# Improving Patient Safety in the Radiation Oncology Setting Through Crew Resource Management

**Experience from The Memorial Cancer Institute – Radiation Oncology Department of the Memorial Healthcare System, Florida**

**Authors:**

Srinath Sundararaman, M.D, M.S., Medical Director, Radiation Oncology, Memorial Cancer Institute, Memorial Healthcare System, South Florida

Angela Babbo, M.D., Radiation Oncologist, Memorial Cancer Institute, Memorial Healthcare System, South Florida

John A. Brown, RTT, BA, Director of Radiation Oncology, The Memorial Cancer Institute, Memorial Healthcare System, Florida

Richard Doss, BSB, Senior Advisor: Performance Breakthroughs and Strategy, LifeWings Partners, LLC, Minneapolis, MN

**Contact information for Corresponding Author:**

Srinath Sundararaman, M.D, M.S.,
Medical Director, Radiation Oncology,
Memorial Cancer Institute,
Memorial Healthcare System,
954.265.5775
SSundararaman@mhs.net

**Statement of Conflict of Interest**

None of the authors has conflicts of interest relating to the publication of this paper. The first three 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.

## 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. The principles of CRM, developed in high-risk /high-reliability industries, include training and teamwork, communication, and the routine usage of checklists and protocols. In recent years, CRM has been introduced to hospitals to focus on patient safety.

**Methods and Materials**
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 two hospital campuses. We were assisted by a consulting group with considerable experience in helping hospitals incorporate CRM principles and practices. 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.

**Results**
Our safety record has improved. In the 5 years prior to CRM implementation, we experienced one treatment deviation per year. Since implementing CRM, none of our treatments have deviated from the treatment plan. Our practices have identified situations where ambiguity or conflicting documentation could have resulted in inappropriate treatment or significant patient harm. 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 considered something potentially unsafe. We have increased our efficiency (and profitability): in 2012 our units of service were up 11% over 2011 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.

## Introduction

Over the last decade, advances in imaging technology have provided more sophisticated, promising, and accurate techniques for targeting malignancies than ever before. And with these new tools, cancer patients are benefitting from radiation therapy with lower levels of toxicity and better chance of tumor control.[1] But these technological advances and more complex treatment plans, using higher doses, come with increasing risks and the consequences of error can be enormous. Public attention has been focused on this concern in recent years by media, including feature stories published by the *New York Times* in 2010 and recent annual reports by the Emergency Care Research Institute (ECRI) naming of radiation therapy errors as among the top ten hazards in health care.[2,3,4] Professional associations, equipment manufacturers, and providers of radiation therapy are each responding to put safeguards in place.

Training in teamwork, communication and the usage of checklists, specific protocols, and algorithms – collectively known as Crew Resource Management– has been extremely effective in the U.S. commercial airline industry in reducing accidents related to human error and poor teamwork. CRM has contributed to an 86% decrease in the risk of dying on a U.S. major jet air carrier since the 1990s.[5] CRM-based team training has an excellent track record in overcoming communication and collaboration causes of adverse events in such high-risk / high-reliability industries as aviation, nuclear power, and military operations.[6,7,8] Some hospitals, including many of the Veterans Health Administration facilities, have begun to tap into CRM training in recent years and have documented its positive effect on reducing both surgical mortality and OR delays.[9,10,11]

This paper addresses the process of introducing CRM, a patient safety culture-change process into a large two-clinic radiation oncology department that is part of a large hospital system. The results of that culture-change effort in terms of increased patient safety and efficiency will be explored.

## Materials/Methods

Our department of radiation oncology operates as a comprehensive single department located on two hospital campuses. We treat adult and pediatric patients with a variety of malignancies 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, dieticians, dosimetrists, registration and scheduling assistants, and patient navigators. Among the services we offer are: CT-based simulation, 3D/Conformal Radiation Therapy, Yttrium-90 Therapy, Multileaf Collimator (MLC) , Intensity Modulated Radiation Therapy (IMRT), Image Guided Radiation Therapy (IGRT), Stereotactic Radiosurgery utilizing the CyberKnife® Robotic Radiosurgery System, HDR Brachytherapy, Prostate Seed Implant, and Radioisotope Treatment (i.e. Zevalin, Strontium, Bexxar). We see 100-125 patients daily in our two locations.

With all the "moving parts" involved in our services – several providers from multiple disciplines dealing with each patient, a plethora of therapy machines, multiple computers and screens pertaining to each patient's treatment, numerous occasions for therapy delivery, arrangement of schedules with multiple departments, etc. – opportunities for error present themselves at every turn. And errors with radiation, especially at high doses, can be deadly.

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.

When the Department of Radiation Oncology began our Crew Resource Management (CRM) Patient Safety training in the in the fall of 2009, our goals were to improve safety, teamwork, communication, and efficiency. 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 two 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 they notice 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 two 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. As the two staff members go through the written check list, 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 LINAC Treatment Guide (Figure 1) is one of our most powerful written tools because it has standardized and streamlined our processes. In the 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 and/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 they are 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 introduced our morning rounds and shift huddle at each shift change. These short meetings for different groupings of personnel have the function of increased communications, 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 (Figure 2). 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 technician is treating the patient at the machine and the dosimetrist is preparing to enter future treatment parameters while in a different location), each screen shows the program is simultaneously being used by another member of the team and blocks certain functions from the second user.

## 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 formally, their communication with staff was often casual, verbal, and subject to misinterpretation. We began a standardized workflow process as part of CRM implementation. Within just a few months, order accuracy (physician intent) improved to 85%. At 6-months post implementation onward, accuracy of orders is consistently 97% or higher.

In the 5 years prior to CRM implementation, we experienced about one treatment deviation per year, although none rose to the level of "mis-administration" (10% or greater difference in the prescribed dose, as detailed in NRC guidelines).[12] As a part of CRM implementation, we instituted a two-person patient ID verification system and the LINAC treatment guide to address the variables that could contribute to improper treatment. When we introduced these tools, we achieved a compliance rate of 55% with regard to ID verification in month-1,

an 80% compliance rate in month-2, and 100% compliance by month-3 and after. We also achieved and sustained 100% congruence between the written treatment plan and the administered procedure. Since implementing CRM, none of our treatments have been out of compliance with the treatment plan.

Our process has allowed us to identify and correct issues that might have resulted in patient harm. Here are some 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 therapist was able to determine right away that the wrong patient had arrived. The patient that was transported had the same last name, but nothing else matched.

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

> Example 3: 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.

**Communication and teamwork:** The physician/staff relationship scores within our department were lower than for the hospital system as a whole prior to the implementation

of CRM. Through CRM training that 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.

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 healthcare system.

**Efficiency:** The standardization of policy and procedure that CRM has facilitated between our two 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 one at a time when our volume was increasing.

See Figure 3 for increases in our units of service from calendar year 2011 to 2012 (11% increase) as well as our increase above planned budget levels. We are now able to cycle our patients through more efficiently and effectively, allowing us handle an increased patient volume without increasing staff – which translates to increased profitability. At a time when other areas of the hospital departments are losing staff head-count due to cutbacks, the data that we are able to generate in terms of efficiency and smooth process allowed us to make a solid case for continuing to staff one nurse for each physician.Discussion

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. Our experience has been just the opposite. 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. Since everyone gets to see the big picture, the staff is 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 1988-1998.[13] 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.

We have addressed the issue of willingness to question authority in the interests of patient safety with our change in own culture, reinforced by increased communication across the disciplines, strict adherence to protocols, and significant encouragement from our leadership to "See it. Say it. Fix it." With the changes we have implemented, our department has become one the safest places to receive quality, state of the art, therapeutic radiation oncology care.

## Conclusion

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 two 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.

[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(7):291-299.

[2] Bogdanich W, Rebelo K. A pinpoint beam strays invisibly, harming instead of healing. *The New York Times.* December 28, 2010.

[3] Bogdanich W. Radiation offers new cures, and ways to do harm. *The New York Times.* January 23, 2010..

[4] Health Devices: Top 10 Health Technology Hazards in 2013. ECRI. Published November 2012. https://www.ecri.org/Documents/Secure/Health_Devices_Top_10_Hazards_2013.pdf Accessed January 16, 2013.

[5] Levin A. Airlines go two years with no fatalities. USA Today, January 1, 2009. http://www.usatoday.com/travel/flights/2009-01-11-airlinesafety_N.htm (last visited 6/29/2012).

[6] Baker DP, Day R, Salas E: Teamwork as an essential component of high reliability organizations. *Health Serv Res* 41:1576-1598, Aug. 2006.

[7] Salas E, Cannon-Bowers J: Design training systematically. In Locke EA (ed): The Blackwell Handbook of Principles of Organizational Behavior. Malden, Massachusetts: Blackwell Publishing, 200, pp. 43-59.

[8] Salas E, Cannon-Bowers J: The science of training: a decade of progress. *Annu Rev Psychol* 52:471-499, 2001.

[9] Shantanu N, Mukkerjee A, Sexton B, et al. Impact of preoperative briefings on operating room delays. Arch Surg, 2008:123;1068-1072.

[10] Henrickson SE, Wadhera RK, ElBardissi AW, et al. Development and pilot evaluation of a preoperative briefing protocol for cardiovascular surgery. *J Am Coll Surg*. 2009:1115-1123.

[11] Neily J, Mills PD, Young-Xu Y, Carney BT, et al. Association between implantation of a medical team training program and surgical mortality. *JAMA*. 2010:304:1693-1700.

[12] U.S. Nuclear Regulatory Commission, Part 20, Standards for Protection Against Radiation, http://www.nrc.gov/reading-rm/doc-collections/cfr/part020/full-text.html#part020-1009. (Last accessed February 21, 2013).

[13] Gladwell, Malcolm. Outliers: The Story of Success. New York City: Little, Bown & Company, 2008.