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Original Report

Software tool for physics chart checks

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Abstract

Purpose: Physics chart check has long been a central quality assurance (QC) measure in radiation oncology. The purpose of this work is to describe a software tool that aims to accomplish simplification, standardization, automation, and forced functions in the process.

Methods and materials: Nationally recognized guidelines, including American College of Radiology and American Society for Radiation Oncology guidelines and technical standards, and the American Association of Physicists in Medicine Task Group reports were identified, studied, and summarized. Meanwhile, the reported events related to physics chart check service were analyzed using an event reporting and learning system. A number of shortfalls in the chart check process were identified. To address these problems, a software tool was designed and developed under Microsoft. Net in C# to hardwire as many components as possible at each stage of the process.

Results: The software consists of the following 4 independent modules: (1) chart check management; (2) pretreatment and during treatment chart check assistant; (3) posttreatment chart check assistant; and (4) quarterly peer-review management. The users were a large group of physicists in the author's radiation oncology clinic. During over 1 year of use the tool has proven very helpful in chart checking management, communication, documentation, and maintaining consistency.

Conclusions: The software tool presented in this work aims to assist physicists at each stage of the physics chart check process. The software tool is potentially useful for any radiation oncology clinics that are either in the process of pursuing or maintaining the American College of Radiology accreditation.

Introduction

Quality control (QC) checks play a pivotal role in safeguarding quality radiation treatments to cancer patients.[1-4] Among various QC checks, physics chart check including plan review before treatment and weekly chart check during treatment have been quantified to have the highest effectiveness in detecting errors. Ford et al[5] recently analyzed approximately 300 incidents that had high-potential severity among over 4000 reported incidents, and reported that physics plan review has a potential effectiveness of 62%, while physics weekly has a potential effectiveness of 43%, placing them as the top 2 QC checks among 15 commonly used QC measures. The combination of physics chart check with other QC measures including physician chart review, radiation therapist timeout, and port films can reach a potential effectiveness of 97%.

The analysis of Ford et al,[5] however, was based on a best-case scenario; namely based on the assumption that if a particular QC check could detect a particular error then it

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Conflicts of interest: None.

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would detect it. For physics chart check QC, however, the actual effectiveness in a clinic may be less, even much less, than the theoretic value due to the shortfalls in chart check management and the lack of QC tools to assist chart check. As a result of poor chart check management and communication, it is not unusual that the same patient's chart has been checked multiple times by the same physicist instead of by multiple physicists with a wide range of expertise, and that a hypofractionated patient's chart has never been checked until treatment completion. Moreover, the current physics chart check QC process relies primarily on training and policies that are, in fact, the least effective in reducing or detecting error according to the hierarchy of effectiveness.[6] For example, in the New York state database, "failure to follow policies/procedures" contributed to 84% of events, versus "inadequate policies/procedures" to 16% of events.[7,8] In contrast, simplification, standardization, automation, and forced functions are at the top of the hierarchy of effectiveness.[6] The recent review by Marks et al[8] on the challenge of maximizing radiation oncology safety has clearly recognized the benefits of hardwiring the systems to support human work. In the follow-up commentary, Hayman[9] further stressed that although many improvements will need to come from the device and software manufacturers whose products are relied upon to treat patients, the clinicians should not wait for vendors to act but instead should be working among themselves to develop tools to maximize QC effectiveness. To assist physics chart check, Siochi et al[10] developed an electronic system to verify data transfer integrity between treatment plan system and treatment management system. Furhang et al[11] developed software to perform intraplan and interplan reviews. Xia et al[12] reported a treatment event detection system to detect and report treatment events. Yang and Moore[13] conducted a study to use dynamic scripting to verify treatment plan integrity.

This work presents a software tool to assist a physics chart check process; we report here the system design, features, and its clinical deployment. The software tool is potentially useful for radiation oncology clinics that are either in the process of pursuing or maintaining the ACR (American College of Radiology) accreditation.

Methods and materials

Problem

The physics chart check comprises an important QC measure in patient care. Nationally recognized guidelines, including ACR and the American Society for Radiation Oncology (ASTRO) guidelines and technical standards, and the American Association of Physicists in Medicine (AAPM) Task Group reports were identified, studied, and summarized by the author.[1-4,14] Meanwhile, the reported events related to the physics chart check service were analyzed using an event reporting and learning system.[15] The event reporting system is a web-based system that was designed for the reporting of individual events in the radiation oncology department. An event was defined as any occurrence that could have, or had, resulted in a deviation in the delivery of patient care. For example, a missed weekly physics chart check would be reported as an event. One of the purposes of analyzing the reported events was to identify the items that are not explicitly included in the practice guidelines but have impact in the patient care in the author's clinic. For example, an incorrectly entered treatment couch vertical value in the treatment management system delays the treatment. The collective efforts in studying practice guidelines and analyzing the reported events led to a consensus that a current physics check process in the author's clinic is not optimal and less effective than expectation due to the following shortfalls:

- Ad hoc, nonsystematic management of chart assignment;
- Inefficient communication between physicists;
- Inefficient tracking of chart checks;
- Lack of tools to assist pretreatment and during treatment chart check;
- Lack of tools to assist final chart check;
- Lack of proper documentation of final chart check;
- Lack of tools to manage the peer-review process;
- Lack of proper documentation of the peer-review process.

Solution

To address these problems, a software tool to assist the physics chart check service was designed and developed in C#. The users were a large group of physicists in the author's radiation oncology clinic with multiple sites equipped with a single treatment management system (MOSAIQ, Elekta Inc, Sunnyvale, CA), 2 treatment planning systems (Pinnacle, Philips Medical, Madison, WI and Eclipse, Varian Medical, Palo Alto, CA), over a dozen linear accelerators, a gamma-knife unit, and 2 high-dose-rate remote afterloader units. The software consists of 4 independent modules: (1) chart check management; (2) pretreatment and during treatment chart check assistant; (3) posttreatment chart check assistant; and (4) quarterly peer-review management. The execution and documentation of these QC measures are required for ACR accreditation.[14] The 3 key components of the design, development, and implementation of the software are the following: (1) patient data collection and integration; (2) chart check policy and rules; and (3) validation.

Patient data collection and integration

The software accesses Pinnacle native plan data through the Pinnacle FTP [file transfer protocol server].