

Physics

Process improvement for the safe delivery of multidisciplinary-executed treatments—A case in Y-90 microspheres therapy

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ABSTRACT

PURPOSE: To develop a safe and robust workflow for yttrium-90 (Y-90) radioembolization procedures in a multidisciplinary team environment.

METHODS AND MATERIALS: A generalized Define-Measure-Analyze-Improve-Control (DMAIC)—based approach to process improvement was applied to a Y-90 radioembolization workflow. In the first DMAIC cycle, events with the Y-90 workflow were defined and analyzed. To improve the workflow, a web-based interactive electronic white board (EWB) system was adopted as the central communication platform and information processing hub. The EWB-based Y-90 workflow then underwent a second DMAIC cycle. Out of 245 treatments, three misses that went undetected until treatment initiation were recorded over a period of 21 months, and root-cause-analysis was performed to determine causes of each incident and opportunities for improvement. The EWB-based Y-90 process was further improved via new rules to define reliable sources of information as inputs into the planning process, as well as new check points to ensure this information was communicated correctly throughout the process flow.

RESULTS: After implementation of the revised EWB-based Y-90 workflow, after two DMAIC-like cycles, there were zero misses out of 153 patient treatments in 1 year.

CONCLUSIONS: The DMAIC-based approach adopted here allowed the iterative development of a robust workflow to achieve an adaptable, event-minimizing planning process despite a complex setting which requires the participation of multiple teams for Y-90 microspheres therapy. Implementation of such a workflow using the EWB or similar platform with a DMAIC-based process improvement approach could be expanded to other treatment procedures, especially those requiring multidisciplinary management. © 2016 American Brachytherapy Society. Published by Elsevier Inc. All rights reserved.

Keywords:

Process improvement; DMAIC; Y-90 radioembolization; Electronic workflow management system

Introduction

A global mortality of approximately 600,000 per year is reported for hepatocellular carcinoma (1). Curative resection or liver transplantation is only feasible for a minority of patients (2). Intra-arterial radioembolization (RE)

techniques using yttrium-90 (Y-90) microspheres have been shown to be a promising treatment option for both unresectable primary and secondary liver metastasis (3–7). In practice, the implementation of a Y-90 RE procedure can vary among different clinics. Some clinics may have the entire procedure and all corresponding steps performed within a single department such as interventional radiology or nuclear medicine. Other facilities may perform the procedure in a multidepartmental environment, such as radiation oncology with interventional radiology. The Radioembolization Brachytherapy Oncology Consortium (8) strongly recommends a multidisciplinary team approach to manage RE treatments due to safety and quality concerns. In either scenario, the workflow of Y-90 therapy is complex due to

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the calculations of dose distributions based on biological imaging, and consideration of radiation safety precautions, requiring a distinct treatment planning process for the safe treatment of these patients, as emphasized by American Society for Radiation Oncology guidelines (9). Employing a multidisciplinary approach for Y-90 RE provides for the application of greater expertise to more aspects of this process (hence the recommendation from the Radioembolization Brachytherapy Oncology Consortium noted above) but adds additional complexity to the workflow. The complex nature of the procedure yields challenges in patient monitoring, multidepartment communication, and treatment process management.

The Six Sigma process with Define-Measure-Analyze-Improve-Control (DMAIC) (10, 11) is a commonly used quality improvement approach among various industries, including health care. In this work, we employed the principles of DMAIC to evaluate and optimize our Y-90 RE treatment process. In the first DMAIC cycle, we define challenges with Y-90 RE therapy at our institution, describe events and identify weaknesses with our Y-90 RE process, and attempt to improve the process via the adoption of an electronic workflow management system, referred to here as the electronic white board (EWB), for patient tracking and reliable communication. As the DMAIC cycles continue, we demonstrate in the second cycle how the EWB-based Y-90 RE workflow evolves into a more robust process with the implementation of rules and verifications.

Methods and materials

Principles of DMAIC

Although DMAIC is a Six Sigma tool, we employ here only the principles of DMAIC and not the entire associated Six Sigma tool set. The DMAIC principles can be adopted to fit the resources and expertise of an individual radiation oncology facility, as we have reported previously (11). Define is the step to describe the problems or challenges of the process subject to the DMAIC approach. Measure is a data collecting step; in our case, any event or incident

that occurred is recorded as our “data” point. In the Analyze stage, the event undergoes root-cause-analysis (RCA) and the error sources are tracked down. Solutions are later implemented in the Improve step to prevent the recurrence of events with the same causes. Mechanisms are put in place in the Control step to monitor the implemented solutions. The DMAIC approach is a cyclical process which ensures the evolving nature and robustness of the target workflow.

Cycle 1—Define: Challenges in Y-90 RE therapy

Y-90 RE therapy was initiated in our clinic in 2005 using the resin-based microspheres (SIR-Spheres, Sirtex Medical Limited, North Sydney, Australia) and was implemented as a multidisciplinary team-based procedure involving two departments: Department of Radiation Oncology (RO) and Department of Radiology—Vascular and Interventional Radiology (IR) division, where the authorized user (AU) is a radiation oncologist. There were several challenges inherent to Y-90 RE therapy at our institution. The first challenge was the requirement for the collaboration of numerous members from different departments, as shown in Fig. 1. There were numerous steps along the entire procedure resulting in a long treatment timeline for pretreatment imaging, planning, dose (or activity) ordering, dose check-in, and treatment delivery. The overall treatment timeline was estimated as 5–6 weeks at our clinic, making the whole procedure difficult to track and monitor. The two departments mentioned above use different electronic medical record (EMR) systems which placed additional challenges on information sharing and communication. In 2010, another treatment option, glass-based microspheres therapy (TheraSphere, BTG, London, United Kingdom) became available, with its own methodology for prescription, dose activity calculation, ordering schedule, dose assay, and treatment delivery. This added another level of complexity to our existing process for microspheres therapy. Finally, in 2012, we experienced a dramatic increase in the patient volume receiving Y-90 microspheres treatment, as shown in Fig. 2. The number of treatments almost doubled from 2011.

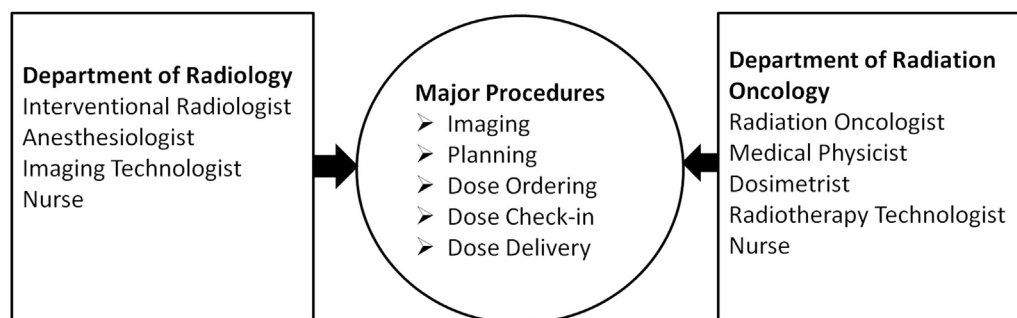


Fig. 1. For Y-90 microsphere administrations, participating team members from two departments are shown as well as major steps in the procedure. Y-90 = yttrium-90.

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