

Special Article

Improving patient safety in the radiation oncology setting through crew resource management

Srinath Sundararaman MD, MS^{a, b, *}, Angela E. Babbo MD^{a, b},
John A. Brown RTT, BA^a, Richard Doss BSB^c

^aDepartment of Radiation Oncology, Memorial Cancer Institute, Memorial Healthcare System, Hollywood, Florida

^bRadiology Associates of Hollywood, Pembroke Pines, Florida

^cPerformance Breakthroughs and Strategy, LifeWings, Minneapolis, Minnesota

Received 11 April 2013; revised 4 September 2013; accepted 5 September 2013

Abstract

Purpose: This paper demonstrates how the communication patterns and protocol rigors of a methodology called crew resource management (CRM) can be adapted to a radiation oncology environment to create a culture of patient safety. CRM training was introduced to our comprehensive radiation oncology department in the autumn of 2009. With 34 full-time equivalent staff, we see 100-125 patients daily on 2 hospital campuses. We were assisted by a consulting group with considerable experience in helping hospitals incorporate CRM principles and practices. Implementation steps included developing change initiative skills for key leaders, providing training in teamwork and communications, creating site-specific tools for safety and efficiency, and collecting data to document results.

Methods and materials: Our goals were to improve patient safety, teamwork, communication, and efficiency through the use of tools we developed that emphasized teamwork and communication, cross-checking, and routinizing specific protocols. Our CRM plan relies on the following 4 pillars: patient identification methods; “pause for the cause”; enabling all staff to halt treatment and question decisions; and daily morning meetings. We discuss some of the hurdles to change we encountered.

Results: Our safety record has improved. Our near-miss rate before CRM implementation averaged 11 per month; our near-miss rate currently averages 1.2 per month. In the 5 years prior to CRM implementation, we experienced 1 treatment deviation per year, although none rose to the level of “mis-administration.” Since implementing CRM, our current patient treatment setup and delivery process has eliminated all treatment deviations. Our practices have identified situations where ambiguity or conflicting documentation could have resulted in inappropriate treatment or treatment inefficiencies. Our staff members have developed an extraordinary sense of teamwork combined with a high degree of personal responsibility to assure patient safety and have spoken up when they

Supplementary material for this article (<http://dx.doi.org/10.1016/j.prro.2013.09.003>) can be found online at www.practicalradonc.org.

Source of support: The first 3 authors are on staff of the hospital system; the final author is on staff with the consulting entity. No funds exchanged hands to make this joint submission of this article possible.

Conflicts of interest: None of the authors has conflicts of interest relating to the publication of this paper.

* Corresponding author. Radiation Oncology, Memorial Cancer Institute, Memorial Healthcare System, 3501 Johnson St, Hollywood, FL 33021.
E-mail address: SSundararaman@mhs.net (S. Sundararaman).

considered something potentially unsafe. We have increased our efficiency (and profitability); in 2012, our units of service were up 11.3% over 2009 levels with the same staffing level.

Conclusions: The rigor and standardization introduced into our practice, combined with the increase in communication and teamwork have improved both safety and efficiency while improving both staff and patient satisfaction. CRM principles are highly adaptable and applicable to the radiation oncology setting.

© 2013 American Society for Radiation Oncology. Published by Elsevier Inc. All rights reserved.

Introduction

Over the last decade, advances in imaging technology have provided more sophisticated, promising, and accurate techniques for targeting malignancies than ever before. With these new tools, cancer patients are benefitting from radiation therapy with lower toxicity and better chance of tumor control.¹ But with these technologic advances and more complex treatment plans using higher doses come increasing risks, and the consequences of error can be enormous. A working meeting “Safety in Radiation Therapy: A Call to Action” in June 2010, sponsored by the American Association of Physicists in Medicine and the American Society for Radiation Oncology, addressed these concerns. The meeting, which was co-hosted by 14 radiation-related organizations in the United States and Canada, yielded 20 recommendations for reducing errors and improving patient safety in radiation therapy facilities.² Articles published subsequently have focused attention on approaches for reducing risks from human error and improving patient safety.^{3,4}

Training in teamwork, communication, checklists, specific protocols, and algorithms, collectively known as crew resource management, has been one of the approaches taken by some hospitals to reduce accidents related to human error and poor teamwork. This qualitative paper addresses the process of introducing CRM, a patient safety culture-change process, into a large 2-clinic radiation oncology department that is part of a large hospital system. The hurdles encountered during our implementation are also addressed. The results of that culture-change effort in terms of increased patient safety and improved workflow efficiency in radiation oncology will be explored.

Our department of radiation oncology operates as a comprehensive single department located on 2 hospital campuses. We treat adult and pediatric patients with a variety of conditions, malignant and benign, with a multidisciplinary staff, some of whom provide coverage at both facilities. Our staff (34 full-time equivalents) includes radiation oncologists, radiation therapists, certified nurses, social workers, medical physicists, dietitians, dosimetrists, registration and scheduling assistants, and patient navigators. Among the services we offer are the following: CT-based simulation; 3-dimensional conformal radiation therapy, yttrium-90 therapy, multileaf collimator, intensity modulated radiation therapy, image guided radiation therapy, stereotactic radiosurgery utilizing the CyberKnife robotic radiosurgery system

(Accuray, Sunnyvale, CA), high-dose-rate brachytherapy, prostate seed implant, and radioisotope treatment (ie, ibritumomab, tositumomab, strontium, samarium). We see 100-125 patients daily in our 2 locations.

With the intent to improve patient safety throughout our hospital system, the assistance of a hospital consulting group with considerable experience in CRM patient safety programs was enlisted. Buy-in, from hospital leaders and key physicians, was the first order of business. With the leadership actively involved, hospital executives and physician department chairs, in concert with our consultants, began introducing teamwork training and communication skills to each department. The broad steps of CRM implementation are the following.

- Step 1 Develop change-initiative skills for key leadership positions and organizational structure that will support the new culture. Step 1 is perhaps the most important step because end-user adoption of culture changing behaviors is a function of effective leadership.
- Step 2 Providing training in teamwork and communication to support desired culture-changing behaviors such as situational awareness, cross-check and assertion, mutual support, pre-briefing, and debriefing protocols.
- Step 3 Create and implement site-specific safety tools such as checklists, structured handoffs, new protocols, algorithms, and team huddles to hardwire the teamwork behaviors into daily work life.
- Step 4 Collect and analyze data to document results.

Methods and materials

Implementing CRM practices in our radiation oncology department

When the Department of Radiation Oncology began our CRM patient safety journey in the fall of 2009, our goals were to improve safety, teamwork, communication, and efficiency. Our CRM plan relies on 4 pillars: patient identification methods, “pause for the cause,” enabling all staff to halt treatment and question decisions, and daily morning meetings.

We have used the Aria (Varian, Palo Alto, CA) electronic medical records system (EMR) since 2009, and currently use version 11 MR1; all patient-related data are documented electronically. We worked together to develop specific tools and expected behaviors that would help each of us recognize patient safety as everyone's primary job. Our written tools ensure deliberate cross-checking involving 2 staff members before a patient is treated. Other tools are aimed at increasing communication among the staff across disciplines such as our daily morning rounds and shift huddles. Among our expected behaviors are the right and responsibility of each team member to speak up if she or he notices something unsafe, the responsibility to concentrate on each task by following the requisite cross-checks without fail, and the practice of having all open computer screens pertain to only one patient. In addition, our patients are empowered to speak up and advocate for their own safety. This critical step of including our patients on their safety journey begins with the initial visit. At that time, they are instructed in our safety protocols and given education about our stop-the-line process.

The written protocols, procedures, and forms we developed for each type of treatment require a dialog between 2 staff members to check and verify such things as the identity of the patient, the site and side to be treated, the original prescription and plan, the expectation for the day's treatment, the consistency of equipment settings with the treatment plan, and the completion of all necessary documentation, etc. All our written guides are laminated placards posted at each patient encounter location. Responses before and after treatment occurrences are entered electronically into the patient's EMR. Variances and near-misses are noted at the time of occurrence in the patient's EMR and subsequently entered in an online debrief log that is reviewed every morning during the team huddle.

As the 2 staff members go through the appropriate checklist, the conversation sounds very much like a pilot and co-pilot checking that all systems are operational before takeoff. We refer to this process of assuring that everything is in order before we proceed with treatment as "pause for the cause," the cause being patient safety. Our process for double-checking gives us further opportunity to educate and empower our patients to speak up in the cause of safety. We continually reinforce their need to speak up about anything that seems unsafe or contrary to their expectations.

Our linear accelerator (LINAC) treatment guide (Fig 1) is one of our most powerful written tools because it has standardized and streamlined our processes. In this laminated and posted guide, we have identified specific items that must be cross-checked before the patient enters the vault (red), another set of items that are checked after the patient enters the vault but before treatment is initiated (blue), and a final set of checks following the completion of treatment and the patient's exit from the room to ensure

treatment completion for the day was correct (green). If something is missing or contradictory in the red section, the patient will not enter the vault, and likewise if something is amiss in the blue section, the patient will not proceed to treatment. Notes about the treatment from the green section of the LINAC treatment guide may be discussed in the next day's morning rounds or huddle if anything noted requires modification or further attention. With our standardization of the required steps for each kind of treatment, and implementation of identical processes and procedures at each clinic site, we have empowered staff to have all the information necessary to treat the patient with confidence, regardless of whether they are the patient's primary therapist or which facility they are covering.

The typical sense of hierarchy in a medical environment makes it unlikely for anyone to challenge the actions of the physician in charge. Yet that is a behavior we very much want to encourage when any of our staff sees something that could compromise safety. Empowering each member of the team to speak up requires support from the top, and assurance at every level that individuals will not risk their jobs when they challenge a superior on a matter of safety. It is inherently a scary thing for a staff member to point out, in real time, that a superior has miscalculated something or is about to undertake an action that will place a patient in jeopardy. But we make it clear that that is not only OK to do, it is the staff person's responsibility to assure the patient's safety. Our code word for calling a halt is "delta." When that word is uttered, we expect that every member of the team will respectfully stop what he or she is doing so that the issue can be discussed and the correction can be made. Our mantra is "See it. Say it. Fix it."

Giving everyone a sense of the big picture by increasing cross-discipline communication about both individual patients and the scheduling for the day has also been a CRM innovation. We introduce our morning rounds and shift huddle at each shift change. These short meetings for different groupings of personnel have the function of increased communication, identifying required improvements based on the prior day's experience, identifying actions that should be (or already have been) taken, and assessing the equipment and personnel needs based on the day's schedule. It alerts the staff to special needs to be addressed during the day, based on the patients that have been scheduled.

CRM also enforces safe work habits. For example, staff members are trained to ensure that one and only one patient's information is shown at a time on all active computer screens. This reduces the possibility of confusion and focuses concentration on the patient in question. Also, since more than one staff person may be accessing a program that relates to a specific patient (for example, when the radiation therapist is treating the patient at the machine and the dosimetrist is preparing to enter future treatment parameters while in a different location), each

Both therapists are to follow this dialogue before bringing patients into room for treatment. If there is a disagreement, stop and adjust what is needed until agreement is reached or get your superviso before continuing.

Red [Steps 1 thru 5] = Before the patient is called and brought to the treatment console.

Blue [Steps 6 thru 11] = After the patient is brought to the treatment console - interaction.

Therapist#1

Therapist#2

1. Read & Say: Prescription & Planning Parameters. <u>Call out treatment</u>	Read 4D & Say: Prescription is to treat (anatomy) to (Dose cGy). <u>Confirm treatment: if NO: ⊗ STOP – Get Physics or Chief Therapist</u>
2. <u>Open</u>: Setup photos: <u>Review</u> with 2nd therapist	<u>Confirm & Say</u> GO or STOP
3. <u>Open</u>: Setup note: <u>Say Aloud</u> (Immobilization) and (SSD) and (single or double tattoos)	<u>Confirm aloud & Say</u> Start at (___ SSD) on (single or double tattoos).
4. <u>Review</u>: Port films (Need today or check past) <u>Say Aloud</u> if need or not	<u>Confirm aloud</u> (Does or Does not) with 1st Therapist
5. <u>Say Aloud</u> Diodes needed?	<u>Confirm aloud</u> (Does or Does not) with 1st Therapist
6. <u>Ask for</u>: Wrist band, name & B-Day (check)	<u>Say</u>: Name & MR# is __. Match to Aria EMR. GO or No match = STOP
7. <u>Look at</u> Face photo & patient. (confirm with 2nd therapist)	<u>Confirm aloud</u>: GO or STOP
8. <u>Ask for</u>: Scan card & scan it (confirm with 2nd therapist)	<u>Confirm aloud</u>: GO or STOP
9. <u>Ask</u>: How are you feeling? On <u>New</u> medications?	<u>Make note to Report</u> to nurses if anything
10. <u>Complete</u>: Pause-for-the-cause then go into room	<u>Take patient in room.</u>

After above is reviewed and approved by both therapists, take patient into treatment room to begin treatment.

After patient's treatment is complete & before patient leaves the room, perform the following read back to ensure treatment completion for the day is correct.

Therapist#1

Therapist#2

<u>Ask & charge</u>: Treatment charge correct?	<u>Say</u>: Treatment charge is for (___ energy).
<u>Ask</u>: Re-sim or boost setup?	<u>Say</u>: (Does or Does Not) & schedule
<u>Ask</u>: Any Notes or photos?	<u>Say</u>: (Yes or No) & do it
<u>Ask</u>: Need to task MD (first, last, or diodes?)	<u>Say</u> : (Yes or No) & do it
<u>Ask</u>: Did treatment go well? What needs improvement?	 was good. STOP was an issue. Note in debrief file.
<u>Ask</u>: Anything to document?	<u>Say</u>: (Yes or No) & do it

Figure 1 LINAC treatment guide utilized for each external beam radiation delivered in our clinics.

screen shows the program is simultaneously being used by another member of the team and blocks certain functions from the second user.

Hurdles we encountered and overcame

Of course, change does not occur without push back.

Why should this apply to me? I am already safe

Our hospital administration and key physician leaders were key in communicating the benefits of CRM for the hospital and our department. They made it clear that this was not a passing fad. (Supplementary Audio file e1; available online only at www.practicalradonc.org).

This CRM checklist will take too much time, and I'm on a tight schedule already

The staff was right on this; initially it did take more time. When they first started using the tools, they were resistant. They were unfamiliar with them. They did not have them memorized. We discussed their concerns at our morning huddles. Some of the steps were out of order with their typical practice. So we modified the tools, some of them several times, and the tools became theirs. The first 3 months staff members were slowed by the tools, but now it makes their process more efficient while assuring patient safety. (Supplementary Audio file e2; available online only at www.practicalradonc.org).

Hurdles for dosimetrists

Dosimetrists were impacted greatly in their patient treatment planning as new procedures added extra steps to their safety evaluation process. They voiced concerns about the extra planning time that would be required for each patient. Additionally, for the first time members of the treatment team were taking a hard look at the treatment planning by the dosimetrists. We acknowledged that this was a critical stage in the inception of our patient care. Our traditional procedural "norms" were considered, with team input, empowering our dosimetrists to align their processes with our CRM goals. For example, other members of the team felt strongly that patient treatment should start from the head going toward the feet rather than from the feet to the head, and that the LINAC gantry should never be swung over the patient's head, even if that seemed the most efficient approach. The feedback of other members of the team during the debriefing has really changed the way our dosimetrists plan the patient treatments. Dosimetrists are now conscious of the whole patient and their treatment experience, not just of the tumor and its location. (Supplementary Audio file e3; available online only at www.practicalradonc.org).

Hurdles for radiation oncologists

Our physicians were most impacted by the debriefing log. Staff documented in the log that delays were because the physician had not dated and timed the film, or approved the treatment plan, or whatever the physician had not done that was delaying patient treatment. (Supplementary Audio file e4; available online only at www.practicalradonc.org). This was the first time staff had been empowered to document lack of physician timeliness, and perhaps the first time that physicians realized that they too were being held accountable for their performance. Our physicians became more cognizant of their role in both patient safety and efficiency. (Supplementary Audio file e5; available online only at www.practicalradonc.org).

Results

Safety

Before implementing CRM, a frequent staff complaint was that physicians' treatment intents, or orders, were sometimes unclear. While physicians formulate their patient treatment plan with formal annotation, their communication with staff was often casual, verbal, and subject to misinterpretation. We began a standardized workflow process as part of CRM implementation. Before CRM, patient prescription or order accuracy ranged between 38% and 61%, based upon monthly calculation. Since implementing CRM, we have achieved and sustained congruence between the physician's electronic prescription and the administered treatment of 91% to 100%. As per the American College of Radiology, we have defined congruence between patient prescription and treatment plan accuracy to include all parameters of the physician's prescription for the patient, including daily dose, total dose, delivery type or modality, staging, body site, and laterality.

The aggregated elements of the physician prescription and the CRM tools used for hand-offs now formulate our denominator for our internal definition of near-misses. Our internal near-miss calculation includes the following parameters: verification of patient ID and patient photo; patient consent; site and laterality, and any team member hand-off (eg, post procedure, treatment debrief, morning rounds, morning huddle). Our numerator is any near-miss.

Our near-miss rate before CRM implementation averaged 11 per month; our adverse event near-miss rate currently averages 1.2 per month. The near-miss rate went down because of CRM implementation, including physician support of the changes, development of tools including the LINAC treatment guide, use of Delta, etc. In the 5 years prior to CRM implementation (baseline), we experienced about 1 treatment deviation (incorrect dose [2], incorrect field size [2], incorrect gantry angle [1]) per

year, although none rose to the level of “mis-administration” (10% or greater difference in the prescribed dose, as detailed in Nuclear Regulatory Commission guidelines).⁵ Since implementing CRM, our current patient treatment setup and delivery process has eliminated all treatment deviations and we are striving for the lowest possible near miss rate (currently 1.2 per month). As a part of CRM implementation, we instituted a 2-person patient identification (ID) verification system and the LINAC treatment guide to address the variables that could contribute to improper treatment. At baseline (before implementing CRM), our compliance rate with regard to ID verification was 55%. After implementing CRM, we experienced 80% compliance over the first 60 days. At 90 days and thereafter, to the present, our compliance rate with regard to ID verification has been 100%.

Our process has allowed us to identify and correct issues that might have resulted in patient harm or inefficiencies in patient care. Here are 2 examples from our documentation.

Example 1: Patient was a 71-year-old female with stage III, moderately differentiated adenocarcinoma of the ampulla of Vater. Following pylorus-preserving Whipple surgery, there were findings of a 2.5 cm tumor that was invading the pancreas, peripancreatic tissue, and the duodenum. The treatment plan was for adjuvant external beam radiation to the abdomen (5040 cGy in 180 cGy daily fractions), with concurrent chemotherapy. Prior to treatment, during our routine cross-checking process with the LINAC treatment guide, staff discovered a discrepancy in dosages ordered; one source noted the total dose should be 5400 cGy; the other said 5040 cGy. The treatment was delayed until the proper dosage could be verified with the physician. We then implemented a single prescription data order source for physicians as the initiation point of the treatment planning process.

Example 2: Our department frequently treats hospital inpatients. Prior to one such scheduled treatment, we called hospital transport with the patient’s name and medical record number and they arrived at our clinic shortly thereafter with a patient. Based on our patient verification protocol involving the checking of the patient photo, medical record number, and patient name, our nurse and therapist hand-off allowed us to immediately determine that the wrong patient had arrived. The patient who was transported had the same last name, but nothing else matched.

We used this opportunity to help the hospital’s transport department and the nursing unit that had released the wrong patient to recognize the seriousness of this type of error and work through their own departments to assure that their own protocols were updated.

Communication and teamwork

The physician and staff relationship scores within our department were lower than for the hospital system as a whole prior to the implementation of CRM. Through CRM

Year	Visits		% increase
2010	25907		
2011	26794	887	3.4
2012	27766	972	3.6
2013	28835	1069	3.8
			11.3

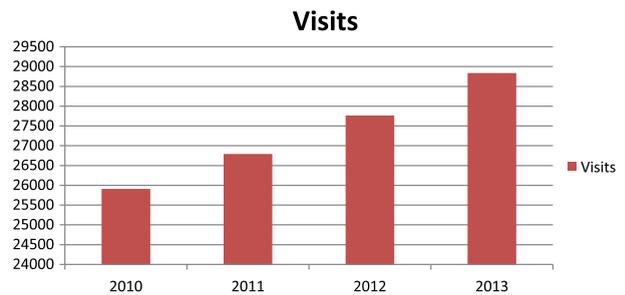


Figure 2 Annual visits tabulating every patient encounter.

training, which emphasized the importance of communication and process, staff morale has increased substantially, as evidenced through our morning rounds huddle conversations. As a result of implementing CRM, staff members have developed an extraordinary sense of teamwork combined with a high degree of personal responsibility to assure patient safety. They appreciate the increased communication that comes as a result of our morning rounds, shift huddles, and other meetings. Patients who have received services outside our system have commented on the higher degree of coordination of care that they experience at our clinics. Internal and external surveys have documented increases in both patient and staff satisfaction scores.

The flexibility to tailor our own CRM tools to fit our department’s operation has encouraged staff creativity in envisioning how our processes might be most safely and efficiently performed. Our staff members have truly adopted the “See it. Say it. Fix it” behaviors, allowing us to catch errors that might have led to patient harm. Their empowerment to speak out regarding any practice that they deem to be unsafe, without jeopardizing their job, is made possible by the incredible support for CRM from the top ranks of our health care system.

Efficiency

The standardization of policy and procedure that CRM has facilitated between our 2 clinic sites has allowed us to create an environment where all employees are able to float and cover either clinic as needed. This efficient and effective deployment of staff, combined with increased order accuracy, and standardized practices set forth in our LINAC treatment guide, have allowed us to handle increased patient volume without increasing the number of staff required to do so. In fact, in one of the clinics, our number of full-time equivalent staff members has actually been reduced by 1 at a time when our volume was increasing.

See Fig 2 for increases in our patient visits from fiscal year 2011 to 2013. Beginning in 2010, we had 25,907 patient visits. For the year 2013, we had 28,835 patient visits, an increase of 11.3% over 3 years. We are now able to cycle our patients through more efficiently and effectively, allowing us to handle an increased patient volume without increasing staff, which translates to increased profitability. At a time when hospital departments may be considering losing staff head-count due to cutbacks, the data that we are able to generate in terms of efficiency and smooth process allow us to make a solid case for continuing to staff 1 nurse for each physician.

Following is an example in which our improved cross-discipline communication improved our efficiency.

In our morning rounds and subsequent shift huddle, we discuss the cases for that day. One morning, we noted that a brachytherapy case was scheduled. Staff reviewed the equipment that would be used for that case and found that although the applicator was available, the transfer tube that connects the applicator to the treatment unit was not available at the clinic, but it was available at our other clinic facility. The staff had the needed transfer tube sent to the clinic where the brachytherapy treatment was to occur; it arrived well before it was needed for that treatment.

Our morning rounds and shift huddle assure that we are communicating effectively across disciplines and planning ahead for the day's scheduled treatments. Because we were prepared, our treatment schedule was able to proceed in a timely way for all patients.

Discussion

We have presented one institution's experience with CRM. Only a long-term, multi-institutional study can demonstrate whether our results are typical. But we offer our experiences (or process, our hurdles, and our results) to guide other facilities in their change efforts.

A commonly expressed concern prior to implementing CRM was that all these meetings and the consistent use of our double-check forms and protocols would bog down our service delivery and reduce our productivity. While initially our work was slowed, we have found that our increased communication has resulted in increased efficiency. By discussing the day's schedule in the morning, we all become more aware of patient- and equipment-specific treatment issues and how they will affect timing for physician availability, etc. Because everyone gets to see the big picture, the staff are able to work together more seamlessly, we are better able to cross-cover for each other in the event of absence, and we increase our chances of identifying potential patient safety issues.

We have become very efficient in both our meetings and our processes so that we are actually saving time. The increased communication among our staff and the hard-wired behavior that we never skip steps in the protocol have

allowed us to smooth the patient flow by anticipating and dealing with potential issues to head off potential problems. We have also been able to identify and address system-wide problems that impact our service delivery, such as untimely patient transport within our hospital system or uncoordinated hand-offs of patients from other departments.

The expectation that every staff member has both the right and the responsibility to call a halt to any process when they see anything that might jeopardize patient safety requires a major shift in employee culture. This is an extraordinarily difficult behavior in organizations where hierarchy is emphasized, as in a medical setting or an airplane cockpit. Author Malcolm Gladwell in his book, *Outliers*, discusses the impact of hierarchy on Korean Air's dismal safety record from 1988 to 1998.⁶ Gladwell reports that a consultant hired to resolve this company's safety issues concluded that Korean deference to authority, which is reinforced within the Korean language, allowed the first officer and flight engineer to only hint at safety problems rather than communicating them to the pilot directly. One of the ways the consultants flattened the cockpit hierarchy and reduced inhibitions about questioning authority was to require the flight crew to communicate to each other only in English during flights. The recommendation was implemented and flight operations safety improved dramatically. Korean Air is now considered to be one of the world's safest carriers.

Conclusions

While instituting such a wide-ranging organizational culture change is by no means an easy process, the advantages that our department has seen from implementing a CRM program for patient safety have been significant. And we have experienced benefits that go beyond patient safety, to include streamlining our processes and standardizing our practices across our 2 clinics. This has allowed us to increase our capacity without increasing staff resources. The principles of CRM can be applied effectively in radiation oncology practices to improve safety practices for patients, encourage teamwork and communication, and increase efficiency.

Acknowledgments

The authors wish to acknowledge the numerous radiation oncology staff members who were willing to provide information through on-site interviews and the cooperation of the senior administrators of the health care system who have strongly supported this cultural-change effort and the writing of this article. We also acknowledge the following staff members for their strong commitment to patient safety: Jennifer Kadis MSN, RN, CPAN—Director of Clinical Effectiveness, Vedner Guerrier RTT,

BS—Director of Physician Practices MHW, Norali Diaz
RTT—Chief Radiation Therapist MRH, Mary Kay Maffe
RTT—Chief Radiation Therapist MHW, and Trudy
Blyskal RTT. Thanks also to our editor Carol Kaemmerer.

References

1. Terezakis SA, Pronovost P, Harris K, DeWeese T, Ford E. Safety strategies in an academic radiation oncology department and recommendations for action. *Jt Comm J Qual Patient Saf.* 2011;37:291-299.
2. Hendee WR, Hermon MG. Improving safety in radiation oncology. *Pract Radiat Oncol.* 2011;1:16-21.
3. Hayman JA. Improving safety in radiation oncology. *Pract Radiat Oncol.* 2011;1:15.
4. Marks LB, Jackson M, Xie L, et al. The challenge of maximizing safety in radiation oncology. *Pract Radiat Oncol.* 2011;1:2-14.
5. U.S. Nuclear Regulatory Commission, Part 20, Standards for Protection Against Radiation. Available at: <http://www.nrc.gov/reading-rm/doc-collections/cfr/part020/full-text.html#part020-1009>. Last accessed February 21, 2013.
6. Gladwell Malcolm. *Outliers: the story of success.* New York: Little, Bown & Company. 2008.