Automatic quality assurance of radiotherapy treatment plans using Bayesian Networks-A multi-institutional study

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# Supplementary Tables

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| Table S1: Data items used from the three different clinics for the creation of Bayesian network |
| Maastro clinicTPS: EclipseOIS: ARIA, LINAC: Truebeam (Varian) | University of Vermont Medical CenterTPS: Pinnacle; OIS: Mosaiq; LINAC: Infinity (Elekta) | University of WashingtonTPS: RayStation; OIS: Mosaiq; LINAC: Infinity and Versa HD (Elekta) |
| Clinical T stage |
| Clinical N stage |
| Clinical M stage |
| Number of plan adaptations |
| Dose per fraction |
| Total dose |
| Number of fractions |
| Radiation type |
| Plan technique |
| Table angle |
| Number of beams |
| Wedge\* |
| Control points |
| Source to surface distance (SSD) |
| Bolus |
| Gantry angle |
| Collimator angle |
| Beam energy |
| Table orientation |
| Tolerance table |
| Treatment intent |
| Monitor Units/cGy\*\* |
| Anatomic tumor location |
| Monitor Units/deg\*\* |
| \*Do not exist in MAASTRO’s dataset, \*\*cGy=Centi Gray, \*\*start and end arc angle for VMAT |

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| Table S2: Variables states used for the creation of the BN by the three different participated centers |
| Variable states/centers | Maastro | University of Vermont Medical Center | University of Washington |
| T stage | "T0" , "T1" , "T2", "T3", "T4", "Tis", "Tx" |
| N stage | "N0","N1" ,"N2", "N3", "Nx" |
| M stage | "M0", "M1", "Mx" |
| Number plan adaptations | 1, 2, 3, 4, >=5 |
| Dose per fraction | "[1001-1200]" ,"[1201-1400]", "[1401-1600]", "[151-200]", "[1601-1800]", "[1801-2000]","[2001-2500]","[201-250]", "[2501-3000]", "[251-300]", "[301-350]", "[351-400]", "[401-600]", "[601-800]", "[801-1000]", "<=150" |
| PTV dose | "[0-200]","[1001-1200]", "[1201-1400]", "[1401-1600]", "[1601-1800]", "[1801-2000]", "[2001-2200]", "[201-400]", "[2201-2400]", "[2401-2600]", "[2601-2800]", "[2801-3000]", "[3001-3200]", "[3201-3400]", "[3401-3600]", "[3601-3800]", "[3801-4000]", "[4001-4200]", "[401-600]", "[4201-4400]", "[4401-4600]", "[4601-4800]", "[4801-5000]", "[5001-5200]", "[5201-5400]", "[5401-5600]", "[5601-5800]", "[5801-6000]", "[6001-6200]", "[601-800]", "[6201-6400]", "[6401-6600]", "[6601-6800]", "[6801-7000]", "[7201-7400]", "[7601-7800]", "[801-1000]" |
| Number of fractions | 1-35 | 1-45 | 1-45 |
| Radiation type | "Electrons", "Photons" | “Electrons”, “Photons”, “HDR” | “Electrons”, “Photons”, “Protons”, Neutrons”, “HDR”, “LDR” |
| Plan technique | "IMRT", "VMAT" | “ConformalArc”, “ConformalPlan”, “VMAT”, “IMRT”, “SBRT”, “SRS”, HDRbrachytherapy”  | “ConformalArc”, “ConformalPlan”, “VMAT”, “IMRT”, “SBRT”, “SRS”, HDRbrachytherapy”, “TBI”, “SIB” |
| Table angle | "[1-10]", "[11-20]", "[21-30]", "[281-290]", "[291-300]", "[31-40]", "[321-330]", "[331-340]", "[341-350]", "[351-359]", "[51-60]", "[61-70]", "[71-80]", "0", "90" |
| Number of beams | 1-15 | 1-20 | 1-20 |
| Wedge | No wedges are used at Maastro | ‘yes’, ‘no’ | ‘yes’, ‘no’ |
| Control points | "[101-120]", "[121-140]", "[141-160]", "[161-180]", "[2-20]", "[41-60]", "[61-80]", "[81-100]", "1" |
| Source to surface distance | "[101-105]", "[106-110]", "[111-115]", "[116-120]", "[80-85]", "[86-90]", "[91-95]", "[96-100]", "<80", ">120" |
| Bolus | "no", "yes" |
| Gantry angle | "[1-10]", "[101-110]", "[11-20]", "[111-120]", "[121-130]", "[131-140]", "[141-150]", "[151-160]", "[161-170]", "[171-179]", "[181-190]", "[191-200]", "[201-210]", "[21-30]", "[211-220]", "[221-230]", "[231-240]", "[241-250]", "[251-260]", "[261-269]", "[271-280]", "[281-290]", "[291-300]", "[301-310]", "[31-40]", "[311-320]", "[321-330]", "[331-340]", "[341-350]", "[351-359]", "[41-50]", "[51-60]", "[61-70]", "[71-80]", "[81-89]", "[91-100]", "0", "180", "270", "90" |
| Collimator angle | "[1-10]", "[101-110]", "[11-20]", "[111-120]", "[121-130]", "[131-140]", "[141-150]", "[151-160]", "[161-170]", "[171-179]", "[181-190]", "[191-200]", "[201-210]", "[21-30]", "[211-220]", "[221-230]", "[231-240]", "[241-250]", "[251-260]", "[261-269]", "[271-280]", "[281-290]", "[291-300]", "[301-310]", "[31-40]", "[311-320]", "[321-330]", "[331-340]", "[341-350]", "[351-359]", "[41-50]", "[51-60]", "[61-70]", "[71-80]", "[81-89]", "[91-100]", "0", "270", "360", "90" |
| Beam energy | 6 , 10 , 12 , 15 | 6, 9, 10, 12, 15, 18, Other | 6, 9, 10, 12, 15, 18, Other |
| Patient orientation | HeadIn-Supine | HeadIn-Supine, FeetIn-Supine, HeadIn-Prone, FeetIn-Prone, Unknown | HeadIn-Supine, FeetIn-Supine, HeadIn-Prone, FeetIn-Prone, HeadIn-RecumbentRight, HeadIn-RecumbentLeft, FeetIn-RecumbentRight, FeetIn-RecumbentLeft, Unknown |
| Tolerance table | Other | Photon-tight, Photon-loose, Electron, SRS/SBRT, Other | Photon-tight, Photon-loose, Electron, SRS/SBRT, Other |
| Treatment intent | "Curative", "NULL", "Palliative" | “Curative”, “Palliative”, “Neoadjuvant”, “Adjuvant”, “Induction” | “Curative”, “Palliative”, “Neoadjuvant”, “Adjuvant”, “Induction”, “BMTRegimen |
| MU/cGy | "[0-1]", "[1.1-1.5]", "[1.6-2]", "[2.1-2.5]", "[2.6-3]", "[3.1-3.5]", "[3.6-4]", "[4.1-4.5]", "[4.6-5]", ">5", "NULL" |
| MU/deg | "[0.1-1]", "[1.1-2]", "[2.1-3]", "[3.1-4]", "[4.1-5]", ">5", "0", "NULL" |

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| Table S3: Categories of simulated errors with description |
| Error category | Error | Examples |
| Patient set-up | Bolus | "Wrong bolus usage" |
| Treatment planning | Beam\_Energy | "Beam energy should have been 6MV instead of 18" |
| Treatment planning | Radiation\_Type | "Electrons should have been used instead of Photons" |
| Patient set-up | Patient orientation | "Patient should have been positioned to HeadIn-Prone" |
| Treatment planning | Number\_of\_Beams | "6 instead of 4" |
| Treatment planning | Source to surface distance | "100 instead of 80" |
| Treatment planning | Collimator angle | "20 instead of 10" |
| Treatment planning | Gantry angle | "90 instead of 80" |
| Patient set-up | Table angle | "10 instead of 0" |
| Treatment planning | Treatment intent | "Curative instead of palliative" |
| Treatment planning | Wedge\* | "Wrong wedges usage" |
| Patient set-up | Tolerance table\* | “Electron plan using Photon tolerance table” |
| Treatment planning | Monitor Units/cGy | "0 instead of 5" |
| Treatment planning | Monitor Units/degree | "5 instead of 0" |
| Dose prescription | PTV\_Dose | 300 cGy x 20 fractions = 6000 cGy vs 200 cGy x 30 fractions = 6000 cGy |
| Dose prescription | Number\_of\_Fractions | 200 cGy x 20 fractions = 4000 cGy vs 300 cGy x 20 fractions = 6000 cGy |
| Dose prescription | Dose\_Per\_Fraction | 200 cGy x 30 fractions = 6000 cGy vs 200 cGy x 20 fractions = 4000 cGy |
| \*Not applicable at Maastro |