them to understand the process of their disease. It has been demonstrated that the implementation of psychoeducational preparation programmes reduces and prevents the development of anxiety in hospitalised paediatric patients (Bagur and Verger, 2022).

Due to the circumstances of hospital classrooms, it is necessary to present flexible and proactive working methods. This would enable learning based on interests and projects, which must be adapted to the specific characteristics of the children and promote creativity, emotion and sociability, with a playful pedagogy (González-González et al., 2021).

It is also important to point out that not only hospital classrooms are relevant in the communication process with people, but the entire healthcare environment plays a decisive role. An adequate communication in any type of healthcare scenario is fundamental for the effective valuation of biopsychosocial needs of people. Therefore, considering this casuistry in all clinical spaces poses an opportunity to improve for healthcare professionals, parents and patients. This is also a strategy to improve the continuity of care, which continues to be a challenge for public and private health systems. Thus, it is essential to advance in policies of coordination among the different healthcare and social levels (formal and informal) that integrate healthcare processes, to ensure that people perceive continuity in the process of diagnosis, treatment and care (Fernández-Moyano and Ollero-Baturone, 2010).

Lastly, we must underline the importance of parents in hospital classrooms and healthcare environments. Parents constitute a relevant element in the communication process with the different professionals that communicate with the patient, obtaining enough information about the situation of their child, being counselled through the guidelines that are given to them, and becoming somewhat responsible of both the clinical treatment and the education of their child. Consequently, AAC strategies must be applied to both hospitalised children and their parents (Palomares-Ruiz and Sánchez-Navalón, 2020).

To sum up, people who present problems in their communication skills cannot fully exercise their right to communication (Reaño, 2022) and have a worse quality of life (Nicola-Jolleff et al., 1992). Addressing this issue from a multidisciplinary point of view through AAC strategies could significantly improve the biopsychosocial aspects of this population (Pina et al., 2020). Thus, the aim of the present study was to identify and synthesize empirical studies reporting the application of AAC strategies in hospital-based educational and healthcare environments for individuals with communication impairments, evaluating the benefits obtained.

## 2 Materials and methods

### 2.1 Design and formulation of the research question

In this work, a systematic review of the scientific literature was conducted, which gathered interventions performed with AAC tools in healthcare environments, identifying the types of tools employed, the obtained benefits, and the groups involved. The PRISMA declaration criteria for systematic reviews (Moher et al., 2015) were applied, thoroughly analysing the selected articles. This study was registered in International Prospective Registry of Systematic Reviews (PROSPERO; application date: 02/23/2024).

We made use of the PICO format (Problem/Population, Intervention, Comparison, Outcomes), which allowed formulating the following question (Sánchez-Martín et al., 2023):

Problem: people with communication difficulties.

Intervention: AAC.

Comparison: people with some type of communication problem.

Outcomes: studies that analysed an AAC intervention strategy in people with disabilities that affect communication.

### 2.2 Selection criteria

The systematic review was carried out between December 2023 and March 2024 in the Web of Science (WOS), SCOPUS and PubMed databases. The searches were limited to studies published in the last 10 years, between January 1st 2014 and January 1st 2024, selecting only open access articles.

### 2.3 Search strategies

The keywords that were used to perform the search were obtained from MeSH descriptors, which were developed by the National Library of Medicine, or the thesauri of the descriptors in Health Sciences (DeCS). The Boolean operators AND and OR were used.

The search strategy was applied selecting the following search criteria:

- For WOS [Comunicación alternativa\* OR alternative communication\* (Topic) AND Aula Hospitalaria\* OR Hospital Classroom\* (Topic) AND Comunicación Aumentativa\* OR Augmentative communication\* (Topic)].
- For PubMed [comunicación alternativa\* (Title/Abstract) OR alternative communication\* (Title/Abstract)) AND (comunicación aumentativa\* (Title/Abstract) or augmentative communication\* (Title/Abstract)) AND (aula hospitalaria\* (Title/Abstract) OR hospital classroom\* (Title/Abstract))].
- For SCOPUS (TITLEABSKEY [comunicación\*] AND (TITLEABSKEY alternativa\* OR alternative\*) AND (TITLEABSKEY (communication\*) AND (TITLEABSKEY (comunicación\*) AND (TITLEABSKEY (aumentativa\* OR augmentative\*) AND (TITLEABSKEY (communication\* OR hospital\*) AND (TITLEABSKEY (classroom\*)).

### 2.4 Inclusion and exclusion criteria

The following inclusion criteria were used: (a) studies that applied AAC strategies; (b) AAC in healthcare environments; (c) studies whose samples were preferentially children and/or adolescents; (d) studies published in scientific journals. Therefore, only original articles were included.

The following documents were excluded: reviews, letters to editors, non-open access articles, commentaries, opinions, perspectives, guidelines and rules, cases or series of cases, and systematic reviews, since one of the inclusion criteria was the application of interventions in the studies.

The declaration of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), which was designed to improve the integrity of the report of systematic reviews and meta-analyses, was followed to identify and select the articles for this study,

and the reasons for the exclusion of those that were not included in the final analysis (see [Figure 1](#)) ([Page et al., 2020](#)).

## 2.5 Data extraction

With the aim of increasing the reliability and certainty of the selection process, the selected articles were adjusted to the aim and inclusion criteria of this study as established in the PRISMA declaration.

This process resulted in numerous judgements and actions after the search. To this end, we started by thoroughly reviewing the title, abstract, method, results and conclusions of each article, extracting the data as they were in their respective studies when they were reviewed, and thus they are included in [Table 1](#).

Furthermore, this systematic review included variables following the PICOS acronym (P: participants; I: interventions; C: comparisons; O: results; S: study design) ([Tomás et al., 2004](#)). With this strategy, it was possible to delimit the inclusion criteria and, based on them, carry out a qualitative analysis of the results. Moreover, this work included other variables that were considered relevant: author, year of publication, country, reference of the article, study object, measurement variables, and scales.

After this analysis, it was possible to select, more accurately, the most suitable articles for this study.

## 2.6 Quality evaluation

A quality analysis was performed for the selection of articles, using the components of quality evaluation and the classifications of the Effective Public Health Practice Project (EPHPP) ([Tomás et al., 2004](#)). This instrument evaluates six elements to carry out a general evaluation of each study ([Table 2](#)). Those with at least four strong classifications and no weak classifications are considered strong. Those with less than four strong classifications and one weak classification are considered moderate. Lastly, those with two or more negative classifications are considered weak ([Tomás et al., 2004](#)).

[Table 2](#) shows the conclusions of this analysis. Out of the ten articles included, two of them presented a strong global score ([Gilroy et al., 2018](#); [Meinzen-Derr et al., 2021](#)) and eight of them presented a moderate global score ([Thunberg et al., 2022](#); [O'Regan et al., 2023](#); [Vaillant et al., 2022](#); [Jenks et al., 2022](#); [Srinivasan et al., 2022](#); [Frizelle and Lyons, 2022](#); [Fäldt et al., 2020](#); [Morison et al., 2023](#)). It is important to highlight that most of the studies had strong internal components in variables such as data collection and the percentage of participants who completed the intervention. Due to their greater connection with the aim of this study, said internal components are relevant and critical compared to others. Therefore, although some articles presented moderate or weak internal

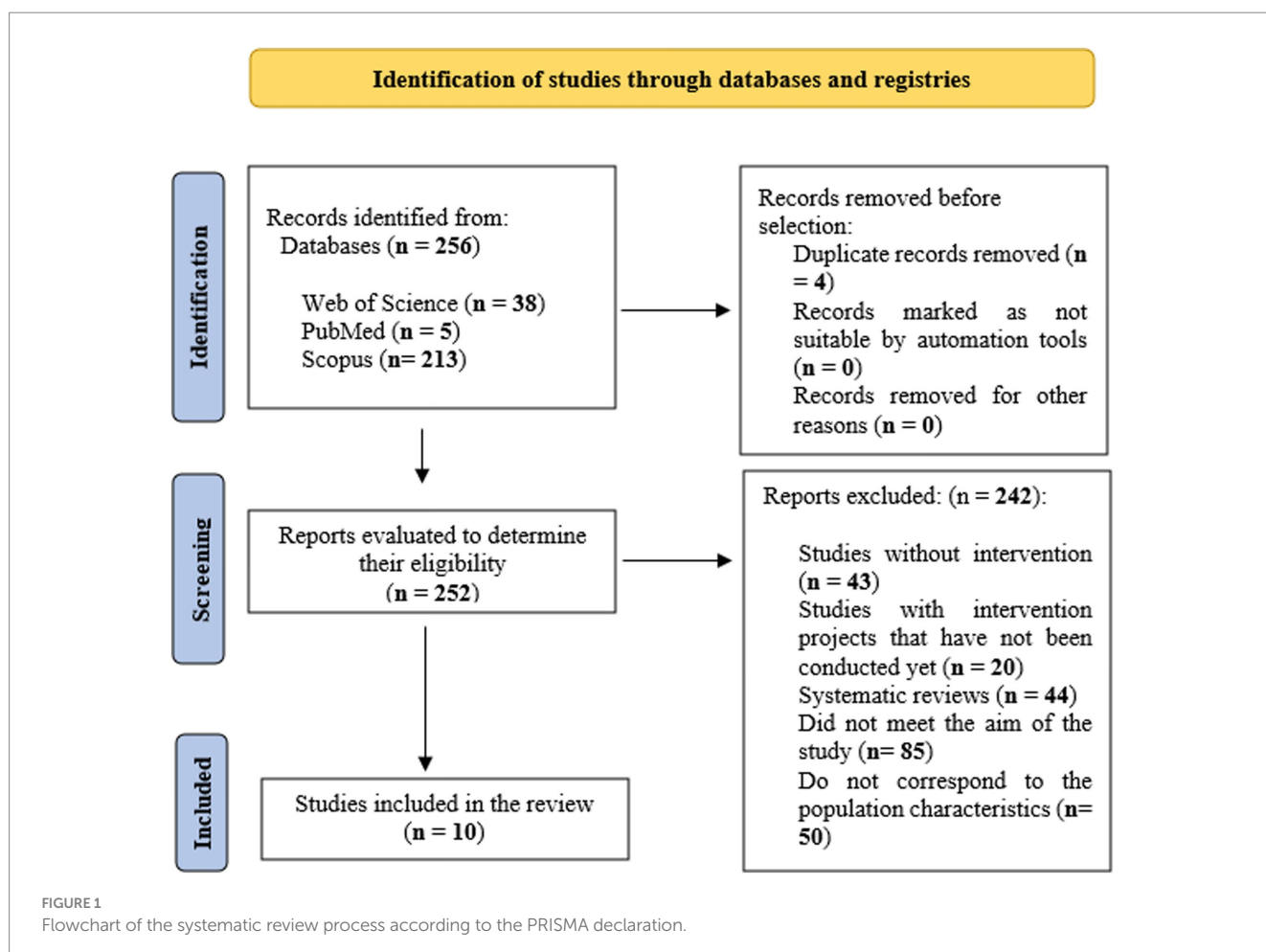


TABLE 1 Characteristics of the results of the studies included in the systematic review.

Reference, country	Study design	Comparisons	Study objective	Participants	Variables measured (measurement scales)	Interventions	Results/conclusions
Thunberg et al. (2022), Sweden	Experimental analytical study	Three centres: -Clinic specialised in child and adolescent psychiatry in a regional hospital. -Outpatient and paediatric operating room of a hospital of the county. - Outpatient and paediatric operating room of a local clinic.	Demonstrate and discuss the use of a communication strategy based on principles of Universal Design and the application of AAC means and strategies. To this end, three clinics participated in a project in which the <i>KomHIT</i> programme was applied to the patients. This programme has different pictorial supports that facilitate communication between the professional and the parents.	<i>N</i> = 41 (14 from a clinic specialised in child and adolescent psychiatry of a regional hospital; 17 from an outpatient and paediatric operating room of a hospital of the county; 10 from an outpatient and paediatric operating room of a local clinic).	Equitable, easy, simple and intuitive use, perceptible information, error tolerance. This information was gathered through interviews developed by the authors.	The <i>KomHIT</i> programme was presented to all healthcare professionals during a meeting. The professionals were also informed about the evaluation and data gathering activities. Each clinic applied the programme according to the casuistry of their patients. After the application, information was gathered about the experiences of both the professionals and the parents.	The use of Universal Design communication with pictorial support and complemented with easy-to-read text facilitates the processes of paediatric communication and care focused on the person. Pictorial resources support the relationship between the child, the parents and the professionals by obtaining the history of the child and documenting it throughout the entire procedure of medical care: before, during and after the medical visit. All these central processes in paediatric care focused on the person involve the professionals, the parents and the child. AAC applied to paediatric healthcare may meet the requirements of the principles of Universal Design.

(Continued)



TABLE 1 (Continued)

Reference, country	Study design	Comparisons	Study objective	Participants	Variables measured (measurement scales)	Interventions	Results/conclusions
<a href="#">Gilroy et al. (2018)</a> , Ireland	Randomised controlled trial	Two groups: -Group with high technology (SGD): received AAC with a sequence of teaching that employed a voice-generating device of high technology. -Group with low technology (PECS): received AAC with a low-technology communication system of image exchange.	Compare the effectiveness of high technology (SGD with a social/communicative approach) and low technology (PECS which used cards with pictures) in AAC, to record social responses to questions and to identify social and communicative behaviours in children with autism spectrum disorder (ASD).	<i>N</i> = 35 school-aged ASD children were randomised to the SGD group or to the PECS group.	Categorisation of child autism (CARS2-ST; CARS2-QPC); Adaptive behaviour (ABAS- 3); preferences in AAC (RAISD).	The participants of both groups received a specific training. The participants of the PECS group were taught how to use cards with images to communicate. The participants of the SGD group were taught how to use a Tablet application with voice generation to communicate. After the application of both programmes, information was gathered from the parents, teachers and carers about the improvements in the communication of the participants.	The newest forms of high technology for AAC are also effective for the improvement of social and communicative behaviour in ASD children. The results indicated that both approaches (high and low technology) generated significant improvements in communication, and that these improvements were not significantly different between the two approaches. These findings support the use of AAC in ASD children.
<a href="#">O'Regan et al. (2023)</a> , Sweden	Cross-sectional study	Only one group of children (5 to 8 years of age) and adolescents (11 to 14 years of age) diagnosed with cerebral palsy.	Monitoring the implementation of a protocol of cognitive evaluations with the use of interpreters and AAC for children with cerebral palsy.	<i>N</i> = 2,627 children aged 5 to 8 years ( <i>n</i> = 1,402) and adolescents aged 11 to 14 years ( <i>n</i> = 1,225)	Gross Motor Function (GMFCS); manual skills (MACS); Communication Function (CFCS); subtype of cerebral palsy, functional classifications, types of cognitive evaluation, use of AAC during the cognitive evaluations, need for AAC/interpreters during the cognitive evaluations (CP Cog questionnaire expanded and validated by the researchers).	The protocol of cognitive evaluations with the use of AAC and interpreters was applied in different rehabilitation centres of Sweden between January 2017 and December 2020. Between December 2020 and February 2021, information was gathered about the results of the programme through the participation of 52 psychologists who worked in different centres.	The psychologists perceived more reliability for cognitive evaluation with the use of AAC than with the collaboration of interpreters. Both measures contributed to improving the cognitive evaluation of children with cerebral palsy. Not using these measures when they are needed may lead to an underestimation of the cognitive capacities of a child.

(Continued)

TABLE 1 (Continued)

Reference, country	Study design	Comparisons	Study objective	Participants	Variables measured (measurement scales)	Interventions	Results/conclusions
Vaillant et al. (2022), Netherlands	Cohort, longitudinal, prospective study.	A single group of children with cerebral palsy.	Analyse the development of spoken language comprehension and functional communication, along with their determining factors, in children with cerebral palsy in whom AAC tools were used.	N = 138 (18 months to 11 years of age).	Use of spoken language, gestures, behaviour, glance, facial expressions (CFCS-NL); effective communication (FOCUS- 34); Communication and social interaction (CPCHILD-DV); spoken language comprehension (C-BiLLT); functional mobility (GMFCS); speech production (Scale: VSS).	The communication of the different participants was evaluated using different functional communication tools. The evaluation of language and functional communication was carried out by clinically qualified researchers of speech and language. The parents/carers also completed validated questionnaires (developed by the authors).	The application of functional communication tools was effective for the evaluation of speech, gestures, behaviour, glance, facial expressions, communication and social interaction, and comprehension of spoken language.
Jenks et al. (2022), United States	Retrospective review of cases and descriptive study.	A single group of children with ASD and cochlear implant.	Review the results of the cochlear implant in children diagnosed with ASD.	N = 30 children (0.8 to 11.8 years of age).	Perception of speech, expression, educational placement, social commitment, consistency with the use of cochlear implant (electronic medical records, auditory integration scale MAIS), communication mode (image-exchange AAC communication system [PECS]), Parent scale about child behaviour (modified and validated version of a questionnaire of the University of Michigan)	A case review of children with ASD and cochlear implant was conducted between 1991 and 2018. The electronic medical records were reviewed to gather information of the study variables and analyse them. The parents were administered a questionnaire via e-mail, which was subsequently analysed.	Understanding AAC as all the options or strategies that facilitate communication for people with severe difficulties to speak, this study analysed people who had undergone surgery or lesions of the organs involved in speech. Cochlear implants can improve auditory skills, language and social participation in some deaf children with ASD.

(Continued)

TABLE 1 (Continued)

Reference, country	Study design	Comparisons	Study objective	Participants	Variables measured (measurement scales)	Interventions	Results/conclusions
Srinivasan et al. (2022), India	Quasi-experimental, longitudinal study.	A single group with ASD children.	Gather data about the efficacy of the Jellow Communicator AAC system to promote communication skills in young children with ASD.	N = 17 children with ASD (3.5 and 12 years of age).	Adaptive behaviour (VABS- 2), development of communication skills (CDDC), psychosocial impact of assistive devices (PIADS).	Each child received individual training sessions with an authorised speech therapist twice per week for 3 months, and each session lasted between 20 and 30 min. A systematic training protocol adapted to the original image-exchange communication system (PECS) was used to train the children in the use of the Jellow system, going from the didactic cards to the application version of Jellow. The speech therapist evaluated the development level of the children in multiple domains in the previous and subsequent test. Three videos per child were coded, that is, one early training session, one intermediate training session and one late training session each, to evaluate the changes in the stage of communication of the children, the spontaneous request skills, the level of attention during the training tests, and the average time to complete the communication tests. Moreover, the careers completed questionnaires to evaluate the changes related to the training in the levels of adaptive function of the children, as well as the psychosocial impact of the Jellow AAC system on the quality of life of the children.	The children significantly improved their communication stage, and most of them went from the didactic cards to the use of the Jellow application to request their preferred articles. The children also increased the proportion of spontaneous requests during the course of the training. The carers reported a positive psychosocial impact of the Jellow AAC system on the self-esteem, adaptability and competence of their children.

(Continued)



TABLE 1 (Continued)

Reference, country	Study design	Comparisons	Study objective	Participants	Variables measured (measurement scales)	Interventions	Results/conclusions
Frizelle and Lyons (2022), Ireland	Cross-sectional, observational study.	Four key groups: participants with Down's syndrome and their classmates, teachers, parents and special needs assistants.	Develop a basic sign vocabulary of keywords (Lámh) in the school to facilitate effective communication between children with Down's syndrome and their classmates in the first year of ordinary primary school.	$N = 28$ (6 children with Down's syndrome, 5 teachers, 8 special needs assistants and 9 classmates).	Attempts to communicate between children with Down's syndrome and their classmates (validated form developed by the authors for data and photograph gathering), use of Lámh and determination of the most appropriate according to the criteria of the teachers, assistants and classmates (interviews developed by the authors)	Data were gathered during an academic year in five educational centres. In the visits, notes and photographs were taken regarding the use of a basic sign vocabulary of keywords (Lámh) in children with Down's syndrome interacting with their classmates. Interviews were conducted with teachers and assistants to gather information about the use of Lámh. Interviews were also carried out with classmates about the same topic.	A basic vocabulary of 140 elements was established, with each of the five classifications of Lámh words represented. This study highlights the importance of an appropriate sign vocabulary to satisfy the communication needs of children with Down's syndrome and of those who interact with them in the ordinary primary school. These findings may serve as a reliable starting point for networks of people and professionals who support the academic and social inclusion of children with Down's syndrome using keyword signs when they start their primary education.
Meinzen-Derr et al. (2021), United States	Randomised controlled trial.	Two groups of children aged 3–12 years with mild-to-severe bilateral hearing loss: -One group received the technology-assisted language intervention (TALI) -The other group received a conventional treatment or intervention that the child was receiving at the time of the study (TAU).	Evaluate the impact of a technology-assisted language intervention on the results of spoken language in deaf children or children with hearing problems	$N = 41$ children; 21 with TALI intervention and 20 with TAU intervention.	Initial non-verbal cognition (Leiter's international performance scale), communication strategies (questionnaire for the parents, developed by the authors), language evaluations (recording of language samples for 20 min in audio and video, transcription of these samples and subsequent analysis).	The intervention lasted 24 weeks for both groups. The TAU intervention group received weekly therapy sessions of one hour each, focused on language and communication skills. The TALI intervention group used the Word Power language programme in iPads for the intervention throughout the 24 weeks; the software provided visual support for abstract linguistic concepts, with voice output for each selection and with a model for verbalisations. The evaluations for the gathering of data were carried out before and after the intervention.	The children of the TALI group, compared to those of the TAU group, obtained significant improvements in the length of the sentences they used to express themselves. The provision of visual support in the TALI group for linguistic concepts that are usually difficult to acquire for deaf children or children with hearing problems allowed them to process and understand spoken language more comprehensively.

(Continued)

TABLE 1 (Continued)

Reference, country	Study design	Comparisons	Study objective	Participants	Variables measured (measurement scales)	Interventions	Results/conclusions
<a href="#">Fäldt et al. (2020)</a> , Sweden	Qualitative study	A single group of parents with young children aged 1 to 3 years with suspected communication difficulties.	Analyse how parents perceive the ComAlong Infant intervention offered to parents of children with communication difficulties in the first stages of the diagnostic process.	N = 16 parents	Acquired knowledge; development of communication of the child; strengthening of relationships; use of AAC; useful learning strategies; benefits with respect to the intervention structure (structured interview developed by the authors).	ComAlong Infant consists in a course for parents with 5 sessions, based on groups, and two home visits, focused on receptive communication, teaching in an improved environment, and multimodal AAC. One year after the intervention, interviews were carried out with the parents who had received the intervention, information was gathered, and the data were analysed.	The findings suggest that the parents of young children with language or communication disorders learned and appreciated receptive communication and teaching in an improved environment. All parents had used multimodal AAC and described its benefits. They emphasised the value of learning from other parents, as well as from a speech therapist, who interacted with their children in the home environment. The parents suggested a greater family approach as a potential improvement.
<a href="#">Morison et al. (2023)</a> , USA, France, Australia, UK, Canada, Netherlands, Belgium, Spain, Sweden and Qatar	Observational, descriptive, cross-sectional study.	A single experimental group composed of people with speech and language alterations due to a disorder related to the CDK13 gene.	Analyse the speech, language, non-verbal communication skills, social behaviour, health and development of 41 people with a disorder related to the CDK13 gene who received a multidisciplinary therapy that included the use of AAC.	N = 41 people with speech and language alterations USA [19]; France [5]; Australia [4]; UK [3]; Canada [3]; Netherlands [2]; Belgium [1]; Spain [1]; Sweden [1]; Qatar [1].	Speech and language (CSBS-DP and CCC-2), non-verbal communication skills (ICS scale administered to carers), social behaviour (SRS-2), health and development (validated questionnaires administered to carers).	The AAC tools applied were based on low technology (communication boards); high technology (speech generating devices); unique signs to communicate; graphic systems; symbolic communication and signs. After receiving this therapy, the information about the study variables was gathered through different scales.	The use of AAC tools was effective in the multidisciplinary therapy for speech impairment. This study underlines the importance of personalised speech therapy and, particularly, early access to AAC support.

TABLE 2 Quality evaluation components and classifications for the EPHPP instrument.

Articles	Components						Global score
	1	2	3	4	5	6	
Thunberg et al. (2022)	M	M	M	M	M	S	M
Gilroy et al. (2018)	S	S	S	M	S	S	S
O'Regan et al. (2023)	S	M	S	M	S	S	M
Vaillant et al. (2022)	M	M	M	M	S	S	M
Jenks et al. (2022)	M	W	M	M	M	S	M
Srinivasan et al. (2022)	M	M	M	M	S	S	M
Frizelle and Lyons (2022)	M	W	M	M	S	S	M
Meinzen-Derr et al. (2021)	S	S	S	M	S	S	S
Fäldt et al. (2020)	M	W	M	M	M	S	M
Morison et al. (2023)	M	W	M	M	S	S	M

\*W, weak; M, moderate; S, strong.

\*\*1, risk of bias; 2, design; 3, confounding factors; 4, masking; 5, data collection.

6, withdrawals and dropouts.

components, other more relevant internal components were strong, and thus they were included in this systematic review. None of the selected articles obtained a low score in risk of bias, confounding factors or masking.

## 3 Results

### 3.1 Article selection and data selection process

After the search, the title, abstract and keywords of each article were evaluated, in order to identify those that could be relevant and remove those that did not meet the inclusion criteria.

The searches were performed and the inclusion criteria were applied, obtaining a total of 256 articles. The first search was carried out in Web of Science (WOS), where 38 articles were identified; the second search was conducted in Scopus, detecting 213 articles; and the third search was performed in PubMed, gathering 5 articles.

Four duplicate articles were discarded, obtaining a sample of 252 studies for full text review. After applying the eligibility criteria, 242 articles were excluded. Thus, a total sample of 10 articles was obtained. The reason for the exclusion of 242 articles from this systematic review was that, although they initially met the inclusion criteria, after a more exhaustive reading, it was found that some articles were systematic reviews ( $n = 44$ ) or studies without an intervention ( $n = 43$ ), whereas others did not meet the study objective ( $n = 85$ ), did not correspond to the population characteristics ( $n = 50$ ) or were studies with projects that had not been carried out yet ( $n = 20$ ). It is worth noting the large number of articles that were not selected because they did not meet the objectives of this research. These studies initially appeared to be suitable for this systematic review; however, upon further analysis, it was observed that they were not conducted in hospital classrooms or healthcare settings, or that they did not measure the benefits of the interventions. Similarly, the high number of studies not selected by the population characteristics or because they were studies without an intervention may also be striking. In these cases, the authors were strict regarding the PICO question, which detailed AAC interventions and people with disabilities that affect communication.

### 3.2 Characteristics of the studies: synthesis of results

Table 1 shows the details of the following data of each of the analysed studies: authors, year of publication, country, type of study, comparisons, study objectives, participants, variables and measurement instruments, interventions, and results.

Of the ten articles included in this review, one (10%) was an experimental, analytical study (Thunberg et al., 2022), two (20%) were randomised controlled trials (Gilroy et al., 2018; Meinzen-Derr et al., 2021); three (30%) were crosssectional studies (O'Regan et al., 2023; Frizelle and Lyons, 2022; Morison et al., 2023), one (10%) was a prospective, longitudinal, cohort study (Vaillant et al., 2022), one (10%) was a retrospective case review and descriptive study (Jenks et al., 2022), one (10%) was a qualitative study (Fäldt et al., 2020), and one (10%) was a quasi experimental longitudinal study (Srinivasan et al., 2022).

With regard to the countries in which the different studies were carried out, three (30%) were conducted in Sweden (Thunberg et al., 2022; O'Regan et al., 2023; Fäldt et al., 2020), two (20%) in Ireland (Gilroy et al., 2018; Frizelle and Lyons, 2022), one (10%) in Netherlands (Vaillant et al., 2022), two (20%) in USA (Jenks et al., 2022; Meinzen-Derr et al., 2021), one (10%) in India (Srinivasan et al., 2022), and one (10%) internationally in several countries [USA, France, Australia, UK, Canada, Netherlands, Belgium, Spain, Sweden and Qatar] (Morison et al., 2023).

In regard with the participants, one study (10%) used children and adolescents (Thunberg et al., 2022), six studies (60%) only used children (Gilroy et al., 2018; O'Regan et al., 2023; Vaillant et al., 2022; Jenks et al., 2022; Srinivasan et al., 2022; Meinzen-Derr et al., 2021), one study (10%) used children and their classmates, teachers and assistants (Frizelle and Lyons, 2022), one study (10%) only used the parents (Fäldt et al., 2020), and one study (10%) used adults, adolescents and children (Morison et al., 2023).

### 3.3 Types of AAC and target application groups

One of the studies (Thunberg et al., 2022) used a programme known as KomHIT to support paediatric care in psychiatric clinics

and operating rooms. This programme consists in a universal design intervention with pictorial support. Another study (Gilroy et al., 2018) employed high technology strategies (Tablet application with voice generation) and low technology strategies (cards with images) in children with Autism Spectrum Disorder (ASD). One of the studies (O'Regan et al., 2023) used AAC tools through different protocols, in order to carry out cognitive evaluations in children with cerebral palsy. Another study (Vaillant et al., 2022) employed AAC through functional communication strategies (speech therapies) to evaluate the communication of children with cerebral palsy. One of the studies (Jenks et al., 2022) analysed how the cochlear implant could also facilitate AAC strategies in children with ASD. The study conducted by Srinivasan et al. (2022) applied the Jellow Communicator AAC system in children with ASD. In this system, didactic cards and behavioural training were used as AAC strategies. Another study (Frizelle and Lyons, 2022) evaluated the development of a basic sign vocabulary of keywords in children with Down's syndrome to be used by the latter as AAC. One study (Meinzen-Derr et al., 2021) applied a technology assisted language intervention in children with bilateral hearing loss. Fäldt et al. (2020) administered the ComAlong Infant programme to parents of children with communication difficulties. This programme consists in group sessions for parents directed by professionals and home visits in which receptive communication and improved environment are addressed as AAC strategies. The study of Morison et al. (2023) evaluated the results of an intervention with communication boards, voice generating devices, communication signs, graphic systems, symbolic communication and signs in people with speech and language alterations due to disorders related to the CDK13 gene.

### 3.4 Benefits obtained in populations who received the interventions

The use of pictorial support as an AAC tool obtained satisfactory results in the communication between the professionals and the parents during paediatric care in psychiatry and surgery (Thunberg et al., 2022). It also obtained favourable results in the communication of children with ASD (Gilroy et al., 2018; Srinivasan et al., 2022) and in people with speech and language alterations due to disorders related to the CDK13 gene (Morison et al., 2023).

The interventions based on the use of voice generation through high technology also produced significant improvements in the communication of children with ASD (Gilroy et al., 2018), children with hearing problems (Meinzen-Derr et al., 2021) and people with speech and language alterations due to disorders related to the CDK13 gene (Morison et al., 2023).

The collaboration of interpreters specialised in AAC significantly helped to evaluate children with cerebral palsy more exhaustively. The improvements derived from the use of this strategy in the communication of this population favoured the adequate estimation of the cognitive capacities of the children by psychologists (O'Regan et al., 2023).

The use of functional communication as an AAC strategy also obtained efficient results to evaluate speech, gestures, behaviour, facial expressions, communication and social interaction, and spoken language comprehension in children with cerebral palsy (Vaillant et al., 2022).

The cochlear implant, as a communication facilitating measure and, therefore, a complement of AAC strategy, conducted in children with ASD and hearing problems, obtained improvements in the hearing skills, language skills and social participation skills of this population (Jenks et al., 2022).

The development and application of a basic vocabulary in children with Down's syndrome, through the identification of keyword signs in this population also obtained satisfactory results in the communication needs of these children and of those who interacted with them (Frizelle and Lyons, 2022).

Similarly, the application of different options of AAC through a multimodal strategy based on the exchange of ideas among groups of families, obtained favourable results in the communication skills of children with communication difficulties (Fäldt et al., 2020).

## 4 Discussion

The general objective of this study was to identify and synthesize empirical studies reporting the application of AAC strategies in hospital-based educational and healthcare environments for individuals with communication impairments.

This work identified different AAC strategies. Some of the analysed studies concluded that pictorial support and easy to read texts obtain good results and improve communication in psychiatric and surgical paediatrics (Thunberg et al., 2022), in ASD children (Gilroy et al., 2018; Srinivasan et al., 2022) and in people with speech and language alterations (Morison et al., 2023). These findings are in line with those of similar studies, in which parents of children with different communication problems reported that pictorial support was effective, as it showed what was going to happen and increased the comprehension of the course of events (Lindblad and Schönborg, 2019; Vaanta-Benjaminsson and Nilsson, 2017). Other studies also demonstrated that pictorial support helped the children to converse and ask questions (Beijer, 2016; Lindblad and Schönborg, 2019). However, in order to generalise conclusions about the effectiveness of this AAC strategy, it is important to consider the population to which it is applied, since it is not possible to compare a group with a language related communication problem with patients with communication problems due to functional diversity (Coyne et al., 2016). Nevertheless, children, parents and healthcare professionals agree that this resource is effective in people with disabilities that affect communication (Lindblad and Schönborg, 2019).

Another strategy with favourable results that was identified in different studies was high technology. In this sense, voice generating applications in Tablets have improved the social and communicative behaviour of children with ASD (Gilroy et al., 2018) and people with speech and language alterations due to disorders related to the CDK13 gene (Morison et al., 2023). Likewise, Meinzen-Derr et al. (2021) employed high technology focused on language and communication skills, reporting significant increases in the length of the sentences used by children with hearing problems. These results are consistent with what has already been reported in the scientific literature, which states that high technology allows accessing information in a more comprehensive manner, thereby improving spoken language, understanding and pragmatic skills (Doosti et al., 2018; Nittrouer et al., 2013). It is important to specify that, before applying high technology applications to people with disabilities that affect

communication, it is necessary to identify which type of communication skill is deteriorated (Bishop, 2003). On the other hand, there seems to be a consensus on the use of this strategy in the first years of life for people with disabilities that affect communication, as it supports the construction of vocabulary and expressive grammar (Branson and Demchak, 2009; Binger and Light, 2008). However, this type of AAC can have significant limitations in developing countries, where the population has fewer technological resources and, therefore, their use and level of information and communication is significantly lower than that of people in developed countries (Rodríguez Fuentes and Gallego Ortega, 2007). In these types of contexts, it seems more appropriate to apply more conventional AAC strategies that are also effective, such as the one applied by Grañana (2022) in Argentina to children with ASD through a non-high-tech intervention.

Furthermore, this systematic review detected two AAC strategies in children with cerebral palsy. O'Regan et al. (2023) employed them as cognitive evaluation tools to enable this population to communicate in a more effective manner and thus prevent the underestimation or overestimation of the cognitive skills of the children. Vaillant et al. (2022) also used AAC strategies through the use of functional communication to perform communicative evaluations, obtaining very satisfactory results. These findings are in line with previous studies, which have demonstrated that children with cerebral palsy could miss effective evaluations due to complex communication needs. However, this problem improved substantially, as it used adaptive response modalities, nonverbal valuations and AAC for the evaluations of this population (Stadskleiv, 2020; Kurmanaviciute and Stadskleiv, 2017). However, this group is usually categorised as patients with physical functional diversity, which has a negative influence on the application of AAC strategies and, therefore, lower priority is often given to the approach of cognition (Rosenbaum et al., 2006). Increasing knowledge about the use of AAC in this population could help to improve their communication skills, as well as their valuation by different sociohealthcare professionals (Geytenbeek et al., 2014; Batorowicz et al., 2018).

With regard to the conceptualisation of AAC, in its broadest definition, it is understood as all the treatment options or strategies that facilitate the communication of people with severe difficulties to execute speech (Viera-Gómez and Reali-Arcos, 2021). In this sense, the current systematic review included a study that addressed an intervention for children with ASD and hearing problems (Jenks et al., 2022). The mentioned study shows the results of patients who had undergone surgery or lesions of organs involved in speech, specifically cochlear implant. It concluded that there were improvements in hearing and language skills and social participation. In this situation, the cochlear implant served as a support strategy for other AAC strategies, since the study population, in addition to hearing difficulties, also had ASD. These findings demonstrate a correlation with similar studies, which report an improvement in the spoken sentences in these children (Valero et al., 2016; Eshraghi et al., 2015). On the other hand, other studies show that very few children with hearing impairment, ASD and cochlear implant developed a limited spoken language (Lachowska et al., 2016; Meinzen-Derr et al., 2014). Nevertheless, it seems that a cochlear implant can improve the participation of the child and their carer, thereby positively influencing their quality of life (Young et al., 2016).

With respect to other types of strategies, it is worth highlighting those based on the development of a basic vocabulary. The present

review included the study of Frizelle and Lyons (2022), who carried out an observation in children with Down's syndrome to develop a basic vocabulary through keyword signs in this population. Their findings reflected satisfaction in the communication needs of these children and those who interacted with them. These results are in line with those of similar studies, which also pointed out games as an important opportunity to learn social skills and build relationships (Moore and Lynch, 2018; Gray and Ryan, 2016). It is important to underline that, in order for this type of strategy to be successful, the environment of the child must be involved, since the limited knowledge and use of keyword signs may create considerable barriers to their inclusion (Cologon and Mevawalla, 2018). Involving the environment is an AAC method that can provide support in the face of those challenges associated with significant speech and language difficulties, while making use of the advantages of visual memory (Rombouts et al., 2017).

Lastly, the work of Fäldt et al. (2020), which was focused on a parent centred AAC intervention, performed a group training for parents with subsequent home visits, observing an improvement in receptive communication thanks to the family and multimodal approach. These conclusions are in line with those of previous studies, which also report a positive perspective toward the modelling, counselling, feedback and relevance of home visits with interventions focused on the parents as essential components of learning (Marshall et al., 2017; Mandak et al., 2017). However, if this type of strategy is not adequately planned, it may pose a constant effort to the parents, in which neither the children nor the parents are ready to use AAC resources (Moorcroft et al., 2019). Therefore, it is important for the different resources to be incorporated gradually, with knowledge of the development of the child and contact with other parents as groups of peers for the exchange of experiences (Iacono et al., 2016).

In short, it has been shown that for AAC strategies to be fully effective, they must be applied in all environments of interaction of people with disabilities that affect communication, that is, in the family, school, health, social and leisure environments (Gilroy et al., 2018; Batorowicz et al., 2018; Fäldt et al., 2020; Jenks et al., 2022; Frizelle and Lyons, 2022).

## 4.1 Limitations and future research lines

This study presents novel and updated information about some very specific aspects that require constant research, although it also has some limitations that must be highlighted. Firstly, it was difficult to find broad scientific evidence that fits the inclusion criteria and objectives of this review. This situation could be due to the fact that this is a very novel topic, of which little information is available.

Furthermore, a great diversity of AAC strategies were identified for different groups with communication problems. Nevertheless, any proposition of intervention for a specific population would have to be reinforced with the evidence of other studies, since the current work is not focused on the specificity of a single group. It should be noted that this systematic review is a pilot study, from which the study researchers have obtained basic information about the study topic, and therefore only open-access works were included. In the future other more specific areas of the topic will be addressed.

Therefore, it is necessary to carry out further systematic reviews, focusing solely on a specific population group, with a specific type of



communication problem, which would allow proposing a broad and specific intervention for that group based on the evidence. Moreover, it would also be convenient to perform a meta-analysis of future systematic reviews.

In short, it is noteworthy that despite the limitations detailed above, 100% of the findings obtained in this research derived from experimental intervention studies. Furthermore, the AAC strategies evidenced could immediately be applied to population groups similar to those in this study, such as individuals with ASD, cerebral palsy, hearing impairments, or Down syndrome. The researchers of this study are currently conducting broader research, so findings on AAC strategies in more population groups may be available in the near future.

## 5 Conclusion

This study shows evidence related to the application of AAC strategies in different population groups with communication problems.

Benefits have been obtained after the application of AAC in: psychiatric and outpatient surgical paediatrics; children with ASD; children with cerebral palsy; children with hearing problems; children with Down's syndrome; young children with communication difficulties; and people with speech and language alterations due to disorders related to the CDK13 gene.

The strategies that presented favourable results are: those of universal design with pictorial support; the use of new technologies with voice generation; cognitive evaluations; the use of functional communication; cochlear implant; the use of a basic vocabulary of keyword signs; technology assisted language; and multimodal and group intervention programmes for parents.

This review highlights the importance of considering variables such as the family, social and academic environment. Taking these aspects into account, the application of AAC would obtain better results. Moreover, the multidisciplinary approach is fundamental.

Likewise, it is also relevant to consider the communication problem in question and determine the type of AAC to be applied. Even in similar groups, there may be variables that condition the use of one or another type of resource.

To sum up, there is a wide range of possibilities in terms of AAC strategies. These resources can be applied and used in people with disabilities that affect communication to improve their quality of life and that of the people who interact with them. Educational centres can be true learning scenarios to favour the maximum psychosocial potential of their students, by fostering the learning of these strategies. In addition, these resources can also be used with clinical and/or therapeutic purposes in the healthcare scope.

### 5.1 Pedagogical, social and healthcare implications

This study offers a possible roadmap to initiate the planning of AAC strategies in different population groups.

The information reported in this systematic review is relevant at a pedagogical, social and healthcare level. The educational aspect is especially relevant in this topic. It is necessary to develop adequate strategies for the learning of these AAC resources to ensure their effective application. As was demonstrated by [Guilar \(2009\)](#), the acquisition of knowledge, abilities and skills in childhood and

adolescence consists in a spiral learning method, where increasingly complex knowledge is progressively presented, integrating it by increasing the competencies related. Moreover, the academic contexts play a fundamental role. Regarding the social area, the improvement of communication skills allows people to develop their socialisation skills. Therefore, an effective AAC will have very favourable consequences in the social area of people who use it. Finally, the importance of an adequate communication in the clinical and healthcare scopes was also highlighted. If the communication skills of people improve, the information they send and receive will be more adequate, which positively influences important variables such as proper clinical diagnosis and evaluation.

## 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

DG-A: Writing – original draft, Formal analysis, Methodology, Visualization. F-JG-V: Writing – original draft, Conceptualization, Investigation, Supervision. CA-Á: Methodology, Project administration, Resources, Writing – review & editing. M-IM-S: Data curation, Funding acquisition, Software, Writing – review & editing. M-JL-L: Funding acquisition, Validation, Writing – original draft. EM-S: Conceptualization, Funding acquisition, Validation, Writing – review & editing.

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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.

## Generative AI statement

The authors declare that no Gen AI was used in the creation of this manuscript.

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