Purpose:
The prognosis for pancreatic cancer is poor, about 5% at 5 years. Definitive radiotherapy dose escalation is limited by critical structures that surround the pancreas. Online adaptive replanning may help reduce the PTV-CTV margins which would allow for larger doses delivered to target. In this work, we compare various online adaptive replanning approaches in terms of target coverage, organ sparing as well as speed of execution.

Methods:
Daily kV-CT images of 9 pancreatic tumor patients with 5 daily image sets were used for this retrospective analysis. During the actual treatments and for daily image acquisitions, Respiratory Gating was used to handle the intra-fraction motion. The original volumes of Pancreas-Head (CTV), Duodenum, Liver, Small Bowel, Large Bowel, Spinal Cord, Stomach, etc. were drawn by physician. The contours were transferred to the daily image sets using a deformable registration based auto-contouring tool (ABAS, CMS), which were further manually modified when necessary. The accuracy of the contours was inspected later on by the physician. A PTV-CTV margin of 3mm was applied to account for the residual intra-fractional errors, delineation errors, IGRT error, etc. to both the planning and the daily CTS. This CTV+3mm volume will be referred to as PTV3mm, is the main target that needs to be covered each day. The PTV3mm was further expanded by 3 different additional margins (AM) (0mm, 2mm, 5mm) to account for the inter-fractional errors, and 3 separate IMRT plans for each AM was generated on the planningCT. The prescription dose is 5040cGy in 28 fractions to cover 95% of the PTV. For the daily treatments, 9 different strategies were considered:  
1. Original plan reposition, simulation of the regular Image guided radiotherapy (IGRT) practice with center of mass (COM) alignment with 0mm additional margin (AM)  
2. Same as scenario 1 with 2mm AM  
3. Same as scenario 1 with 5mm AM  
4. Original plan reposition with doses scaled to maintain 95% volume coverage of target.(AM=0mm)  
5. Reoptimization starting from scratch.  
6. Reoptimization starting from the original plan (segment shapes and weights)  
7. Segment Aperture Morphing (SAM) applied to original plan  
8. SAM + Segment Weight Optimization (SWO) with SAM generated segment shapes  
9. SAM + Reoptimization starting from the SAM adjusted plan  

Note: For scenarios 4-9, the AM is 0mm.  
SAM (Segment Aperture Morphing) and SWO (Segment Weight Optimization) methods were previously reported. SAM modifies the segment shapes based on the daily vs. original plan target shape variation, while the SWO only optimizes the monitor units of individual segments while keeping the segment shapes intact.

Results:
Table 1. Comparison results from 9 scenarios in terms of dosimetric parameters from target and duodenum. HI:Heterogeneity Index, MDD: Mean Duodenum Dose, Rx: Prescription dose (5040cGy), SAM: Segment Aperture Morphing, SWO: Segment Weight Optimization.