Implementing an Auto-contouring Software (Limbus AI) into a Radiotherapy Planning Workflow

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Clinical Problem

- When planning radiotherapy, oncologists must contour target volume (TV) and organs at risk (OAR) on the planning CT

- CTs have hundreds of images/slices so contouring is time consuming

- Delays in contouring may contribute to delays in patient pathways

AI Solution

- Limbus AI is a CE marked auto contouring software that will draw these contours automatically, the clinician will then edit and approve them

- Limbus AI is 1 of the 9 companies that are NICE approved auto-contouring companies. NICE and RCR state we should be producing evidence on clinical acceptability, time saving and errors and their implications.

Deployment

Pre-implementation

- Funding was sought locally and from the North Central London Cancer Alliance fund

- Locally a digital healthcare checklist was followed and included the safety case report, information governance (IG) and data protection impact assessment (DPIA)

- Systematic review on existing literature done to determine site order roll out

- Retrospective review using Likert score (1-5) and clinician feedback to determine if adequate for use

Step 1
- Use mouse to select the dotted box around the Limbus structure set and the contouring structure set (white arrow).
- The window should now contain both the limbus structure set and the empty contouring structure set side by side (opposite).

Step 3
- The structures have now been copied over to the contouring structure set.
- The suffix "^AI" needs to be deleted by right clicking on the volume on the contouring structure set, selecting properties, and deleting this in the ID.
- These are ready for editing as per usual contouring process.

Implementation

- Anatomical structures for each site were decided and templates created

- Protocols were matched to templates to ensure automatic attachment of the correct template

- Clinician training undertaken using a simple powerpoint

- We have implemented into all adult and pediatric site – over 1500 scans through Limbus!

Protocol Name	Structure Set To Apply
UCH_RT_4DCT_ABDOMEN (Adult)	Abdomen_v1.0
UCH_RT_4DCT_SABR (Adult)	Thorax_All
UCH_RT_4DCT_THORAX (Adult)	Thorax_All
UCH_RT_Abdomen_Adult (Adult)	Abdomen_v1.0
UCH_RT_Aboveknee (Adult)	SacromaLowerLimb_v1.0
UCH_RT_ADV_ABDO (Adult)	Abdomen_v1.0
UCH_RT_Belowknee (Adult)	SacromaLowerLimb_v1.0
UCH_RT_Brachy_Pelvis (Adult)	Prostate(+Anorectum)_v3.0 (M), Anorectum(+Gynae)v_2.0
UCH_RT_Breast (Adult)	Breast
UCH_RT_CSI (Adult)	CSIv1.0
UCH_RT_DIBH_BREAST (Adult)	Breast
UCH_RT_Head (Adult)	Brainv1.0

Structure	Modality	Introduced in version	HNv2.0 (discontinued)	Thorax for Oesophagus structure
A_Aorta	CT	1.1.0	No	Yes
A_Aorta_B ase	CT	1.8.0		Yes
A_Aorta_I	CT	1.7.0	No	Yes
A_Celiac	CT	1.7.0	No	No
A_LAD	CT	1.6.0	No	Yes
A_Mesente ric_S	CT	1.7.0	No	No
A_Pulmona ry	CT	1.7.0	No	Yes
Applicator_ Cylinder (beta)	CT	1.8.0		No
Applicator_ Ring (beta)	CT	1.8.0		No
Atrium_L	CT	1.8.0		Yes
Atrium_R	CT	1.8.0		Yes
Bladder	CT	1.1.0	No	No
Bladder	MR T2	1.7.0	No	No
Bladder_CB CT	CT CBCT	1.8.0		No

Real World Analysis

Prospective Subjective Feedback

- Retrospective review using Likert score (1-5) and clinician feedback to determine what structures contoured well

- The feedback was incorporated into the training

AVERAGE PER STRUCTURE
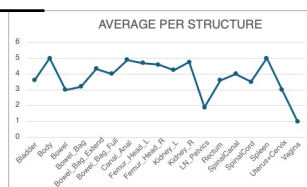
Cost Analysis

(Cost of Limbus for a year/ Total cost of contourer contouring) * 100 = % of time per person needed to be saved to make Limbus viable

6.77% of time if assuming 1/5th time (2PAs) → 32.5 minutes/week → **130 mins/month/pp**
Median time saving = 45 minutes (self reported)
Median = 6 patients/month/consultant
6 * 45 = **270 minutes/month**
Almost DOUBLE the required time saving to be viable

Re-planning Work

- Compared the plans generated by Limbus structures to the edited plans to see which OAR structures violate the dose optimisation constraints
- Results of this are currently under analysis

Workflow Analysis

- Limbus reduced the no. of replans needed due to plan quality (plans sent back to clinicians by physics team)
- Significantly (p = 0.002) reduced the number of patients that took >31 days from CT to receiving radiotherapy
- Specifically, significantly reduced the number of patients that took <21 days from CT to plan sign off showing this reduction could be due to speeding up contouring

Subjective vs Objective Findings

- Comparison of clinician scores to objective Dice score and Hausdorff distance (objective measures of difference)

- No correlation between the two showing that Likert scores by clinicians may not be an accurate way of analysing AI contours

- Spearman = 0.41, p=0.239

Correlation between Clinician Score and DICE
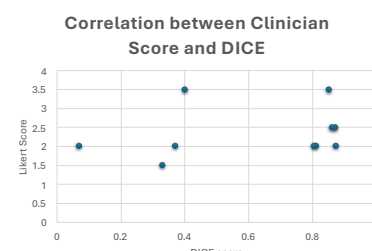
Milestones

✓ Implemented into all adult and paediatric sites at UCLH
✓ Analysed implementation subjectively and objectively – showed the benefit in feedback, cost savings and shortening patient pathway
✓ Business case written

Milestones and Future Steps

➢ Finish analysis on plan comparisons
➢ Conference abstract submission
➢ Paper on 'Real-world analysis methods for an auto-contouring software'