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Approach	Description	Tumour site	Advantages	Disadvantages
Individualised margins e.g. patient specific PTV or ITV	Create ITV by merging CTV from bladder full and empty planning scan (20)	Cervix	Not resource intensive Single plan with no impact to treatment on set Can use information already available Can account for rectal and bladder filling	May increase PTV volume and therefore increase overlap with OARs and reduce bladder sparing etc May require multiple imaging sessions, with corresponding outlining
	Create ITV by fusing multiple pre-treatment imaging modalities with varied bladder and bowel filling (NCT03617133)	Bladder		
	Create patient-specific PTV by combining planning CT bladder contour and a number of CBCTs, aiming to cover all excursions of the bladder, over the chosen time frame (21, 22)	Rectum		
'Plan library' or 'Plan of the day' (POTD)	POTD based on variable bladder filling with the creation of individualised model-based ITVs from bladder full and empty planning scans (20, 24)	Cervix	Significant reduction in OAR dose whilst ensuring CTV coverage Possible increase in target coverage For bladder sparing approaches, limits the amount of healthy bladder within the high dose region	Adequate training needed Time consuming on set if difficult Need to consider intra-fraction filling and monitor treatment times Does not account for all scenarios therefore may need conformal backup
	Library of 3-6 plans based on PTVs of incremental increasing volumes (25–30)	Bladder		
	Use of multiple plans (plan library) based on expected variations in target volume position towards the bladder (31–34)	Rectum		
Planned adaptation	Scheduled re-plan at set points through treatment course (35, 36)	Cervix	Reduce OAR dose whilst maintaining CTV coverage Compensate for reduction in tumour volume which can be dramatic in cervical or rectal cancers	Time and resource consuming – less replanning needed in dosimetry triggered strategy
	Utilising imaging from first half of the treatment course to plan a simultaneous integrated boost to the primary tumour during the second half of the treatment course, with individual patient PTV margins for the tumour (37–39)	Rectum		

Daily re-optimisation or real time planning	Acquire daily CBCTs for the patient and re-optimize plan online based on the patient's anatomy (28, 40, 41)	Prostate, Bladder	Potential reduction of doses to OARs Highly personalised treatment	Significant change of practice Adequate training needed Resource intensive Specialised systems or treatment platforms required
	Acquire daily MRIs for the patient and re-optimize plan online based on the patient's anatomy (42-46)	Prostate, Bladder, Rectum		
Live tracking	Ultrasound guided tracking (47)	Prostate	Certainty regarding target position Allows very small margin around target	Complex Additional procedure needed If treating nodal target too concern re nodal dose coverage
	Real time tracking using fiducials or transponders (48, 49)	Multiple	Tracks intra-fraction motion	

Table 1: Overview of adaptive treatment strategies in pelvic image guided radiotherapy. CBCT: Cone Beam Computed Tomography, CTV: Clinical Target Volume, ITV: Internal Target Volume, OAR: Organ at Risk, POTD: Plan of the Day, PTV: Planning Target Volume.