# PEER-REVIEW OF RADIATION TREATMENT PLANNING ACTIVITIES IN A PROVINCIAL RADIATION ONCOLOGY PROGRAM: CURRENT PRACTICE AND FUTURE DIRECTIONS

<table>
<thead>
<tr>
<th>Journal:</th>
<th>BMJ Open</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manuscript ID:</td>
<td>bmjopen-2013-003241</td>
</tr>
<tr>
<td>Article Type:</td>
<td>Research</td>
</tr>
<tr>
<td>Date Submitted by the Author:</td>
<td>16-May-2013</td>
</tr>
</tbody>
</table>

### Complete List of Authors:
- Brundage, Michael; Queen's -CRI, Cancer Care & Epidemiology; Cancer Care Ontario, Radiation Treatment Program
- Foxcroft, Sophie; Princess Margaret Hospital, Radiation Medicine Program; Cancer Care Ontario, Radiation Treatment Program
- McGowan, Thomas; Credit Valley Hospital, Department of Radiation Oncology; University of Toronto, Department of Radiation Oncology
- Guitierrez, Eric; Cancer Care Ontario, Radiation Treatment Program
- Sharpe, Michael; Princess Margaret Hospital, Radiation Medicine Program; Cancer Care Ontario, Radiation Treatment Program
- Warde, Padraig; Princess Margaret Hospital, Radiation Medicine Program

### Primary Subject Heading:
- Oncology

### Secondary Subject Heading:
- Evidence based practice

### Keywords:
- RADIOTHERAPY, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Clinical audit < HEALTH SERVICES ADMINISTRATION & MANAGEMENT
PEER-REVIEW OF RADIATION TREATMENT PLANNING ACTIVITIES IN A PROVINCIAL RADIATION ONCOLOGY PROGRAM: CURRENT PRACTICE AND FUTURE DIRECTIONS

Michael Brundage, MD1,5 Sophie. Foxcroft, MRTT,2,5 Tom McGowan, MD3,4 Michael Sharpe, PhD2,4,5 Eric Gutierrez, MRTT5 and Padraig Warde, MD2,4,5

1. Cancer Care and Epidemiology, Queen’s Cancer Research Institute, Kingston, ON, and Kingston General Hospital
2. Radiation Medicine Program, Princess Margaret Hospital, Toronto, ON
3. Department of Radiation Oncology, Credit Valley Hospital, Mississauga, ON
4. Department of Radiation Oncology, University of Toronto, Toronto, ON
5. Radiation Treatment Program, Cancer Care Ontario, Toronto, ON

Corresponding Author
Dr. Michael Brundage
Professor, Cancer Care and Epidemiology,
Queen’s Cancer Research Institute
10 Stuart Street, Level 2
Kingston, Ontario, Canada K7L 3N6
Tel 613 533-6895
Fax 613 533-6794

Funding
Dr. Brundage is supported by a research chair award from Cancer Care Ontario.

Key words: Radiation Oncology; peer-review; patterns of practice; quality improvement; knowledge translation

Word count excluding title page, abstract, references and figures: 3032

Conflicts of Interest Notification:
No conflicts of interest for any author.
Abstract

Purpose: To describe current patterns of practice of radiation oncology peer review within a provincial cancer system (Ontario, Canada), and to identify barriers and facilitators to its use.

Method: All Ontario cancer centers (n=14) were surveyed. Centre responses to the survey were prepared by their multidisciplinary Radiation Oncology teams. Response categories varied by survey item, but were typically scored using a 10-point Likert scale.

Results: Fourteen (100%) centers responded. All rated the importance of peer-review as at least 8/10 (10=extremely important). Detection of medical error and improvement of planning processes were the highest rated benefits of peer-review (each median 9/10). Six centers (43%) reviewed at least 50% of curative cases; four of these centers (29%) conducted peer review in more than 80% of cases treated with curative intent. Fewer than 20% of cases treated with palliative intent were reviewed in most centers. Five centers (36%) reported usually conducting peer review prior to the initiation of treatment. Five centers (36%) recorded the outcomes of peer-review on the medical record. Thirteen centers (93%) planned to expand peer review activities; a critical mass of radiation oncologists was the most important limiting factor (median 6/10).

Conclusions: Radiation Oncology peer review practices can vary even within a cancer system with provincial oversight. The application of guidelines and standards for peer-review processes, and monitoring of implementation and outcomes, will require effective knowledge translation activities.
Introduction

High quality of care is important to any medical discipline, but is of particular concern in radiation oncology treatment programs given the potential for serious harm in the event of a treatment-related error.[1] As modern radiotherapy planning and delivery systems become increasingly sophisticated and complex, quality assurance procedures must also evolve in order to ensure that consistently effective and safe therapy is delivered.[1,2] Although much of the attention regarding the safety of radiotherapy has focused on the relationship between quality-assurance practices and critical high-profile dose delivery incidents, quality assurance programs are also necessary to minimize the potential for less severe ‘errors’, or inappropriate variations in processes or practice, that represent threats to the overall quality of radiotherapy care.[3] While radiation oncology has a long history of high quality technical assurance (e.g., processes designed to ensure technical quality, such as valid machine calibration, laser setup calibration, and accurate treatment planning systems), the more subjective decisions made by attending physicians are less routinely subject to quality assurance processing, and are the target of peer review.[2] Clearly, both high quality technical processes and high quality technical medical care are required to optimize patient outcomes.

Peer review has been defined in a variety of ways in the literature. An often cited broad definition of peer-review is "the evaluation of creative work or performance by other people in the same field to enhance the quality of work, or the performance", where the word “peer” refers to people in the same profession who are of the same or higher ranking.[4] This definition has been applied to peer review in many disciplines, and in many contexts, including radiation oncology.[5] Others have suggested the term “audit
These definitions are conceptually broad, and encompass peer review activities occurring on several levels. For example, tumor board conferences typically review medical decision making in a specific patient’s case, and ensure that the decision to employ radiotherapy (alone or with other modalities) is appropriate. At an organizational level, accreditation processes have been used to ensure adequate structures and processes are in place in a radiation oncology program to support a high level of care and safety.

In this report, we focus on a specific aspect of peer-review, namely, the review of individual radiation plans. In this context, a radiation oncologist (alone or as part of a multidisciplinary team) reviews the subjective decisions made by the prescribing oncologist when implementing technical aspects of care, including volume segmentation or contouring, choice of prescribed dose and fractionation, selection of regional anatomy covered, and dosimetry optimization. These activities are distinct from quality assurance practices in radiation oncology that involve other disciplines (e.g., plan review by medical physics[5,7] or by radiation therapist[5]).

There is evidence that oncologist-to-oncologist peer review is critical to the quality of radiation treatment plans. Studies of observer variation in contouring practices make clear that radiation oncologists can substantially differ in their contouring patterns when presented with an identical case. This variation has been demonstrated in the treatment settings of prostate cancer,[8,9] lung cancer,[10] and breast cancer,[11] and has prompted the development of contouring guidelines.[12,13] In the conduct of randomized clinical trials, "real-time review" of treatment plans has consistently detected planning protocol deviations, underscoring how inter-oncologist planning variation occurs in
practice despite the availability of a prescriptive clinical trial protocol. Importantly, this observed variation can have significant negative impact on treatment quality,[9,14] and on clinical outcomes if not mediated by the peer-review process.[15] Finally, direct evidence from audit and feedback processes has shown that peer review does detect errors that can be corrected prior to the initiation of treatment. In a large Ontario study of over 1,000 patients, errors were detected in approximately 7% of cases, and multivariate analyses showed that the error rate was independent of time of year, experience of the oncologist, or of a post-residency fellow being involved in the case.[3] In Australia, regular use of audit and feedback has revealed similar findings, with 6% of plans overall ‘failing’ the audit process.[2] Less well described is the extent to which the identified errors were acted on.

Ontario’s provincial cancer agency Cancer Care Ontario (CCO) has identified the need to improve and expand peer review activities across the Ontario cancer system as a strategic direction of the Provincial Radiation Treatment Program to improve the quality of care. As is the case in most Canadian provinces, radiation oncology services are highly centralized in Ontario, where fourteen centers serving a population of about 13 million. Cancer centers range in size from relatively small centers (700-1,000 new case referrals per year); to two large centers in a large metropolitan area (over 6,000 new case referrals per year). Most either participate in, or operate, post-graduate education programs in radiation oncology. In the interests of developing a program to optimize the use of peer-review in the province, we undertook this research to describe current patterns of peer review in Radiation Oncology practices across Ontario and to identify existing barriers and potential facilitators to its expanded and optimal use.
Methods

We undertook a survey of fourteen cancer centers using an electronic survey. Survey items were developed by the authors and pilot tested in one regional cancer center with an established peer review program. The survey began with a brief set of instructions, and information regarding the scope of peer review addressed in the survey. A representative from each cancer center filled out a single survey based on input from their multi-disciplinary team, which included radiation oncology, medical physics, and radiation therapy at that center. Confidentiality of the responses was ensured. Some survey items asked questions with response options constructed as a Likert scale ranging from 0-10, with anchors defined as appropriate for each section of questions (for example, "not important", 0 and "extremely important”, 10). Some questions utilized binary (e.g., yes/no) responses or categorical responses (e.g., “almost always”, “often”, “only sometimes”, “rarely or never”) defined as appropriate for the question stem. The survey was approved the Queen’s University research ethics board.

Following pilot testing and subsequent editing to address clarity and redundancy within the questionnaire, the survey was administered by email in April 2011, with responses closing six weeks later in May 2011. An introductory letter was included and telephone reminders were used as required.

The survey results were compiled using descriptive statistics, including medians, quartile distributions, and ranges where appropriate. Owing to the nature of the study, no inferential statistics were calculated given that no specific hypothesis testing was undertaken.
Results

All fourteen (100%) cancer centers responded. All centers performed peer review activities, although the extent, nature and use of the review varied.

Importance and Purpose of Peer Review

Regarding the importance of peer review, eight (57%) centers ranked the importance as 10/10 (extremely important), with the remaining centers rating the importance as either 8/10 (n=2 centers) or 9/10 (n=4 centers). No center rated the importance of peer review below eight points.

Figure 1 illustrates respondents’ opinions regarding the importance of each of eight potential reasons for undertaking peer review in radiation oncology. Detection of medical error, and improvement of the treatment planning processes or policies, were both rated highly in terms of their importance (median scores of nine on a scale ranging from 0, “not important” to 10, “most important”). Inter-quartile ranges for all of the reasons listed in Figure 1 were 5/10 or higher.

Current Utilization of Peer Review at Individual Centers

Figure 2 illustrates the percentage of plans that were typically peer reviewed across centers. Four centers (29%) reported routine peer review in more than 80% of cases treated with curative intent, and six centers (43%) reported using peer review processes in at least 50% of curative cases. For curative plans employing IMRT, eight centers (57%) peer-reviewed more than 50% of cases. Eleven centers reported that the
majority of the curative cases were guided by a local radiation-specific treatment policy. As illustrated in Figure 2, peer review in cases treated with palliative intent was performed less frequently.

Format of Peer Review Practices

Centers reported a number of different formats for conducting peer review. The most common format, used in nine centers (64%) routinely, was the use of peer review in multidisciplinary groups that did not have a site-specific focus. Six centers reported using peer review by site-specific multidisciplinary groups (e.g., head and neck cancer cases), and four centers reported the routine use of peer review by an individual (for example, a radiation oncologist reviewing the contouring on a colleague’s case).

When peer review was conducted in multidisciplinary groups, all centers reported that radiation oncologists were routinely present, with radiation therapists (n=10, 71%) and medical physicists (n=9, 64%) attending “always” or “almost always”. Residents, fellows, and other students attended in fewer centers (n=3), and allied health professionals and nurses were rare participants.

Most centers (12 of 14) performed peer review in breast, lung, and genitourinary (GU) sites, although each center reported at least one site that was not yet active in a peer-review program routinely.

Organization and timing of peer review activities

Most centers reported that the organization of the peer review processes was done by radiation therapists, either exclusively (46%) or in combination with other staff. The
process for case selection varied considerably between centers; radiation oncologists identified cases in four centers, medical physicists in three, and radiation therapists in six, whereas four centers used a routine mechanism by which cases were identified systematically.

With regard to the timing of peer-review, five centers reported “always” or “almost always” conducting peer review prior to the initiation of treatment, and two centers reported “always” or “almost always” conducting peer review after commencing treatment. The remaining seven centers reported a mixed timing of case review.

Case attributes subjected to peer review

The survey used a case example of a patient receiving radiotherapy for stage IIIB Non-Small Cell Lung Cancer with curative intent. In this context, centers were asked to identify which aspects of the radiation treatment plan were peer reviewed. The results are shown on Figure 3. As can be seen, the most common elements of peer review performed were choice of treatment volume, review of DVH's, and contouring of volumes. Many attributes such as pathology review and staging review, were undertaken as part of other quality assurance exercises (e.g., tumor board case conferences).

Outcomes of peer review activities and their recording

Eleven centers (79%) recorded the outcome of at least one aspect of the peer review process. Of these, 1 center recorded 15-20% of plans requiring some change as a result of peer-review processes, 5 centres (45%) recorded 5-9% of reviewed plans requiring change, 1 centre recorded 2-4% of reviewed plans requiring change, and 3
(27%) centres recorded < 2% of plans requiring change. Figure 4 illustrates centers’ responses regarding the how these outcomes of the peer review processes were documented. Eleven centers routinely made recommendations from the peer review to the attending oncologist, but fewer recorded these recommendations either off-line or as part of the medical record. Only one center recorded the response of the attending physician to these recommendations on the medical record. Six centers reported having some concerns about recording the outcomes of peer review activities as part of the legal medical record.

Expanding peer review activities: perceived barriers and facilitating factors

Thirteen centers (93%) reported plans to expand or enhance peer review activities. Nine reported a plan to increase the proportion of curative cases reviewed, whereas only two centers had plans to expand activities in cases managed with palliative intent. Eleven centers planned on improving their current processes for conducting peer review.

A number of potential barriers to expanding peer review were rated by each center on a scale from 0 (not limiting) to 10 (important limiting factor). The results are shown on Figure 5. Considerable variation was seen between centers; each item ranged widely in responses, with no single item being rated higher than 6/10 for more than half of the centers. Engaging radiation oncologists in attending peer review sessions more regularly was the highest rated item.
Discussion

Our results illustrate that across a comprehensive provincial radiation oncology program, all centers perform peer-review. These activities, which include oncologist-to-oncologist peer review as a minimum criterion, complement other departmental review activities (such as accreditation or tumor boards) by focusing explicitly on review of radiation oncology planning. Although some form of peer-review occurs at all radiotherapy centers in Ontario, the current patterns of peer-review activities, the intended expansions of peer review, and the perceived barriers and facilitators of peer review activities vary substantially. This variation implies some potential differences across centres in quality of the peer-review processes, and the impact of those processes on quality of technical care.

All centers strongly endorse peer review in principle. This endorsement was reflected in the universally high importance ratings of peer-review activities, and in the stated plans for expansion of peer-review activities in most centers. This endorsement is congruent with the recognized benefits of peer review as reviewed earlier.[3,16,17] Our survey results strongly reflect the perceived benefits of peer review for promoting process feedback and improvement, for reinforcing (or identifying needed change in) existing intervention-specific policies, and for detecting medical errors prior to treatment completion. These findings were common across centers.

In contrast, the observed variation in many survey response categories indicates the need for standards and/or guidelines for peer-review processes. Guidelines for case selection, for the case elements/attributes that are highest priority for peer review, and for
acceptable timing of peer-review activities would assist centers to improve consistency of practice, prioritization and optimization of their efforts. With regard to the timing of peer-review, volume segmentation and contouring decisions need to be reviewed prior to treatment dosimetric planning, if re-planning of cases (due to identification of required modification) is to be avoided. Peer-review of dosimetric judgments (e.g. dose-volume histogram results), however, can only be undertaken after treatment planning. Programs must therefore consider a two-stage peer-review process, or accept that some re-planning will be required if a single-stage peer-review is utilized following treatment planning decisions. Obviously, peer-review should be performed prior to treatment initiation since changes are less likely to be made once treatment commences. Recommendations from an upcoming ASTRO white paper should be helpful in the development of such standards. Such recommendations, however, will require accompanying strategies for implementation processes and reporting mechanisms in order to be most effective.

A second key area of observed variation between centers relates to documentation of peer-review processes, and action taken based on the results. Concerns have been expressed regarding the medical-legal implications of recommendations by peers for changes to prescribed treatment.[18] How large a barrier these potential medical-legal issues pose to optimal use of peer-review processes remains unknown in Ontario, and may vary significantly in other jurisdictions depending on their related jurisprudence. Nevertheless, the potential for improvement in the quality of care of individual patients, and more broadly, in the quality of treatment programs, suggests that clear and permanent documentation of the peer-review components of quality assurance is needed.[19] In Ontario, rather than allowing individual documentation practices to evolve with time as
more centers gain greater experience with peer-review activities, action will be undertaken at a provincial level to assist centers with policies for appropriate and adequate documentation.

Thirdly, there were other inter-center differences that provoke potential areas of further research. For example, what is the optimal target or benchmark for the proportion of cases to be peer reviewed; a target of 100% ensures the maximal detection of medical error but may not be feasible in some centres, and other objectives (such as reduced variation in care and evaluation of treatment policies) can be achieved by reviewing a sub-set of cases. For palliative cases specifically, given their often unique characteristics, what are the benefits of increasing peer-review activities in this patient group? Given the teaching opportunities inherent in peer review, do opportunities for research in medical education exist? What are the incremental costs for implementing peer-review activities? What effect does a local champion have in establishing and maintaining the importance of peer review within the department? What are the advantages of having multiple disciplines involved in the review?

Finally, our survey identified facilitators and barriers to peer-review; this provides an opportunity to act on research findings, reinforcing facilitators and addressing barriers. Knowledge translation activities will be initiated by the provincial program including: acknowledging and remediating the barriers described by survey respondents; clarifying the relationships between peer-review exercises (e.g., the decision to treat review by a multidisciplinary tumor board); establishing quality indicators and measures to monitor system performance; assessing progress in peer-review initiatives routinely at provincial meetings of clinic program heads; and exploring the use of technology to improve
consistency[20] and facilitate processes (e.g., use of explicit processes such as an Audit tool[16]).

**Conclusion**

Review of radiation treatment planning decisions by radiation oncologists within their clinical peer group is being undertaken in all radiation treatment centers within a large Canadian jurisdiction (Ontario). The strong support for peer-review and widespread plans to expand peer-review activities is encouraging, but standards for best practices are required. Plans are currently underway to develop guidelines and standards for peer-review activities and policies in Ontario, aligned with those of other professional organizations such as ASTRO. Many of the identified facilitators and barriers will be common to other jurisdictions or organizations providing radiation oncology services, and as such, can provide those agencies with a basis for implementing peer-review quality improvement activities (although additional unique barriers may exist in a particular clinic context). Research linking peer-review practices with improved patient outcomes is recommended.
Acknowledgements
We acknowledge Ms. Elizabeth Lockhart and Ms. Brenda Bass for their invaluable administrative assistance in conducting this project. We also acknowledge each of the radiation oncology program leads at Cancer Care Ontario Centers for providing information specific to their program and for feedback regarding the interpretation of the survey results: Drs. C. de Metz, M. Gospodarowicz, F. Iqbal, J. Kamra, M. Lock, R. Rachakonda, K. Schneider, S. Shehata, S. Gulavita, W. Wells, S. Wong, J. Wright.

Dr. Brundage is supported by a research chair award from Cancer Care Ontario.

Conflicts of Interest: None of the authors report a conflict of interest for this manuscript.

Article Summary:

1. Article Focus
Peer-review is promoted as a quality improvement exercise in radiation oncology. Current practice regarding peer-review is not known. This research was the first step in a strategic initiative to optimize peer-review activities within a centralized cancer system. The research consisted of a cross-sectional analysis of patterns of peer-review in 14 radiotherapy (RT) programs within a provincial cancer system. Existing barriers and potential facilitators to optimal use of peer-review in this context were identified.

2. Key Messages
• Peer-review was strongly endorsed in principle.
• Although some form of peer review currently exists within all surveyed cancer centres, practice variation suggests potential variation in quality.
• Standards and guidelines for peer review processes are needed and recommendations from an ASCO white paper should facilitate their development.
3. Strengths and Limitations

A strength of the study was that all cancer centres within a large centralized cancer control system responded to the survey, allowing the full scope of peer-review activities within the province of Ontario to be identified along with barriers to its use.

The findings may not be generalizable to cancer control agencies in other jurisdictions in which unique barriers to use of peer-review may exist.

Contributions of the Authors:
MB was the PI of the study and the lead writer. SF was co-lead of the overall project and the radiation therapist lead provincially. TM was a radiation oncologist co-investigator, and head of radiation oncology at a participating centre. EG was the provincial program administrator, and PW the provincial program leader. All authors participated in the planning of the study, the design of the questionnaire, the analysis and interpretation of the findings. All authors read and approved the final manuscript. MB as the PI takes responsibility for the accuracy of the report.
Figure Legends

Figure 1: Survey results regarding the importance of peer-review. The range (horizontal bar), inter-quartile range (box) and median score (vertical line) are illustrated.

Figure 2: Stacked bars represent the proportion of centers that report how comprehensive peer-review activities are in curative and palliative cases respectively.

Figure 3: Elements of a curative case (stage III non-small cell lung cancer) that are typically reviewed in each center. The length of each bar represents the number of centers typically reviewing each element of the plan.

Figure 4: Bars represent the number of centers that report how each outcome of peer-review processes is documented.

Figure 5: Survey results regarding barriers to expanding peer-review activities. The range (horizontal bar), inter-quartile range (box) and median score (vertical line) are illustrated.
Reference List


(7) Gossman M, Halvorsen P, Orton CG. Point/Counterpoint. Peer reviews of medical physics practices often yield little information because the AAPM has not


2010 February 1;76(2):361-8.


Survey results regarding the importance of peer-review. The range (horizontal bar), inter-quartile range (box) and median score (vertical line) are illustrated.

254x190mm (96 x 96 DPI)
Stacked bars represent the proportion of centers that report how comprehensive peer-review activities are in curative and palliative cases respectively.

254x190mm (96 x 96 DPI)
Elements of a curative case (Stage III non-small cell lung cancer) that are typically reviewed in each center. The length of each bar represents the number of centers typically reviewing each element of the plan.

254x190mm (96 x 96 DPI)
Figure 4

Patterns of Recording Peer-Review Outcomes

Bars representing the number of centers that report how each outcome of peer-review processes is documented.

254x190mm (96 x 96 DPI)
Figure 5

Peer Review Practice – Concerns/Barriers

Survey results regarding barriers to expanding peer-review activities. The range (horizontal bar), inter-quartile range (box) and median score (vertical line) are illustrated.

*Includes case volume and overall availability of participants

254x190mm (96 x 96 DPI)
A SURVEY OF RADIATION TREATMENT PLANNING PEER-REVIEW ACTIVITIES IN A PROVINCIAL RADIATION ONCOLOGY PROGRAM: CURRENT PRACTICE AND FUTURE DIRECTIONS

<table>
<thead>
<tr>
<th>Journal:</th>
<th>BMJ Open</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manuscript ID:</td>
<td>bmjopen-2013-003241.R1</td>
</tr>
<tr>
<td>Article Type:</td>
<td>Research</td>
</tr>
<tr>
<td>Date Submitted by the Author:</td>
<td>04-Jun-2013</td>
</tr>
<tr>
<td>Complete List of Authors:</td>
<td>Brundage, Michael; Queen's -CRI, Cancer Care &amp; Epidemiology; Cancer Care Ontario, Radiation Treatment Program Foxcroft, Sophie; Princess Margaret Hospital, Radiation Medicine Program; Cancer Care Ontario, Radiation Treatment Program McGowan, Thomas; Credit Valley Hospital, Department of Radiation Oncology; University of Toronto, Department of Radiation Oncology Guitierrez, Eric; Cancer Care Ontario, Radiation Treatment Program Sharpe, Michael; Princess Margaret Hospital, Radiation Medicine Program; Cancer Care Ontario, Radiation Treatment Program Warde, Padraig; Princess Margaret Hospital, Radiation Medicine Program</td>
</tr>
<tr>
<td>Primary Subject Heading:</td>
<td>Oncology</td>
</tr>
<tr>
<td>Secondary Subject Heading:</td>
<td>Evidence based practice</td>
</tr>
<tr>
<td>Keywords:</td>
<td>RADIOTHERAPY, Quality in health care &lt; HEALTH SERVICES ADMINISTRATION &amp; MANAGEMENT, Clinical audit &lt; HEALTH SERVICES ADMINISTRATION &amp; MANAGEMENT</td>
</tr>
</tbody>
</table>
A SURVEY OF RADIATION TREATMENT PLANNING PEER-REVIEW ACTIVITIES IN A PROVINCIAL RADIATION ONCOLOGY PROGRAM: CURRENT PRACTICE AND FUTURE DIRECTIONS

Michael Brundage, MD1,5, Sophie Foxcroft, MRTT,2,5 Tom McGowan, MD3,4 Eric Gutierrez, MRTT5, Michael Sharpe, PhD2,4,5 and Padraig Warde, MD2,4,5

1. Cancer Care and Epidemiology, Queen’s Cancer Research Institute, Kingston, ON, and Kingston General Hospital
2. Radiation Medicine Program, Princess Margaret Hospital, Toronto, ON
3. Department of Radiation Oncology, Credit Valley Hospital, Mississauga, ON
4. Department of Radiation Oncology, University of Toronto, Toronto, ON
5. Radiation Treatment Program, Cancer Care Ontario, Toronto, ON

Corresponding Author
Dr. Michael Brundage
Professor, Cancer Care and Epidemiology,
Queen’s Cancer Research Institute
10 Stuart Street, Level 2
Kingston, Ontario, Canada K7L 3N6
Tel 613 533-6895
Fax 613 533-6794

Funding
Dr. Brundage is supported by a research chair award from Cancer Care Ontario.

Key words: Radiation Oncology; peer-review; patterns of practice; quality improvement; knowledge translation

Word count excluding title page, abstract, references and figures: 3032

Conflicts of Interest Notification:
No conflicts of interest for any author.
ARTICLE SUMMARY

1. Article Focus

Peer-review is promoted as a quality improvement exercise in radiation oncology. Current practice regarding peer-review is not known. This research was the first step in a strategic initiative to optimize peer-review activities within a centralized cancer system. The research consisted of a cross-sectional analysis of patterns of peer-review in 14 radiotherapy (RT) programs within a provincial cancer system. Existing barriers and potential facilitators to optimal use of peer-review in this context were identified.

2. Key Messages

- Peer-review was strongly endorsed in principle.
- Although some form of peer review currently exists within all surveyed cancer centres, practice variation suggests potential variation in the quality of the peer-review processes.
- Standards and guidelines for peer review processes are needed.
  Recommendations from an ASTRO “white paper” will guide and potentially facilitate development of standards for peer-review.

3. Strengths and Limitations

A strength of the study was that all cancer centres within a large centralized cancer control system responded to the survey, allowing the full scope of peer-review activities within the province of Ontario to be identified along with barriers to its use.

The survey findings may not be generalizable to cancer control agencies in other jurisdictions in which unique barriers to use of peer-review may exist. The survey recorded self-reported perceptions of the peer-review process; future research should be directed at collecting the direct and indirect outcomes of peer-review.
Abstract

**Purpose:** To describe current patterns of practice of radiation oncology peer review within a provincial cancer system (Ontario, Canada), and to identify barriers and facilitators to its use.

**Method:** All Ontario cancer centers (n=14) were surveyed. Centre responses to the survey were prepared by their multidisciplinary Radiation Oncology teams. Response categories varied by survey item, but were typically scored using a 10-point Likert scale.

**Results:** Fourteen (100%) centers responded. All rated the importance of peer-review as at least 8/10 (10=extremely important). Detection of medical error and improvement of planning processes were the highest rated perceived benefits of peer-review (each median 9/10). Six centers (43%) reviewed at least 50% of curative cases; four of these centers (29%) conducted peer review in more than 80% of cases treated with curative intent. Fewer than 20% of cases treated with palliative intent were reviewed in most centers. Five centers (36%) reported usually conducting peer review prior to the initiation of treatment. Five centers (36%) recorded the outcomes of peer-review on the medical record. Thirteen centers (93%) planned to expand peer review activities; a critical mass of radiation oncologists was the most important limiting factor (median 6/10).

**Conclusions:** Radiation Oncology peer review practices can vary even within a cancer system with provincial oversight. The application of guidelines and standards for peer-review processes, and monitoring of implementation and outcomes, will require effective knowledge translation activities.
Introduction

High quality of care is important to any medical discipline, but is of particular concern in radiation oncology treatment programs given the potential for serious harm in the event of a treatment-related error.[1] As modern radiotherapy planning and delivery systems become increasingly sophisticated and complex, quality assurance procedures must also evolve in order to ensure that consistently effective and safe therapy is delivered.[1,2] Although much of the attention regarding the safety of radiotherapy has focused on the relationship between quality-assurance practices and critical high-profile dose delivery incidents, quality assurance programs are also necessary to minimize the potential for less severe ‘errors’, or inappropriate variations in processes or practice, that represent threats to the overall quality of radiotherapy care.[3] While radiation oncology has a long history of high quality technical assurance (e.g., processes designed to ensure technical quality, such as valid machine calibration, laser setup calibration, and accurate treatment planning systems), the more subjective decisions made by attending physicians are less routinely subject to quality assurance processing, and are the target of peer review.[2] Clearly, both high quality technical processes and high quality technical medical care are required to optimize patient outcomes.

Peer review has been defined in a variety of ways in the literature. An often cited broad definition of peer-review is "the evaluation of creative work or performance by other people in the same field to enhance the quality of work, or the performance", where the word “peer” refers to people in the same profession who are of the same or higher ranking.[4] This definition has been applied to peer review in many disciplines, and in many contexts, including radiation oncology.[5] Others have suggested the term “audit
and feedback”. These definitions are conceptually broad, and encompass peer review activities occurring on several levels. For example, tumor board conferences typically review medical decision making in a specific patient’s case, and ensure that the decision to employ radiotherapy (alone or with other modalities) is appropriate. At an organizational level, accreditation processes have been used to ensure adequate structures and processes are in place in a radiation oncology program to support a high level of care and safety.

In this report, we focus on a specific aspect of peer-review, namely, the review of individual radiation plans. In this context, a radiation oncologist (alone or as part of a multidisciplinary team) reviews the subjective decisions made by the prescribing oncologist when implementing technical aspects of care, including volume segmentation or contouring, choice of prescribed dose and fractionation, selection of regional anatomy covered, and dosimetry optimization. These activities are distinct from quality assurance practices in radiation oncology that involve other disciplines (e.g., plan review by medical physics[5,7] or by radiation therapist[5]).

There is evidence that oncologist-to-oncologist peer review is critical to the quality of radiation treatment plans. Studies of observer variation in contouring practices make clear that radiation oncologists can substantially differ in their contouring patterns when presented with an identical case. This variation has been demonstrated in the treatment settings of prostate cancer,[8,9] lung cancer,[10] and breast cancer,[11] and has prompted the development of contouring guidelines.[12,13] In the conduct of randomized clinical trials, "real-time review" of treatment plans has consistently detected planning protocol deviations, underscoring how inter-oncologist planning variation occurs in
practice despite the availability of a prescriptive clinical trial protocol. Importantly, this observed variation can have significant negative impact on treatment quality,[9,14] and on clinical outcomes if not mediated by the peer-review process.[15] Finally, direct evidence from audit and feedback processes has shown that peer review does detect errors that can be corrected prior to the initiation of treatment. In a large Ontario study of over 1,000 patients, errors were detected in approximately 7% of cases, and multivariate analyses showed that the error rate was independent of time of year, experience of the oncologist, or of a post-residency fellow being involved in the case.[3] In Australia, regular use of audit and feedback has revealed similar findings, with 6% of plans overall ‘failing’ the audit process.[2] Less well described is the extent to which the identified errors were acted on.

Ontario’s provincial cancer agency Cancer Care Ontario (CCO) has identified the need to improve and expand peer review activities across the Ontario cancer system as a strategic direction of the Provincial Radiation Treatment Program to improve the quality of care. As is the case in most Canadian provinces, radiation oncology services are highly centralized in Ontario, where fourteen centers serving a population of about 13 million. Cancer centers range in size from relatively small centers (700-1,000 new case referrals per year); to two large centers in a large metropolitan area (over 6,000 new case referrals per year). Most either participate in, or operate, post-graduate education programs in radiation oncology. In the interests of developing a program to optimize the use of peer-review in the province, we undertook this research to describe current patterns of peer review in Radiation Oncology practices across Ontario and to identify existing barriers and potential facilitators to its expanded and optimal use.
Methods

We undertook a survey of fourteen cancer centers using an electronic survey. Survey items were developed by consensus of expert opinion of the project leaders based on a literature review and current knowledge. The survey was pilot tested in one regional cancer center with an established peer review program. The survey, which was sent electronically to the attention of the Heads of Radiation Oncology (RO) programs in Ontario, began with a brief set of instructions, and information regarding the scope of peer review addressed in the survey. A delegate from each cancer center RO program filled out a single survey based on input from their multi-disciplinary team, which included radiation oncology, medical physics, and radiation therapy at that center. Each Head of RO took responsibility for the survey responses, and used delegates at their discretion based on local circumstances. Confidentiality of the responses was ensured. Some survey items asked questions with response options constructed as a Likert scale ranging from 0-10, with anchors defined as appropriate for each section of questions (for example, "not important", 0 and "extremely important", 10). Some questions utilized binary (e.g., yes/no) responses or categorical responses (e.g., “almost always”, “often”, “only sometimes”, “rarely or never”) defined as appropriate for the question stem. The survey was approved the Queen’s University research ethics board.

Following pilot testing and subsequent editing to address clarity and redundancy within the questionnaire, the survey was administered by email in April 2011, with responses closing six weeks later in May 2011. An introductory letter was included and telephone reminders were used as required.
The survey results were compiled using descriptive statistics, including medians, quartile distributions, and ranges where appropriate. Owing to the nature of the study, no inferential statistics were calculated given that no specific hypothesis testing was undertaken.

Results

All fourteen (100%) cancer centers responded. All centers performed peer review activities, although the extent, nature and use of the review varied.

Importance and Purpose of Peer Review

Regarding the importance of peer review, eight (57%) centers ranked the importance as 10/10 (extremely important), with the remaining centers rating the importance as either 8/10 (n=2 centers) or 9/10 (n=4 centers). No center rated the importance of peer review below eight points.

Figure 1 illustrates respondents’ opinions regarding the importance of each of eight potential reasons for undertaking peer review in radiation oncology. Detection of medical error, and improvement of the treatment planning processes or policies, were both rated highly in terms of their importance (median scores of nine on a scale ranging from 0, “not important” to 10, “most important”). Inter-quartile ranges for all of the reasons listed in Figure 1 were 5/10 or higher.

Current Utilization of Peer Review at Individual Centers
Figure 2 illustrates the percentage of plans that were typically peer reviewed across centers. Four centers (29%) reported routine peer review in more than 80% of cases treated with curative intent, and six centers (43%) reported using peer review processes in at least 50% of curative cases. For curative plans employing IMRT, eight centers (57%) peer-reviewed more than 50% of cases. Eleven centers reported that the majority of the curative cases were guided by a local radiation-specific treatment policy. As illustrated in Figure 2, peer review in cases treated with palliative intent was performed less frequently.

**Format of Peer Review Practices**

Centers reported a number of different formats for conducting peer review. The most common format, used in nine centers (64%) routinely, was the use of peer review in multidisciplinary groups that did not have a site-specific focus. Six centers reported using peer review by site-specific multidisciplinary groups (e.g., head and neck cancer cases), and four centers reported the routine use of peer review by an individual (for example, a radiation oncologist reviewing the contouring on a colleague’s case).

When peer review was conducted in multidisciplinary groups, all centers reported that radiation oncologists were routinely present, with radiation therapists (n=10, 71%) and medical physicists (n=9, 64%) attending “always” or “almost always”. Residents, fellows, and other students attended in fewer centers (n=3), and allied health professionals and nurses were rare participants.
Most centers (12 of 14) performed peer review in breast, lung, and genitourinary (GU) sites, although each center reported at least one common cancer site that was not yet active in a peer-review program routinely.

**Organization and timing of peer review activities**

Most centers reported that the organization of the peer review processes was done by radiation therapists, either exclusively (46%) or in combination with other staff. The process for case selection varied considerably between centers; radiation oncologists identified cases in four centers, medical physicists in three, and radiation therapists in six, whereas four centers used a routine mechanism by which cases were identified systematically.

With regard to the timing of peer-review, five centers reported “always” or “almost always” conducting peer review prior to the initiation of treatment, and two centers reported “always” or “almost always” conducting peer review after commencing treatment. The remaining seven centers reported a mixed timing of case review.

**Case attributes subjected to peer review**

The survey used a case example of a patient receiving radiotherapy for stage IIIB Non-Small Cell Lung Cancer with curative intent. In this context, centers were asked to identify which aspects of the radiation treatment plan were peer reviewed, and 11 centres with established review for lung cancer patients provided data. The results are shown on Figure 3. As can be seen, the most common elements of peer review performed were choice of treatment volume, review of DVH's, and contouring of volumes. Many
attributes such as pathology review and staging review, the decision to treat (and use of evidence-based guidelines) were undertaken as part of other quality assurance exercises (e.g., tumor board case conferences).

**Outcomes of peer review activities and their recording**

Eleven centers (79%) recorded the outcome of at least one aspect of the peer review process. Of these, 1 center recorded 15-20% of plans requiring some change as a result of peer-review processes, 5 centres (45%) recorded 5-9% of reviewed plans requiring change, 1 centre recorded 2-4% of reviewed plans requiring change, and 3 (27%) centres recorded < 2% of plans requiring change. **Figure 4** illustrates centers’ responses regarding the how these outcomes of the peer review processes were documented. Eleven centers routinely made recommendations from the peer review to the attending oncologist, but fewer recorded these recommendations either off-line or as part of the medical record. Only one center recorded the response of the attending physician to these recommendations on the medical record. Six centers reported having some concerns about recording the outcomes of peer review activities as part of the legal medical record.

**Expanding peer review activities: perceived barriers and facilitating factors**

Thirteen centers (93%) reported plans to expand or enhance peer review activities. Nine reported a plan to increase the proportion of curative cases reviewed, whereas only two centers had plans to expand activities in cases managed with palliative intent. Eleven centers planned on improving their current processes for conducting peer review.
A number of potential barriers to expanding peer review were rated by each center on a scale from 0 (not limiting) to 10 (important limiting factor). The results are shown on Figure 5. Considerable variation was seen between centers; each item ranged widely in responses, with no single item being rated higher than 6/10 for more than half of the centers. Engaging radiation oncologists in attending peer review sessions more regularly was the highest rated item.

Discussion

Our results illustrate that across a comprehensive provincial radiation oncology program, all centers perform peer-review. These activities, which include oncologist-to-oncologist peer review as a minimum criterion, complement other departmental review activities (such as accreditation or tumor boards) by focusing explicitly on review of radiation oncology planning. Although some form of peer-review occurs at all radiotherapy centers in Ontario, the current patterns of peer-review activities, the intended expansions of peer review, and the perceived barriers and facilitators of peer review activities vary substantially, and in no centre was peer-review performed on all cases. This variation implies some potential differences across centres in quality of the peer-review processes, and the impact of those processes on quality of technical care.

All centers strongly endorse peer review in principle. This endorsement was reflected in the universally high importance ratings of peer-review activities, and in the stated plans for expansion of peer-review activities in most centers. This endorsement is congruent with the recognized benefits of peer review as reviewed earlier.[3,16,17] Our survey results strongly reflect the perceived benefits of peer review for promoting process
feedback and improvement, for reinforcing (or identifying needed change in) existing intervention-specific policies, and for detecting medical errors prior to treatment completion. These findings were common across centers.

In contrast, the observed variation in many survey response categories indicates the need for standards and/or guidelines for peer-review processes. Guidelines for case selection, for the case elements/attributes that are highest priority for peer review, and for acceptable timing of peer-review activities would assist centers to improve consistency of practice, prioritization and optimization of their efforts. With regard to the timing of peer-review, volume segmentation and contouring decisions need to be reviewed prior to treatment dosimetric planning, if re-planning of cases (due to identification of required modification) is to be avoided. Peer-review of dosimetric judgments (e.g. dose-volume histogram results), however, can only be undertaken after treatment planning. Programs must therefore consider a two-stage peer-review process, or accept that some re-planning will be required if a single-stage peer-review is utilized following treatment planning decisions. Obviously, peer-review should be performed prior to treatment initiation since changes are less likely to be made once treatment commences. Recommendations from an ASTRO white paper[18] (one in a series of papers addressing quality assurance methods for radiotherapy treatment) should be helpful in the development of such standards. Such recommendations, however, will require accompanying strategies for implementation processes and reporting mechanisms in order to be most effective.

A second key area of observed variation between centers relates to documentation of peer-review processes, and action taken based on the results. We did not undertake in the survey to systematically collect outcomes of the peer-review process (which was
beyond the scope of many participating centres), but rather, collected survey information on patterns of current data recording. Concerns have been expressed regarding the medical-legal implications of recommendations by peers for changes to prescribed treatment.[19] How large a barrier these potential medical-legal issues pose to optimal use of peer-review processes remains unknown in Ontario, and may vary significantly in other jurisdictions depending on their related jurisprudence. Nevertheless, the potential for improvement in the quality of care of individual patients, and more broadly, in the quality of treatment programs, suggests that clear and permanent documentation of the peer-review components of quality assurance is needed.[20] In Ontario, rather than allowing individual documentation practices to evolve with time as more centers gain greater experience with peer-review activities, action will be undertaken at a provincial level to assist centers with policies for appropriate and adequate documentation.

Thirdly, there were other inter-center differences that provoke potential areas of further research. For example, what is the optimal target or benchmark for the proportion of cases to be peer reviewed; a target of 100% ensures the maximal detection of medical error but may not be feasible in some centres, and other objectives (such as reduced variation in care and evaluation of treatment policies) can be achieved by reviewing a sub-set of cases. For palliative cases specifically, given their often unique characteristics, what are the benefits of increasing peer-review activities in this patient group? Given the teaching opportunities inherent in peer review, do opportunities for research in medical education exist? What are the incremental costs for implementing peer-review activities? What effect does a local champion have in establishing and maintaining the importance
of peer review within the department? What are the advantages of having multiple disciplines involved in the review?

Finally, our survey identified facilitators and barriers to peer-review; this provides an opportunity to act on research findings, reinforcing facilitators and addressing barriers. Knowledge translation activities will be initiated by the provincial program including: acknowledging and remediating the barriers described by survey respondents; clarifying the relationships between peer-review exercises (e.g., the decision to treat review by a multidisciplinary tumor board); establishing quality indicators and measures to monitor system performance; assessing progress in peer-review initiatives routinely at provincial meetings of clinic program heads; and exploring the use of technology to improve consistency[21] and facilitate processes (e.g., use of explicit processes such as an Audit tool[16]). With regard to the barrier of costs to treatment programs, to date in Ontario, these costs have primarily been absorbed by existing operational budgets. Further research will determine the direct and indirect costs of peer-review activities; defining these costs might allow for incremental funding for these activities.

Conclusion

Review of radiation treatment planning decisions by radiation oncologists within their clinical peer group is being undertaken in all radiation treatment centers within a large Canadian jurisdiction (Ontario). The strong support for peer-review and widespread plans to expand peer-review activities is encouraging, but standards for best practices are required. Plans are currently underway to develop guidelines and standards for peer-review activities and policies in Ontario, aligned with those of other professional
organizations such as ASTRO. Many of the identified facilitators and barriers will be common to other jurisdictions or organizations providing radiation oncology services, and as such, can provide those agencies with a basis for implementing peer-review quality improvement activities (although additional unique barriers may exist in a particular clinic context). Research linking peer-review practices with improved patient outcomes is recommended.

Acknowledgements

We acknowledge Ms. Elizabeth Lockhart and Ms. Brenda Bass for their invaluable administrative assistance in conducting this project. We also acknowledge each of the radiation oncology program leads at Cancer Care Ontario Centers for providing information specific to their program and for feedback regarding the interpretation of the survey results: Drs. C. de Metz, M. Gospodarowicz, F. Iqbal, J. Kamra, M. Lock, R. Rachakonda, K. Schneider, S. Shehata, S. Gulavita. W. Wells, S. Wong, J. Wright

Dr. Brundage is supported by a research chair award from Cancer Care Ontario.

Conflicts of Interest: None of the authors report a conflict of interest for this manuscript.

Contributions of the Authors:

MB was the PI of the study and the lead writer. SF was co-lead of the overall project and the radiation therapist lead provincially. TM was a radiation oncologist co-investigator, and head of radiation oncology at a participating centre. EG was the provincial program administrator, and PW the provincial program leader. All authors participated in the planning of the study, the design of the questionnaire, the analysis and interpretation of the findings. All authors read and approved the final manuscript. MB as the PI takes responsibility for the accuracy of the report.

Funding:

None
Data sharing:

There are no additional data available.

Figure Legends

Figure 1: Survey results regarding the importance of peer-review. The range (horizontal bar), inter-quartile range (box) and median score (vertical line) are illustrated.

Figure 2: Stacked bars represent the proportion of centers that report how comprehensive peer-review activities are in curative and palliative cases respectively.

Figure 3: Elements of a curative case (stage III non-small cell lung cancer) that are typically reviewed in each center. The length of each bar represents the number of centers typically reviewing each element of the plan. Abbreviations: GTV, gross tumour volume; CTV, clinical target volume; PTV, planning target volume; DVH, dose-volume histogram; DRR, digitally reconstructed radiograph; CBCT, cone-beam computed tomography.

Figure 4: Bars represent the number of centers that report how each outcome of peer-review processes is documented.

Figure 5: Survey results regarding barriers to expanding peer-review activities. The range (horizontal bar), inter-quartile range (box) and median score (vertical line) are...
illustrated. Abbreviations: RO, radiation oncologist; PC, personal computing infrastructure; MRTT, medical radiation technologist (therapy).
Reference List


(7) Gossman M, Halvorsen P, Orton CG. Point/Counterpoint. Peer reviews of medical physics practices often yield little information because the AAPM has not


A SURVEY OF PEER-REVIEW OF RADIATION TREATMENT PLANNING PEER-REVIEW ACTIVITIES IN A PROVINCIAL RADIATION ONCOLOGY PROGRAM: CURRENT PRACTICE AND FUTURE DIRECTIONS

Michael Brundage, MD1,5 Sophie. Foxcroft, MRTT, 2,5 Tom McGowan, MD3,4 Michael Sharpe, PhD, 2,4,5 Eric Gutierrez, MRTT 5 and Padraig Warde, MD2,4,5

1. Cancer Care and Epidemiology, Queen’s Cancer Research Institute, Kingston, ON, and Kingston General Hospital
2. Radiation Medicine Program, Princess Margaret Hospital, Toronto, ON
3. Department of Radiation Oncology, Credit Valley Hospital, Mississauga, ON
4. Department of Radiation Oncology, University of Toronto, Toronto, ON
5. Radiation Treatment Program, Cancer Care Ontario, Toronto, ON

Corresponding Author
Dr. Michael Brundage
Professor, Cancer Care and Epidemiology,
Queen’s Cancer Research Institute
10 Stuart Street, Level 2
Kingston, Ontario, Canada K7L 3N6
Tel 613 533-6895
Fax 613 533-6794

Funding
Dr. Brundage is supported by a research chair award from Cancer Care Ontario.

Key words: Radiation Oncology; peer-review; patterns of practice; quality improvement; knowledge translation

Word count excluding title page, abstract, references and figures: 3032

Conflicts of Interest Notification:
No conflicts of interest for any author.
Abstract

Purpose: To describe current patterns of practice of radiation oncology peer review within a provincial cancer system (Ontario, Canada), and to identify barriers and facilitators to its use.

Method: All Ontario cancer centers (n=14) were surveyed. Centre responses to the survey were prepared by their multidisciplinary Radiation Oncology teams. Response categories varied by survey item, but were typically scored using a 10-point Likert scale.

Results: Fourteen (100%) centers responded. All rated the importance of peer-review as at least 8/10 (10=extremely important). Detection of medical error and improvement of planning processes were the highest rated perceived benefits of peer-review (each median 9/10). Six centers (43%) reviewed at least 50% of curative cases; four of these centers (29%) conducted peer review in more than 80% of cases treated with curative intent. Fewer than 20% of cases treated with palliative intent were reviewed in most centers. Five centers (36%) reported usually conducting peer review prior to the initiation of treatment. Five centers (36%) recorded the outcomes of peer-review on the medical record. Thirteen centers (93%) planned to expand peer review activities; a critical mass of radiation oncologists was the most important limiting factor (median 6/10).

Conclusions: Radiation Oncology peer review practices can vary even within a cancer system with provincial oversight. The application of guidelines and standards for peer-review processes, and monitoring of implementation and outcomes, will require effective knowledge translation activities.
Introduction

High quality of care is important to any medical discipline, but is of particular concern in radiation oncology treatment programs given the potential for serious harm in the event of a treatment-related error.[1] As modern radiotherapy planning and delivery systems become increasingly sophisticated and complex, quality assurance procedures must also evolve in order to ensure that consistently effective and safe therapy is delivered.[1,2] Although much of the attention regarding the safety of radiotherapy has focused on the relationship between quality-assurance practices and critical high-profile dose delivery incidents, quality assurance programs are also necessary to minimize the potential for less severe ‘errors’, or inappropriate variations in processes or practice, that represent threats to the overall quality of radiotherapy care.[3] While radiation oncology has a long history of high quality technical assurance (e.g., processes designed to ensure technical quality, such as valid machine calibration, laser setup calibration, and accurate treatment planning systems), the more subjective decisions made by attending physicians are less routinely subject to quality assurance processing, and are the target of peer review.[2] Clearly, both high quality technical processes and high quality technical medical care are required to optimize patient outcomes.

Peer review has been defined in a variety of ways in the literature. An often cited broad definition of peer-review is "the evaluation of creative work or performance by other people in the same field to enhance the quality of work, or the performance", where the word “peer” refers to people in the same profession who are of the same or higher ranking.[4] This definition has been applied to peer review in many disciplines, and in many contexts, including radiation oncology.[5] Others have suggested the term “audit
and feedback”. These definitions are conceptually broad, and encompass peer review activities occurring on several levels. For example, tumor board conferences typically review medical decision making in a specific patient’s case, and ensure that the decision to employ radiotherapy (alone or with other modalities) is appropriate. At an organizational level, accreditation processes have been used to ensure adequate structures and processes are in place in a radiation oncology program to support a high level of care and safety.

In this report, we focus on a specific aspect of peer-review, namely, the review of individual radiation plans. In this context, a radiation oncologist (alone or as part of a multidisciplinary team) reviews the subjective decisions made by the prescribing oncologist when implementing technical aspects of care, including volume segmentation or contouring, choice of prescribed dose and fractionation, selection of regional anatomy covered, and dosimetry optimization. These activities are distinct from quality assurance practices in radiation oncology that involve other disciplines (e.g., plan review by medical physics[5,7] or by radiation therapist[5]).

There is evidence that oncologist-to-oncologist peer review is critical to the quality of radiation treatment plans. Studies of observer variation in contouring practices make clear that radiation oncologists can substantially differ in their contouring patterns when presented with an identical case. This variation has been demonstrated in the treatment settings of prostate cancer,[8,9] lung cancer,[10] and breast cancer,[11] and has prompted the development of contouring guidelines.[12,13] In the conduct of randomized clinical trials, "real-time review" of treatment plans has consistently detected planning protocol deviations, underscoring how inter-oncologist planning variation occurs in
practice despite the availability of a prescriptive clinical trial protocol. Importantly, this observed variation can have significant negative impact on treatment quality,[9,14] and on clinical outcomes if not mediated by the peer-review process.[15] Finally, direct evidence from audit and feedback processes has shown that peer review does detect errors that can be corrected prior to the initiation of treatment. In a large Ontario study of over 1,000 patients, errors were detected in approximately 7% of cases, and multivariate analyses showed that the error rate was independent of time of year, experience of the oncologist, or of a post-residency fellow being involved in the case.[3] In Australia, regular use of audit and feedback has revealed similar findings, with 6% of plans overall ‘failing’ the audit process.[2] Less well described is the extent to which the identified errors were acted on.

Ontario’s provincial cancer agency Cancer Care Ontario (CCO) has identified the need to improve and expand peer review activities across the Ontario cancer system as a strategic direction of the Provincial Radiation Treatment Program to improve the quality of care. As is the case in most Canadian provinces, radiation oncology services are highly centralized in Ontario, where fourteen centers serving a population of about 13 million. Cancer centers range in size from relatively small centers (700-1,000 new case referrals per year); to two large centers in a large metropolitan area (over 6,000 new case referrals per year). Most either participate in, or operate, post-graduate education programs in radiation oncology. In the interests of developing a program to optimize the use of peer-review in the province, we undertook this research to describe current patterns of peer review in Radiation Oncology practices across Ontario and to identify existing barriers and potential facilitators to its expanded and optimal use.
Methods

We undertook a survey of fourteen cancer centers using an electronic survey.

Survey items were developed by consensus of expert opinion of the project leaders based on a literature review and current knowledge. The survey was the authors and pilot tested in one regional cancer center with an established peer review program. The survey, which was sent electronically to the attention of the Heads of Radiation Oncology (RO) programs in Ontario, began with a brief set of instructions, and information regarding the scope of peer review addressed in the survey. A representative delegate from each cancer center RO program filled out a single survey based on input from their multi-disciplinary team, which included radiation oncology, medical physics, and radiation therapy at that center. Each Head of RO took responsibility for the survey responses, and used delegates at their discretion based on local circumstances. Confidentiality of the responses was ensured. Some survey items asked questions with response options constructed as a Likert scale ranging from 0-10, with anchors defined as appropriate for each section of questions (for example, "not important", 0 and "extremely important", 10). Some questions utilized binary (e.g., yes/no) responses or categorical responses (e.g., “almost always”, “often”, “only sometimes”, “rarely or never”) defined as appropriate for the question stem. The survey was approved the Queen’s University research ethics board.

Following pilot testing and subsequent editing to address clarity and redundancy within the questionnaire, the survey was administered by email in April 2011, with responses closing six weeks later in May 2011. An introductory letter was included and telephone reminders were used as required.
The survey results were compiled using descriptive statistics, including medians, quartile distributions, and ranges where appropriate. Owing to the nature of the study, no inferential statistics were calculated given that no specific hypothesis testing was undertaken.

**Results**

All fourteen (100%) cancer centers responded. All centers performed peer review activities, although the extent, nature and use of the review varied.

**Importance and Purpose of Peer Review**

Regarding the importance of peer review, eight (57%) centers ranked the importance as 10/10 (extremely important), with the remaining centers rating the importance as either 8/10 (n=2 centers) or 9/10 (n=4 centers). No center rated the importance of peer review below eight points.

**Figure 1** illustrates respondents’ opinions regarding the importance of each of eight potential reasons for undertaking peer review in radiation oncology. Detection of medical error, and improvement of the treatment planning processes or policies, were both rated highly in terms of their importance (median scores of nine on a scale ranging from 0, “not important” to 10, “most important”). Inter-quartile ranges for all of the reasons listed in Figure 1 were 5/10 or higher.

**Current Utilization of Peer Review at Individual Centers**
Figure 2 illustrates the percentage of plans that were typically peer reviewed across centers. Four centers (29%) reported routine peer review in more than 80% of cases treated with curative intent, and six centers (43%) reported using peer review processes in at least 50% of curative cases. For curative plans employing IMRT, eight centers (57%) peer-reviewed more than 50% of cases. Eleven centers reported that the majority of the curative cases were guided by a local radiation-specific treatment policy. As illustrated in Figure 2, peer review in cases treated with palliative intent was performed less frequently.

Format of Peer Review Practices

Centers reported a number of different formats for conducting peer review. The most common format, used in nine centers (64%) routinely, was the use of peer review in multidisciplinary groups that did not have a site-specific focus. Six centers reported using peer review by site-specific multidisciplinary groups (e.g., head and neck cancer cases), and four centers reported the routine use of peer review by an individual (for example, a radiation oncologist reviewing the contouring on a colleague’s case).

When peer review was conducted in multidisciplinary groups, all centers reported that radiation oncologists were routinely present, with radiation therapists (n=10, 71%) and medical physicists (n=9, 64%) attending “always” or “almost always”. Residents, fellows, and other students attended in fewer centers (n=3), and allied health professionals and nurses were rare participants.
Most centers (12 of 14) performed peer review in breast, lung, and genitourinary (GU) sites, although each center reported at least one common cancer site that was not yet active in a peer-review program routinely.

**Organization and timing of peer review activities**

Most centers reported that the organization of the peer review processes was done by radiation therapists, either exclusively (46%) or in combination with other staff. The process for case selection varied considerably between centers; radiation oncologists identified cases in four centers, medical physicists in three, and radiation therapists in six, whereas four centers used a routine mechanism by which cases were identified systematically.

With regard to the timing of peer-review, five centers reported “always” or “almost always” conducting peer review prior to the initiation of treatment, and two centers reported “always” or “almost always” conducting peer review after commencing treatment. The remaining seven centers reported a mixed timing of case review.

**Case attributes subjected to peer review**

The survey used a case example of a patient receiving radiotherapy for stage IIIB Non-Small Cell Lung Cancer with curative intent. In this context, centers were asked to identify which aspects of the radiation treatment plan were peer reviewed. And 11 centers with established review for lung cancer patients provided data. The results are shown on Figure 3. As can be seen, the most common elements of peer review performed were choice of treatment volume, review of DVH's, and contouring of volumes. Many
attributes such as pathology review and staging review, the decision to treat (and use of evidence-based guidelines) were undertaken as part of other quality assurance exercises (e.g., tumor board case conferences).

**Outcomes of peer review activities and their recording**

Eleven centers (79%) recorded the outcome of at least one aspect of the peer review process. Of these, 1 center recorded 15-20% of plans requiring some change as a result of peer-review processes, 5 centres (45%) recorded 5-9% of reviewed plans requiring change, 1 centre recorded 2-4% of reviewed plans requiring change, and 3 (27%) centres recorded < 2% of plans requiring change. Figure 4 illustrates centers’ responses regarding the how these outcomes of the peer review processes were documented. Eleven centers routinely made recommendations from the peer review to the attending oncologist, but fewer recorded these recommendations either off-line or as part of the medical record. Only one center recorded the response of the attending physician to these recommendations on the medical record. Six centers reported having some concerns about recording the outcomes of peer review activities as part of the legal medical record.

**Expanding peer review activities: perceived barriers and facilitating factors**

Thirteen centers (93%) reported plans to expand or enhance peer review activities. Nine reported a plan to increase the proportion of curative cases reviewed, whereas only two centers had plans to expand activities in cases managed with palliative intent. Eleven centers planned on improving their current processes for conducting peer review.
A number of potential barriers to expanding peer review were rated by each center on a scale from 0 (not limiting) to 10 (important limiting factor). The results are shown on Figure 5. Considerable variation was seen between centers; each item ranged widely in responses, with no single item being rated higher than 6/10 for more than half of the centers. Engaging radiation oncologists in attending peer review sessions more regularly was the highest rated item.
Discussion

Our results illustrate that across a comprehensive provincial radiation oncology program, all centers perform peer-review. These activities, which include oncologist-to-oncologist peer review as a minimum criterion, complement other departmental review activities (such as accreditation or tumor boards) by focusing explicitly on review of radiation oncology planning. Although some form of peer-review occurs at all radiotherapy centers in Ontario, the current patterns of peer-review activities, the intended expansions of peer review, and the perceived barriers and facilitators of peer review activities vary substantially, and in no centre was peer-review performed on all cases. This variation implies some potential differences across centres in quality of the peer-review processes, and the impact of those processes on quality of technical care.

All centers strongly endorse peer review in principle. This endorsement was reflected in the universally high importance ratings of peer-review activities, and in the stated plans for expansion of peer-review activities in most centers. This endorsement is congruent with the recognized benefits of peer review as reviewed earlier.[3,16,17] Our survey results strongly reflect the perceived benefits of peer review for promoting process feedback and improvement, for reinforcing (or identifying needed change in) existing intervention-specific policies, and for detecting medical errors prior to treatment completion. These findings were common across centers.

In contrast, the observed variation in many survey response categories indicates the need for standards and/or guidelines for peer-review processes. Guidelines for case selection, for the case elements/attributes that are highest priority for peer review, and for
acceptable timing of peer-review activities would assist centers to improve consistency of practice, prioritization and optimization of their efforts. With regard to the timing of peer-review, volume segmentation and contouring decisions need to be reviewed prior to treatment dosimetric planning, if re-planning of cases (due to identification of required modification) is to be avoided. Peer-review of dosimetric judgments (e.g. dose-volume histogram results), however, can only be undertaken after treatment planning. Programs must therefore consider a two-stage peer-review process, or accept that some re-planning will be required if a single-stage peer-review is utilized following treatment planning decisions. Obviously, peer-review should be performed prior to treatment initiation since changes are less likely to be made once treatment commences. Recommendations from an upcoming ASTRO white paper[18] (one in a series of papers addressing quality assurance methods for radiotherapy treatment) should be helpful in the development of such standards. Such recommendations, however, will require accompanying strategies for implementation processes and reporting mechanisms in order to be most effective.

A second key area of observed variation between centers relates to documentation of peer-review processes, and action taken based on the results. We did not undertake in the survey to systematically collect outcomes of the peer-review process (which was beyond the scope of many participating centres), but rather, collected survey information on patterns of current data recording. Concerns have been expressed regarding the medical-legal implications of recommendations by peers for changes to prescribed treatment.[19] How large a barrier these potential medical-legal issues pose to optimal use of peer-review processes remains unknown in Ontario, and may vary significantly in other jurisdictions depending on their related jurisprudence. Nevertheless, the potential
for improvement in the quality of care of individual patients, and more broadly, in the quality of treatment programs, suggests that clear and permanent documentation of the peer-review components of quality assurance is needed.[20] In Ontario, rather than allowing individual documentation practices to evolve with time as more centers gain greater experience with peer-review activities, action will be undertaken at a provincial level to assist centers with policies for appropriate and adequate documentation.

Thirdly, there were other inter-center differences that provoke potential areas of further research. For example, what is the optimal target or benchmark for the proportion of cases to be peer reviewed; a target of 100% ensures the maximal detection of medical error but may not be feasible in some centres, and other objectives (such as reduced variation in care and evaluation of treatment policies) can be achieved by reviewing a sub-set of cases. For palliative cases specifically, given their often unique characteristics, what are the benefits of increasing peer-review activities in this patient group? Given the teaching opportunities inherent in peer review, do opportunities for research in medical education exist? What are the incremental costs for implementing peer-review activities? What effect does a local champion have in establishing and maintaining the importance of peer review within the department? What are the advantages of having multiple disciplines involved in the review?

Finally, our survey identified facilitators and barriers to peer-review; this provides an opportunity to act on research findings, reinforcing facilitators and addressing barriers. Knowledge translation activities will be initiated by the provincial program including: acknowledging and remediating the barriers described by survey respondents; clarifying the relationships between peer-review exercises (e.g., the decision to treat review by a
multidisciplinary tumor board); establishing quality indicators and measures to monitor system performance; assessing progress in peer-review initiatives routinely at provincial meetings of clinic program heads; and exploring the use of technology to improve consistency[21] and facilitate processes (e.g., use of explicit processes such as an Audit tool[16]).

With regard to the barrier of costs to treatment programs, the incremental costs for professional time taken by peer-review activities are not reimbursed directly by funding, but are considered under indirect patient care activities. With regard to the barrier of costs to treatment programs, to date in Ontario, these costs have primarily been absorbed by existing operational budgets. Further research will determine the direct and indirect costs of peer-review activities; defining these costs might allow for incremental funding for these activities.

Conclusion

Review of radiation treatment planning decisions by radiation oncologists within their clinical peer group is being undertaken in all radiation treatment centers within a large Canadian jurisdiction (Ontario). The strong support for peer-review and widespread plans to expand peer-review activities is encouraging, but standards for best practices are required. Plans are currently underway to develop guidelines and standards for peer-review activities and policies in Ontario, aligned with those of other professional organizations such as ASTRO. Many of the identified facilitators and barriers will be common to other jurisdictions or organizations providing radiation oncology services, and as such, can provide those agencies with a basis for implementing peer-review quality improvement activities (although additional unique barriers may exist in a
particular clinic context). Research linking peer-review practices with improved patient outcomes is recommended.

Acknowledgements

We acknowledge Ms. Elizabeth Lockhart and Ms. Brenda Bass for their invaluable administrative assistance in conducting this project. We also acknowledge each of the radiation oncology program leads at Cancer Care Ontario Centers for providing information specific to their program and for feedback regarding the interpretation of the survey results: Drs. C. de Metz, M. Gospodarowicz, F. Iqbal, J. Kamra, M. Lock, R. Rachakonda, K. Schneider, S. Shehata, S. Gulavita. W. Wells, S. Wong, J. Wright.

Dr. Brundage is supported by a research chair award from Cancer Care Ontario.

Conflicts of Interest: None of the authors report a conflict of interest for this manuscript.

Article Summary:

1. Article Focus

Peer-review is promoted as a quality improvement exercise in radiation oncology. Current practice regarding peer-review is not known. This research was the first step in a strategic initiative to optimize peer-review activities within a centralized cancer system. The research consisted of a cross-sectional analysis of patterns of peer-review in 14
radiotherapy (RT) programs within a provincial cancer system. Existing barriers and potential facilitators to optimal use of peer-review in this context were identified.

2. Key Messages

- Peer-review was strongly endorsed in principle.
- Although some form of peer review currently exists within all surveyed cancer centres, practice variation suggests potential variation in the quality of the peer-review processes.
- Standards and guidelines for peer review processes are needed.

Recommendations from an ASTRO “white paper” will guide and potentially facilitate development of standards for peer-review.

3. Strengths and Limitations

A strength of the study was that all cancer centres within a large centralized cancer control system responded to the survey, allowing the full scope of peer-review activities within the province of Ontario to be identified along with barriers to its use.

The survey findings may not be generalizable to cancer control agencies in other jurisdictions in which unique barriers to use of peer-review may exist. The survey recorded self-reported perceptions of the peer-review process; future research should be directed at collecting the direct and indirect outcomes of peer-review.

Contributions of the Authors:

MB was the PI of the study and the lead writer. SF was co-lead of the overall project and the radiation therapist lead provincially. TM was a radiation oncologist co-investigator, and head of radiation oncology at a participating centre. EG was the provincial program administrator, and PW the provincial program leader. All authors participated in the planning of the study, the design of the questionnaire, the analysis and interpretation of the findings. All authors read and approved the final manuscript. MB as the PI takes responsibility for the accuracy of the report.
Figure Legends

Figure 1: Survey results regarding the importance of peer-review. The range (horizontal bar), inter-quartile range (box) and median score (vertical line) are illustrated.

Figure 2: Stacked bars represent the proportion of centers that report how comprehensive peer-review activities are in curative and palliative cases respectively.

Figure 3: Elements of a curative case (stage III non-small cell lung cancer) that are typically reviewed in each center. The length of each bar represents the number of
centers typically reviewing each element of the plan. **Abbreviations:** GTV, gross tumour volume; CTV, clinical target volume; PTV, planning target volume; DVH, dose-volume histogram; DRR, digitally reconstructed radiograph; CBCT, cone-beam computed tomography.

Figure 4: Bars represent the number of centers that report how each outcome of peer-review processes is documented.

Figure 5: Survey results regarding barriers to expanding peer-review activities. The range (horizontal bar), inter-quartile range (box) and median score (vertical line) are illustrated. **Abbreviations:** RO, radiation oncologist; PC, personal computing infrastructure; MRTT, medical radiation technologist (therapy).
Reference List


(7) Gossman M, Halvorsen P, Orton CG. Point/Counterpoint. Peer reviews of medical physics practices often yield little information because the AAPM has not


Survey results regarding the importance of peer-review. The range (horizontal bar), inter-quartile range (box) and median score (vertical line) are illustrated.
Stacked bars represent the proportion of centers that report how comprehensive peer-review activities are in curative and palliative cases respectively.

119x90mm (300 x 300 DPI)
Figure 3

Elements of a curative case (Stage III non-small cell lung cancer) that are typically reviewed in each center. The length of each bar represents the number of centers typically reviewing each element of the plan.

119x90mm (300 x 300 DPI)
Figure 4

Patterns of Recording Peer-Review Outcomes

Bars representing the number of centers that report how each outcome of peer-review processes is documented.

119x90mm (300 x 300 DPI)
Survey results regarding barriers to expanding peer-review activities. The range (horizontal bar), interquartile range (box) and median score (vertical line) are illustrated.

119x90mm (300 x 300 DPI)
A survey of radiation treatment planning peer-review activities in a provincial radiation oncology programme: current practice and future directions
Michael Brundage, Sophie Foxcroft, Tom McGowan, Eric Gutierrez, Michael Sharpe and Padraig Warde

BMJ Open 2013 3:
doi: 10.1136/bmjopen-2013-003241

Updated information and services can be found at:
http://bmjopen.bmj.com/content/3/7/e003241

These include:

References
This article cites 18 articles, 1 of which you can access for free at:
http://bmjopen.bmj.com/content/3/7/e003241#BIBL

Open Access
This is an Open Access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 3.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/3.0/

Email alerting service
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Topic Collections
Articles on similar topics can be found in the following collections
Evidence based practice (740)
Oncology (437)

Notes

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/