Implementation of intelligent dynamic checklists for improving treatment planning quality control

Jeremy Hoisak, Ryan Manger, Irena Dragojević[1]

[1]Dept. of Radiation Medicine and Applied Sciences, UC San Diego, La Jolla, CA, USA

JULY 12–16 2020 VIRTUAL — JOINT AAPM | COMP MEETING — Improving Health QUALITY, Increasing Global IMPACT

UC San Diego Health — RETHINKING MEDICAL PHYSICS

INTRODUCTION

Checklists can reduce errors and improve quality in the healthcare setting and are recommended by the AAPM MPPG 4.a and TG-275 for effective physics plan checks and chart review. However, traditional 'read and do' checklists are of limited effectiveness if they do not enforce the completion of the task and can raise cognitive workload by requiring the user to locate information relevant to completing the checklist item. Furthermore, if checklists are perceived by users as creating more work or interfering with efficient workflows, acceptance and compliance may also limit their effectiveness. Electronic checklists have advantages over traditional checklists including ease of access, standardization, and digital record keeping of sign-offs and time stamps, but can have the same limitations as paper checklists if, for example, they are simply reproduced as a static 'read and do' checklist in a spreadsheet.

Our clinic has implemented a simple software solution within the oncology information system (OIS) to create an electronic intelligent, dynamic checklist that overcomes many of the limitations of traditional checklists. They intelligently link to the patient's electronic medical record (EMR) and embed to specific instances of quality control (QC) in the clinic workflow. The checklist dynamically retrieves, displays and stores information as required by the user to complete a checklist item, improving efficiency and reducing workload.

AIM

To describe the implementation of electronic intelligent dynamic checklists in our clinic and to illustrate their effectiveness with a case study of their introduction into the workflow for treatment planning, plan preparation, and documentation.

METHODS

Electronic intelligent dynamic checklists were created by repurposing existing functionality within the ARIA OIS (version 15.6, Varian Medical Systems, Palo Alto, CA). The Encounters workspace in ARIA was originally designed as a clinical assessment tool to facilitate interactions between patients and care-providers such as nurses or physicians by providing a customizable interface for the user to view and enter patient information and clinical documents. As such, it has broad access to much of the ARIA OIS and patient EMR and can also access radiation prescription and plan information from the Eclipse treatment planning system (TPS). This flexibility has allowed our clinic to adapt Encounters into a multi-purpose clinical quality tool for use by all staff including physicists, dosimetrists and radiation therapists.

Encounters-based checklists can retrieve real-time contextual information such as tasks, appointments and documents in a patient's chart as well as radiation prescription data, reference points, plan parameters and offline image review change requests. The checklist also allows the user to create new documents, create and assign tasks in the patient's care path for staff attention, or generate alerts for therapists at the treatment console. Electronic dynamic checklists have been created to support many clinical workflows and QC activities in our clinic including CT simulation, brachytherapy, physics plan checks, therapist checks, weekly physics chart review and physician peer review

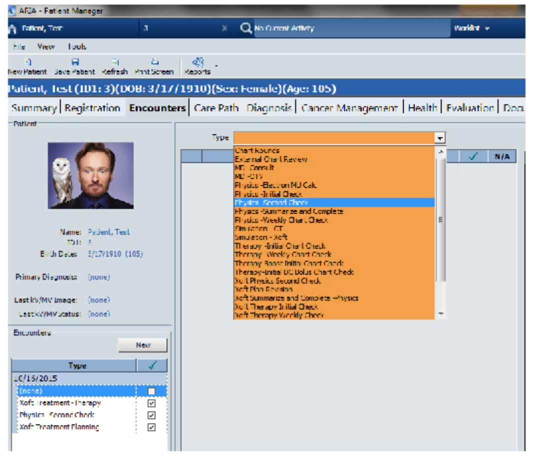

Figure 1. Encounters-based electronic dynamic checklists are used for many clinical processes

CREATING DYNAMIC CHECKLISTS

- Dynamic checklists are created in the ARIA Data Administration application by select "Encounters" from the sidebar within the Clinical Assessment tab.
- Drag and drop checklist items from the master list on the left into the checklist. Checklist items can be re-ordered, and sub-section dividers can be inserted. Checklist items can also be classified as optional (the checklist can be marked as completed if they are not checked off).
- Prescriptions can be visually compared with treatment planning parameters using the Radiation Review feature. Data elements can be customized by inserting new columns.
- Documents can be retrieved based on customizable search parameters including document type and creation date. New documents can also be created. For efficient use of dynamic document retrieval abilities, pre-defined document templates and types should be created in the Data Administration application for all major documents used in the clinic e.g. consult notes, physician orders, simulation notes, treatment plans, quality assurance, etc.
- Tasks such as physics consults, in-vivo dosimetry, can be displayed by type, date and status.
- Appointments can also be displayed by type, date and status.
- For each checklist item, the + allows the creation of new data (in the form of a task, appointment, document, etc) and is pre-configurable.
- Free-text fields can be used for multi-step checks or for those items completed external to ARIA.
- Similar checklist functionality can be created in the MOSAIQ OIS (Elekta AB, Stockholm, Sweden) under the Assessments menu.

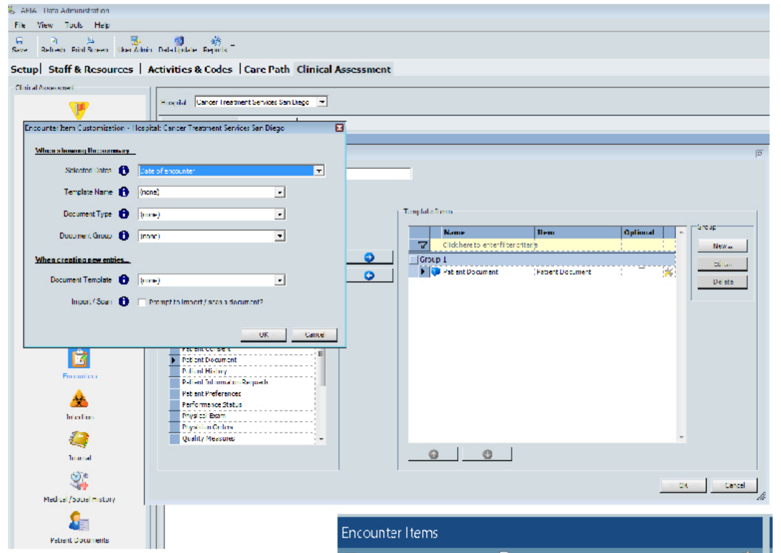

Figure 1. Configuring dynamic checklists within ARIA Data Administration

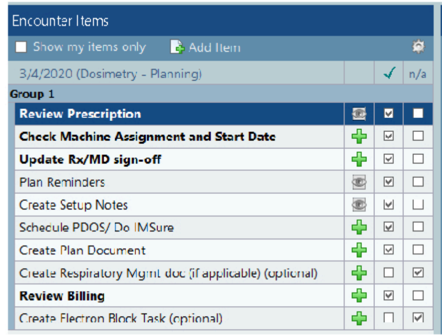

Figure 2. Electronic dynamic checklist for Treatment Planning

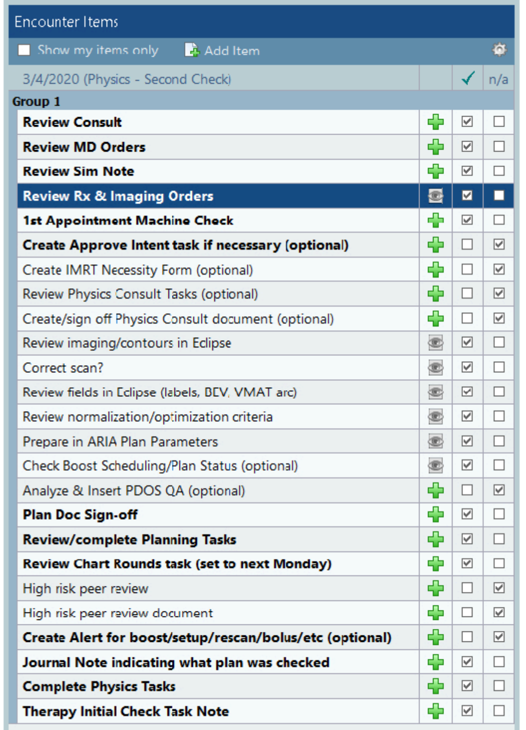

Figure 3. Electronic dynamic checklist for Physics Initial Plan Review

CASE STUDY

Electronic checklists have been used at our clinic for physics plan review since 2014. In addition to recommending checklists for physics plan review, TG-275 recommends that checklists be used to perform QC earlier in the workflow than at the end of treatment planning. Through retrospective review of QC reports by frequency and error type, we hypothesized that the use of an electronic checklist during treatment planning would reduce the frequency and type of errors arising in this phase of the patient's care. In this case study, two qualified medical physicists used our clinic's standardized electronic dynamic checklist for physics plan review to evaluate a total of 276 treatment plans, then based on the QC issues that were detected, a dynamic checklist was designed that would be suitable for our clinic's treatment planning workflow. All treatment planners in our clinic were then asked to create and follow the items prescribed in the checklist prior to submitting a plan for physics plan review.

The same qualified medical physicists then reviewed an equal number of plans created with the planning checklist. For each physics plan review, the number and type of QC issues were tracked (Prescription, Naming Conventions, Planning, Plan Preparation, Setup Notes, Documentation and Quality Assurance). Planning was a broad category that included contouring, technique, fields, optimization, dose calculation, plan quality metrics, target coverage and organs-at-risk dose constraints.

Prior to the introduction of the treatment planning checklist, the rate of QC issues detected during physics plan review was 23.2%. After introduction, the rate of QC issues decreased to 6.0%, with some error types being eliminated completely (Figure 3). Of the persistent error types, 58% were of a nature not covered by the treatment planning checklist. As shown in Figure 3, the distribution of QC issue types also changed after introducing the checklist, with less issues related to documentation, naming, prescriptions, quality assurance and setup notes, and more issues related to treatment planning and preparation. The categories of errors showing a decrease involved checks of numeric parameters and binary conditions, e.g. prescription vs plan for energy, dose and fractionation, existence of documentation, quality assurance, correct use of naming conventions, etc.

Error categories showing an increase involved complex issues related to plan quality and plan preparation for treatment, such as treatment technique, dose optimization and setup notes. A current limitation of this checklist implementation is the inability to prevent checklist completion if tasks are not actually completed. It still relies on user compliance to complete the task. Encounters-based checklists are also limited in their ability to open other ARIA applications within the ARIA OIS, currently only accessing the Prescription workspace. The inability to launch other applications requires the user to leave the checklist to complete the task, which can impact user focus and limit full effectiveness.

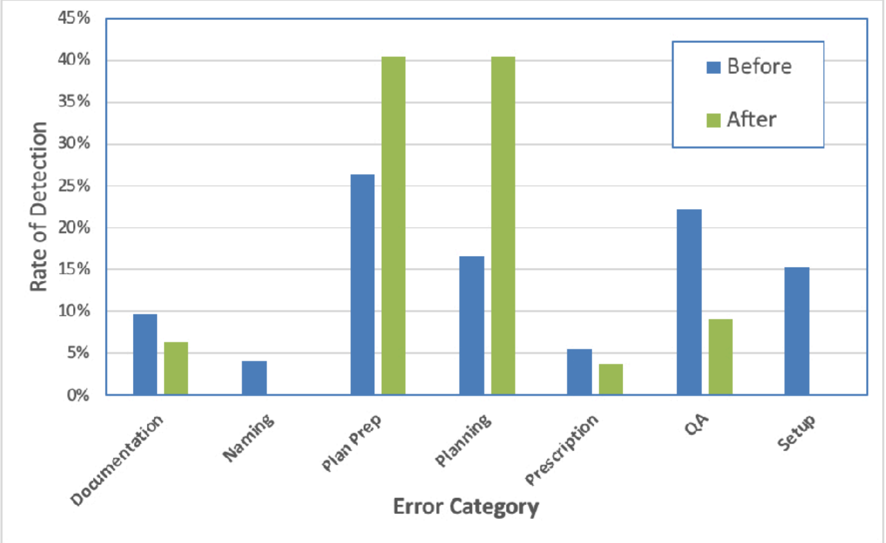

Figure 3. Rate of error detection by category before and after introduction of electronic dynamic checklists into the treatment planning workflow

CONCLUSIONS

A relatively simple electronic checklist suitable for physics plan review and other workflows can be implemented using existing tools in the ARIA oncology information system. By fully residing within the OIS, the checklists can intelligently link to the patient's record, dynamically accessing documents, tasks, treatment plan parameters and other information necessary to perform duties such as physics initial chart review.

The introduction of electronic dynamic checklists into the treatment planning workflow reduced the overall frequency of QC issues detected by physics plan review. The distribution of QC issue types moved away from numerical and binary tests towards complex plan quality issues that precluded easy detection and correction via a checklist. The results of this analysis will be used to iteratively improve the physics plan review and planning checklists to address recurring errors.

Reducing the frequency of simple errors during treatment planning not only improves plan quality but reduces physicist workload during physics plan review and allows more efficient use of the time available, for example, to focus on detecting complex plan quality issues.

REFERENCES

de los Santos EF, Evans S, Ford EC, Gaiser JE, Hayden SE, Huffman KE, Johnson JL, Mechalakos JG, Stern RL, Terezakis S, Thomadsen BR. Medical Physics Practice Guideline 4. a: Development, implementation, use and maintenance of safety checklists. *Journal of applied clinical medical physics. 2015 May;16(3):37-59.*

Ford E, Conroy L, Dong L, de Los Santos LF, Greener A, Gwe-Ya Kim G, Johnson J, Johnson P, Mechalakos JG, Napolitano B, Parker S. Strategies for effective physics plan and chart review in radiation therapy: Report of AAPM Task Group 275. *Medical Physics. 2020 Jan 22.*

Berry SL, Tierney KP, Elguindi S, Mechalakos JG. Five years' experience with a customized electronic checklist for radiation therapy planning quality assurance in a multicampus institution. *Practical radiation oncology. 2018 Jul 1;8(4):279-86.*

Rassiah-Szegedi P, Su F, Huang Y, Spitznagel D, Sarkar V, Szegedi M, Zhao H, Paxton A, Nelson G, Salter B. Utilization of Failure Mode Effect Analysis (FMEA) to Generate An Initial Plan Check Checklist. *Medical Physics 2019 Jun 1 (Vol. 46, No. 6, pp. E531-E531).*

CONTACT INFORMATION

For more information please contact jhoisak@health.ucsd.edu