Departmental quality initiative to establish turnaround times from simulation to treatment

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ABSTRACT

Introduction: The process of treatment delivery involves a series of steps from patient evaluation, therapeutic simulation (simulation), followed by dosimetric treatment planning, pre-treatment quality assurance and plan verification, and ultimately treatment delivery. Each step has a strict precedence relationship, requiring the preceding task to be completed prior to the initiation of the next task. The minimum time for a patient to undergo treatment is based on the summation of times of the individual tasks. Nevertheless, patients are often scheduled based on factors that do not directly consider the overall time required to complete these steps.

Materials and methods: To better help in scheduling patients and to ensure quality of safety of treatment planning and delivery, we undertook a quality initiative based on team members tabulating time required to complete tasks required for treatment delivery. We established “fastest possible” turnaround times based how quickly a task could be accomplished if there were minimal or no competing obligations, as well as processing times under routine operating conditions.

Results: For urgent situations, we found that our center can accommodate treatment within 24 h. For routine plans using 3D conformal radiation, an approximately 1-week turnaround time is needed. For patients being treated with IMRT/VMAT an approximately 2-week turnaround time is needed.

Conclusions: The growing complexity of radiotherapy delivery also requires additional steps which has increased turnaround times from simulation to treatment compared to historical standards. We report our estimates for turnaround time based on plan type and acuity level. While our turnaround times may not be applicable to all centers, we believe that this exercise was helpful to facilitate inter- and intra-departmental communication regarding reasonable start times for patients.

Introduction

The American Society for Radiation Oncology’s (ASTRO) publication, “Safety Is No Accident” [1] provides a framework regarding the administration of safe, high-quality radiation therapy. This document outlines process of treatment as series of steps from patient evaluation, therapeutic simulation (simulation), followed by dosimetric treatment planning, pre-treatment quality assurance and plan verification, and ultimately treatment delivery (Fig. 1). Each task is necessary prior to treatment delivery, and has a strict precedence relationship, requiring completion of the preceding task. The resulting time to administer treatment for any patient is the summation of the time it takes to complete each of the individual steps.

For treatment to be delivered safely and effectively, each step requires careful attention to detail from dedicated professionals across the department including physicians, medical dosimetrists, medical physicists, and radiation therapists to ensure accuracy of delivery. To ensure that each center has sufficient resources to complete the necessary tasks in a timely fashion, the American College of Radiation Oncology (ACRO), American College of Radiology (ACR), and ASTRO have all instituted guidelines regarding minimum staffing requirements for radiation therapy centers as part of the accreditation process [2–4].

The time needed to complete each task can be highly variable based on intrinsic and extrinsic factors specific to the task. For example, the time for MD contouring is highly dependent on the nature of the case such as radiation technique being used (3D, IMRT, SRS/SBRT), planned dose to be delivered, and proximity to critical structures. Additionally, extrinsic competing obligations such as other treatment plans requiring...
Therapeutic Simulation → MD Contouring and Field Design → Treatment Planning → Pre-Treatment Review and Verification → Treatment Delivery

Fig. 1. Process of Radiotherapy Delivery (Adapted from ASTRO’s Publication, “Safety is No Accident”).

The process of developing processing times was initially proposed by the radiation oncologist, chief therapist, and medical dosimetrist during the quarterly Quality Assurance/Quality Improvement (QA/QI) meeting. To draft the proposal, a stakeholder within the pathway was tasked with analyzing their step workflow pathway to determine an estimate of the time needed to complete each step. Members had the opportunity to seek feedback within the discipline as needed, though such conversations were not specifically recorded. Individual estimates from each stakeholder were initially tabulated in Microsoft Excel (Microsoft Excel, 2008) using the “=ROUNDUP(Total Hours/8,0)” formula. In general, we believe turnaround time estimates were generally consistent with that of our current practice, and we are not aware of any differences of opinion among team members.

Results

The first aspect of this initiative was to establish “fastest possible” turnaround times. In determining expected processing times, each member established how quickly a task could be accomplished if there were minimal or no competing obligations. Feedback from relevant parties was obtained, and the results are shown in Table 1. Based on the summation of processing times, we estimated that 2D and 3D plans could be completed in one day. Since onsite physics support is required for pre-treatment QA of patients receiving 3D conformal radiation with electronic compensation (3-D/E-comp) or IMRT/VMAT plans, an expected processing delay of 24 h was allocated. As a result, we estimated that these patients requiring 3D/E-comp or IMRT/VMAT plan would need at least 4-5 days from simulation to treatment (Table 1).

For the next part of this initiative, we determined processing times under routine operating conditions. Our results are shown in Table 2. In general, we expected that contours can be completed within 1 business day regardless of the type of case. Since routine on-site physics coverage is only available one day per week, we built in a 5-day (40 h) turnaround time required to complete necessary pre-treatment QA, though this essentially represents a worst-case scenario. Since in many cases it is possible to complete physics QA faster, any additional time can be built into the preceding steps including contouring, treatment planning, and plan evaluation. Our results suggest that most treatment plans 2D or 3D technology can initiate treatment within one week, while patients needing 3D/E-comp or IMRT/VMAT require an appropriately 2-week turnaround time (Table 2).

Discussion

The purpose of this initiative was to establish reasonable standards within our department regarding treatment turnaround times under routine operating conditions, as well as under emergent situations. The complexity of radiotherapy delivery also requires additional steps which have increased turnaround times compared to historical standards. Our initiative has created greater awareness that an unforeseen delay at one step in the process does not automatically mean other steps can be easily expedited, potentially leading to an overall treatment delay. Formulating the time required to complete these processes is important to communicate to members of the care team that are providing complementary therapies (such as concurrent chemotherapy).

Prior to this initiative, we would establish treatment start dates based on arbitrary determination without fully considering treatment technique, as well the time required for each of the initial steps. This framework has helped us with departmental mindset regarding patient scheduling under routine as well as urgent circumstances.
Table 1
“Fastest-Possible” Turnaround Time (In hours, unless otherwise indicated).

| Technique | Target Volumes | Treatment Planning | Plan Evaluation | Treatment Preparation | Pre-treatment QA | Final Checks | Treatment Total Time (Hours) | Total Time (Days) |
|-----------|----------------|-------------------|----------------|------------------------|-----------------|-------------|----------------------------|------------------|
| 2D        | 1              | 1                 | 1              | 1                      | 1               | 0.5         | 0.5                        | 6.0              | 1                |
| 3D        | 1              | 2                 | 1              | 1                      | 1               | 0.5         | 0.5                        | 7.0              | 1                |
| 3D Ecomp  | 2              | 2                 | 1              | 1                      | 24              | 0.5         | 0.5                        | 31.0             | 4                |
| IMRT/VMAT | 4              | 5                 | 1              | 1                      | 24              | 0.5         | 0.5                        | 36.0             | 5                |

Table 2
Usual Operating Turnaround Times (In hours, unless otherwise indicated).

| Technique | Target Volumes | Treatment Planning | Plan Evaluation | Treatment Preparation | Pre-treatment QA | Final Checks | Treatment Total Time (Hours) | Total Time (Days) |
|-----------|----------------|-------------------|----------------|------------------------|-----------------|-------------|----------------------------|------------------|
| 2D        | 8              | 8                 | 4              | 4                      | 8               | 4           | 0.5                        | 36.5             | 5                |
| 3D        | 8              | 8                 | 8              | 4                      | 8               | 4           | 0.5                        | 40.5             | 6                |
| 3D Ecomp  | 8              | 8                 | 8              | 4                      | 40              | 4           | 0.5                        | 72.5             | 10               |
| IMRT/VMAT | 8              | 16                | 8              | 4                      | 40              | 4           | 0.5                        | 88.5             | 11               |

Based on the turnaround processing times determined in this initiative, established routine turnaround times accounting for patient acuity as well as treatment technique (Table 3). In writing this guideline for our department, we considered the importance of timely treatment combined with the time needed for treatment planning and pre-treatment review. While the writing of this departmental guideline is not meant to substitute for close communication, it is meant to establish expectations regarding treatment turnaround times among members of our care team. Given potential delays associated with patients who need on-site QA, we will often consider the processing time of preceding steps and determine if such steps can be reasonably accommodated prior to the routine day of on-site physics preference. In such situations, pre-treatment QA processing time could be much shorter. While extenuating circumstances may warrant deviations from our general guidelines, the expectation is that such deviations would be rare.

One of the major limitations of this study is that while we believe processing time estimates are important to help with scheduling, it is beyond the scope of this project to determine the extent of the benefit. Additionally, another one of the limitations of this QI initiative is that processing time estimates were created based on team members estimates of time required to complete tasks, rather than using historical data to compute actual times. On one hand, using historical data could have given us a better sense on the state of our current practice, it may not have been necessarily helpful with the goals of this project in improving quality and safety by reducing team member strain. For example, if our current practice had been utilizing overly ambitious turnaround times in our current state of practice, it could have given us the false sense that it is acceptable to continue that state of practice. By incorporating feedback of team members, we were able to better ascertain reasonable time estimates that hopefully can prevent burnout from unrealistic expectations. While it is our general sense that the estimates developed reflect our prior practice, we believe formal documentation of these processes is important.

We recognize that our processing estimates would not be applicable to all treatment centers, yet we believe a similar process is helpful regardless of the center type. It is possible that larger academic centers with redundant resources might be able to accommodate faster turn-around times, while these estimates could be overly ambitious for other centers. Nevertheless, we believe that this exercise has been helpful in scheduling patients and the initiative is an important aspect of ensuring patient safety within the department.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence
the work reported in this paper.

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