The Quest for Quality: Principles to Guide Medical Radiation Technology Practice

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ABSTRACT
Quality is a ubiquitous term in medical radiation technology; technologists, programs, and organizations emphasize the importance of “quality care,” yet the concept of what is encompassed by the term, how it is built and measured, and who is the judge of whether it has been achieved, are often left undefined. This article will present theoretical definitions of quality, considering the value of professional, patient, and organization perspectives. Foundational quality principles and frameworks will be explored to highlight tools necessary to engage in “quality-related” activities and research at the individual, institutional, and systems level. Being equipped with an understanding of the work of Deming, the underpinnings of the lean strategy and the idea of continuous quality improvement will support technologists in contributing to evidence-based, high-quality, and safe practice. Building on these basics, concepts of complexity and standardization will be explored as they relate to achieving and maintaining quality given changing practice, focusing on personalized medicine, technological innovation, and best practice guidelines. Means to measure and evaluate quality will be presented, emphasizing the need for a structured approach. Using the work of the Canadian Partnership for Quality Radiotherapy as an example, key quality-related considerations, such as incident reporting, organizational structure, and quality culture will be discussed, with specific attention to roles within the team. When appropriately defined, measured, and evaluated, the quest for quality has the potential to improve safety and mitigate risk. Engaging technologists to assume strong roles in providing the highest quality of care will contribute positively at the level of the individual patient, the organization, and the system.

RÉSUMÉ
La qualité est un terme passe-partout en technologie de radiation médicale: les technologues, les programmes et les organisations mettent l’accent sur les « soins de qualité ». Pourtant, le concept de ce que recouvre le terme, comment la qualité est construite et mesurée, et qui juge si elle a été atteinte est souvent non défini. Cet article présente des définitions théoriques de la qualité, en considérant le point de vue des professionnels, des patients et des organisations. Les principes et les cadres de base de la qualité seront explorés dans le but de mettre en lumière les outils nécessaires pour engager des activités et des recherches liées à la qualité au niveau individuel, institutionnel et systémique. Le fait de comprendre les travaux de Deming, qui sous-tendent la stratégie lean et la notion d’amélioration continue de la qualité aidera les technologues à contribuer à une pratique fondée sur les données probantes, de grande qualité et sécuritaire.

À partir de ces éléments de base, les auteurs examinent les concepts de complexité et de normalisation dans leur application à l’atteinte et au maintien de la qualité dans un contexte de pratique en évolution, d’accent sur la médecine individualisée, d’innovation technologique et de lignes directrices sur les pratiques exemplaires. Des moyens de mesurer et d’évaluer la qualité seront présentés, en mettant l’accent sur la nécessité d’une approche structurée. En utilisant les travaux du Partenariat canadien pour une radiothérapie de qualité comme exemple, les auteurs abordent des considérations clés reliées à la qualité, comme la déclaration des incidents, la structure organisationnelle et la culture de qualité, avec une attention particulière aux différents rôles au sein de l’équipe.

Quand elle est définie, mesurée et évaluée de façon appropriée, la qualité des soins a le potentiel d’améliorer la sécurité et d’atténuer les risques. Inciter les technologies à prendre un rôle fort dans la prestation de soins de la plus haute qualité permettra d’augmenter la qualité et la sécurité des soins.
Introduction

Quality is a ubiquitous term in medical radiation technology; technologists, programs, and organizations emphasize the importance of “quality care,” yet the concept of what is encompassed by the term, how it is built and measured, and who is the judge of whether it has been achieved, are often left undefined. With respect to basic entry to practice standards for medical radiation technologists (MRTs) in Canada, competency profiles and training requirements tend to focus on quality as it relates to the MRT’s role in assuring the safe performance and operation of the equipment used in care delivery, issues related to radiation safety, and adherence to departmental policies and procedures [1]. As integral members of interprofessional care teams, organizations, and systems, however, MRTs have the responsibility and opportunity to contribute meaningfully to broader quality goals and activities that maximize safe and quality patient care.

This article will present theoretical principles of quality and quality improvement, considering the value of professional, patient, and organization perspectives. Focusing on examples in radiation therapy, key dimensions of quality from complexity and standardization to incident reporting and organizational culture will be explored. When appropriately defined, measured, and evaluated, efforts to achieve quality care have the potential to improve safety and mitigate risk. Engaging MRTs to assume strong roles in all aspects of quality, through equipping them with the knowledge, skills, and judgement to do so, is critical to achieving that goal.

Definition of Quality

Quality in health care is difficult to define in a manner that adequately encompasses all domains, perspectives, and levels. In medical radiation technology, definitions of quality have until recently been primarily limited to considerations of technical quality control of equipment, but there is growing appreciation for the importance of other dimensions [2–4]. Most generally, it can be seen as a degree of excellence, often in comparison with a gold standard [5]. Edwards Deming, an engineer and quality expert, defined it as being “on target, with minimum variance,” suggesting the need to define that target and then have a means to measure a high consistency of performance against it [6]. In its publication entitled Crossing the Quality Chasm, the Institute of Medicine defined six broad aims which could be considered to encompass the scope of that target or gold standard- that care be safe, effective, patient-centred, timely, efficient, and equitable, with the overall goal to deliver the “right care, to the right patient, at the right time” [7]. Quality must then also be appreciated through different lenses. It can be considered at the level of the individual, the organization, or even the health care system, and will likely be defined differently by the patient than it is by the provider- with further nuance between the physician, the medical physicist, and the MRT within a team of providers.

With all this in mind, it is perhaps safest to conclude that quality is a nebulous concept, but in essence, is a goal to which everyone aspires. Practically, it requires specific articulation in different contexts to allow it to be measurable and achievable. Be it the wait time for radiation therapy in a given jurisdiction, consistency of the output of a linear accelerator, patient satisfaction with ambulatory services, or acceptability of a dose distribution for a single patient, there are certain principles and concepts which serve as tools with which to approach any effort toward quality improvement. The remainder of this article will be dedicated to an introduction to these tools, so that the MRT can better appreciate quality and how best to achieve it, especially at the level of the organization and the system.

Establishing and Fostering a Quality Culture

Equipped with an appreciation of the terms and tools that form the foundation of quality and quality improvement, MRTs can engage effectively and efficiently in efforts to optimize quality and safety for their individual patients, within their departments, and even in the broader health care system. These efforts are made more impactful if pursued within an environment that is supportive of such efforts, open to change to improve care, and supportive of just culture when it comes to looking at the source of incidents of poor quality care.

The concept of a “quality culture” is not a new one, but is one that is garnering increasing attention as the importance of a collaborative and holistic approach to quality is better appreciated. Roberts and Perryman defined building a quality culture as “developing norms and values that assure patient safety and quality outcomes by managing relationships among and between independent, autonomous physicians, nurses, and allied health professionals. These interpersonal relationships are built on trust, respect, confidentiality, responsiveness, empathy, effective listening, and communication between providers and patients.” [8].

Essential to ensuring success in quality endeavours, thought must be put into building the best team for the given activity. Teams should be built with consideration for the components of high-performance teams. These components include clearly defined leadership, appropriate skill set mix, defined roles, interprofessional and communication skills, self-motivation, and the ability to adjust to new challenges and changing resources [9, 10]. Building interprofessional teams can increase quality and safety by introducing redundancy to detect and mitigate errors and system failures and can increase the organization’s efficiency through optimal use of existing and often limited resources [9]. Breaking down the professional silos in which health care often operates gives different members of the health care team the autonomy and respect to question, speak up, or make suggestions.
without fear of reprimand [11]. Effective teams are required for efficient and safe clinical operations, but a collaborative approach to engaging in a quality culture can also apply to safety rounds, incident analyses, quality committees, continuing education, evaluation, and implementation of new techniques or infrastructure [12, 13].

On a systems level, the Canadian Partnership for Quality Radiotherapy (CPQR; www.cpqqr.ca) is a recent and unique initiative that has sought to establish a quality culture at the systems level, while also identifying the requirements of fostering such an environment at the organizational level [13]. CPQR was founded in 2010 as a collaboration between the three most relevant national professional associations—the Canadian Association for Radiation Oncology, the Canadian Association of Medical Radiation Technologists, and the Canadian Organization of Medical Physicists, with strategic and funding support from the Canadian Partnership Against Cancer-the engagement of all groups being thought critical to the success of its endeavours. As well as establishing standards, guidelines, and frameworks in areas such as programmatic quality assurance, technical quality control, national incident reporting and learning, and patient engagement in quality, it has championed and supported the strengthening of a radiation treatment culture of quality in all areas of practice, serving as an example to other jurisdictions and health care domains. The establishment of CPQR reflected the desire within the radiation treatment community to address emergent quality issues and opportunities, both within radiation treatment and in the broader health care system.

Key areas of focus to build quality within a department or program can include, but are not limited to, evidence-based practice (EBP), simplification and standardization, continuing education, and incident reporting and learning. With each of these key areas, a foundation of quality improvement must first be cemented.

Frameworks for Improvement

Continuous Quality Improvement

Quality requires the most effective use of processes and performance. Therefore, to improve quality, systems, procedures, practices, and roles must be examined on a regular basis for inefficiencies [14]. Although often considered a difficult concept to pin down, continuous quality improvement (CQI) refers to a structured organizational process for progressively advancing a system through multiple and perpetual improvement processes [15].

It is important that a department or organization recognize and be clear that the advancement of quality is best addressed through a systems-level approach, through process improvement, rather than identifying the shortcomings of individuals or groups of staff [14]. An organized CQI program provides means to identify quality improvement opportunities and mechanisms to develop teams to assess, analyze, and redesign these processes [15].

A number of CQI tools exist. Three CQI frameworks commonly used in health care will be presented here; Plan–Do–Study–Act (PDSA) cycle, lean methodology, and failure modes and effects analysis (FMEA).

PDSA Cycle

The PDSA cycle, also referred to as the Plan–Do–Check–Act cycle, or Deming cycle, is used to identify potential improvements in processes [16, 17]. The model is divided into four systematic components.

Plan: Clearly identifying objectives, including purpose, hypotheses, data to be collected and measured, by whom, when, where, and how.

Do: The pilot or test phase of the PDSA cycle involving execution of the plan on a small test population, including observing and documenting results.

Study: Analysis of the impact of the change, involving examination of what happened and how it relates to planned objectives.

Act: Decision made based on an analysis of data. Rarely, the implemented change may have fully accomplished the objectives at first pass, but more commonly, revisions to the plan are necessary and more data are collected and analyzed [18].

Like all CQI methodologies, the PDSA cycle should be approached iteratively, seeking to optimize a process, maximizing its effectiveness. To provide an example of the use of a PDSA cycle, one can consider a radiation therapy department looking to decrease head and neck radiotherapy wait times, specifically the wait from consult to first treatment. When compared with a national benchmark, the department recognizes the need for improvement and sets a goal of decreasing wait times from 15 days to 10 days from consult to treatment. The plan, or the proposed action to achieve this goal, was to implement a process of prebooking diagnostic imaging department magnetic resonance imaging and positron emission tomography appointments that were required in conjunction with CT simulation, having them within one day of the simulation appointment. The department then took action, reflecting the “do” of the PDSA, implementing the plan and monitoring the outcomes, which included changes in wait times and data regarding reasons for unanticipated delays, and impact on other scheduling and treatment parameters. The collection and evaluation of these data reflect the “study” aspect of the cycle and is discussed in greater detail later in the Measurement and Evaluation section. If the department were to find that this small change in practice achieved the goal of decreasing wait times, without a negative impact on other aspects of care, then its “act” phase might solely be to finalize the new practice as a standard of care. If, however, wait times were not
sufficiently decreased, or any other consideration were to come to the fore, a new iteration of the cycle would be undertaken, with a modified or entirely novel plan to achieve the goal.

**Lean Methodology**

Many years ago, Toyota realized the need to develop a more high-quality, cost-effective product and implemented a number of more efficient practices into its manufacturing [19]. These concepts, principles, and tools became the basis of lean methodology, best described as a both a tool set and a means to maximize the value for stakeholders while minimizing resources consumed and leveraging the knowledge and skills of the members of the organization [20].

Lean methodology uses a number of key concepts outlined in the following:

1. Identification of the value stream: through value stream mapping, identifying steps in the process from start to finish; the flow of information, steps, and other activities associated with the product (or patient experience in the health care setting) [19].

2. The value stream is examined for sources of improvement, known as lean improvement. The various steps and activities of the values stream are divided into one of three classification schemes:
   a. Value-adding: critical activities that define and change the function of the service and make it more valuable from the customer’s perspective [21]. An example of a value-adding activity would be a diagnostic test that provides information that contributes to a patient’s diagnosis.
   b. Non–value-added but necessary: activities that do not add value to a service from the customer’s perspective; however, are required to complete the process [21]. For example, the completion of a report to a government agency: although this activity will have no consequence to the care of patient, it may impact the organization.
   c. Non–value-added (waste): does not add value from the customer’s perspective. An example of waste would be a poorly designed clinical unit, requiring unnecessary and inefficient movement for the patient and caregiver to administer care.

3. Lean methodology identifies perfection as an ideal to strive for through ongoing iterations of the process; and thus, the final step is engaging in this iterative process, as with other methodologies such as the PDSA.

**Failure Modes and Effects Analysis**

FMEA seeks to study the dynamics of a process and reduce the probability of an adverse event [22]. In comparison, incident learning, discussed later in this article, is a reactive risk management tool seeking to determine and mitigate the causes of an event after the fact, usually from a “why did this happen?” perspective. FMEA is a proactive risk assessment tool that examines a particular process, asking “What if?” to determine and eliminate any possibility of failure along the trajectory of the process.

Approaches to FMEA can differ, but there are common steps regardless of the process used.

1. Identify the process to review and the stakeholders to engage.
2. Process mapping: the exercise of identifying the individual steps that comprise the entire process being examined.
3. For each step in the process, potential failure modes and their effects are identified. A failure mode describes the specific manner in which a failure can occur at that particular step [22].
4. The failure modes are ranked and prioritized with respect to risk (severity, degree of detection, and the likelihood of the failure mode from occurring) [23].
5. The failure modes are then analyzed, and the root causes are identified. The attempt is made to mitigate these root causes to reduce the probability of the failure modes from occurring.
6. Using the information obtained through the root cause analysis, a redesign is completed with the intention of developing a more robust process.
7. The new process is analyzed and tested through such means as a PDCA cycle, through implementation and monitoring [24].

CQI seeks to create a robust organization using a number of tools. These tools are not intended for single-time use; multiple iterations are required, in various combinations at different levels of practice, to develop a system that performs efficiently, effectively and, most importantly, meets the needs of the patients in the safest manner possible.

Equipped with some valuable and practical tools for improving quality, efforts can be focused on applying these tools to achieve progress toward various quality priorities. EBP, standardization, and incident reporting and learning practices are three such priorities.

**Quality Domains & Practices**

**Evidence-Based Practice**

Simply put, EBP can be seen as doing the right thing, at the right time, for the right person [7]. EBP has evolved over the last two decades and is a derivative of evidence-based medicine. Sackett et al defined evidence-based medicine as “the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients …it means integrating individual clinical expertise with the best available external clinical evidence from systematic research” [25].

For MRTs, this implies that practice is guided by the highest level of evidence. The purpose of EBP is to ensure all aspects of care are guided by best evidence, informing the continued effort to achieve the best possible outcome for the patient [26]. MRTs can achieve EBP by questioning...
practice, evaluating ideas, critically analyzing the evidence, and applying the learning achieved to future practice. Key characteristics associated with EBP are [27] as follows:

- Clinical competence, knowledge, and skills
- Observance and sensitivity: ability to identify needs of patients and families
- Effective communication
- Reflective practice: ability to develop clinical expertise based on personal practice and experience
- Lifelong learning: continuously and conscientiously keeping abreast of evolving practice, including research awareness and critical appraisal of evidence
- Modeling of EBP behaviours through building capacity in others and working to change culture.

EBP can contribute to safer health care as MRTs challenge themselves and become open to challenges from others to ensure that their practice is based in science, effectiveness, and efficiency [28]. With an increasingly savvy and educated patient population, with ready access to more health-related information, the philosophy of EBP rings true for this stakeholder group as well, and will require that MRTs are prepared to engage in relevant conversations with patients. This may be a reason the concept of EBP is gaining traction in all spheres of health care [28].

As health care professionals, MRTs work in an era where evidence is forever changing in light of new publications, practice guidelines, research, technology, and ideas, and old ideas and options put together in new ways [27]. What might have once been believed to be unfailing truth or competence can quickly become obsolete. To a greater degree than ever before, MRTs must adapt to changes in science and technology as fast as they are implemented and discontinued. “It is no longer acceptable to continue to practice based largely on tradition. Patients expect and should receive the best evidence-based care available” [29].

To address the need to stay abreast of changing practice, the Canadian Association of Medical Radiation Technologists built a comprehensive and accessible series of best practice guidelines, first made available in 2013 [30]. The guidelines did not address the technical aspect of care, but rather focused on the broader aspect of practice that might transcend basic clinical competency. Many of these guidelines relate to quality and safety considerations, in efforts to establish a consistently high standard of care across the country. These include guidance and associated rationale regarding patient screening for pregnancy, ALARA (as low as reasonably achievable), managing patients with pacemakers and other implantable devices, and safe documentation of procedures [30]. Most importantly, there was the appreciation that the guidelines would need to remain fluid, evolving as evidence informed practice.

**Standardization**

If EBP is seen as offering the right care to the right patient, then it can be seen that having standards, or standardization of care, is essential to EBP. The quality and safety afforded to patients through EBP can be lost if practice is inconsistent; the role of standardization is to control unnecessary variation in practice.

It is important to remember that MRTs practice in an area of rapidly expanding technology, making the field inherently open to numerous and potentially conflicting guidelines and priorities: from organization to organization, department to department, and clinician to clinician. Take, for example, the instance of the introduction of new, state-of-the-art imaging capabilities in a department, increasing the ability of radiation therapists (RTTs) to assess and address patient positioning on a daily online basis. Recognizing that increased precision might warrant the tightening of planning target volumes, the practice of the three radiation oncologists (ROs) in that department begin to diverge based on their preference and lack of collaboration. They also request differing practices of the therapists in terms of image registration, such as surrogates, use of registration algorithms, and so forth. Regardless of the knowledge, skills, and judgement of either the ROs or the RTTs in using the technology, the lack of a standard practice or defined policy begins to lead to overly-complicated and poorly-documented workflows, and frequent incidents as confusion grows regarding individual practices. If the need for a standardized workflow were acknowledged in efforts to minimize variation in practice, appropriate measures could be implemented to determine collaboratively the most EBP for that department.

MRTs should be driven to use EBP to develop a standard relevant for their practice. It is important to remember, however, that standards should not be used as “cookie cutters,” taking away the element of clinical expertise and individual judgment given the situation. Standards (such as clinical practice guidelines) should be used as a tool to assist in clinical decision making. Standards are the foundation for technical guidelines, policies, protocols, and procedures.

EBP and standardization are a means of improving quality in medical radiation technology where care can be inconsistent and uninformed due to a number of professional, cultural, and organizational factors, resulting in some patients receiving excellent care, whereas others may receive substandard care. The impact of EBP and standardized protocols highlights the relationship between developing standards to inform quality in health care and the impact of well-documented policy on reducing error.

**Incident Reporting and Learning**

Fundamentally, incident reporting and learning (IRL) are about using the opportunities from reported actual or potential incidents and analyzing them to determine the systemic and human factors involved. Unlike FMEAs, IRL is a reactive and retrospective look at a known error, and the practice of IRL should be seen as a final layer of CQI, which then feeds back to, and can inform, all other key quality areas. When implemented effectively, it can be of value in mitigating risk for any patients directly affected by that particular incident, draw attention to factors that might contribute to that
incident occurring again, and suggest CQI initiatives that would reduce risk and improve quality moving forward.

For IRL to be a valuable tool for CQI rather than solely a mechanism to meet organizational and legal requirements of managing incidents, it is important to analyze errors from a systems perspective, understanding they may be the result of many smaller events, involving multiple persons and contributing factors influenced by the working environment and organizational structure [11]. Consider a department that has logged four “near miss” events through its reporting system in a single week. Although no harm reached the patient in any case, the high number of instances over a short period prompted the department to investigate. An interprofessional team, independent of those involved in the actual events, was brought together to determine the specific sequence of actions or inactions that led to the event in each case and the potential contributing factors that served to propagate the issue. It was recognized that a recent change in practice, moving from paper records to electronic charting, had led to an unexpected potential for error when launching electronic planning documentation. A risk mitigation exercise was undertaken, which led to a reorganization and more robust labelling and quality assurance system for published treatment plans. A process for change management, education, and monitoring of the effectiveness of the strategy was put in place and communicated to staff—effectively launching a PDSA cycle. The value of monitoring and evaluating performance, such as that which led to an investigation of a few unexpected “near miss” events, is further discussed later.

An effective IRL structure must be easy to use and to access, nonpunitive, confidential, and deidentified to address confidentiality. Timely and intelligible feedback must be given to the reporting community to address the often underappreciated learning aspect of IRL [8]. Barriers to incident reporting may include lack of time, fear of reprimand from coworkers or leadership, and skepticism that reporting will lead to meaningful change. Because of such barriers, reported incidents may not represent the actual frequency of events.

When IRL is used appropriately, it can transcend the originating department, and can be used to inform the larger interprofessional, organizational, provincial, regional, or national communities for shared learning and greater collaboration. This is evident in the launch of the CPQR-driven National System for Incident Reporting in Radiation Treatment, which will provide all departments with the opportunity to report radiotherapy incidents using common language and classification into a searchable database, giving centres from across the country the chance to inform and learn from the incidents of others and share successful strategies created to avoid future occurrences.

**Measurement and Evaluation of Performance**

Responsible collected and interpreted data can provide insight into how a process is performing and where improvements in quality are warranted as well as the impact of any improvement measures, as illustrated by the PDSA cycle. Conversely, a lack of data dooms any quality initiative to failure. Evaluation of process performance first requires appreciation of variation inherent in any process.

**Variation in a Process**

All processes demonstrate some degree of variation. For example, although the radiation treatment planning time for the average breast tangent might be two hours, there are cases that will require more, or less time. The less stable a process, the more variation there will be, given considerations such as the people performing the process, the methods used, the clinical environment, the patient, or the measurement itself. There are two types of variation; common cause and special cause.

Common cause variation is the summation of all the small causes that accumulate by chance and is often referred to as background noise. For example, for wait time data, this might include patients whose treatment is delayed by a day or two due to limited space on the treatment units or where the waiting time is recorded as a day or two longer than it actually was because of incorrect data collection.

Special cause variation is that which is unpredictable in nature and attributed to a specific cause. It is usually large when compared with common cause variation and can also be referred to as an outlier. For instance, if a patient’s wait for treatment was 100 days because she took a vacation before starting treatment, this would be classed as special cause variation. It is important to recognize the difference and be able to exclude special cause variation from any assumptions about how the process is performing. To ensure an accurate reflection of the process, special cause variations are often removed from the data set.

In general, a process that is stable will continue to perform with the same amount of variation unless something is done to alter that process. The intent of improving quality is to both minimize the amount of variation within the process and to ensure that the process is performing at the desired level.

**Data Collection and Bias**

Approaches to data collection can impact the quality of measurement. It is first important to appreciate what information is required about a given process to stabilize and improve it, and what data could provide that information. Clearly articulated and commonly understood metrics might include waiting time to receive a service, utilization rate for certain resources, or rate of failure of a process.

It is also useful to understand how the data collection method may introduce bias and how this can be minimized. Errors in data collection can be either systematic or random. Systematic errors are because of underlying bias in the data collection. The use of English-only surveys may generate a systematic error, as data from non-English speakers are excluded. If workload data are being collected, collection of data only on Mondays could represent a reliable average across the week, or
could be consistently higher or lower than on other days, also creating the potential for systematic error.

Random errors are caused by inherent variability in measurement. For example, different people may interpret data or definitions differently or misunderstand instructions for reporting. Collected data should be reviewed carefully for random errors, often appearing as data outliers. Such data should be reviewed and a decision made as to whether to include, ignore, or correct it. For instance, if the average number of procedures performed per day is around 30, and data are reported indicating a workload of 45 on one day, the accuracy of these data should be verified. It may well represent an abnormally high workload on one day, and should be included, or it may be incorrect data requiring correction. Understanding how errors can be introduced into data collection can make it easier to design adequate collection methods. The ideal is that all events are accurately captured, meaning that the data reflects the process.

Run and Control Charts

Once the data are collected, they need to be presented and interpreted. Data can be presented as a simple table or in a variety of graphical formats. The intent of displaying the data is to make it easier for the user to see the trends in the data and establish if a process is improving or worsening over time. A simple and effective means of doing this is to use a run chart or its more sophisticated version, the control chart. These are graphical representations of variations over time. They allow the user to see trends in performance and to identify if those trends are the result of normal variation or of other causes. Target performance levels, or benchmarks, can easily be incorporated, providing guidance for quality improvement initiatives.

Interpreting a run chart is straightforward. A stable process will have little variation over time.

This is desirable if the process is deemed to be performing well, but an upward or downward trend can also be a good sign. Figure 1 represents a run chart demonstrating the percentage of radical prostate radiotherapy plans undergoing oncology peer review in 2011. Overlaid is the CPQR target performance level, published for all Canadian radiation treatment centres in April 2011 [31]. Although centre A is performing at a stable and relatively high rate, centre B demonstrates an increase in the percentage of plans reviewed, shortly after publication of the new CPQR guidelines. Query into centre A’s practices may suggest an initiative to better facilitate the peer review process to meet the defined national target. Both centres might find such graphical representation of their respective data to be valuable in review and evaluation of their practices.

A control chart differs from a run chart in that it defines statistical upper and lower “control limits” on either side of the plotted mean. These limits can reflect the boundaries of acceptable variation around a process expected to be stable. For example, medical physicists often use control charts to report on the dosimetric output of a linear accelerator. Although small fluctuations may not warrant resource-intensive intervention, if a series of points is plotted outside a control limit, it may be necessary to take the accelerator out of service to undergo recalibration.

Accurate collection of data can give valuable information about the performance of a process, but only if the data reflect the process and are understood. The data collection method should be accurate, and the sampling method representative. Robust measurement is critical to ensuring continued high performance of a process, suggesting the need to undergo a quality improvement initiative of an underperforming process and evaluating the success of a newly implemented process. As such, measurement should be a consideration in all aspects of quality, so that data collection can be implemented appropriately.

Conclusions

All health care disciplines have, at the core of their practice, the ultimate objective to provide the safest and highest quality care possible to their patients. Possessing an appreciation of what constitutes that safe and quality care, what mechanisms can be put in place to achieve it, and what data should be collected and analyzed to evaluate performance, can help MRTs to meet this objective as it pertains to their scope of practice.

The CPQR has helped to further accelerate an emerging appreciation for formal quality concepts and programmatic and systemic CQI efforts in radiation therapy. Although some of the specific initiatives mentioned in this article may be unique to this field, the principles, collaborative approach to quality culture, and desire to offer the safest and highest quality care to the patient are equally applicable to all MRT disciplines and their respective areas of practice. MRT engagement and leadership on relevant initiatives is critical to achieving quality care at all levels.

References
