THE QUALITY OF MCC DECISION-MAKING IN ONTARIO

THE DESIGN, IMPLEMENTATION AND EVALUATION OF THE KT-MCC STRATEGY: A KNOWLEDGE TRANSLATION STRATEGY AIMED AT IMPROVING THE QUALITY OF DECISION MAKING FOR ONTARIO MULTIDISCIPLINARY CANCER CONFERENCES

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A Thesis Submitted to the School of Graduate Studies in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy

McMaster University DOCTOR OF PHILOSOPHY (2017) Hamilton, Ontario (Health Research Methodology)

TITLE: The Design, Implementation and Evaluation of the KT-MCC Strategy: A Knowledge Translation Strategy Aimed at Improving the Quality of Decision Making for Ontario Multidisciplinary Cancer Conferences AUTHOR: Christine Fahim, MSc, BHSc. (McMaster University) SUPERVISOR: Dr. Marko Simunovic NUMBER OF PAGES: x, 176.

Lay Abstract:

Multidisciplinary cancer conferences (MCCs) are regular meetings held by health professionals to prospectively discuss diagnoses and treatment plans for patients with cancer. The purpose of MCCs is to facilitate input from numerous experts to ensure that each patient receives an optimal treatment recommendation. To date, the quality of MCCs, specifically MCC decision making, in Ontario has not been formally evaluated. We aimed to identify gaps in Ontario MCC decision making and design an intervention to mitigate these gaps. The intervention was designed using an integrated knowledge translation approach, meaning MCC participants were involved in the design, implementation and evaluation of the intervention. The resulting intervention, called the KT-MCC Strategy, was evaluated at four Ontario MCC sites. This thesis provides a significant contribution to the knowledge translation literature and provides recommendations to improve the quality of MCCs in Ontario.

Abstract

Multidisciplinary cancer conferences (MCCs) are prospective meetings to discuss diagnoses and treatment plans for patients with cancer. MCCs are typically attended by surgeons, medical and radiation oncologists, pathologists and radiologists. To date, the quality of MCCs, specifically MCC decision making, has not been formally evaluated in a Canadian context.

We utilized progressive knowledge translation methodology, specifically the use of theory, models and an integrated knowledge translation approach, to design, implement and evaluate an intervention, titled the KT-MCC Strategy (KT-MCC). The purpose of the KT-MCC is to improve the quality of MCC decision making. This thesis is comprised of four parts. In Part 1, we completed a generalizability study to evaluate the reliability of an MCC assessment tool (MTB-MODe) in an Ontario context. In Part 2, we conducted key informant interviews using the Theoretical Domains Framework (TDF) to identify barriers and facilitators to optimal MCC decision making. In Part 3, we mapped identified TDF barriers and facilitators to the COM-B Behavioural Change Wheel to develop the KT-MCC, an intervention aimed at improving the quality of MCC decision making. In this study, we examined the validity of the key informant findings using focus groups and surveys completed by individual MCC participants. In Part 4, we conducted a before-and-after pilot study to evaluate the feasibility and impact of the KT-MCC on MCC decision making in preparation for a possible randomized controlled trial testing the efficacy of the KT-MCC.

There are few examples in the KT literature that provide a complete and detailed description of the design, implementation and evaluation of a complex KT strategy using progressive KT methods such as TDF interviews to identify barriers and facilitators to practice change; the COM-B model to identify potential interventions; and use of integrated KT with front-line workers. We describe in detail our methods to design, implement and evaluate the KT-MCC. This thesis provides a significant contribution to the knowledge translation literature and provides recommendations to improve the quality of MCCs in Ontario.

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List of Abbreviations

CCO	Cancer Care Ontario
COM-B	Capabilities, Opportunities, Motivators- Behaviour Change Wheel
G-theory	Generalizability theory
iKT	Integrated knowledge translation
KT	Knowledge translation
LHIN	Local Health Integrated Network
MCC	Multidisciplinary Cancer Conferences
MRP	Most responsible physician
TDF	Theoretical Domains Framework

Declaration of Academic Achievement

Christine Fahim was responsible for all aspects of this thesis, including data collection, analysis, and thesis preparation. All submitted work is original.

Jenna Rathbone assisted in data collection for Chapter 2.
Anita Acai assisted in data analysis for Chapter 3.

The thesis committee advised on all aspects of this thesis

INTRODUCTION AND THESIS OVERVIEW

Multidisciplinary cancer conferences (MCCs), also referred to as multidisciplinary tumor boards, are regular meetings that prospectively discuss diagnoses and determine treatment plans for patients with cancer. MCCs typically include representatives from surgery, medical and radiation oncology, pathology, radiology, and may include nursing and other allied health professionals. In 1995, the Calman-Hine report recommended a series of reforms to reduce inequality and improve outcomes for cancer care in the United Kingdom.[1] One of the key recommendations of the report was the promotion of multidisciplinary collaboration to improve the quality of cancer care. Since then, MCCs have been mandated in the United Kingdom and Australia and are prevalent in the United States and other European countries. In Ontario, Canada, Cancer Care Ontario (CCO), the agency responsible for promoting quality care for patients with cancer in the province, has mandated the implementation of MCCs at Ontario hospitals.[2]

MCCs are believed to strengthen collaboration and communication among participating physicians, increase adherence to clinical guidelines, decrease wait times to treatment plan implementation, and improve multidisciplinary collaboration between physicians.[3-5] Other benefits include increased patient satisfaction with clinical care, increased enrollment in clinical trials, continuous learning for physicians, and in some cases, improved patient outcomes.[5,6] Data show that physicians who participate in MCCs report high rates of satisfaction and perceive MCCs to be a critical component of cancer care. For example, a recent survey of over 5,000 members of the American Society of Clinical Oncology showed that 95% of members perceived MCCs to be of benefit and viewed MCCs as an essential component of cancer care.[6]

There are two main challenges associated with MCC functioning: lack of quality assessment of MCCs, and inadequate access to MCCs. First, MCC decision making quality is subject to substantial variability, caused by the varied preferences and biases of individual physicians in attendance, lack of preparation of case information, command of the MCC discussion by few individuals, and the social dynamics of the MCC team. Such tensions are believed to influence the quality of MCC decision making by leading to groupthink biases or a sense of false consensus regarding a proposed treatment; however, the impact of such tensions on the quality of MCC processes or decision making is not commonly evaluated. In Ontario, for example, the quality of MCCs has never been formally evaluated. Evaluations of MCC quality in the province have been conducted by CCO using only rudimentary markers such as attendance and MCC frequency. Such markers do not speak to the quality of decision making or resulting treatment recommendations.

The second challenge pertains to lack of access to MCCs. Despite the potential positive impact of MCCs, not all patients with cancer receive the benefit of a MCC review. In fact, Ontario data suggest that less than half of all new cancer cases are discussed prospectively in a multidisciplinary forum.[7] Resource barriers, specifically a lack of time coupled with high case volumes, preclude MCC teams from discussing all new or suspected cancer cases. Other barriers that hinder access to a good quality MCC review include administrative and technological gaps.

In this thesis, we will focus on the evaluation of MCC quality, specifically the quality of decision making at Ontario MCCs. We will aim to identify and mitigate gaps in the quality of MCC decision making using a quality improvement intervention designed using progressive knowledge translation methodology.

Knowledge translation (KT) is the process of developing, disseminating and applying knowledge and evidence to health care. Examples of KT interventions include use of audit and feedback, incentives, educational meetings, and team training.[8-11] Systematic literature often demonstrate minimal impact of such interventions on professional practice,[12] while complex interventions, including the use of local opinion leaders and outreach training visits, have resulted in moderate effects on professional practice.[12] KT experts have since called for the use of more progressive methods of knowledge translation to increase the impact of quality improvement interventions. In this thesis, we refer to progressive KT methods as the use of integrated knowledge translation, theoretical frameworks and models to identify evidence-based interventions. In contrast to traditional KT where interventions are often designed and implemented through an external research or policy group, integrated knowledge translation (iKT) encourages end users to be involved in the design, implementation and evaluation of a KT intervention. It is postulated that such involvement can increase the likelihood of success of quality intervention(s), by better accounting for local context and acceptability of the KT intervention by the target population.

The Theoretical Domains Framework[13] and the COM-B Behavioural Change Wheel[14] have recently gained traction as theoretical models that can aid implementation scientists in the design and implementation of quality improvement interventions. The Theoretical Domains Framework (TDF) is a comprehensive framework comprised of over 30 psychological theories. The TDF can be used to design interviews or surveys to identify barriers and facilitators to a behaviour of interest. The COM-B is a model that links theoretical mediators of behaviour change to evidence-based interventions. The TDF can be transposed to the COM-B to directly identify potential solutions to identified mediators of behaviour change.

We suggest KT methods can be used to mitigate gaps in MCC functioning. In this study we used progressive KT methods to design, implement and evaluate the KT-MCC, a quality improvement strategy designed to improve the quality of MCC decision making in an Ontario context.

Overview of Thesis

This doctoral thesis will be comprised of five chapters, which are briefly outlined below.

Chapter 1: The first chapter presents a comprehensive review of the MCC literature using systematic and recent evidence. The state of MCCs in Ontario is described and quality gaps in Ontario MCCs are highlighted. This chapter also presents an overview of the knowledge translation methodology used to guide this dissertation.

Chapter 2: We sought to determine whether the quality of MCC decision making could be reliably evaluated in an Ontario context. In this chapter, we used a generalizability study to assess the reliability of an MCC decision making quality assessment tool called the MTB-MODe. This tool has been validated in the UK for urology MCCs but not in other contexts or geographic regions. The generalizability study provided an overall estimate of reliability, and estimates of various factors (e.g., test subjects, raters, items on the assessment tool, and overall random error) that can impact a reliability score.

Chapter 3: KT experts recommend the use of theory when designing a quality improvement intervention, to better identify mediators of behaviour change and to guide the selection of appropriate interventions. In this chapter, we present the findings of theoretically-rooted, key informant interviews with Ontario MCC participants to identify barriers and facilitators to optimal MCC decision making. The interviews were designed using the Theoretical Domains Framework, which classifies behavioural mediators into 14 domains.

Chapter 4: In this chapter, we describe the methodology used to develop the intervention components of the KT-MCC. The KT-MCC was developed by mapping identified TDF domains to corresponding behavioural interventions using the COM-B Behavioural Change Wheel. MCC participants completed focus groups and surveys to confirm trustworthiness of the TDF-rooted, key informant data. In addition, MCC participants confirmed face validity of the KT-MCC.

Chapter 5: The fifth chapter presents the findings of a before-and-after pilot study used to evaluate the feasibility and impact of the KT-MCC. Our intent was that findings would inform the design of a subsequent stepped-wedge randomized controlled trial.

Chapter 6: The final chapter presents a summary of our methods and findings, observations from our methods and results, and serves as the conclusion to this doctoral thesis.

There are few examples in the KT literature that provide a complete and detailed description of the design, implementation and evaluation of a complex KT strategy using progressive KT methods, including TDF interviews to identify barriers and facilitators to practice change; the COM-B model to identify potential interventions; and integrated KT with front-line workers. This dissertation will describe the process of designing, implementing and evaluating a KT strategy, with the goal of improving the quality of MCC decision making in Ontario.

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CHAPTER 1: BACKGROUND

In this chapter, we present a summary of MCC literature and describe the state of MCCs in Ontario. In addition, we introduce key concepts from knowledge translation science that will be used to guide the methodology for this dissertation.

MULTIDISCIPLINARY CANCER CONFERENCES

Multidisciplinary Cancer Conferences (MCCs), also known as multidisciplinary tumour boards, bring together surgeons, medical and radiation oncologists, pathologists and radiologists to discuss diagnoses and treatment options for new or suspected cases of cancer. As the complexity of cancer care increases, the use of MCCs has increased worldwide. MCCs are considered an integral part of cancer care in the United Kingdom, United States, Australia and Canada. In Ontario, Cancer Care Ontario, the leading agency charged with improving the quality of care for patients with cancer, has championed the implementation of MCCs across the province.

Review of Systematic Evidence: The Promise of MCCs

Four systematic reviews pertaining to MCCs have been published. The first, published in 2007 by Wright et al. reviewed literature pertaining to the impact of MCCs on physician practices and patient outcomes.[1] The authors included peer reviewed manuscripts and unpublished grey literature relevant to the development, function and evaluation of MCCs. Grey literature was obtained using an internet search of relevant health care agencies coordinating MCCs in Canada, and through contact with individuals responsible for MCCs at Canadian hospitals. Study data could not be meaningfully meta-analyzed due to the level of heterogeneity in the included articles.

Clinicians reported high satisfaction rates (95%) with MCCs, and over 90% of treatment plans made at an MCC were subsequently implemented.[2] MCC facilitators included availability

of an MCC protocol or mandate (i.e., a clear purpose), attendance by core disciplines (which typically refers to radiologists, pathologists, surgeons, medical and radiation oncologists, and can include family physicians, nurses and other allied health professionals), presence of an MCC coordinator and MCC chair, up to date technological and physical resources, and a regular, set time for MCCs (e.g., weekly meeting). The authors used the findings of this review to develop a set of clinical practice guidelines for MCCs in Ontario. The guidelines were further refined by 89 Ontario practitioners and administrators tasked with MCC implementation, under the leadership of Cancer Care Ontario.

In 2014, Prades et al. updated Wright et al.'s review using the same search criteria to identify relevant articles published between 2005-2012.[3] This systematic review was completed in response to a policy developed by the European Partnership for Action Against Cancer (EPAAC) that highlighted MCCs as a core component in European cancer care.[4] Fifty-one studies met the inclusion criteria, demonstrating a temporal, exponential increase in MCC literature, as compared to the Wright et al. review. Once again, the data could not be meaningfully meta-analyzed, due to heterogeneity among included studies.

MCCs were associated with increased rates of optimal staging, decreased time between diagnosis to treatment, and increased use of neoadjuvant treatment. A number of studies also correlated MCC use with improved survival for patients with colorectal, head and neck, breast, esophageal and lung cancer.[5-8] Similar to Wright et al.'s review, Prades et al. found that MCCs lead to high rates of patient and physician satisfaction with clinical care, likely due to more timely treatment and coordinated care between cancer specialists.[9] Recommendations for MCC functioning were consistent with Wright et al.'s guidelines and included having a regular meeting time, relevant technology, a designated chairperson and MCC coordinator, and

participation by core and allied team members. Some studies highlighted the importance of involving nurses as core, rather than peripheral, MCC participants. The role of nurses was to represent patient views at time of MCC decision making, provide psychosocial support to patients, and coordinate treatment.

Both Wright et al. and Prades et al. completed systematic reviews to inform the development of national guidelines around MCCs, and reported consistent findings. The majority of articles included in the reviews were retrospective in design (27/38, 71%). Prospective studies were either cohort studies or questionnaires (11/38, 29%). None of the included studies were randomized. All studies demonstrated a positive correlation between MCCs and outcomes related to improved timeliness of cancer treatment, increased use of neoadjuvant treatment, or, improved survival. However, causal links between MCCs and improved patient outcomes could not be established. The reviews differed slightly in respect to the types of cancers studied in the individual articles. For example, Prades et al. found an increase in papers concerning colorectal, head and neck, urologic and ovarian cancers.[3] Many of these differences can be attributed to temporal changes associated with advancements in neoadjuvant therapies, and increased uptake of MCCs at these disease sites. In addition to reporting the impact of MCCs on process and patient outcomes, these review authors provided a summary of facilitators to MCC functioning to inform Canadian and European cancer policy guidelines.

The third review, by Lamb et al., aimed to describe the processes of MCC decision making using empirical and descriptive data.[10] The 37 identified articles included observational trials, surveys, and one randomized trial. Once again, data could not be meta-analyzed due to heterogeneity. MCCs were shown to change management in 2-52% of cases.[10] Changes included adjustments to diagnoses, revisions of treatment plans to align with clinical guidelines, or

changes to either more or less aggressive treatments.[10] Two studies evaluated the survival benefit of MCCs.[11,12] One study suggested that for patients with advanced lung cancer, MCCs had increased the use of chemotherapy from 7% to 23% which correlated with a significant improvement in median survival (3.2 to 6.6 months ($p<0.001$)).[11] The other study used a survey to estimate clinicians' predictions of survival for presented cases. The study authors did not identify any significant differences in survival predictions before and after multidisciplinary discussion.[12] Lamb et al. found that MCC recommendations were most often made by physicians and MCCs were most commonly led by surgeons.[13] Time constraints, high case volume, poor teamwork and leadership, and a lack of technological supports were found to negatively impact processes of decision making.[10]

The most recent systematic review by Pillay et al. evaluated the impact of MCCs on patient outcomes, assessment, diagnosis, management, and clinician practice (n=27 studies).[14] The review included all studies published between 1995-April 2015 that reported empirical MCC outcomes. Six studies found that patients who were discussed at an MCC had more accurate preoperative staging as compared to those not discussed at an MCC.[14-19] For example, two studies showed that patients with rectal cancer discussed at an MCC had increased rates of MRI imaging.[19,20] Twenty-five of 27 studies showed that MCCs changed diagnostic reports in 4-45% of cases. As per previous reviews, patients discussed at an MCC were more likely to receive adjuvant or neoadjuvant therapy and referrals to other specialists. Finally, six studies examined the correlation between MCC use and patient survival.[19,21-25] Four studies that controlled for confounding factors found that MCC discussion was not associated with improved overall survival.[19,21,23,25] However, in each of these studies, MCC use was associated with increased rates of neoadjuvant therapy, use of chemotherapy, or improved quality of life due to increased use of

neoadjuvant therapy or palliative care. The remaining two studies found improved survival for lung and colorectal cancer patients who were discussed at an MCC, compared to those who were not discussed.[22,24] Patients with advanced lung cancer who were presented at an MCC showed an increased average survival of 10 weeks, compared to patients not discussed at an MCC.[24] In addition, patients with colorectal cancer in a post-MCC implementation cohort had an improved three-year survival as compared to the pre-MCC cohort (66% versus 58% three-year survival, respectively).[22]

Due to the complex nature of cancer and an inability to disentangle the influence of MCCs on natural cancer progression, systematic reviews have not established a significant correlation between MCC use and improved patient outcomes. However, the evidence does suggest that MCCs can positively impact process measures of patient care, by helping to ensure patients are staged with appropriate diagnostic tests, and receive more guideline-concordant neoadjuvant and adjuvant treatments. MCC quality, specifically the quality of decision making, can be affected by the following factors: lack of attendance by core specialists, unavailability of an MCC chair and coordinator, gaps in technological supports, and lack of reserved time for MCC functioning.

Update of the Literature

We sought to perform a literature review to identify any recently published literature regarding the processes of MCC decision making. Unlike the data identified via the systematic reviews that mainly reported empirical data pertaining to diagnostic or patient outcomes, we sought to identify barriers and facilitators to processes of MCC decision making, and potential solutions to mitigate barriers. To complete this review, we used Medline and Google Scholar (search completed July 2017). Keywords included *decision making, multidisciplinary,*

multidisciplinary cancer conferences, tumor boards, and their variations. MeSH terms were exploded for relevant keywords and limits were set to include studies published in the English language. Included studies were those that described processes of MCC decision making or studies that aimed to evaluate or improve the quality of MCCs. Studies pertaining to the impact of MCCs on the rate of diagnostic or treatment change, patient survival, and studies depicting site-specific guidelines for MCC case selection (e.g. case selection for lung cancer) were not included in this literature review, due to the consistent related findings in the four systematic reviews presented above.

Medline revealed 276 potential articles for this literature review. Much of these articles pertained to shared decision making between physicians and patients. The purpose of shared decision making is to involve patients in the decision making process, to ensure that recommended treatment plans are in line with patient preferences, beliefs and psychosocial factors.[26] Other identified articles related to decision making in order to avoid errors in hierarchial contexts (e.g., collaborative decision making between nurses and physicians to avoid medication errors on a hospital ward).[27] There was considerably less evidence that pertained to decision making in a non-hierarchical setting, particularly in the context of multidisciplinary cancer conferences.

Of the 276 articles identified via Medline, 11 were selected for full text screening.[26,28-37] Of these 11 articles, five studies were included in the current literature review.[26,28,32,36,37]Google Scholar revealed an additional six articles that were germane to the MCC decision making literature.[38-43] The findings of this literature review reinforce the systematic findings. Main barriers to MCC decision making include gaps in the quality of information presented (e.g., lack of clinical information, lack of imaging, non-consideration of patient-important factors), non-

attendance by core MCC participants, and technological barriers.[26,28,38,40,42,43] Gaps in the quality of information presented can result in failure to reach a consensus decision 27-52% of the time.[10] Similarly, gaps in teamworking can also influence team performance and decision making. For instance, a randomized study showed significant negative correlations between 'rudeness' and the performance of medical teams, where teams who communicated using rude statements exhibited lower performance scores on diagnostic and procedural skills.[44]

There were unique findings (i.e., findings not previously reported in the systematic reviews) that were identified in our literature review. For example, a qualitative study by Dew et al. found variation in processes of MCC decision making among various MCC teams.[37] The study team audio-recorded 10 MCCs at four treatment sites and described the 'activity' of decision making. The authors found that MCC structure and processes (e.g., stage at which a case was discussed and types of questions asked) differed by disease site. In addition, there was little consistency regarding the presence of an MCC chair, format of case discussion, and the amount of detail provided in the MCC agenda.[37] Such MCC variation was also confirmed in other articles.[32] Dew et al. also reported that MCC participants vary their strategies of case presentation, in order to justify their treatment decisions and persuade the group to implement their preferred treatment plan. Some of these strategies include "overtalking" (i.e., speaking so much so as to devalue the contributions of others and gain the 'floor'), guessing the preferences of patients (e.g., "I don't think this patient will want surgery"), and using extreme-case formulations (i.e., using exaggerated descriptive terms to confirm opinion, such as "*severe"* or "*most horrible"* comorbidity).[36,p.711] Use of such techniques allows participants to dominate the MCC discussion and influence the group to adopt their preferred treatment plan.[36,45]

Of relevance, one study demonstrated that MCCs often result in a false sense of group consensus because non-dominant MCC participants fail to voice their concerns with a proposed treatment plan.[41] Sidhom et al. also reported that while 85% of physicians in their sample (n=136) had disagreed with a final MCC decision, 71% did not formally dissent.[45] Because decisions are typically made using a "majority goes" phenomenon, the quality of the resulting treatment recommendation is rarely assessed.

An opinion piece by D. Green suggests that MCC case discussions comprise two phases: the *identification* and the *selection phase*.[36] MCC participants articulate the various treatment options in the *Identification* phase and select a final treatment plan in the *Selection* phase. Green suggests that social factors, such as seniority and likeability of the presenting physician, can bias the final treatment selection. Suggestions to overcome these biases include anonymous balloting to determine a consensus treatment, or assignment of a 'devil's advocate' to question the efficacy of a status quo treatment plan. A similar case study by Sharma et al. also suggests that decision-making can be facilitated using voting and consensus processes.[40] There is no evidence to suggest that these recommendations are based on empirical data or have been evaluated. Further, it is unlikely that such recommendations are pragmatic in a high volume MCC.

Despite mandates for increased use of MCCs, there have been few efforts to evaluate the quality of decision-making at MCCs and mitigate gaps in the quality of information, teamworking and other MCC barriers.[3,10,41] The paucity of literature aimed at evaluating or improving MCC quality demonstrate that a regional or national MCC policy does not necessarily result in optimal MCC decision making. As quoted by Prades et al.,

> [the] *"advantages of a multidisciplinary approach do not result inevitably from the will to implement it on the basis of a policy decision"*[3,p.472]

That is, policy recommendations by a guiding agency for MCC implementation will not inevitably result in high quality MCC decisions, with positive impacts on patient process or outcome measures. Prades et al. further highlight that while many national policy guidelines recommend the use of MCCs, few agencies provide guidance on how to effectively run MCCs, manage discussions, or promote effective teamwork among participants.[3] As a result, reports of burnout and emotional exhaustion, due to a lack of teamworking coupled with large case volumes, are prevalent among MCC participants.[3,43]

Evaluation of MCC Decision Making Quality

There has been an exponential increase in the prevalence of scholarly articles and books published on the topic of MCCs, with a sharp uptrend beginning in the early 2000s (see Figure 1). However, despite this increase, few studies have evaluated the quality of MCCs, and there are no studies that have evaluated the quality of MCCs in a Canadian setting. Moreover, while data show gaps in optimal MCC decision making quality, there is a paucity of evidence identifying pragmatic strategies to improve this quality.[3,10] For the purpose of this study, 'optimal decision making' refers to all aspects of MCC case presentation, discussion, and the final selection of treatment plans.

Lamb et al. are the only researchers to implement and evaluate a quality improvement intervention aimed at improving the quality of MCC decision making.[46] The team introduced a three-component quality intervention to improve decision-making for a urological MCC at an academic hospital in the United Kingdom. The intervention comprised a MCC checklist to guide case discussion, team training, and written guidance on optimal decision making. The authors evaluated the quality of decision making using the Metric for the Observation of Decision Making for Multidisciplinary Tumor Boards assessment tool (MTB-MODe).[46,47] The study

authors detected moderate improvements in teamworking (9%) and marginal improvements in the quality of information presented (5%) following the introduction of their quality improvement intervention.[46]

Metrics for the Evaluation of Decision Making Quality

A study by Elwyn et al. states that in order to measure the quality of decision making, the concept of a 'good decision' must first be defined.[48] There are many measurement tools available to evaluate the quality of decision making; however, many of these tools evaluate surrogate outcomes of decision making, such as fidelity of the decision, efficiency of a discussion, conflict during decision making, and satisfaction with the final decision. Elwyn et al. propose that the quality of a decision should be evaluated *independent* of the outcome. The authors highlight the work of Fisher and Fisher, who state

> *"because a good or bad outcome may powerfully influence perceptions (of decisions)…such a judgment is best made before the outcome is known"*[48, p.190]

The authors recommend assessing decision quality by examining the knowledge, preferences, and deliberation that lead to a decision. Therefore, assessments of MCC decision quality should evaluate the quality of knowledge presented, whether various treatment options were considered, and whether team members deliberated effectively to integrate clinical knowledge with patient preferences.[48]

Using the literature review and a hand search of relevant MCC articles, we identified two assessment tools that evaluate MCC decision making quality as per the recommendations of Elwyn et al. The first, Lamb et al.'s MTB-MODe evaluates the quality of MCC decision making on two domains: the quality of information presented at an MCC and the quality of teamworking exhibited by MCC participants.[47] Each case presented at an MCC can be evaluated using the

MTB-MODe tool, with individual items anchored on a scale of 1-5 to reflect whether the information presented and teamworking exhibited are of high or low quality.

We identified only one other assessment tool to evaluate the quality of MCC decision making. This tool, the Multidisciplinary Team Meeting Observational Tool (MTOT), evaluates the decision making quality of an MCC round, rather than an individual case.[49,50] This tool establishes MCC quality using five domains: team characteristics, teamworking and culture, infrastructure for meetings, meeting organization and logistics, and patient-centered decision-making. In this thesis, we will evaluate the quality of decision making independent of the decision outcome, using the MTB-MODe and MTOT assessment tools.

MCCs in Ontario

Cancer Care Ontario (CCO) championed the use MCCs after an audit revealed significant gaps in the uptake of MCCs in the province's hospitals. In 2006, CCO released a standards document that recommended best practices for MCCs, based on the evidence identified in Wright et al.'s systematic review.[51] The CCO guideline recommends that new or suspected cancer cases, as well as select complex or recurrent cases, be discussed in a multidisciplinary forum. The guideline also provides disease site specific recommendations on case selection, meeting format (at least once every two weeks), recommended team members (e.g., surgical, medical and radiation oncology, diagnostic radiology, pathology and nursing), and minimum institutional requirements (MCC coordinator, appropriate teleconferencing and imaging facilities, availability of a meeting room, etc.). Finally, the guideline outlines the roles and responsibilities of each MCC member. The main responsibilities of MCC participants is to ensure regular attendance, forward new cases to the MCC administrative coordinator, present the case at the tumor board, and record the MCC treatment recommendation in the patient's record.

Subsequently, the role of the MCC chair is defined as "the actual running of the MCC".[51] Chairs are expected to ensure cases are discussed within the allotted time, encourage participation by all MCC members, and ensure patient confidentiality is maintained. To guide MCC implementation and functioning, CCO created a series of educational tools that include a list of required MCC resources, a disease-specific guide to MCC case selection, and an example of a 'well-functioning' MCC.[52,53]

In 2008, CCO created a scorecard to evaluate the quality of each Ontario MCC.[54] The first item on the scorecard requires each hospital with at least 35 unique cancer patients per disease site (per annum) to hold a minimum of five MCCs within a three-month period. Hospitals that do not fulfill this criterion receive a score of 0. Hospitals that meet the minimum number of MCCs required are given a score of 1, and are eligible to obtain an additional point for each of the following items: patient cases are prospectively reviewed, an MCC coordinator is assigned, and an MCC chair is assigned. Sites are also awarded 1 point for attendance by each seminal specialty (surgery, medical oncology, radiation oncology, pathology and radiology), given that each specialty attended 75% of MCCs within a three-month period. A summative score is reported on a scale of 7-9, depending on site variability for seminal specialists.

In 2010, CCO estimated that only 37% of cases met the minimum requirements outlined on the scorecard.[54] Moreover, Wright's research team conducted a survey to examine the attitudes and preferences of Canadian cancer care providers and administrators.[55] Over 1,700 responses to the survey were received. Seventy-four percent of participants were aware of MCCs in their region, but only 58% attended regularly. The study authors also found significant variability among cancer providers and administrators regarding perceptions around MCCs.

Moreover, there was variability in MCC participation due to location, with lower participation by community hospitals.[55]

In response, CCO set a goal that required 80% of hospitals to meet the required provincial MCC standards by 2015.[54] A secondary objective was to double the volume of cases discussed by the 2015 deadline (from 24,000 cases in 2010 to 50,000 cases in 2015). The province met these goals, and by 2015, 80% of hospitals (51/64 hospitals) met the minimum CCO quality criteria. Recent 2016/2017 data also show a further increase in MCC standard concordance among non-regional cancer center hospitals, with 85% of these hospitals having met CCO quality criteria.[56]

In Ontario, CCO has greatly increased the use of MCCs.[57] However, available data suggest that gaps pertaining to MCC access remain a challenge. Many patients in Ontario with a cancer diagnosis do not receive the benefit of a prospective multidisciplinary discussion. CCO data show that a total of 43,000 were discussed at MCCs in 2016/2017.[56] But during this time there were approximately 85,600 new cancer cases in Ontario. Moreover, many cases discussed at MCCs are recurrences, or require multiple MCC discussions, suggesting that many new cancer cases are not discussed in an MCC. In this thesis, we will focus on improving the quality of MCC decision making for cases brought forward to MCCs. We posit that improving the quality of current processes of MCCs may lead to improved efficiency and thus increase the number of patients that can be discussed in a multidisciplinary forum.

Summary of Findings: MCCs

There are a number of barriers to MCC decision making quality including lack of case preparation, unorganized case discussion, and gaps in teamworking, leadership and technological resources.[10,58] Despite the recognition of such gaps and their potential impact on MCC quality,

there have been few studies that have evaluated, or aimed to improve, the quality of MCCs. One exception is Lamb's research team, who developed a quality improvement intervention aimed at improving MCC decision making quality. The authors implemented an intervention that marginally improved the quality of information presented and quality of teamworking exhibited. In Ontario, MCC quality has only been evaluated using rudimentary metrics, such as frequency of the MCC round or attendance by core specialists. We hypothesize that a number of quality gaps identified in the decision making literature exist in Ontario. There is a need to identify and mitigate such gaps if they exist.

In this thesis, we designed, implemented and evaluated an intervention to improve the quality of decision making at Ontario MCCs. The design of this intervention was guided using progressive knowledge translation methodology.

KNOWLEDGE TRANSLATION

Knowledge translation (KT) is the dynamic process of developing, disseminating and applying knowledge and evidence to health care.[59] KT interventions aim to increase the uptake of evidence-based interventions by identifying the potential individual, organizational, and systems barriers to change. KT interventions are believed most effective if they first identify determinants of behaviour change, and subsequently identify strategies that target these determinants.[60]

Common examples of quality improvement interventions used in KT include physician education, use of opinion leaders, reminders, and audit and feedback.[61] However, the effectiveness of these interventions remains in question. For example, systematic reviews demonstrate that most interventions have a minimal impact on physician or other health care worker practice.[62-63] Audit and feedback and opinion leader interventions are, to date, the only

interventions that consistently demonstrate an impact on practice change, but this is in the approximate range of only 17% and 12%, respectively.[64]

Studies have shown that the sustained impact and generalizability of quality improvement interventions is low.[65] In response, KT experts recommend the use of an iterative approach to intervention development.[65,66] The Knowledge-to-Action cycle provides a 'blueprint' for implementation scientists aiming to close evidence-to-practice gaps.[66] The cycle outlines a series of eight cyclical, iterative steps that can be used to translate knowledge into practice. The steps include: *Identify problem, Identify review and select knowledge, Adapt knowledge to local context, Assess barriers to knowledge use, Select, tailor, implement intervention, Monitor knowledge use, Evaluate outcomes, Sustain Knowledge Use*.[66] At the core of the KTA cycle is the continuous process of knowledge creation, where evidence is formed and knowledge is tailored to the appropriate audience. Despite the wide use of the KTA cycle, evidence-to-practice gaps continue to exist.

In response to these minimal impacts of KT interventions, KT researchers have called for the use of progressive KT methodology, specifically the use of theoretical frameworks, models, and an integrated knowledge translation (iKT) approach to promote the uptake and impact of quality improvement interventions.

Theory and the Theoretical Domains Framework

Approximately ten years ago, KT experts increasingly identified that quality improvement interventions did not explicitly link their interventions to the context, culture and current behaviours of the target population.[67] Poor descriptions of intervention selection led researchers to question the generalizability of even successful interventions.[67] In response, implementation science experts advocated for the use of theory in the design of quality

improvement interventions.[67] A theory refers to a systematic way of understanding events or situations.[68] The use of theory in intervention design is important, as it allows for the systematic identification of constructs that influence behaviour change; guides researchers to map behavioural constructs to appropriate interventions; and provides testable models that can be used to explain the success or failure of a quality improvement intervention.[68]

D. D. Clarke, Emeritus Professor of Psychology, has been quoted by implementation scientists for his belief that,

> "[*Research that lacks explicit theory*] *is like pieces of a jigsaw which accumulate in journals…a real jigsaw puzzle can only be made by taking a picture and cutting it up into pieces, not by making pieces and hope they will form a picture*" [68,69,p.35]

Researchers that do not use theory may overlook important mediators of behaviour, which can result in the development of less effective interventions.

In recent years, there has been an increase in the use of theory for the development of quality improvement interventions; however, gaps still remain. First, a recent appraisal of KT reports found that only 23% of studies explicitly use theory to design and evaluate health professional behavioural interventions.[70] Secondly, researchers who do cite theory often do so passively, and do not explicitly describe how the theory was used to design or evaluate a quality intervention.[68] Of note, there remains a paucity of empirical data to correlate use of theory with more effective interventions.[70-72]

Investigators have also recognized that there are many theories that describe mediators of behaviour change, and thus it is difficult to justify the prioritization of one theory over another.[73] Theories for health care behaviour can be identified at the level of the individual health professional, the health care team, the organization (e.g., the hospital), or the larger health care

system (e.g., Cancer Care Ontario).[67] A number of frameworks attempt to guide researchers to select an appropriate theory for specific behaviour changes. However, these frameworks are often challenging to interpret and implement, and raise concerns that use of a single theory may not be sufficient to influence a complex behaviour. For instance, data show that 17% of theoretically-informed studies drew upon only one behaviour change theory, and may therefore have missed important mediators of behaviour change not specific to the selected theory.[74]

In response, Michie et al. sought to provide a pragmatic solution to the issue of theory selection by creating a single validated framework that summarized relevant theories that impact behaviour change.[75] The purpose of this framework was to integrate the most relevant theories of behaviour change into a comprehensive framework that could be used by KT researchers interested in improving health care practice and patient health. Michie et al. identified 33 psychological theories that encompassed 128 behavioural-change constructs and used a consensus method to refine these theories into 12 theoretical domains. The result was the first iteration of the Theoretical Domains Framework (TDF).[75] Following further input from KT experts, the TDF was revised to its current form, which encompasses 84 behavioural constructs nested in 14 theoretical domains.[76]

The major strengths of the TDF are that it covers a wide range of theories that influence behaviour change, and that it can be used to directly identify mediators to behaviour change.[74] Researchers can use the TDF to inform the design of interviews, focus groups, or questionnaires in order to comprehensively identify barriers and facilitators to stakeholder behavior change. Recent KT literature also demonstrates that the TDF elicits more findings about mediators to behaviour change as compared to other interviewing techniques[77], and that it can be successfully

implemented to identify behavioural mediators, even for complex and multifaceted behaviours (e.g., MCC decision making).[78,79]

MCC decision making is a complex behavior that is likely influenced by a number of individual and group behaviours. For example, physicians must optimize their presentation of clinical and imaging information, prepare for MCCs, and teams must engage in an effective discourse to identify and select potential treatment options. The TDF can be used to systematically identify the various barriers and facilitators that impact MCC decision making.

COM-B Behaviour Change Wheel

Once a KT theory is applied and determinants of behaviour change are identified, there are numerous KT interventions that can be used with the intention of impacting a behaviour change. For example, the Cochrane Effective Practice and Organisation of Care (EPOC) group has developed a taxonomy that identifies KT interventions that can impact change for health professionals.[80] The Cochrane group has also developed a series of systematic reviews and meta-analyses that evaluate the efficacy and impact of many of these interventions (e.g., audit and feedback, opinion leaders). Such a list does not assist the researcher or policy maker in selecting the appropriate intervention for the identified behavior determinant.

Michie, one of the developers of the TDF, developed a categorization model that guides KT researchers to select the KT tools, or interventions, that best correspond with identified barriers to behaviour change.[81] This model, the Behaviour Change Wheel (also known as the COM-B) describes a 'behaviour system' as comprised of capabilities, opportunities, and motivators.[81] The COM-B hub (capabilities, opportunities and motivators) is at the center of the wheel, and is surrounded by corresponding intervention functions and policy items; the

intervention functions and policy items can be indicate specific interventions that are thought to best address or impact the identified component of the behaviour system. The TDF can be transposed on to the COM-B model to allow for the direct mapping of identified barriers and facilitators to corresponding interventions.[76] There is a lack of empirical data evaluating the use of the TDF and COM-B for KT intervention strategy design, though there is consensus that more rigorous, comprehensive, reproducible and generalizable approaches are needed.[60,67,68] The use of the TDF and COM-B may well fit this need.

Integrated Knowledge Translation

Most KT intervention strategies involve researchers or policy makers implementing interventions onto end users. In contrast, the process of integrated knowledge translation (iKT) involves the end users in the design, implementation and evaluation of a KT intervention.[82] Careful consideration of the local context and acceptability of the KT intervention by the target population is believed to increase the likelihood that the KT intervention will be successful. Graham et al. define iKT as,

> "*A way of approaching research to increase the chances that the results will be applicable to the population under study…Essentially, it is a collaborative way of conducting research that involves researchers and knowledge-users...working together as partners in the research process"* – [83,p.11]

iKT is believed to accelerate the dissemination of research findings, increase confidence in the research findings, and produce greater impact due to knowledge user readiness to translate research findings into practice.[83]

KT and MCCs

We previously quoted Prades et al. who highlight that while many national policy guidelines recommend regular MCCs, few agencies provide guidance on how to effectively run MCCs, manage discussions, or promote effective teamwork among participants.[3] According to KT evidence, generic recommendations and policy statements regarding MCCs are unlikely to impact the quality of MCC functioning. We suggest validated theoretical approaches to identify barriers and facilitators to MCC functioning, and, an iKT approach, should be used to develop and implement a strategy to mitigate MCC quality gaps.

To the best of our knowledge, Lamb et al. are the only research team to develop a quality improvement intervention aimed at improving MCC decision making quality.[46] The authors do not cite their intervention as a knowledge translation strategy, yet they did utilize some traditional KT interventions. The first component of their intervention was a MCC checklist developed by the team to guide case discussion. The checklist was meant to ensure that all core members are present, all relevant information (pertaining to case history, imaging, patient views, etc.) was presented, and all team members had the opportunity to participate in the discussion. The checklist also prompted the user to identify whether a treatment recommendation was articulated, whether there were any objections, and whether the case should be re-discussed at a subsequent MCC. The second component of the intervention was team training, which involved a half-day didactic training session followed by a workshop. Published studies to date have not provided a description of what the team training entailed, or who led the didactic and workshop sessions. Finally, the study team provided written guidance on how to "draw the optimal clinical information required for decision making"; however, again, the details of this written guidance have not been published. Study outcomes included the rate of treatment decisions reached, quality of the information, and quality of teamworking.

The authors noted a 9% improvement in the quality of teamworking and a 5% improvement in the quality of information presented.[46] Improvements in the quality of the information were attributed to case preparation by residents, who were essential to the processes of MCC functioning. Lamb et al. concluded that their intervention was effective, and that the success of the intervention was likely due to 'team engagement and effective team leadership'.[46]

However, the findings of this study should be interpreted with caution. First, the study team observed a single MCC for a period of 16 months. Second, this MCC involved members of the study team, which likely improved the rate of team engagement and may have had a positive impact on quality markers. Third, while teamworking and quality of information scores improved, they only rose from 38% to 43% and from 29% to 38%, respectively, which may not be clinically a significant improvement. Finally, the study team depended on residents to prepare case information, and attributed success of the intervention on resident involvement. This model of involving residents in the preparation of MCC cases is not currently feasible in many settings, due to high MCC case volumes, lack of protected time for residents to participate in MCCs, or absence of residents in many Ontario hospitals.

Lamb et al. identified the importance of team engagement to the success of their quality improvement intervention, but they did not provide details on how they engaged MCC participants in the intervention components (e.g., team training, use of the discussion checklist). Rather, the authors state that,

> *"lack of engagement from [MCC clinicians] would likely render the quality-improvement effort ineffective…although it is difficult to imagine how a clinical team dealing with such a complex disease might not be focused on improvement. If this is the case, it might actually be a signal that the team is dysfunctional, and review of the team's decision making and potentially additional intervention might be warranted."* [46p.419]

Further, the study authors developed their intervention strategy without using any progressive KT elements, namely identifying barriers and facilitators using theoretical frameworks, using theory to select intervention components, or employing a formal iKT approach. Rather, it is likely the authors used an 'ISLAGIATT' approach to select and implement interventions. In the KT literature this refers to *It Seemed Like A Good Idea At The Time.*[83] KT thought leaders suggest this approach will likely result in short-term solutions that are not typically sustained or generalisable.[83] While Lamb et al.'s work is seminal to the field of MCC decision making, there is a lack of published guidance regarding how the quality intervention was designed, implemented or evaluated. In this thesis, we hope to build on this work.

Summary: Knowledge Translation

Knowledge translation interventions aim to bridge the evidence-to-practice gap by mapping evidence-based interventions to mediators of behaviour change when a quality gap is identified. KT experts recommend the use of theory to systematically identify all mediators of behaviour change and corresponding quality improvement interventions. Experts also suggest that the use of an iKT approach, which involve the target population in the design, implementation and evaluation of a quality improvement strategy, is more likely to result in uptake of study interventions.

Lamb et al. provide an example of a quality improvement intervention targeting MCC decision making; however, their quality improvement intervention did not explicitly integrate KT methodology. The intervention resulted in marginal improvements to MCC decision making and may not be generalizable to an Ontario context. **In this thesis, we will utilize progressive KT methods, specifically the TDF, the COM-B framework, and iKT to design, implement and evaluate an intervention aimed at improving MCC decision making quality in Ontario.**

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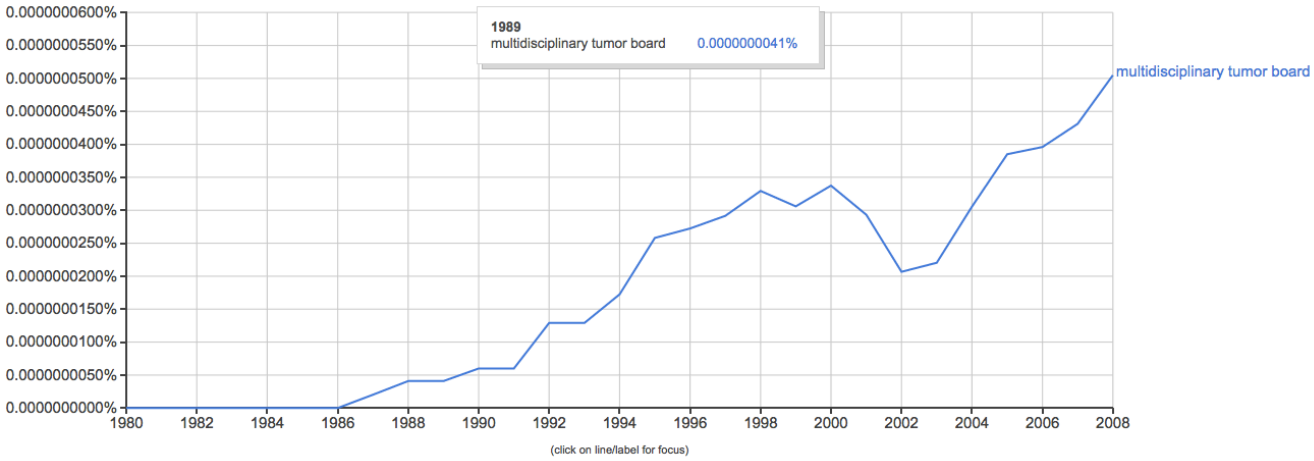

Figure 1: Temporal trends of published studies citing “multidisciplinary tumor boards”
(taken from Google trends)

CHAPTER 2: RELIABILITY ASSESSMENT OF MCC EVALUATION TOOL

Introduction

Multidisciplinary Cancer Conferences (MCCs) are associated with improved adherence to decision-making guidelines, strengthened peer collaboration and communication, increased participation in clinical trials and standardization of care practices.[1,2] The benefits of MCCs have led to their worldwide implementation. While the uptake of MCCs has increased markedly worldwide, a number of barriers to optimal MCC decision making have been reported in the literature. These barriers include a lack of clinical information and diagnostic findings at time of case discussion, limited participation by core MCC participants, and technological limitations.[3] Such barriers can result in failure to reach a consensus decision 27-52% of the time.[4]

Cancer Care Ontario (CCO), the agency charged with improving the quality of care received by Ontario patients diagnosed with cancer, has mandated regular MCCs at hospitals in Ontario, Canada.[5] CCO has provided guidance on required participants, the recommended frequency of MCCs, and case selection. For example, all cases of rectal cancer and only complex cases of colon cancer must be discussed in an MCC with radiation and medical oncology, surgery, pathology and radiology participation. However, beyond rudimentary quality markers that assess attendance and MCC frequency, the quality of MCCs, specifically the quality of MCC decision making, has not been evaluated in Ontario.

Lamb et al. developed an assessment tool to evaluate decision making quality for each MCC case presented. This tool, titled the Metric for the Observation of Decision-making (MTB-MODe), evaluates decision making through an assessment of the quality of information presented and the quality of teamworking exhibited during a case discussion.[6,7] The MTB-MODe was previously validated for urology and colorectal MCCs in the United Kingdom and demonstrated good reliability (ICC= >0.70) for the majority of items.[8] The tool was also found to

be reliable when used by both medical and non-medical observers.[6] The MTB-MODe has not been evaluated in non-UK contexts.

To date, reliability scores for the MTB-MODe have only been reported as intraclass correlations (ICCs).[6,8] The limitation of ICCs is that they can be affected by various factors, including inter-rater and between-rater variability. Moreover, a composite ICC does not allow for generalizability to other contexts, unless the user is confident that the new context of measurement holds the same heterogeneity as the context in which the ICC was generated.[9] In contrast, generalizability theory (G-theory) accounts for multiple sources of variation that can affect score reliability.[10,11] G-theory can produce an overall score of reliability that accounts for inter-rater reliability, internal consistency, and random error, and provides a more comprehensive overview of reliability.

The purpose of this dissertation is to develop and pilot a KT strategy to improving Ontario MCC decision making processes. We surmised that the MTB-MODe could be used to evaluate such a strategy, but that its reliability would have to be first established in an Ontario context. The primary objective was to use G-theory to assess the overall reliability of the MTB-MODe in an Ontario setting. Specifically, we wished to determine if the tool could distinguish between high and low quality decision making between MCC cases. The generalizability study was used to identify sources of variance that could lead to measurement error and thus affect overall reliability scores. The secondary objective was to observe if barriers and facilitators to optimal MCC decision making identified in non-Ontario jurisdictions were also present in an Ontario setting.

Methods

Setting

The province of Ontario (population 14 million) is divided into 14 health administrative regions known as Local Health Integrated Networks (LHIN). The Juravinski Cancer Centre provides nearly all radiation and the majority of chemotherapy to patients with cancer from LHIN 4 (population 1.4 million). We evaluated two forms of MCCs, both related to colorectal cancer, that take place at the Juravinski Cancer Centre. The first was a weekly, traditional MCC (MCC1) for gastrointestinal cancers that is regularly attended by surgeons, radiation and medical oncologists, radiologists and pathologists. Cases are brought to the conference at the behest of individual clinicians. Most cases are challenging, and involve questions related to the use of radiation or chemotherapy. The second MCC (MCC2) was a weekly conference attended primarily by surgeons. Presented cases are consecutive cases of rectal, rectosigmoid and complex colon cancer being managed by participating surgeons, and thus are comprised of routine and challenging cases.

Description of Assessment Tool

The quality of MCC decision making was assessed using the MTB-MODe tool. This tool evaluates decision making using 9 items relating to the quality of information presented (n=4 items) and the quality of teamworking (n=5 items).[6,7] Quality of information items includes case history, radiological information, pathological information, and patient views. Quality of teamworking items include contributions of the MCC chair, surgeons, oncologists, radiologists, and pathologists. Each of the items is scored on a 1-5 Likert scale, with 1 indicating poor quality and 5 indicating high quality. Items are anchored at 1, 3, and 5 points (Appendix A).

The MTB-MODe was designed initially to assess the quality of decision-making at urology MCCs.[6] We made slight adjustments to the tool to facilitate evaluation of gastrointestinal MCCs. Specifically, we removed items assessing the contribution of specialists

groups (e.g., nurses) that do not regularly attend MCCs at our site. In addition, psychosocial factors and comorbidities were condensed to one item, *Case History Information*, as per an earlier published version of the MTB-MODe.[6] These changes were made to reduce artificial inflation scores of reliability. For example, non-attendance of nurses would consistently be given a score of '1'. Consistent scores of '1' for an item would reduce variability in scores, and artificially reduce the overall reliability of the MTB-MODe.

Data Collection & Sample Size

Objective 1 –Field notes on Barriers and Facilitators to MCC Decision Making: Fifteen MCC rounds at three hospitals were observed over a period of 5 months (April – September 2015) prior to collection of MTB-MODe data. The purpose of these observations was to familiarize the researcher with processes of MCC functioning, key terminology used during MCC discussions, and key stakeholders at MCC rounds. Field notes were recorded by a single researcher. Specifically, notes regarding MCC attendance, types of cases presented, information presented, observed teamworking, and leadership were recorded.[12] Field notes included descriptions of people, events, conversations, observations, and hypotheses.[12] Observations were then linked to potential barriers and facilitators to optimal decision making identified in our previous literature search.

Objective 2 – Reliability Assessment: MCC1 and MCC2 were evaluated using the MTB-MODe. Two independent researchers first jointly evaluated three MCCs to orient themselves with the MCC participants and discussion processes, and to ensure general consistency with tool implementation. For all subsequent cases, each rater independently assessed all nine items of the tool. Sample size calculations were based on previously published work using the MTB-MODe, which reported average intraclass coefficients (ICC) of 0.61 for items related to the Information

Score and 0.75 for items related to Team Contribution Score.[6] Using the more conservative ICC value of 0.61, we required a minimum sample size of 25 cases in each MCC group (MCC1 and MCC2) to obtain 95% confidence intervals of 0.1 around the reliability coefficients.

Outcomes

Objective 1 – Field notes on Barriers and Facilitators to MCC Decision Making: Descriptive observational data were provided for the observed MCCs. Data regarding the process of MCC functioning (e.g., the types of cases presented, time spent per case, organization of the round, information presented, observed teamworking, and, leadership) were recorded and summarized.

Objective 2 – Reliability Assessment: G-theory was used to determine whether the MTB-MODe could reliably discriminate cases with high versus low quality information or teamworking. In addition, G-theory was used to assess overall tool reliability and to identify sources of variance that most impact reliability scores (e.g., Does variability stem from rater error? Which items of the MTB-MODe contribute to a greater variance in reliability scores?).

Data Analysis

Objective 1 – Field notes on Barriers and Facilitators to MCC Decision Making: An informal qualitative analysis of observational field notes was used to describe the processes of MCC functioning in Ontario, and to determine whether barriers and facilitators identified using the literature search resonated with Ontario MCCs. The purpose of this analysis was not to provide a comprehensive qualitative assessment of Ontario MCC functioning; but rather, to confirm the presence of gaps to MCC decision making, to further justify the rationale of this dissertation.

Objective 2 – Reliability Assessment: G-theory accounts for multiple sources of variation that can affect score reliability.[10,11] Each of these sources are referred to as *facets*.[10] Because the purpose of the study was to distinguish between high versus low quality *cases*, the facet of

differentiation, or primary object of measurement, was defined as the individual case and coded as 'c'. The three remaining facets of generalization, meaning other items that can attribute to variance in reliability scores, included raters (r=2), domains (d=2, information; teamworking), and MTB-MODe items (i=9). By accounting for each of these facets and all of their potential interactions, G-theory produces an overall score of reliability, which takes into account inter-rater reliability, internal consistency, and other sources of score variance, including random error. Moreover, reliability scores for internal consistency and inter-rater reliability can be generated using G-theory.

Mean scores and corresponding standard deviations were generated for each of the 9 items, to allow for analysis of response distribution. A G-study was generated for each of the conferences (MCC1, MCC2) to account for differences in MCC attendance. G-String software was used to perform the G-study.[13] The raters ('r') and domains ('d') facets were "crossed" with cases ('c'), which means that each rater evaluated each item for every case. Finally, items ('i') were "nested" within domains, indicating that each of the 9 MTB-MODe items were embedded in one of two overarching categories, or domains, used to define MCC quality (information or teamworking). The overall reliability score depicted a real world scenario, where different raters would utilize the same tool to evaluate each case, thereby holding the items and domains as 'fixed' facets, and raters as 'random' facets. Absolute reliability scores, which are more conservative than relative reliability scores, were generated. Scores of 0.7 or greater demonstrate acceptable reliability scores. Analysis of variance scores were used to identify sources that most contributed to differences in reliability scores.

This study was approved by the Hamilton Integrated Research Ethics Board.

Results

Objective 1: Field notes on Barriers and Facilitators to MCC Decision Making

Differences in MCC functioning per MCC team were observed. First, each of the five MCC teams observed employed a different process of case submission, discussion, and documentation. For example, some teams used MCCs to triage cases (i.e., present case to determine appropriate referral path), others discussed difficult and interesting cases, and some discussed consecutive cases of new or suspected cancers. There was significant variation in the time spent discussing cases (<1 minute - >20 minutes). Each team utilized a different case intake form to submit and organize MCC cases. Intake forms differed within the same disease site (e.g., gastrointestinal MCCs) and among different hospitals.

MCC cases were brought forward at the directive of physicians, and were not always in accordance with CCO site-specific guidelines regarding which cases should be presented. MCC chairs appeared to hold strong influence on the manner of case presentation, discussion and decision making. All MCC teams had a group coordinator who recorded the final treatment decision, as per CCO requirements. However, the final MCC treatment plan was not consistently disseminated. For instance, some groups required the presenting physician to dictate the final treatment decision in their clinical notes, others articulated the treatment decision in writing and circulated it to the MCC team following the discussion, and others did not have any formal dissemination processes in place (i.e., the treatment was recorded but not disseminated to MCC participants).

Poor attendance and late arrival to MCCs appeared to impede MCC efficiency. Field notes show that some participants arrived >30 minutes late to rounds, which negatively impacted the decision making process. For example, instances of late arrival required the presenting

physician to re-present case history and comorbidity, and summarize the MCC discussion for the late participant. One MCC participant expressed frustration by stating, *"Since everyone is in the room now, we need to start all over."*

Finally, observed collegiality differed between disease sites and hospitals. While some teams had a relaxed and collaborative environment, others demonstrated tension between members. This tension was greater in instances where there was clinical equipoise, or when the MCC team did not have pertinent evidence to direct treatment plans. For example, one case discussion resulted in observed tension between colorectal surgeons, hepatobiliary surgeons, and radiation oncologists. Statements such as *"we're putting people at risk [due to unnecessary radiation]", "we're wasting resources", "that's unnecessary"* and *"you're delaying treatment"* demonstrate such tension. In this case, the final treatment plan was unclear and was not reiterated to the group by the chair.

Objective 2: Reliability Assessment

MTB-MODe Scores

A total of 12 MCCs took place from February to April 2016. These data were used to complete the generalizability study. During this time, 33 and 37 cases were discussed in MCC1 and MCC2, respectively (see Table 1). The average time of discussion per case was 9.02 minutes (SD 3.12) for MCC1 and 4.52 minutes (SD 2.53) for MCC2.

Average mean scores across raters were generated for each of the items (see Table 2). MCC1 demonstrated slightly higher means for all information items, as compared to MCC2. The highest scores for quality of information presented was the quality of radiologic information, scoring 4.53 and 3.78 for MCC1 and MCC2, respectively. The lowest quality of information

item for both teams was consideration of patient views, which had a mean score of 1.73 and 1.56 for MCC1 and MCC2, respectively.

MCC1 teamworking scores were fairly comparable across specialties (4.39 for oncologists, 3.62 for surgeons, and 3.14 for radiologists) with the exception of pathologists, who scored very low in regards to their degree of contribution (1.24). Surgeon scores were comparable for MCC1 and MCC2, with a mean contribution of 3.62 and 3.84, respectively. The contribution of the MCC chair averaged around 2/5, indicating that "*chair leadership neither enhanced nor impeded information presentation, discussion or decision making*".

Generalizability Study

The overall reliability scores for MCC1 and MCC2 were high at 0.72 and 0.74, respectively (see Table 3). This suggests that overall reliability scores are not excessively influenced by factors such as random error or individual rater. Inter-rater reliability was fairly high, exhibiting scores of 0.56 and 0.58 for MCC1 and MCC2, respectively. Internal consistency of the MTB-MODe items for these same conferences was low at 0.15 and 0.19, respectively, indicating that the MTB-MODe items were not highly correlated. That is, scoring high on one item did not correlate with a high score on another item (e.g., high information scores for radiologists did not correlate with high scores for pathologists).

Sources of Variance

The greatest amount of variability stemmed from items nested in domains. For MCC1 and MCC2, respectively, 39% and 50% of the differences in reliability scores were attributable to items in the tool. This is consistent with the low measures of internal consistency described above. Scores from items nested in domains interacting with cases accounted for 26% and 19% of the variance in scores for MCC1 and MCC2, respectively. This suggests that mean item scores

within domains varied from one case to another. These findings demonstrate that the overall quality of a case was not determined as a 'global' assessment, but rather, was highly dependent on the individual items and domains. That is, the quality of a case could be significantly impacted by each of the individual items in the tool. The rest of the G-study terms, including rater terms, accounted for less than 10% of the total variation, indicating that rater bias had minimal influence on reliability scores (see Table 4). Rater interactions accounted for very little variability in scores, illustrating that raters had high agreement in their ratings. This suggests that the tool can be reliably implemented using a single rater.

Discussion

Our observations of Ontario MCC functioning are consistent with the findings of our literature review. Dew et al. audiorecorded 10 MCCs at four treatment sites and described the "activity" of decision making. The authors found that MCC structure and processes (e.g., stage at which a case was discussed and types of questions asked) differed by disease site.[14] In addition, we observed variation in MCC site and MCC case for the quality of information. Similarly, Dew et al. noted little consistency in case presentation, processes of case discussion, and level of detail provided in MCC intake forms.[14] These data suggest that a clear case history presentation, articulation of a clinical question, presentation of relevant evidence where available, and a clearly articulated treatment decision may improve the quality of decision making.

The literature also suggests that decision making can be affected by team collegiality and social factors. For instance, seniority and likeability of a presenting physician can bias the final treatment plan.[15] In our observations, final treatment plans were often not articulated by the chair, and may have led to a false sense of final treatment consensus among treatment members, when multiple treatment options were suggested. The literature suggests that while up to 85% of physicians have disagreed with an MCC treatment decision, 71% did not formally dissent.[16]

Such patterns may be true of Ontario MCCs as well, given that dominant team members were more likely to contribute to the discussion as compared to their less vocal colleagues. Moreover, our observations demonstrate that MCC chairs do not always formally lead the discussion to ensure equal contributions by MCC team members. Finally, other barriers noted in the literature, including lack of attendance by core specialties, late arrival to MCCs, and technological barriers were also observed at Ontario MCCs.

A crude analysis of MCC decision making scores using the MTB-MODe demonstrate gaps in decision making quality at our hospital site. Quality gaps for both information presented and teamworking were evident. Specifically, there were significant gaps in the presentation of patient views and quality of chair leadership. In addition, pathologists in MCC1 did not appear to be core contributors to the MCC decision making process, given their limited contributions to the MCC discussion. However, these scores may reflect the nature of the gastrointestinal round, where the complexity of the decision relies less heavily on histologic/pathologic findings (which are relatively consistent), and more so on the nuances of radiation, chemotherapy and surgical decision-making.

The MTB-MODe performance assessment tool has been validated for a number of MCCs in the UK.[6,8,7,17] A slightly modified version of MTB-MODe was used to evaluate the quality of two gastrointestinal MCCs in Ontario. Generalizability studies were used to determine the overall reliability of the MTB-MODe in an Ontario context. Both MCCs demonstrated high overall reliability scores (>0.70), which suggests that the reliability of the MTB-MODe is robust and not susceptible to large variability caused by rater or random error. Raters did not greatly contribute to variance scores, which indicates that the tool can be implemented using a single rater. The low internal consistency of the MTB-MODe indicates a weak relationship between the

individual tool items; therefore, the tool can be used to separately highlight the quality of MCC information presented or teamworking.

The generalizability study revealed that cases, which were the main object of differentiation, did not account for the most variability. A high degree of variance attributed to the main facet/object of differentiation indicates that score variability stems from 'real' differences (e.g., differences in colorectal cases), rather than other facets, or random error. Our findings likely reflect that there was homogeneity in the types of cases that were presented, which is reasonable given the narrow scope of cases presented in a gastrointestinal tumor board. In this study, the most variance stemmed from the individual items (n=9) that were used to assess overall case quality. This suggests the tool can reliably distinguish between individual components (e.g., discussion of patient views, case history) that comprise a high quality MCC discussion. This information can be used to generate feedback for MCC participants and highlight areas in case information or teamworking that require improvement. The two domains (information and teamworking) did not account for much variance, meaning that scores would not be skewed if one item of information or teamworking was higher than another item in the same domain. For example, a high score in surgical contribution does not correlate with an overall high teamworking score.

Limitations

The observational data presented in this study were collected informally as field notes. These data are not intended to stand alone as an observational study of descriptive, qualitative findings. Rather, these data are meant to demonstrate that the barriers and facilitators to optimal MCC decision making processes identified in the literature review are likely also present in Ontario. These findings justify the need to develop and pilot a quality improvement intervention

to improve Ontario MCC decision making quality, and encourage us to further develop the methods of Lamb et al.

The results of the generalizability study are subject to a number of limitations. First, the generalizability study findings are based on data collected at a single Ontario hospital, and may not be generalizable to other Ontario or North American sites. However, our results are very similar to studies in the United Kingdom, which supports the robustness of the MTB-MODe. Regardless, additional testing of the MTB-MODe within other cancer sites and hospital sites would be prudent. Second, study raters were non-clinicians and may have been biased in their interpretations of 'effective contributions' of MCC participants. Previous evidence by Lamb et al. suggest good inter-rater reliability between a surgeon and non-clinician.[6] Therefore, we do not believe that non-clinician biases affected the reliability scores. Finally, the MTB-MODe was slightly modified for the purposes of this study, which may have affected the psychometric properties of the original tool. However, previously published data, coupled with our own findings, suggest this tool can be slightly modified and reliably implemented in other contexts.[8,17,18]

Conclusion

This study demonstrates that quality gaps in MCC decision making exist in Ontario MCCs. Specifically, MCC teams do not present all pertinent case information, and there is not equal contribution by all MCC core specialists to the discussion. A generalizability study shows that the MTB-MODe demonstrates high overall reliability, and inter-rater reliability. Rater variance played little role in the variance of overall reliability scores, which suggests that the MTB-MODe can likely be implemented using just one rater. Low scores of internal consistency indicate that the individual items were not highly correlated. This likely explains why, despite our slight tailoring of the tool to reflect our practice setting (i.e., removal of nursing contribution

from Teamworking domain), overall reliability scores were high. These observations suggest that groups wishing to implement the MTB-MODe can do so effectively with a parsimonious use of resources (i.e., only one rater) and with the ability to make slight adjustments to tool items to reflect local practice contexts.

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Table 1: Conference Descriptives

	MCC 1	**MCC 2**
Conferences	6	6
Cases	33	37
Discussion time per case (mean)	9.02 min (SD 3.12)	4.52 min (SD 2.53)

Table 2: Mean Item Scores

		Mean (SD)	Range	Mean (SD)	Range
Information	History	4.09 (0.91)	2-5	3.67 (1.03)	1-5
	Radiology	4.53 (1.17)	1-5	3.78 (0.84)	1-5
	Pathology	3.14 (0.71)	1-5	2.78 (0.68)	1-5
	Pt. Views	1.73 (1.02)	1-5	1.56 (0.90)	1-4
Teamworking	Chair	2.55 (0.91)	1-5	2.28 (1.33)	1-5
	Surgeons	3.62 (1.53)	1-5	3.84 (0.90)	2-5
	Radiologists	3.14 (1.76)	1-5	N/A	
	Oncologists	4.39 (0.69)	3-5	N/A	
	Pathologists	1.24 (0.91)	1-5	N/A	

Table 3: Reliability Scores

	MCC 1				**MCC 2**			
Type of Reliability	Facet of Differentiation	Facet of Generalization		Reliability Coefficient (Absolute)	Facet of Differentiation	Facet of Generalization		Reliability Coefficient (Absolute)
		Random (levels)	Fixed (levels)			Random (levels)	Fixed (levels)	
Inter-rater	Cases (33)	Rater (1.00)	Domain (1.98); Item (4.50)	0.564	Cases (37)	Rater (1.00)	Domain (1,96); Item (3.50)	0.584
Internal Consistency	Cases (33)	Item (4.50)	Rater (1.00); Domain (1.00)	0.191	Cases (37)	Item (3.50)	Rater (1.00); Domain (1.00)	0.148
Overall	Cases (33)	Rater (2.00)	Domain (1.98); Item (4.50)	**0.721**	Cases (37)	Rater (2.00)	Domain (1.96); Item (3.50)	**0.737**

Table 4: Generalizability Coefficients

Facet	MCC 1		MCC 2		Description
	Variance Component	% Total Variance	Variance Component	% Total Variance	
Case (c)	0.069	17.6%	0.067	14.5%	Variance due to differences in scores across cases
Rater (r)	0.000	0.0%	0.002	0.4%	Variance due to differences in scores across raters
Domain (d)	0.000	0.0%	0.000	0.0%	Variance due to differences in scores across domains (e.g., quality of information vs. teamworking)
Items within Domain (i:d)	0.153	39.0%	0.231	50.1%	Variance due to differences between item scores
c*r	0.035	8.9%	0.000	0.0%	Variance due to interaction between cases and raters (e.g., did raters rate some cases differently than others)
c*d	0.003	0.8%	0.015	3.3%	Variance due to interaction between cases and domains (e.g., were some cases varied depending on domain being measured)
c*i:d	0.100	25.5%	0.088	19.1%	Variance due to interaction between cases and items (e.g., did scores for case A vary from item ratings within domain for case case B)
r*d	0.000	0.0%	0.000	0.0%	Variance between raters and domain (e.g., did one rater rate domains differently than the other rater?)
r*i:d	0.005	1.3%	0.003	0.7%	Variance between raters and items (e.g., did one rater rate individual items differently than the other rater?)
c*r*d	0.001	0.3%	0.014	3.0%	Variance between cases, raters, and domain (e.g., did one rater rate domains differently than the other rater across the cases)
c*r*i:d	0.026	6.7%	0.041	8.9%	Random error

Appendix A
Tailored MTB-MODe Tool

Category	1	2	3	4	5
Case history information	No patient case history presented		Partial case history		Fluent, comprehensive case history
Radiological Information	No provision of radiological information		Radiological information from a report/account		Review of radiological images
Pathological Information	No provision of pathological information		Pathological information from a report/account		Review of pathological images
Patient Views	No knowledge of patient wishes		Vague first-hand knowledge, or good second-hand knowledge of past medical history or performance status		Comprehensive first-hand knowledge of patient's wishes or opinions regarding treatment
MDT Chair	Leadership impeding information/ presentation/ discussion/decision making		Leadership neither enhancing or impeding information/ presentation/ discussion/decision making		Leadership enhancing information/ presentation/ discussion/decision making
Surgeons	Nil/ Impedes contribution of others		Contribution inarticulate or vague		Articulate and precise specialty related contribution
Oncologists	Nil/ Impedes contribution of others		Contribution inarticulate or vague		Articulate and precise specialty related contribution
Radiologists	Nil/ Impedes contribution of others		Contribution inarticulate or vague		Articulate and precise specialty related contribution
Histopathologists	Nil/ Impedes contribution of others		Contribution inarticulate or vague		Articulate and precise specialty related contribution

Taken from Lamb et al, 2011; Lamb et al, 2013

CHAPTER 3: IDENTIFICATION OF BARRIERS AND FACILITATORS TO OPTIMAL MCC DECISION MAKING

Background

Multidisciplinary cancer conferences (MCCs) improve adherence to clinical practice guidelines, strengthen collaboration and communication among clinicians, and standardize treatment pathways for cancer care.[1] In a recent review, MCCs have been shown to change treatment decisions from initial physician treatment recommendation to final consensus treatment recommendation in up to 52% of discussed cases.[2] Data from Cancer Care Ontario (CCO) show that the uptake of MCCs has increased across the province. For example, 85% of Ontario MCCs met CCO quality standards in 2017, as compared to only 37% in 2010.[3] However, CCO quality metrics remain largely based on the frequency of MCCs and attendance by core specialties. For instance, the quality of breast MCCs improved from 67% compliance in 2013 to 87% compliance in 2016, due to increased concordance with required MCC frequency, presence of an MCC chair and coordinator, and attendance by surgery, medical and radiation oncology, pathology and radiology.[3] Yet, despite the increased uptake of MCCs in the province, the quality of MCC functioning, specifically the quality of MCC decision making, has yet to be evaluated in Ontario.

Knowledge translation (KT) is the dynamic process of developing, disseminating and applying knowledge and evidence to health care. Common KT interventions include audit and feedback, use of opinion leaders, education, and reminders, among others.[4] Audit and feedback and opinion leaders, to date, are the only KT interventions that consistently demonstrate an impact on practice, but effect sizes of these interventions are often marginal to moderate.[5] For example, audit and feedback can result in a 4-17%

relative change in physician practice.[5] In response, KT experts have called for the use of more progressive KT methods, namely use of a theoretical framework, a model to identify appropriate KT interventions, and an integrated KT (iKT) approach to develop and implement quality improvement interventions.[6]

The use of theory in intervention design allows for the systematic identification of constructs that influence behaviour change, guides researchers to map behavioural constructs to appropriate interventions, and provides a testable model that can be used to explain the success or failure of a quality improvement intervention.[6] The Theoretical Domains Framework (TDF) can be used to identify or understand factors influencing complex behaviours.[7,8] The TDF summarizes 33 behavioural change theories into 14 domains that may influence a particular behavior of interest. For example, an individual clinician who does or does not routinely perform hand hygiene may be influenced by factors at the individual level - Domain of *Beliefs about Capabilities* – or at the organizational level - Domain of *Environment.* The comprehensiveness and validity of the TDF has been demonstrated, and systematic evidence shows that use of the TDF is an effective strategy to identify mediators of behaviour change for health care professionals.[8,9] For example, Patey et al. used the TDF to successfully identify barriers and facilitators to anesthesiologists' and surgeons' decisions to order pre-operative tests for anesthesia management.[10] Other study teams used the TDF to inform the design of KT interventions. Alexander et al. used the TDF to inform the design of an intervention to promote health assessment uptake among Australian preschool children,[11] while Dhopte et al. used the TDF to develop a KT intervention for Canadian chiropractors to improve care for adults with neck pain.[12]

Participant interviews guided by the TDF have been shown to identify more mediators of behaviour change as compared to non-theoretically rooted interviews or surveys.[13] In one study, Dyson et al. developed two sets of question schedules – one that was theoretically informed and one that lacked a theoretical basis – to identify barriers and facilitators to hand hygiene.[13] Interviews, questionnaires and focus groups that were informed by the theoretically-informed question schedules elicited more barriers and facilitators, as compared to the non-theoretically informed questions.[13]

The objective of this thesis chapter was to use the TDF to conduct key informant interviews with MCC participants to identify barriers and facilitators to optimal MCC decision making. These data will be used to design a quality improvement intervention to improve the quality of decision making for Ontario MCCs.

Methods

Study Design

We used the TDF to inform the design of an interview guide to identify barriers and facilitators to optimal MCC decision making. For the purpose of this study, "optimal decision making" encompasses all aspects of MCC case presentation, discussion, and final selection of treatment plans. Qualitative interviews with key informants (cancer care providers that do and do not participate regularly in MCCs) provided data for analyses. This study was approved by the Hamilton Integrated Ethics Review Board.

Setting

The province of Ontario, Canada is comprised of 14 Local Health Integrated Networks (LHINs). Relevant stakeholders from two LHINs were sampled for this study. Both LHINs contained academic and community hospitals. The LHINs collectively

service a population of 2.5 million Ontarians, or approximately 20% of residents in the province.

Interview Guide

The 14 TDF domains that can be used to identify barriers and facilitators to a behavior change of interest include: *Knowledge; Skills; Social/Professional Role and Identity; Beliefs about Capabilities; Optimism; Beliefs about Consequences; Reinforcement; Intentions; Goals; Memory, Attention and Decision Processes; Environmental Context and Resources; Social Influences; Emotion;* and *Behavioural Regulation.* Table 1 provides a list of the TDF domains, definitions and theoretical constructs, as provided by Cane et al., who validated the framework.[8]

Our literature review was used to design content-specific questions relating to each of the 14 TDF domains. For example, to assess the influence of the *Social Influences* domain of optimal MCC decision making, participants were asked questions such as: *'To what extent do your peers/your patients facilitate or hinder MCC participation?'* and *'Do the majority of your colleagues participate in MCCs?'* Participants were also asked to suggest interventions that they believed would improve MCC decision making processes. A content expert was consulted to ensure face validity of the interview guide (see Appendix A for study interview guide).

The interview guide was semi-structured and allowed for an adaptive approach to include relevant questions. Semi-structured interviewing is the best option for researchers interviewing participants in a single interview.[14] This approach allows the researcher to pursue probing questions to gain further context and ensure a comprehensive

understanding of the key informants' experiences or perceptions. The interview guide was modeled after examples provided in the implementation science literature.[10,15-17]

Study Procedure and Participants

Participants were recruited using purposeful and snowball sampling. Participants were emailed and invited to participate in either a face-to-face or telephone key informant interview. An experienced qualitative researcher (C.F.) trained in the use of the TDF conducted all interviews. Following participant consent, all interviews were recorded and transcribed verbatim. We ensured participant representation by specialist type (surgeons, oncologists, radiologists & pathologists) to allow for a comparison of findings by specialist group.

There is little consensus in the qualitative literature regarding the minimum number of interviews required to establish saturation of the data, with estimates ranging from 6-30 interviews.[18,19] Rather, most experts recommend continuing key informant interviews until no new themes emerge. Francis et al. provide an example of how to achieve an adequate sample size for interview studies rooted in a theoretical framework.[20] The authors recommend setting an a priori minimum sample size of 10, with a 'stopping criterion' of three interviews (that is, continue key informant interviews until three consecutive interviews exhibit data saturation, or do not result in any new emergent themes). The study authors demonstrate this to be an effective technique through an analysis of two studies rooted in the theory of planned behavior to identify medical practitioners' beliefs regarding the use of antibiotics and genetic testing.[22] We used this criterion as the basis to guide our sample size.

Analysis

Interview data were first categorized using the TDF domains. Two researchers (C.F. and A.A.) first jointly analyzed three interviews to ensure consistency in coding. In instances where discrepancies in coding arose, the researchers discussed the differences in order to reach consensus. A coding tree with context-specific definitions for each of the TDF domains was developed and used to guide the remainder of the coding. Given the context of this study, *Beliefs about Consequences* and *Behavioural Regulation* were condensed to a single term, due to complete overlap in identified themes. The two researchers double-coded the remainder of the key informant interviews. Once the data were analyzed by TDF-domain, a secondary analysis was performed to identify salient themes within the TDF domains. Themes are qualitative descriptions of interview findings that further provide context to the TDF domains. For example, MCC literature demonstrates that some MCC participants dominate the conversation to bias MCC decisions.[21] This finding would be categorized under the TDF domain of *Social Influences*. To further provide context within the *Social Influences* domain, a theme developed via content analysis would be "certain MCC participants dominate the MCC discussion". The decision to present the findings as both TDF domains and emergent themes was made to provide context to the theoretical findings and ensure that the key informant data were meaningful to the target population.

If a quote was found to fit into multiple themes following discussion, it was double coded. Double coding allowed our research team to identify linked themes and related domains. The decision to double code the qualitative data is consistent with evidence that some TDF domains measure a combination of factors and do not represent an isolated behaviour.[21,23] Salient quotes were highlighted to provide "thick descriptions"

of participants' experiences in MCCs. Finally, data were analyzed by physician specialist group.

Results were first reported as a summary of all TDF domains identifying barriers and facilitators to optimal MCC decision making, respectively. TDF domains with the greatest number of themes presenting barriers and facilitators to optimal decision making are first presented, followed by an analysis of themes that overlapped across multiple domains. For example, willingness to regularly attend MCCs and participate in multidisciplinary decision making was influenced by multiple theoretical domains: *Social Influences* (e.g., influence of peers), *Professional Identity* (i.e., is it my professional responsibility to attend MCCs?) as well as *Emotional* and *Environmental* factors. Finally, the analyses of findings by physician specialty were reported.

Results

Participant Demographics

Interviews were conducted from April 2016 – July 2017 by a single researcher. Data saturation was reached at n=21 interviews. Participants included seven surgeons, eight oncologists (five medical oncologists, three radiation oncologists), three radiologists and three pathologists. Participants were from three academic and four community sites. The majority of interviews (17/21) were conducted in person, while the remainder (4/21) were conducted via telephone. Thirteen participants (13/21) attended MCCs at hospitals in the Hamilton Niagara Haldimand Brant LHIN and eight (8/21) were from the Toronto Central LHIN. Mean time per interview was 33 minutes (range 19 min – 78 min).

Themes within TDF Domains Identified as Barriers to Optimal MCC Decision Making

Barriers to Optimal MCC Decision Making

Themes identified as barriers and ascribed to 10 TDF domains included the following: *Knowledge; Memory, Attention and Decision Processes; Environment; Social Influences; Social/Professional Role and Identity; Emotion; Beliefs about Capabilities; Beliefs about Consequences/ Behavioural Regulation; Reinforcement;* and *Optimism.* Each domain contained an average of 2-4 qualitative themes (see Table 2).

The TDF domain of *Memory, Attention and Decision Processes* contained the greatest number of qualitative themes pertaining to barriers that influence MCC decision making (n=5 themes, see Table 2). Themes within the *Memory, Attention and Decision Processes* domain included gaps in MCC leadership, lack of participant attendance, lack of MCC participant preparation, unstructured processes for case presentation, individual treatment preferences by treating physicians, and prolonged case discussions. These themes interacted to impede MCC decision making. One participant stated,

> *"[MCCs] get[s] frustrating because the discussion goes on way past the decision making point and we going to get into 'at nauseum' discussions where there cannot be a black and white answer"- Participant 8 (Surgeon)*

The *Social Influences* domain contained the second greatest number of themes (n=4) identified as barriers to optimal MCC decision making. These themes included a lack of soft skills (e.g., use of non-effective communication strategies) among group members, negative group dynamics or bullying, the inability to ask questions openly, and the domination of the conversation by few individuals. In one example of how social factors can be a barrier to MCC decision making, a participant stated,

"*I can name oncologists who won't go back to rounds because they're made to feel stupid at the rounds*"-*Participant 2 (Medical Oncologist)*

Overlap of themes within TDF domains

The *Social Influences; Environment; Social/Professional Role and Identity;* and *Emotion* domains overlapped with the domain of *Memory, Attention, and Decision Processes*. For example, time demands (i.e., a lack of time to prepare for, and attend, MCCs) were one of the most commonly reported barriers to MCC decision making. Time demands were categorized as a theme within the *Environment* domain. However, time demands also caused MCC participants to feel under-appreciated at rounds, which was categorized in the *Emotion* domain. These feelings of under-appreciation arose when an MCC participant felt they had dedicated significant time to prepare for an MCC case, and their colleagues had not reciprocated in kind. This is best explained in the following quote by a radiologist who highlights the interaction between time demands and feelings of underappreciation,

"*Nobody, honestly, has the appreciation of the amount of time…we [radiologists] put in those rounds and the time it takes…they [surgeons] ask us to prepare for those rounds. I think it's unacceptable that they're not prepared." – Participant 3 (Radiologist)*

Lack of attendance by presenting physicians (oncologists or surgeons), and time barriers often led to a cancellation of cases listed for discussion. This further caused feelings of frustration for radiologists and pathologists (who had prepared the case imaging and slides), and other participants who were in attendance at time of MCC discussion.

Identified Barriers by Specialist Group

Themes in the *Environment* domain, specifically themes relating to time demands, were identified by all specialist groups as a barrier to MCC decision making. Surgeons identified scheduling conflicts and operating room demands as barriers to regular MCC attendance. Oncologists cited time demands as a barrier to discuss all new or suspected cancer cases, as per CCO criteria. Finally, pathologists and radiologists described the significant amount of time required to prepare for MCCs, and highlighted that MCC preparation adds greatly to their regular workload. For instance, preparation of radiologic or pathologic findings for an MCC can take up to one full work-day per week to prepare.

While some barriers were common to all specialists (e.g., time demands), others varied by specialist group. For example, surgeons' level of participation in MCCs varied according to their intrinsic beliefs regarding the importance of collaborative decision making (i.e., those who valued collaborative decision making were more likely to regularly participate in MCCs).. Moreover, surgical participants reported that surgeon hierarchy, technical ability, and group dominance often influenced the final surgical recommendation (*Memory, Attention and Decision Processes).*

Unlike surgeons, there was less variation in oncologists' opinions regarding the role of MCCs in practice, and most oncologists cited MCCs as an integral part of their practice. The most common barrier cited by oncologists was the inability to make a decision, due to limited evidence and conflicting treatment recommendations *(Knowledge).* One medical oncologist highlighted being "quite confused" when surgeons and radiation oncologists presented conflicting treatment decisions that left him feeling "lost" in the decision making process. Oncologists further highlighted that lack of

leadership lead to cyclical discussions without a clearly articulated final plan, as seen in the following quote,

> *"The facilitator tends to just let people talk in circles over and over again for ten minutes about the same thing and there's no directing the discussion to 'Okay, let's kind of get back on course to this patient…let's kind of, you know, circle back to what do we need to do for this patient now'."- Participant 16 (Medical Oncologist)*

Finally, as previously described, the most common barrier cited by radiologists and pathologists was related to time demands *(Environment)* and the subsequent feelings of frustration and under-appreciation *(Social Influences, Emotion)* when treating physicians did not adequately contribute the required time to prepare for, and attend, MCCs.

Themes within TDF Domains Identified as Facilitators to Optimal MCC decision making

Facilitators to Optimal MCC Decision Making

A total of ten TDF domains contained themes identified as facilitators to optimal MCC decision making. Seven of these ten domains (*Knowledge; Social Influences; Social/Professional Role/Identity; Beliefs about Capabilities; Beliefs about Consequences/ Behavioural Regulation; Reinforcements; and Optimism)* contained themes that were identified as barriers. As expected, for these seven domains, the converse of barrier themes were identified as facilitator themes. For example, the *Knowledge* domain encompasses physician knowledge of available clinical guidelines and recent evidence. Such *Knowledge* facilitated clinicians' ability to make a treatment

recommendation; however, the absence of this knowledge was a barrier to treatment recommendations.

A summary of all identified domains and corresponding themes are listed in Table 3. The TDF domains with the most facilitator themes were *Knowledge*, *Social Influences*, and *Reinforcements* (n=2,2,2, respectively). Regarding *Knowledge,* MCCs were found to provide opportunities for learning and standardization of decision making. In regards to *Social Influences,* participants believed MCCs facilitated collegiality and teamworking. *Reinforcements* that further facilitated MCC decision making included CCO hospital funding (that could be jeopardized if MCCs were not held regularly), as seen in the following quote,

> *"CCO will say, 'you did twenty radical prostatectomies last quarter, only four of those patients saw a radiation oncologist, can you explain why?' and with the subtle hint that eventually, they'll start to withdraw funding if the patients aren't seen" – Participant 14 (Radiation Oncologist)*

However, the primary motivating factor to MCC participation appeared to be an intrinsic belief in the benefit of MCCs, rather than external reinforcements, as highlighted by one medical oncologist,

> *"I think people like going to rounds, I think it's an enjoyable experience, generally. I can't see the financial being the driving force" – Participant 11 (Medical Oncologist)*

The TDF domains of *Skills; Intentions;* and *Goals* were identified uniquely as facilitators to MCC processes (i.e., the converse of these domains were not identified as barriers). Participants reported that regular attendance and participation in MCC rounds increased

their *Knowledge* and *Skills* and allowed them to gain an appreciation of their colleagues' decision making practices. For example, pathologists highlighted that participation in MCCs equipped them to better present histological findings to treating physicians, while simultaneously promoting a collaborative culture of interdisciplinary teamwork. Participants reported that their motivations to engage in MCCs stemmed from an intrinsic affinity to quality improvement (*Intentions*). Intrinsic motivation and general optimism towards MCCs were suggested to be more effective than external *Reinforcements* or *Beliefs about Consequences*. Patient preference, a desire to collaborate with peers, and increased confidence in the final treatment decisions drove intrinsic motivation and optimism towards MCCs. Finally, many participants described the importance of MCC team *Goals* to facilitate decision making. Examples of these goals included an MCC attendance schedule and a triage system for urgent cases. MCC goals appeared to differ based on the culture and needs of the individual team.

Overlap in TDF domains

Many of the facilitator themes were closely correlated. For example, there was overlap in the domains of *Skills, Social Influences; Social/Professional Role and Identity; Intentions; Optimism;* and *Beliefs about Consequences*, as MCCs were perceived to improve knowledge, collaboration with colleagues, and decision making quality. There were no significant differences in identified MCC facilitators by specialist groups. Rather, surgeons, medical and radiation oncologists, and radiologists and pathologists all spoke favorably of MCCs (*Optimism)*, and noted their importance, despite having identified barriers to their functioning. One participant stated,

> *"[MCCs] are absolutely vital. I can't imagine having a centre [or] any area where there's multidisciplinary care of patients, where you're not getting together to discuss the difficult cases" – Participant 14 (Radiation Oncologist)*

One difference between specialist groups was related to remuneration, categorized in the *Reinforcement* domain. Many radiologists noted that they did not receive the same level of monetary compensation as other MCC participants. This was confirmed by a surgeon, as seen in the following quote,

> *"The current reality is that radiologists are working for free...our radiologists prepare to get 30 cases done in the day, they spent an afternoon reviewing those cases for which there is miniscule remuneration, plus the hour and a half they are in that room…it's only at the goodness of them and their colleagues [to participate]". – Participant 8 (Surgeon)*

However, funding discrepancies did not preclude radiologists and pathologists from regularly attending and participating in MCCs, which further reinforces the notion that intrinsic motivation is likely the main catalyst to MCC participation.

Discussion

Emergent themes from each of the TDF domains were identified as either a barrier or facilitator to MCC decision making. This study is the first to utilize a theoretical framework to identify domains that influence physician behaviour during MCC decision making. Our findings parallel those in the literature, but highlight the extent of the problem—that constructs from 14 behavioural domains interact to impact optimal MCC decision making. There were ten TDF domains that identified barriers and ten TDF domains that identified facilitators to optimal MCC decision making.

Our study found significant overlap of identified themes within seven domains. Figure 1 presents a conceptual figure showing an interaction of five TDF domains. For example, an MCC decision can be affected by the availability of environmental factors, by the social interactions of MCC participants, and by the perceived importance of MCC attendance by core specialties. Figure 1 presents shows how the *Decision Processes* domain interacts in a feedback loop with the domains of *Professional Identity, Emotions, Social Influences, and Environment.* Because of the significant interaction and overlap between TDF domains, it is likely that a strategy intending to improve MCC decision making must concurrently target individual and group behavioral and, organizational, factors.

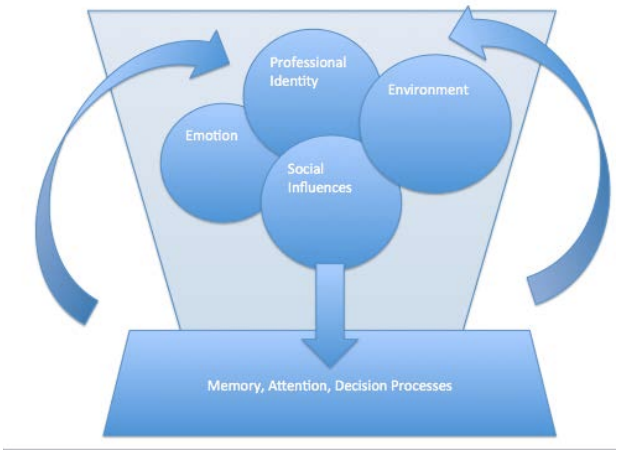

Figure 1: Conceptual figure of interacting TDF domains

Myriad processes influenced MCC decision making, as evidenced in our results, which identified barriers and facilitators pertinent to all TDF domains. Seven domains contained themes identified as both barriers and facilitators, with the converse of the barrier serving as an MCC facilitator. As expected, our results suggest that the mitigation of a MCC barrier to decision making may also enhance a facilitator to MCC decision

making. For example, a negative team dynamic (*Social Influences*) was a barrier to MCC processes, yet a positive team dynamic (*Social Influences*) resulted in improved attendance, increased perceptions of MCC value and enhanced collegiality. That is, elimination of a negative team dynamic can mitigate barriers to decision making by facilitating a team collegiality, participant motivation, and thus likely improve decision making quality.

There appeared to be differences in specialist groups' perceptions of existing MCC decision making barriers. For instance, surgeons identified surgical hierarchy *(Social Influence)* and technical ability *(Beliefs about Capabilities; Skills)* as factors that affect decision making. Other barriers, such as time shortages, were common to all groups, but impacted specialists differently. Time barriers barred surgeon participation in MCCs and precluded oncologists from presenting all their desired cases. In contrast, time barriers encumbered the ability of radiologists and pathologists to complete their other clinical responsibilities in a timely manner, and left many feeling overwhelmed or frustrated. Such differences suggest the need to further explore perceived barriers and facilitators to optimal MCC decision making by specialist group, prior to designing a quality improvement intervention. Despite having identified barriers to MCC decision making, participants in this study were generally optimistic towards MCCs, and many recognized the influence of MCCs on treatment plans and patient care. As a result, many were intrinsically motivated to participate in MCCs, independent of external reinforcements (e.g., remuneration).

Finally, there is evidence to suggest that the needs and culture of MCC teams differ, and may impact the type of intervention required to improve MCC decision

making. For instance, some key informants cited examples of good MCC collegiality and teamwork, while others reported negative team dynamics that impeded MCC decision making. Due to these variations, a quality-improvement intervention aimed at targeting MCC decision making should be adapted to the context of each MCC site. This recommendation is consistent with recently published findings that highlight the importance of considering context when implementing a complex intervention.[24] Use of integrated KT methods should be encouraged to allow for such contextual considerations.

Our findings are generally consistent with other Ontario and international MCC literature. Look Hong et al. completed a thematic analysis of key informant interviews with MCC physicians and administrators participating in Ontario gastrointestinal MCCs.[25] The study showed that efficient management of cases by an MCC chair, identification of strategies to improve participant attendance, and recognition of radiologist and pathologist roles were critical to MCC structure. Moreover, collegiality, level of teamworking, and the availability of technological and institutional factors were likely to impact MCC functioning. Similarly, Jalil et al. conducted a qualitative study in the United Kingdom to assess MCC participants' views on decision making.[26] Their analysis indicated that inadequate clinical information, lack of investigation results, non-attendance of key members, and teleconferencing failures were major barriers to MCC decision making.

Limitations

There were limitations to the presented study. First, these qualitative findings may not be representative of MCCs across Ontario. Our research team aimed to promote generalizability of the findings by selecting a representative sample of physicians at

multiple academic and community hospitals from two regions of Ontario that service approximately 20% of the population in Ontario. As well, the results of this study are comprehensive, and identified themes pertaining to each of the TDF domains. Moreover, our observations are consistent with previously published MCC literature. Thus, our findings are likely generalizable to other jurisdictions, and reflect the state of other Ontario MCCs.

Secondly, we incurred the challenge of interpreting themes pertaining to 14 TDF domains. The purpose of the TDF is to guide researchers to identify domains that are most likely to impact a behavior change. However, our results revealed themes relevant to all domains, and showed significant overlap between domains. A review of the KT literature did not identify any strategies to identify domains that were considered most salient by participants. Moreover, we were unable to determine whether some domains were more likely to influence MCC decision making, as compared to others. Our experience likely reflects those of other researchers who use the TDF to identify barriers to complex and multifaceted behaviours. Additional methods should aim to identify the most salient domains likely to influence a behavior of interest, as identified by the target population.

Conclusion

This study utilized the Theoretical Domains Framework to identify barriers and facilitators to optimal decision making processes for Ontario MCCs. All 14 domains of the TDF were identified as mediators to MCC decision making. There was overlap in seven of the TDF domains, indicating that the converse of a barrier theme could serve as a facilitator, and vice-versa. There was also overlap in identified barrier and facilitator

themes, respectively, further highlighting interactions between TDF domains. This study was the first to utilize the TDF to describe the complex processes that impact MCC decision making. These findings will be used to design and pilot a quality improvement intervention to improve the quality of MCC decision making in Ontario MCCs.

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TDF Domain	Definition	Constructs
Knowledge	An awareness of the existence of something	Knowledge; Procedural Knowledge; Knowledge of task environment
Skills	An ability or proficiency acquired through practice	Skills; Skills development; Competence; Ability; Interpersonal skills; Practice; Skills assessment; Professional Identity
Social/Professional Role and Identity	A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting	Professional role; Social identity; Identity; Professional boundaries; Professional confidence; Group identity; Leadership; Organisational commitment
Beliefs about Capabilities	Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use	Self-confidence; Perceived competence; Self-efficacy; Perceived behavioural control; Beliefs; Self-esteem; Empowerment; Professional confidence; Optimism
Optimism	The confidence that things will happen for the best or that desired goals will be attained	Pessimism; Unrealistic optimism; Identity
Beliefs about Consequences	Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation	Outcome expectancies; Characteristics of outcome expectancies; Anticipated regret; Consequents
Reinforcements	Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus	Incentives; Punishment; Consequents; Reinforcement; Contingencies; Sanctions
Intentions	A conscious decision to perform a behaviour or a resolve to act in a certain way	Stages of change model; Transtheoretical model and stages of change
Goals	Mental representations of outcomes or end states that an individual wants to achieve	Goals (distal/proximal); Goal priority; Goal/target setting; Goals (autonomous/controlled); Action planning; Implementation intention
Memory, Attention and Decision Processes	The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives	Memory; Attention; Attention control; Decision Making; Cognitive overload/tiredness
Environmental Context and Resources	Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour	Environmental stressors; Resources/material resources; Organisational culture/climate; Salient events/critical incidents; Person x environmental interactions; Barriers and facilitators
Social Influences	Those interpersonal processes that can cause individuals to change their thoughts, feelings or behaviours	Social norms; Group conformity; Social comparisons; Group norms; Social support; Power; Intergroup conflict; Alienation; Group identity; Modelling
Emotion	A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event	Anxiety; Affect; Stress; Depression; Positive/negative affect; Burn-out; Self-monitoring
Behavioural Regulation	Anything aimed at managing or changing objectively observed or measured actions	Breaking habit; Action planning

Table 1: Definitions of TDF Domains (taken from Cane et al., Implementation Science; 2012;(7)37)

Table 2: Barriers to Optimal MCC Decision Making

TDF DOMAIN	THEMES	QUOTES
Knowledge	Lack of awareness of CCO (governing body) guidelines regarding which cases should be discussed at MCC	"I didn't even know CCO guidelines existed" – P16
	The quality of the discussion and decision making process is contingent on the amount of knowledge the MCC participants hold	"I've spend forty-five minutes at looking at the patient's imaging having partial information…it's not against the nurse, they don't have the knowledge [of the patient]…[this discussion is] kind of poor quality or sub-par, it has no place there. The level should be higher than that. – P3
Memory, Attention, Decision Processes	MCC chairs do not always control the flow of MCC discussion	"It gets frustrating because the discussion goes on way past the decision making point and we going to get into "at nauseum" discussions where there cannot be a black and white answer ... the discussion is out of line" – P8
	Presenting physicians (MRP) are not prepared for MCC discussion	"I mean, we're all players in there, they [surgeons] ask us [diagnostic imaging] to prepare for those rounds. I think it's unacceptable that they're not prepared for the rounds, you see what I mean? If they have two patients that they, at least for their patient, they have to know everything, and they should review [the reports]" – P3
	There is no standard format for presentation of cases or processes of discussion/decision making	"What had been happening is we would print out the case list, me or, generally the nurse, would scribble the decision, and it would get put in a binder, and once again they get thrown out. So there was no way to even go back and document "Oh, this person's been discussed on three different occasions," or to pull up the last discussion" –P3
	The right specialists are not in the room at time of MCC discussion (linked to time demands) - Practice site (community, academic) influences attendance and subsequently, decision making	"We're limited in doing the multidisciplinary rounds by, usually by surgeons' availability, because their time is [limited], we can't really meet at lunch because they're in the O.R. and, so, you know, we're limited by that" –P4 "I'm in a difficult spot because I'm the sole oncologist [at a community site], so I have to attend so many MCC, but most people at academic centres, you're one of 15 oncologists, so if you don't show up, one of your colleagues will" – P1
	Decisions vary by the individuals present - Hierarchy (age, seniority) influences decision making	"[There is] definite variability based on who is in the room. So the most is in surgery 'cause you know, one surgeon operates, and the other feels like they can't operate, so there's a lot of surgical variation" –P7 "or even though we try to do evidence-based, sometimes the trial that we base our evidence on is not, not the best, right, and some people will say 'Well, I'll still use that data', and some people will say 'Oh, I'll throw it away'" – P1 "There's standard of care, then there's a bit of art to oncology, and there's different ways that people do things" –P1
Environment	Group mandates to mitigate time demands (e.g., max number of cases, deadline to submit cases) are not always effective	"Part of the frustration with MCC is the turnaround time...So for example…you have to have your case emailed in by Wednesday, or whatever it is to get on for the next week...well I see my new patients on Wednesdays, right, and so I will often bat my eyelashes and say "Please,

		please [discuss my case]" – P2
	Inadequate administrative supports (community and academic sites)	"It's a lot of legwork, that maybe academic [sites that have coordinators] don't really appreciate, you know, but certainly I'm [med onc] the one who has to get that [imaging] disc, get it to the right person, make sure it's uploaded, and sometimes I'll go [to MCC] and my disc is not uploaded, so I can't present [my case]" –P1 "I have no secretary, essentially. We have one on paper, and I ask her [to do] something and she starts crying… seriously, no, no, I'm not joking, so we have no clerical help" –P3
	Inadequate physical resources (space, technology, access to imaging)	"The teleconferencing itself, it's a complex process, sometimes it's time consuming, we don't always hear each other that well" –P6 "We have barriers here with our technologies so it takes forever to load up images...and the computers we use are too slow I think, they always seize up"-P9 "So you have a problem, you're in the room, and then you have somebody knocking at the door and saying 'We have the room at five o'clock, so please finish your rounds" –P3
Social Influences ***Factors that affect discussion and decision making***	Lack of soft skills (e.g., effective communication, collaboration) among group	"You have really psychopathic groups, really, where people are not really collaborating...I mean, some people have pretty, can have pretty bad attitudes, and that's known, right, and we have some rounds that work not as well as others for that reason" –P3 "We're pretty collegial group, so in our own environment there's not much of a conflict, we can call each other idiots or swear but it's very benign" –P12 "I was sitting around the table and [was able to] stop the side discussions and all the joking and all the irrelevant stuff but it's much more difficult when you're sitting here and you see them on TV [satellite site] making jokes and stuff" –P6
	Negative group dynamics/ Bullying	"I can certainly see in certain centres there may be bullying from one group to the other or from one physician to the other. It's just like high school" –P12
	Lack of psychological safety (ie: ability to ask questions/ make mistakes)	"But the folks [at certain MCC] will be a major pain… they make you feel stupid…and I can name names of oncologists…who won't go back to those rounds because they're made to feel stupid at the rounds" –P2
	Certain individuals dominate the conversation	"Well everything is always driven by a few people but there is always an opportunity – no body is shut down. If they don't speak, its because they choose not to" –P12 "[at some rounds] we have forceful individual who want to take over, want to shine" – P3
Social/Professional Role and Identity	The desire to discuss cases collaboratively at MCC is not tied to professional role/identity (i.e.: some physicians don't feel that they must attend MCC in order to effectively fulfill their professional role)	"The impact of that [MCC] would be extremely minimal. If you've got a well-trained clinician, they can decide which [cases] need to be discussed" –P9
	Preference of 'solo practice' versus 'collaborative style' defines willingness to regularly attend MCC	"The other barrier to that is that surgeons are very proud and autonomous in the way that they want to perform in operation and they don't want to take criticism very easily and so volunteering to subject yourself to scrutiny and criticism may not be very acceptable to a lot

		of surgeons" –P7 "I mean, the problem that I have with [not attending] is that I find it hard to believe that anyone in a large-volume centre that treats very complicated cases doesn't have any cases where they need peoples' help ... how could you be treating two-hundred people a year and not have questions on, like, ten percent of them, I mean, it just doesn't make any sense" – P14
	Professional identity (linked to specialty/ hospital site) and beliefs dictate treatment recommendations and preferences	"When [academic physicians] go out [to a community site], they [community physicians] get their backs up and they resent the fact that you're the "professor" coming…and it's like 'Huff, you think you know more than me!' – P14
Emotion	Emotions during MCC discussions can run high and lead to conflict	"There is definitely conflict" – P1 "Every once in a while, some good-old fights break out" –p2 "You have to be very zen. You have to be very zen" –P3
	Feeling underappreciated; undervalued in the MCC decision making process	"Nobody, honestly, has the appreciation of the amount of time…we [radiologists] put in those rounds and the time it takes… no clue or no appreciation, or no idea, actually, how detailed and how, the amount of time we have to spend at looking, at looking at [the images] –P3 "The fact that they [radiologists] do as many MCC as they do with no direct compensation whereas everybody else in that room is [compensated] in some form. It's not fair" – P8
	Emotion and recent experiences affect decision making	"The one thing that's hard to capture is the mood that the physicians are in – there can be fluctuations in the mood where you can present the same case weekly three times, and get a different opinion depending on the mood of the specialists that may be involved in the decision making"–P12
Beliefs about capabilities	Capacity to make a decision is limited when there are conflicting decision recommendations	"You'll see them arguing over, you know, long-course radiation chemo-radiation versus short-course, and sometimes whether you need any radiation pre-op if you do a good TME (total mesorectal excision). So as a non-surgeon, non-rad onc, it's quite confusing when I make the referral and then we have two completely different opinions, and I think a lot of medical oncologists feel that same way, that on that particular issue, that we're a bit lost" –P1
	Individuals use MCC to empower their own decisions	"In as much as that if something goes wrong, at least I can say 'Well, it wasn't just my decision, it was everyone's'" –P16 "You know, if somebody attends tumor boards regularly and you like the way they think and their opinion then you're more likely to want to work with them…And by virtue or referring to that person, you refer less to the persons that you don't like" –P7
Beliefs About Consequences/ Behavioural Regulation	There are little to no perceived consequences to individuals participating in MCC discussion (as long as the hospital site meets the minimum provincial requirements)	"There's unfortunately no consequence to not attending tumor board" –P12 "The surgeon wanted to do a radical prostatectomy, everyone, even all of the surgeons were like 'No!' like, "This is wrong', and he did it anyways" –P14 (ties to autonomy – beliefs about capabilities)
Reinforcements	Carrots vs. Sticks: Beliefs that lack of 'sticks' is a barrier to efficient MCC discussion and decision making	"If people can't comply [with MCC goals] you either say ok we'll let inefficiency reign…and offenders will stay offenders…or you're gonna say no were serious about this, therefore the rules are absolute" – P8

		"I don't believe that carrots help. Going to MCC and learning, it should be a carrot enough. So, I think, I think there'd have to be a stick. It would have to be, if you don't show up, then you lose... 'you lose money, you lose ability to see patients', or whatever it is. You theoretically could give people a financial bonus to go but I have a philosophical problem with paying people for things they should be doing already" –P14 "It's hard to police that though unless you have, you really would need a physician champion, who's senior enough and has the authority to say "Well, that's you're question, we're not reviewing that this week." –P17
Optimism	Evidence of disfavor for CCO guidelines regarding which cases to discuss at rounds/ how MCC are evaluated	"Well their [CCO's] intent is to try and encourage MCC to happen, I think they're a little bit too prescriptive and they're not practical for some disease sites and some institutions. Same thing with the sub-specialties that are required to be there, it is not always logical to have all the sub-specialties there. For instance, from the perspective of hepatobiliary rounds, radiation oncology is not usually all that common" –P9

Table 3: Facilitators to Optimal MCC Decision Making

TDF DOMAIN	THEMES	QUOTES
Knowledge	MCC provide opportunities for learning (from colleagues, other specialists, resident learning)	"We learn way more in MCC than anything else now" – P14 "You learn things from the MCC, right, a trial might come up that you weren't aware of, or a new drug approval might come that you didn't know about, and you get that education at the tumour boards" – P1
	MCC allow for standardization of decision making and treatment plans	"You get to stay up with what the rest of your colleagues are thinking, and we get some kind of standardization around treatment" –P4
Skills	Attending MCC allows specialists to better collaborate with their colleagues/ understand what others need	"From my perspective as a pathologist, I have learned a lot over the years about what is relevant and what is not…what are the major parameters that radiation oncologists, medical oncologists or the surgeons look for in guiding their management" – P15 "I love getting to see how my other colleagues think, we don't get an opportunity to do that outside of MCC, because right, it's not like I go to my colleagues' clinics, so right, it's good to know how other people are thinking" –P1
Social Influences	The ability to work cohesively as a group positively impacts decision making and teamworking	"You have to be able to practice as a group and to value people's opinion" – P3 "Culture eats strategy for breakfast…in a big group inter-personal relationships are diluted but in a smaller group, inter-personal relationships are very important. And so all of that will probably overshadow any process [of decision making]" – P7
	MCC facilitate collegiality	"There's coffee and muffins there...and there's, every one of the surgeons, they like to come and talk about their cases, like I think it's a very positive social culture" – P10
Social/Professional Role and Identity	Many MCC participants feel a personal responsibility to discuss cases, beyond the scope of CCO instruction (e.g., use of email to circumvent time restraints)	"I get emails all the time. They'll email like ten experts...and we all weigh in on how we might look at a case" –P2 "Email is also quite good because for a lot of non-urgent things you can just send an email and get responded to later down the line" – P11
Beliefs about capabilities	Participation in MCC doesn't limit physician autonomy to make decisions	"I don't think [autonomy is affected], because at the end of the day, we're making recommendations, and it's not like they have to follow through with them if they are uncomfortable or if they don't agree" – P2 "I don't feel that my autonomy has been taken away from me, because I probably would have been thinking about the problem differently" –P7
Goals	MCC groups have set goals to improve efficiency and ensure comprehensive discussion of cases	"We rotate, so we send a medical oncologist to [rounds] every week" – P2 "We try to time the discussion as well with patient's treatment urgency, kind of, sense of

	- Rotate attending specialists - Set limits on number of cases to be discussed - Triage cases based on urgency MCC goals dictate what MCC participants define as an 'optimal MCC'	urgency, we triage the cases" – P3
Intentions	Motivation to discuss cases due to: - Patient requests - Intrinsic motivation - Facilitate quality improvement	"There are people who bring cases to tumor board when they tell the patient up front we will discuss you at tumor board and then we will come up with a recommendation" – P12 "For the support and care of my patients. I've always gone [to MCC], I've been doing these for almost 20 years" – P9
Optimism	General positive attitudes towards MCC	"They're [MCC] absolutely vital. I can't imagine having a centre where you were having a- any area where there's multidisciplinary care of patients where you're not getting together to discuss the difficult cases" – P14
Beliefs About Consequences/ Behavioural Regulation	Positive consequences of MCC decisions: - streamlines decision making for complex cases - save patients from unnecessary consults/ results in more efficient care - improves quality care	[If someone says] "well, actually they should probably see this specialist," and then they [patient] wait for a consult to see that specialist, I mean that's avoided, the waiting from one doctor to another, so I think that's its primary benefit, is that you can narrow down what to do fairly quickly and were the patient should go next " – P16
Reinforcement	CCO ability to withdraw funding is a major driver in bringing patients forward for MCC discussion	"There's a [CCO] score card, and one of them has to do with, um, participation in MCC, so, you know…you had to have five [MCCs] per quarter…there's also pressure from the organization to make sure that the organization gets credit, because if they don't, then there are funding implications" – P4 "CCO will say, 'you did twenty radical prostatectomies last quarter, only four of those patients saw a radiation oncologist, can you explain why?' And with the subtle hint that eventually, they'll start to withdraw funding if the patient's aren't seen" –P14 "We have to meet this metric otherwise Cancer Care Ontario will take our money away" – P16
	Personal Incentives: - Billing for MCC - Obtaining continuing medical education credits	"I think people like going to rounds, I think it's an enjoyable experience generally, I can't see the financial being the driving force but I mean well you have that for sure" –P11

APPENDIX A: Interview Guide

TDF Domain	Questions
Knowledge	1. Our study is evaluating the impact of MCCs in Ontario. Are you aware of the CCO mandate regarding MCCs? *If not: state that every new or suspected cancer case should be discussed in a collaborative setting* 2. Do you know of any evidence to support this mandate?
Skills	3. How easy or difficult do you find it to discuss every new or suspected case in a multidisciplinary cancer conference?
Professional role and identity	4. Do you think that the CCO guideline should mandate behavior in real practice? 5. What are your perceptions of CCO guidelines, in general? 6. Do you believe that participating in a weekly multidisciplinary MCC limits physician autonomy?
Beliefs about capabilities	7. Do you consider it easy or difficult to participate in MCCs? Why or why not 8. Have you encountered any problems by participating in MCCs? 9. Have you encountered any problems by not participating in MCCs? 10. What would help you attend MCCs more frequently OR if they attend, what would make the MCC process more enjoyable? 11. Are you comfortable discussing all of your treatment plans in a multidisciplinary context?
Beliefs about consequences	12. Do you believe that discussing cases in a multidisciplinary context influences change in patient care? Why or why not? 13. Do you think there would be any consequences if you did not participate in MCCs OR Do you think that your colleagues who do not participate in MCCs face any consequences? 14. Do the benefits of MCCs outweigh the costs (costs to be prompted by conversation: ie lack of time, resources, etc.)
Motivation and goals	15. Do you enjoy participating in MCCs? 16. Do you feel more comfortable with your management plans if they have been discussed in a multidisciplinary conference? 17. Which cases do you bring to MCC? How do you decide? 18. Are there any incentives to participating in MCC? Probe: are they aware that they can bill for MCCs?
Memory, attention and decision processes	19. Are there any reasons why you do not/ would not participate in MCCs? (prompt: competing tasks, time constraints) 20. Do you believe that MCC generate consensus? Do you abide by this consensus/ by the group decision? Why or why not? Are there any factors that make you more likely to implement a decision re management (ie: who made the suggestion, evidence, etc.)?
Environmental context and resources	21. To what extent do physical or resource factors provided by the hospital facilitate MCC participation? 22. To what extent do physical or resource factors provided by the hospital hinder MCC participation?
Social influences	23. To what extent do social influences facilitate or hinder MCC participation? (peers, patients?) 24. Do the majority of your colleagues participate in MCCs? Does that influence your decision to participate?
Emotion	25. Do MCCs lead to any tension between colleagues? Does this affect your decision to participate? 26. Do MCCs promote teamworking? Does this affect your decision to participate?
Behavioural regulation	27. Is the manner by which MCCs are conducted helpful to case discussion? Why or why not? What could be improved?
Nature of the behavior	28. How often should clinicians participate in MCCs (ie: should the same people show up every week, are there any consequences in that?) 29. Are there any systems in place/ what systems should be put in place to monitor the impact of MCCs?

CHAPTER 4: DEVELOPMENT OF THE KT-MCC STRATEGY

Introduction

KT researchers recommend the use of theoretical frameworks, models, and an integrated KT (iKT) approach to design quality improvement interventions. In the previous chapter, we utilized the Theoretical Domains Framework (TDF) to conduct key informant interviews with multidisciplinary cancer conference (MCC) participants to identify barriers and facilitators to optimal MCC decision making. Identified barriers to optimal MCC decision making included lack of leadership by the MCC chair, preparation by MCC participants, and attendance by core specialists. In addition, participants cited barriers pertaining to discussion inefficiency, lack of teamworking, and technological barriers.

Identified TDF domains can be transposed to the COM-B Behaviour Change Wheel, which is a categorization model that can be used to understand behaviour.[1] The COM-B identifies three components of behaviour – Capabilities, Opportunities and Motivation – that correspond with evidence-based quality improvement interventions (called intervention functions) that can be used to direct behaviour change. Each TDF domain corresponds with an intervention function that can be used to overcome barriers and enhance facilitators to a behaviour of interest. KT experts have recommended the use of the TDF and COM-B to ensure the design of rigorous, comprehensive and generalizable interventions. However, there are few examples of the literature that have utilized both the TDF and COM-B to design and implement a KT strategy.

In this chapter, we mapped TDF domains identified via the key informant interviews to corresponding evidence-based interventions, using the COM-B. The resulting interventions were used to develop the KT-MCC, which is intended to improve the quality of decision making at Ontario MCCs. We used focus groups and surveys to confirm the trustworthiness of the key informant interviews. Focus groups were also used to confirm the face validity of the KT-MCC. Focus groups are advantageous in qualitative research as they provide in-depth insight regarding participant perceptions, attitudes and beliefs, in an efficient manner.[2] Unlike key informant interviews, focus groups allow

members of similar groups to interact while sharing their experiences. This forum allows the researcher to direct the discussion as needed, and explore emergent themes beyond those originally highlighted in the focus group interview script.[2] The use of focus groups are common in KT literature, and many researchers use them as a starting point to identify barriers and facilitators to a behaviour of interest.[3-7] For instance, Alexander et al. used focus groups to identify barriers and facilitators to health practitioners' decisions to engage in a health assessment program for preschool children.[4] Our decision to utilize both key informant interviews and focus groups to develop the KT-MCC is in keeping with an iKT approach, and ensured that members of the target population, namely MCC participants, participated in the design of the quality improvement intervention.

In summary, this part of our study had three objectives. The first objective was to develop the KT-MCC using a mapping process that linked identified TDF domains to interventions, using the COM-B model and supplementary evidence. The second objective was to confirm validity of the key informant interview data using focus groups and surveys with MCC participants. The final objective was to present the KT-MCC to MCC participants to confirm face validity and ensure acceptability of the intervention, prior to implementation.

Methods

Setting and Participants

Study participants for focus groups were recruited from a single Ontario LHIN that services approximately 1.4 million people in Ontario. Study participants included surgeons, medical and radiation oncologists, radiologists, pathologists and nurse administrators who regularly attend MCCs at two hospital sites within the LHIN. MCC participants were invited to participate in the focus groups if they had not participated in the key informant interviews that informed this study (see Chapter 3).

Ethics approval for this study was obtained from the Hamilton Integrated Research Ethics Board.

Study Design

Objective 1 - Mapping the TDF findings to the COM-B to Develop KT-MCC

The COM-B model is a categorization model that systematically identifies and integrates 19 behavioural change frameworks into three facets of behaviour - Capabilities, Opportunities, or Motivation. At the core of the COM-B are six sources of behaviour that affect the Capabilities, Opportunities and Motivation for behaviour change. Capabilities refer to an individual's psychological and physical capacity to engage in the desired behavior.[1] Opportunities refer to the various factors that are external to an individual, but influence an individual's ability or desire to engage in a behavior. Finally, Motivation, as defined by Michie et al, is "*the brain processes that energize and direct behavior, not just goals and decision making*".[1,p.4] Motivation is influenced by active decision making, as well as emotion and individual tendencies. Each component of behavior on the COM-B is comprised of two sources of behavior change. For example, Capabilities is comprised of both psychological and physical capabilities; Opportunities is comprised of both social and physical opportunities; and Motivation is comprised of both automatic and reflective motivation. Each of these six sources correspond to various intervention functions (see Table 1). The next layer of the wheel outlines nine interventions that can be used to alter the six corresponding sources of individual behaviour. Finally, at the outer edge of the wheel are a number of policy categories that can be used to promote organizational or systems change.[1] Michie et al., who are the developers of the COM-B and contributed to the design of the Theoretical Domains Framework, demonstrate that TDF domains can be transposed to the COM-B to identify corresponding evidence-based interventions (See Appendix A). In this way it is suggested that effective behaviour change interventions can be matched to identified barriers.[1]

We mapped TDF domains identified as mediators to MCC decision making to the COM-B to first identify the aspect of behavior (Capability, Opportunity, or Motivation) requiring intervention. Corresponding interventions to each behavioural category were identified and used to develop the KT-MCC.[1,7] Systematic evidence was used to further design the intervention components. The Cochrane Effective Practice and Organisation of Care (EPOC) group have published a series of systematic reviews and meta-analyses that evaluate the efficacy and impact of many quality improvement

interventions for health professionals.[8] Evidence from these reviews, as well as other pertinent evidence from the aviation and business literature, were used to provide context to identified COM-B intervention functions.

Objective 2 - Trustworthiness of key informant interview data

Trustworthiness in qualitative research pertains to the accuracy and truthfulness of findings, and is often referred to as: credibility, peer reviewer confirmability, or validity.[9-12] Researchers can confirm the trustworthiness of qualitative findings by comparing the original findings with other primary or secondary evidence, as a means of data triangulation.[9] Experts suggest that "*researchers can learn a great deal about the accuracy and validity of their data by having the people described in that data analysis react to what is described.*"[13,p.1196] We sought to confirm the trustworthiness of the key informant data using focus groups and surveys with MCC participants. Focus groups provide a number of advantages as compared to key informant interviews alone. First, focus group methodology depends on group interaction for data collection – that is, a researcher relies on the social dynamics of the group to ensure relevant questions are highlighted, different opinions are raised and debated, and various experiences are presented.[14] These dynamics allow the researcher to probe new emergent themes, while exploring the non-verbal interactions of group members. As stated by Kitzinger,

> *"group work helps researchers tap into the many different forms of communication that people use in day to day interaction, including jokes, anecdotes, teasing and arguing. Gaining access to such a variety of communication is useful, because people's knowledge and attitudes are not entirely encapsulated in reasoned responses to direct questions."*[14,p.1]

We sought to compare the key informant data to focus group data, to ensure validity of the findings and further triangulate the data. Because the key informant data identified differences in reported barriers by specialist group, we conducted specialty-specific focus groups. One focus group was held with surgeons (n=5), one with medical and radiation oncologists (n=6) and one with radiologists and pathologists (n=7). Each focus group included a MCC nurse coordinator. Focus groups took place at a single academic hospital site.

Focus group participants also completed a survey, prior to the start of the focus group. The survey presented themes identified in the key informant interviews for each of the 14 TDF domains. Participants were asked to score each theme on an anchored scale of 1-5 to demonstrate whether the theme was considered a barrier or a facilitator to MCC decision-making processes (where *1 is a strong facilitator; 2 is a moderate facilitator; 3 is neither a barrier or a facilitator; 4 is a moderate barrier; 5 is a strong barrier*).

Once the survey was completed, a trained researcher (C.F.) led participants in a focus group to determine the validity of the identified themes. Focus group participants were asked to confirm the accuracy of identified barriers and facilitators to MCC decision making, identified using the TDF. Participants were also asked to highlight the top two barriers to MCC decision-making to determine the validity of specialist group differences in perceived barriers, as initially identified in the key informant data.

The purpose of this objective was to confirm trustworthiness of identified barriers and facilitators to optimal MCC decision making. Insights obtained from the surveys and focus group findings were used as needed to modify the KT-MCC.

Objective 3 - Face Validity of the KT-MCC

Focus group participants were presented with the first iteration of the KT-MCC and were asked to confirm the applicability and perceived usefulness of the proposed interventions. Participants were asked to provide feedback to ensure credibility of the KT-MCC in the target population.[9] Finally, participants were also asked to provide suggestions for potential interventions not identified to that point by the research team.

Study Outcomes & Data Analysis

Objective 1 - Mapping the TDF findings to the COM-B to Develop KT-MCC

The outcome for this objective was identification of interventions for the KT-MCC. Intervention functions identified using the COM-B were compared to Cochrane findings and other

evidence to inform the KT-MCC. For example, the COM-B identifies modelling (providing an example for people to aspire to or imitate) as an intervention function that can influence behavioural Capability. The EPOC taxonomy and Cochrane evidence show that physicians respond well to local opinion leaders. Therefore, a researcher seeking to impact behavioural Capability might employ the use of local opinion leaders to serve as effective models to promote the target behavior.

Objective 2: Trustworthiness of key informant interview data

The outcome for the second objective was a determination of validity (or credibility, peer review, trustworthiness) for the key informant interview data. Following participant consent, all focus group data were recorded and transcribed verbatim. These data were analyzed thematically using a compare and contrast method, to determine the validity of the key informant data. In this method, themes are compared in order to identify similarities and differences.[15] Descriptive statistics for the survey results were generated using SPSS software.

Objective 3 - Face Validity of the KT-MCC

The outcome for the final objective was a determination of face validity, mainly the perceived acceptability of the KT-MCC.[16] Focus group data were recorded and transcribed verbatim. These data were analyzed using thematic analysis to describe participants' perceptions of the acceptability and appropriateness of the proposed KT-MCC. Implementation scientists have previously used this strategy to confirm face validity of quality improvement interventions. For instance, Lu and Haase used focus group data to confirm the validity, usefulness and acceptability of an intervention to improve activity engagement among persons with cognitive impairment.[16]

Results

Objective 1 - Mapping Process to Develop the KT-MCC

The COM-B mapping exercise revealed that all six sources of behaviour change on the behaviour change wheel (psychological and physical Capabilities; social and physical Opportunities; automatic and reflective Motivation) required intervention. Based on these data, we determined that a

multipronged intervention was required to improve the quality of MCC decision making. Table 1 outlines each TDF domain that was identified as either a barrier or facilitator to MCC decision making, and depicts the corresponding COM-B intervention function. For example, the key informant interviews identified barriers pertaining to the domain of *Social Influences.* The *Social Influences* domain corresponds with the Opportunity aspect of behavior in the COM-B, meaning that *Social Influences* (e.g., lack of effective communication, collaboration) are an external social factor that can influence an individual's ability or desire to engage in optimal MCC decision making. The corresponding interventions to this category of behavior include education (increasing knowledge or understanding) and persuasion (using communication to induce positive or negative feelings, or stimulate action). Therefore, according to the COM-B, barriers pertaining to *Social Influences* can be mitigated by educating participants about these barriers (e.g., why social skills are important to MCC decision making), or persuading them to engage in more effective teamworking strategies. In summary, identified intervention functions to improve MCC decision making included modelling, environmental restructuring, restrictions, education, persuasion, incentivisation, coercion, enablement, and training.

The resulting interventions from the mapping exercise included workshops, chair training, team training, standardized intake forms, standardized synoptic discussion forms, and audit and feedback.[17,18] Each component of the KT-MCC, along with supporting evidence, is presented below.

- **Workshops to develop local consensus processes:** Key informant data demonstrated that MCC processes differed by MCC team. As well, the goals for each MCC team differed depending on the context of the team and the nature of the disease site. Barriers in the following TDF domains influenced the establishment and implementation of such MCC processes: *Memory, Attention and Decision Processes; Behavioural Regulation; Social Influences; Environmental context and resources;* and *Goals.* Facilitators to such MCC processes encompassed the TDF domains of *Knowledge* and *Skills*. When mapped to the COM-B, these

domains correspond with the intervention functions of *Environmental Restructuring; Education, Persuasion, Restrictions,* and *Coercion.*

We determined that a workshop to develop tailored, local consensus processes specific to each MCC team would be a necessary first step to the KT-MCC.[19,20] EPOC evidence shows that workshops are optimized when they involve interactive and didactic sessions.[19] MCC participants will be presented with data regarding the functioning of their own MCC in a didactic session. Participants will then be guided to generate local consensus processes regarding the purpose and goals of their MCC team. Consensus processes will include articulation of the group's expectations for: weekly attendance, case submission process (e.g., the deadline to submit weekly cases), processes of discussion (e.g., maximum time spent discussing each case), and MCC documentation. Additionally, the team will determine whether a 'carrot versus stick' (ie: *persuasion* versus *coercion*) approach will be used to enforce these processes (e.g., will the team discuss a case if the presenting physician is not present at time of discussion).

- **Team Training:** Participants identified gaps in MCC decision making processes that stem from a lack of soft skills (e.g., effective communication and teamworking). Such themes were classified in the domains of *Social Influences; Emotion; Skills; and Memory, Attention and Decision Processes.* These TDF domains correspond to the COM-B intervention functions of *Training, Environmental Restructuring, Enablement, Education, and Persuasion.*

A systematic review of team training strategies demonstrates that training to promote teamwork (i.e., soft skills) as opposed to taskwork (e.g., technical skills) more significantly impacts process outcomes.[21] Business literature further indicates that ideal teamworking strikes a balance between 'speaking up' and 'listening intensely'.[22] Participants should feel comfortable to ask questions, identify errors, raise issues and offer ideas in a team setting, to develop a sense of 'psychological safety' within the group. Psychological safety refers to the

ability of a group to ask questions and suggest opinions freely without fear of negative repercussions.[23] Teams should invite their members to speak freely and the team should be open to opposing viewpoints that challenge the status quo.[22-26] Therefore, the second component of the KT-MCC is a team training session, led by a team training expert. This expert will provide MCC participants with actionable recommendations to improve MCC teamworking and soft skills.[27]

- **MCC Chair Training:** A lack of MCC leadership was found to negatively impact MCC decision making. Gaps in leadership were correlated with cyclical case discussions, unequal contributions by MCC participants, and unclear final treatment plans. These themes correspond to the TDF domains of *Memory Attention and Decision Processes; Behavioural Regulation; Social Influences; and Social/Professional Role and Identity* and correspond to the intervention functions of *Modelling, Environmental Restructuring, Persuasion, Education,* and *Training.*

  MCC chairs are responsible for implementing any MCC quality improvement intervention and will act as gatekeepers to the success of the KT-MCC.[28] In some instances, MCC chairs serve as local opinion leaders to MCC participants, and are well positioned to influence the behaviour of MCC participants.[29] EPOC data suggests that use of opinion leaders in tandem with other interventions can successfully influence behaviour change.[30] Teamworking literature stresses the importance of a well-trained team leader, who is able to ensure an effective balance of 'speaking up' and 'listening intensely' between team members.[22] As such, MCC chairs will be invited to participate in a training session with a team training expert who will outline strategies to promote effective discussion, teamwork and efficiency, during processes of MCC decision making. Moreover, our research team will partner with the MCC chair at each implementation site, to allow for further tailoring of the KT-MCC and ensure its acceptability by each MCC team.

- **Intake Form and Synoptic Case Discussion Form:** Lack of imaging at time of discussion, gaps in patient case history presentation, and a lack of preparation by the presenting physician were identified as barriers to *Knowledge; Environment;* and *Memory, Attention and Decision Processes.* Some MCC participants found the MCC discussion to be confusing and unorganized, and were unsure how to proceed with treatment, which encompasses the *Beliefs about Capabilities* domain. Further, participants did not perceive any consequences to lack of preparation, which encompasses the TDF domain of *Beliefs about Consequences.* These domains corresponded to the COM-B intervention functions of *Environmental Restructuring; Modelling; Training;* and *Coercion.*

  Ensuring preparedness at time of MCC discussion will likely promote discussion clarity and efficiency of decision-making. MCC teams will be required to complete a standard intake form prior to the MCC round. For example, presenting physicians will be required to define a clear clinical question, provide a summary of patient history, and specify the relevant imaging/pathology required for case discussion.

  MCC chairs will also be provided with a synoptic discussion form to guide case discussion. This form is adapted from the MDT-QuIC checklist, which was developed by a research team in the United Kingdom who sought to improve the quality of decision making for urology MCCs.[31] The MDT-QuIC checklist prompts the chair to ensure all relevant case history and imaging are present at the time of case presentation, all seminal specialties contribute equally to the case discussion, all patient-important factors are considered, and that a final treatment decision is articulated to the group. In an evaluation by 175 MCC members, the MDT-QuIC was found to be a useful tool to prepare cases for MCC meetings, structure case discussion, and record MCC decisions. The MDT-QuIC will be adapted to the context of local Ontario MCCs and will serve as a reminder prompt to MCC chairs and team members to engage in an effective MCC discussion and decision making process.[31,32]

- **Audit and Feedback**: Feedback on MCC quality is currently provided to hospitals by Cancer Care Ontario and includes general quality markers pertaining to frequency of MCCs and attendance. MCC participants hold a lack of *Knowledge* regarding the current quality of their MCCs, due to a lack of rigorous quality assessments. Regular feedback can educate MCC participants to the current quality of their MCC, and provide them with goals to improve quality gaps (*Modelling).*

  Our research team will provide audit and feedback to MCC teams participating in the KT-MCC. The team will receive feedback pertaining to the time spent per MCC round, time spent per MCC case, quality of information presented, and quality of teamworking. The quality of information and quality of teamworking will be evaluated using Lamb et al's MTB-MODe decision making quality assessment tool (see Chapter 2). The group will determine whether they desire other quality markers (e.g., rate of a clear clinical question asked) to be fed back via the chair.[33]

  Ivers et al. demonstrate that feedback is most effective when disseminated by a leader, provided on an iterative basis, provided both verbally and in writing, and includes clear targets and recommendations for improvement.[34] MCC feedback will be disseminated to teams on a monthly basis. The chair will be asked to provide verbal feedback to the team, which will be supplemented with a detailed feedback report provided by the research team.

Objective 2 – Trustworthiness of Key Informant Data

Results of Survey

The survey confirmed the majority of the themes identified in the key informant interviews. A complete list of barriers, the corresponding TDF domain, Likert scores, and rank order by specialty, are presented in Table 2.

Respondents indicated that *Not having the right specialists in the room during MCC discussion* and *Time Barriers* were the most significant barriers to MCC functioning, scoring 4.2 and 4.1 on a 5-

point scale, respectively (see Table 2). These barriers were closely followed by *Inadequate physical resources*; *Certain individuals dominate the conversation; and Belief that the use of email is an equivalent substitute to a multidisciplinary discussion* (3.9/5). The next four barriers, scoring 3.8/5, were all related to the TDF domain of *Social Influence* and included *negative group dynamics, bullying, lack of effective communication,* and *lack of psychological safety* (i.e., participants' sense of security to ask questions and provide suggestions in a team setting).

According to the survey, the strongest facilitator to MCC decision-making processes was the desire to acquire skills and knowledge. *MCC allow for opportunities of learning* was the strongest facilitator at 1.33, followed by *MCC empower physicians to make treatment decisions* at 1.50.

The results of the survey were also analyzed by specialist group. The range in scores varied between groups (surgeons: 2.00-4.00; oncologists: 1.00-4.67; diagnostic specialists: 1.00-4.33), with surgeons least likely to identify any of the themes as "strong" barriers or "strong" facilitators. Interestingly, each specialist group identified different factors as the most significant barrier to MCC functioning (see Table 2). The top two barriers identified by surgeons were *Belief that the use of email is an equivalent substitute to a multidisciplinary discussion* (4.2/5) and *A lack of consequences for physicians who do not attend or participate in MCCs* (4.2/5). The top two barriers for oncologists were *The right specialists are not in the room during MCC discussion* (4.6/5), followed by *MCC times are limited by specialist availability* (4.4/5). Finally, diagnostic specialists highlighted that the greatest MCC barriers were *Submission standards are not effective* (4.3/5), and *Inadequate physical resources limit efficiency* (4.3).

There was more consistency between specialist groups regarding the identification of strong MCC facilitators, which is consistent with the key informant findings. All groups cited themes relating to *Beliefs about Consequences* as facilitators to MCC decision-making processes. Specifically, participants perceived MCCs to facilitate learning, collaboration and teamworking.

Results of Focus Group

Tables 3 and 4 summarize all themes identified as either a barrier or a facilitator, respectively, in the key informant interviews. All key informant themes were identified by some focus group participants. Participants consistently reported the need to clarify the purpose and processes of MCC rounds in order to improve efficiency. As per the key informant data, MCC participants generally held positive attitudes regarding the importance of MCCs (e.g., improved collegiality, timely development of treatment plans, and reassurance for the management of complex cases). Consistent with the interview data, participants did not perceive incentives, such as billing or continued medical education (CME) credits, to be significant motivators regarding their willingness to engage in MCCs.

While the trustworthiness of all themes were confirmed by some focus group participants, there were themes that did not generate consensus within and between focus groups. Tables 3 and 4 demonstrate the differences in reported barriers and facilitators by focus group. For example, one of the barriers identified via key informant interviews pertained to negative *Social Influences*, specifically, the presence of bullying at MCC rounds. Focus group participants' opinions varied regarding the validity of this theme. Some surgical participants presented first-hand examples of when they were bullied, or treated poorly at rounds, while others rejected the notion of bullying within their MCC team. Pathologists and radiologists did not report being personally bullied, but witnessed other treating physicians falling victim to negative group dynamics. In contrast, oncologists did not confirm this theme and did not perceive team dynamics to be a significant problem to MCC decision making. These differences demonstrate that perceived barriers to MCC decision making differ not only by specialist group, but can also be influenced by the dynamics of an individual MCC team.

Overall, using focus group and survey data, we concluded that the key informant data were trustworthy. As a result, we did not make any changes to the TDF to COM-B mapping process and presented focus group participants with the initial iteration of the KT-MCC, as described in Objective 1.***Objective 3 - Face Validity of the KT-MCC***

The final study objective was to present the KT-MCC to focus group participants to determine its perceived acceptability and usefulness. While some components of the KT-MCC were deemed acceptable by all participants, others were not. For example, all groups identified chair training as an acceptable intervention, as demonstrated in the following participant quote:

> "*I think having an effective chair that helps promote flow and efficiency is very helpful. These things [leading a discussion] are not necessarily things that are intuitive."*

Participants were also generally positive towards the use of workshops to identify MCC goals, audit and feedback, and use of a standard intake form. However, participants were divided regarding whether a synoptic case discussion form and a team training session would be helpful. Concerns around the use of the synoptic case discussion form was that it would reduce the efficiency of case discussion. In regards to the team training component, one participant stated,

> *"Nobody is going to go (to a team training session). You can set it up and I don't know if anybody would show up."*

Participants highlighted that MCC participants are busy, and that time barriers would preclude attendance for an MCC team training session. However, such attitudes were not consistent among team members, and many believed improving soft-skills in a team training session would improve team communication and increase MCC efficiency. Therefore, we were unable to generate consensus regarding which components of the KT-MCC, if any, should be removed or modified prior to implementation. We therefore determined that individual MCC teams partaking in the KT-MCC pilot study would select the components of the KT-MCC they wished to implement.

Discussion

In the previous chapter, we presented the findings of key informant interviews that used the TDF to identify barriers and facilitators to optimal MCC decision making (see Chapter 3). MCC participants confirmed the trustworthiness of the key informant data through focus groups and surveys. Identified barriers were consistent with those presented in Chapter 3, including a need for improved

leadership, organized case presentation, and availability of technological factors. As per the key informant interviews, MCC participants held positive attitudes regarding the importance of MCCs, and identified the ability to acquire new knowledge and skills as key facilitators to MCC participation.

Identified TDF domains were mapped to the COM-B Behavioural Change Wheel to identify potential interventions to overcome barriers and enhance facilitators to MCC decision making. The mapping process showed that all components of the COM-B required intervention. The resulting KT-MCC is comprised of workshops, team and chair training, use of a synoptic reporting form and standard intake form, and audit and feedback.

There are few examples in the KT literature that use both the TDF and COM-B to develop quality improvement interventions. One example is a study by Templeton et al. who used the TDF and COM-B to identify barriers and facilitators to dental care visits to reduce dental caries.[35] The authors identified guidance, professional development, and oral health promotion as potential interventions to reduce dental caries. Our study adds to this body of literature by clearly outlining the methods used to map TDF domains to COM-B intervention functions in order to develop a quality improvement intervention. To the best of our knowledge, this is the first study to use such progressive KT methods to develop an intervention aimed at improving the quality of MCCs. Previously, Lamb et al. developed a quality improvement intervention to improve the quality of MCC decision making for a urology MCC in the UK.[36] The authors did not use a theoretical approach or a corresponding model to identify evidence-based interventions. Despite this limitation, the authors noted a 9% improvement in teamworking quality and a 5% improvement in the quality of information presented. We hypothesize that the effect size of the KT-MCC will be comparable or greater than that reported by Lamb et al., due to the progressive KT methodology we used to develop the intervention.

In this study, we used a survey to assess MCC participants' perceptions of the strength of each theme identified in the TDF key informant interviews. We believed use of a survey would inform whether participants perceived some barriers or facilitators to be more significant than others. To the

best of our knowledge, there is no evidence to suggest that a weighted analysis has previously been used to identify the strength of barriers and facilitators themes identified using the TDF. In the event that many TDF domains are identified, it is likely that some barriers pose a greater challenge to the target population, as compared to others (or alternatively, some facilitators influence behaviour more pointedly than others).

Our findings demonstrate that a weighting approach to further explain qualitative data is feasible. The survey uncovered discrepant findings that would have gone overlooked using qualitative data alone. For example, surgeons were less likely to rate any of the themes as a "strong" barrier or facilitator, which may suggest that MCC barriers affect specialist groups differently. Triangulation using mixed methods in KT research may be particularly useful when multiple domains emerge as mediators to a behavior of interest, or when identified domains include reveal contentious findings (e.g., presence of group bullying). Qualitative data ensures richness of the study themes while a survey allows participants to dictate the areas they believe require the greatest intervention. This can be a helpful approach for policy makers seeking to determine where limited resources should be prioritized in the first iteration of a complex intervention. Moreover, use of a Likert scale is efficient, requires few resources, and can be disseminated with each iteration of a behavioural intervention to track the impact of the intervention on behavioural change.

Finally, we believe it necessary to allow each MCC team to modify the KT-MCC, as needed, prior to implementation. Despite the theoretically-informed, iKT approach utilized to develop the KT-MCC, some focus group participants demonstrated concern regarding the acceptability and usefulness of some intervention components, specifically use of a synoptic discussion form and team training. However, there was no consensus regarding which components of the KT-MCC were considered not acceptable by MCC participants. Therefore, in keeping with an iKT approach, all components of the KT-MCC will be presented to MCC teams. The decision to engage in some, or all, components of the KT-MCC will be made by each MCC team, under the guidance of the MCC chair.

Limitations

This study had some limitations. First, use of the TDF and COM-B identified a number of intervention functions to improve the quality of MCC decision making. One identified intervention was the use of incentives to overcome Environmental barriers. However, provision of incentives likely requires a policy-level intervention (e.g., renumeration), something beyond the scope of this doctoral thesis. Future iterations of the KT-MCC can consider adding incentives to further promote MCC engagement.

Second, focus group and survey data were used to triangulate focus group participant's perceptions of the validity of the key informant findings. To the best of our knowledge, this is the first study that attempted to weight the strength of identified TDF barriers and facilitators, according to participants' perceptions. In some instances, there appeared to be discordance between participant responses in the qualitative and quantitative data. For instance, oncologists identified *bullying* as a barrier in the surveys, but not during the focus groups. Such inconsistencies might be ascribed to a desirability bias. Another explanation for this discordance may be attributed to the varied interpretation of the Likert-scale questions (for example: *Is this a general barrier to MCC decision-making processes* versus *Is this a barrier in my MCC team's processes of decision-making?).* More descriptive anchors to ensure consistent interpretation of the survey may reduce the potential for misinterpretation of the survey items. Furthermore, we used a survey anchored on a scale of 1-5, where 1 indicated a strong facilitator and 5 indicated a strong barrier. However, anchoring barriers and facilitators using two separate scales (one for barriers and one for facilitators) may prove a more effective method to identify the magnitude of difference between each item. This approach requires additional validation.

Finally, the face validity of the KT-MCC was evaluated among focus group participants that represented a single LHIN. We posit that the findings presented in this study are likely generalizable beyond this LHIN, due to consistencies with our key informant data as well as Ontario and international MCC literature.

Conclusion

The KT-MCC aims to improve the quality of MCC decision making. The KT-MCC is comprised of workshops to develop local consensus processes, team training, chair training, use of a synoptic discussion form and standard intake form, and audit and feedback. The trustworthiness of the key informant data used to develop the KT-MCC were confirmed using focus groups and surveys. MCC participants were also asked to confirm the face validity of the KT-MCC. Respondents were in favor of implementing workshops, chair training, a standard intake form, and audit and feedback. Some MCC participants did not confirm acceptability of team training or use of a synoptic reporting form; however, these attitudes did not generate consensus among focus group participants. These data suggest variability in intervention preferences by individuals, specialist group or MCC team. Such variability further confirms the need to tailor the KT-MCC within each MCC site prior to implementation. In the next phase of our study, we will use a pilot study MCC teams to evaluate the feasibility and potential impact of the KT-MCC.

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Table 1: TDF Domains Mapped to COM-B
*TDF domain uniquely identified as a facilitator to MCC discussion and decision-making.
**Definitions taken from Michie M, van Stralen M, West R. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, 2011; 6:42

COM-B SYSTEM	TDF DOMAIN	INTERVENTION FUNCTION**
Capability: Psychological	1. Knowledge 2. Memory, Attention and Decision Process 3. Behavioral Regulation	**Modelling**: Providing an example for people to aspire to or imitate **Environmental restructuring:** Changing the physical or social context
Capability: Physical	4. Skills*	**Environmental restructuring** **Restrictions**: Using rules to increase the target behaviour by reducing the opportunity to engage in competing behaviours **Education**: Increasing knowledge or understanding
Opportunity: Social	5. Social Influences	**Education** **Persuasion:** Using communication to induce positive or negative feelings or stimulate action
Opportunity: Physical	6. Environmental context and resources	**Persuasion** **Incentivisation:** Creating expectation of reward **Coercion:** Creating expectation of punishment or cost
Motivation: Automatic	7. Emotion	**Enablement:** Increasing means/reducing barriers to increase capability or opportunity **Training:** Imparting skills
Motivation: Reflective	8. Professional role and identity 9. Beliefs about capabilities 10. Goals* 11. Intentions* 12. Beliefs about consequences	**Training** **Coercion**
Other (not transposed on TDF)	13. Reinforcement 14. Optimism	

Table 2: Results of Survey

Rank Order*	Content analysis – Theme	TDF Domain	Overall mean score	Surgeon Rank Order; (mean)	Oncology Rank Order; (mean)	Diagnostic Specialist Rank Order; (mean)
Strong to Moderate Barriers						
1	The right specialists are not in the room at time of MCC discussion	Memory, Attention and Decision Processes	4.22	2 (4.00)	1 (4.67)	4 (4.00)
2	MCC times are limited by specialists availability (e.g.: for surgeons, conflicting operating room time commitments)	Environment	4.11	3 (3.80)	2 (4.40)	3 (4.14)
3	Inadequate physical resources limit efficiency (e.g.: space, teleconferencing units, PACS)	Environment	3.89	6 (3.20)	7 (3.80)	2 (4.29)
3	Certain individuals dominate the MCC conversation	Social Influence	3.89	5 (3.40)	5 (4.00)	3 (4.14)
3	Belief that use of email is equivalent to discussing the case at MCC	Knowledge	3.89	1 (4.20)	7 (3.80)	4 (4.00)
4	Negative group dynamics	Social Influence	3.83	4 (3.60)	4 (4.00)	5 (3.86)
4	Bullying	Social Influence	3.83	3 (3.80)	3 (4.20)	6 (3.71)
4	Lack of psychological safety (i.e.: team members' comfort in asking questions, providing suggestions within the group)	Social Influence	3.83	4 (3.60)	7 (3.80)	3 (4.14)
5	Ineffective communication	Social Influence	3.78	4 (3.60)	7 (3.80)	5 (3.86)
6	No standard format for case presentation	Memory, Attention and Decision Processes	3.72	6 (3.20)	5 (4.00)	1 (4.33)
6	Lack of time to prepare for MCC	Environment	3.72	5 (3.40)	7 (3.80)	5 (3.86)
7	Inadequate time within MCC to discuss all desired cases	Environment	3.67	5 (3.40)	4 (4.00)	8 (3.57)
7	Belief in the "art of practice" (i.e.: treatment plans vary by practitioner preferences/ not guided by evidence)**	Knowledge; Beliefs about Capabilities	3.67	4 (3.60)	7 (3.80)	6 (3.71)
8	Presenting physician not prepared	Memory, Attention and Decision Processes	3.61	8 (2.80)	4 (4.17)	6 (3.71)
9	Inadequate administrative supports limit MCC efficiency	Environment	3.56	4 (3.60)	5 (4.00)	11 (3.14)

Neither a Barrier or a Facilitator						
10	Lack of MCC documentation standards	Goals	3.50	8 (2.80)	9 (3.67)	5 (3.86)
11	Limited evidence to guide treatment plans**	Knowledge	3.44	5 (3.40)	10 (3.60)	10 (3.43)
11	Intrinsic belief that participation in MCC is outside of the scope of treating physicians' professional role	Social/Professional Role and Identity	3.44	5 (3.40)	5 (4.00)	7 (3.67)
11	No consequences to physicians who do not attend or participate in MCC	Beliefs about Consequences (versus converse: Reinforcements as facilitator to promote attendance)	3.44	1 (4.20)	11 (3.40)	9 (3.50)
12	Chair does not control the flow of discussion	Social Influences	3.39	8 (2.80)	9 (3.67)	8 (3.57)
13	No standard format for case discussion	Memory, Attention and Decision Processes	3.33	6 (3.00)	6 (3.83)	11 (3.14)
14	Lack of consensus regarding MCC purpose	Goals	3.00	6 (3.20)	11 (3.40)	12 (3.00)
Moderate to Strong Facilitators						
15	Adequate physical resources improve efficiency	Environment	2.33	10 (2.60)	13 (2.20)	16 (2.29)
16	Rotating attendance schedule reduces MCC participant burnout	Environment	2.33	8 (2.80)	12 (2.40)	17 (2.00)
17	Adequate administrative supports improve efficiency of MCC	Environment	2.28	10 (2.60)	13 (2.20)	15 (2.50)
18	Decisions made in an MCC setting mitigate medico-legal risk	Memory, Attention and Decision Processes; Beliefs about Capabilities; Knowledge	2.28	12 (2.20)	13 (2.20)	13 (2.67)
19	Standard case submission (intake form) increases efficiency	Memory, Attention and Decision Processes	2.22	7 (3.00)	12 (2.40)	21 (1.50)
20	Billing codes (i.e.: remuneration) promote MCC participation	Reinforcements	2.00	9 (2.75)	12 (2.40)	18 (2.00)
21	MCC allow physicians to obtain second opinion from colleagues efficiently	Memory, Attention and Decision Processes; Beliefs	1.72	14 (1.60)	13 (2.20)	22 (1.42)

		about Capabilities; Knowledge; Environment				
22	MCC facilitate collegiality and teamworking	Social Influences	1.72	14 (1.60)	14 (2.00)	19 (1.67)
23	MCC can standardize decision making for complex cases	Memory, Attention and Decision Processes; Knowledge	1.67	10 (2.60)	16 (1.60)	24 (1.00)
24	CME (continued medical education) credits promote MCC participation	Reinforcements	1.61	11 (2.25)	15 (1.80)	20 (1.60)
25	MCC empower physicians to make treatment decisions	Memory, Attention and Decision Processes; Beliefs about Capabilities	1.50	14 (1.60)	15 (1.80)	23 (1.14)
26	MCC allow for opportunities of learning	Skills; Knowledge	1.33	13 (2.00)	17 (1.00)	24 (1.00)

*Rank Order: Order of items ranked from Strong Barriers to Strong Facilitators. Overall Range is 1=26 (scores 4.22-1.33), where Overall Rank Order 1-10 (scores 5.0-3.5) considered "barriers to moderate barriers", Overall Rank Order 11-14 (scores 3.5-2.5) considered "neither a barrier or a facilitator", Overall Rank order 15-26 (scores 2.33-1.33) considered "moderate to strong facilitators".

Scores by specialty:

Surgeon Scores: Overall Range 1-14 (scores 4.00-2.00), where rank order 1-4 (scores 4.2-3.60) considered "barriers to moderate barriers", rank order 5-10 (scores 3.4-2.6) considered "neither a barrier or a facilitator", and rank order 11-14 (scores 2.25-1.60) considered "moderate to strong facilitators".

Oncology Scores: Overall Range 1-17 (scores 4.67-1.00), where rank order 1-10 (scores 4.67-3.60) considered "barriers to moderate barriers", rank order 11 (scores 3.4) considered "neither a barrier or a facilitator", and rank order 12-17 (scores 2.4-1.00) considered "moderate to strong facilitators".

Diagnostic Specialist Scores: Overall Range 1-24 (scores 4.33-1.00), where rank order 1-7 (scores 4.33-3.57) considered "barriers to moderate barriers", rank order 9-15 (scores 3.50-2.50) considered "neither a barrier or a facilitator", and rank order 16-24 (scores 2.29-1.00) considered "moderate to strong facilitators".

**Problem exacerbated by lack of follow up/feedback regarding MCC case outcomes

Table 3: Focus group findings compared to key informant data - Barriers

TDF Domain	**Key Informant Themes identified as Barriers**	**☐ group thinks this is not a barrier ☐ group agrees this is a barrier ■ group divided**			**Sample Quote**
		Surgery	Oncology	Diagnostic Specialists	
Memory, Attention and Decision Processes	Presenting physician not prepared	☐	■	☐	"MCCs are complex and there are occasions where people present and they come to a conclusion and (then they) suddenly realize, 'oh I missed this detail'"
	Chair does not control flow of discussion	☐	☐	☐	"Sometimes the chair forgets they're the chair and gets involved in the discussion as one of the experts" "Sometimes we don't get through all the cases because some people go on and on and the chair doesn't control it"
	No standard format for case submission	☐	☐	☐	"very rarely does (the MCC form) get filled out adequately, some people don't fill it out at all and their cases still get on MCC, then they don't show up and we have to actually try to figure out what their question is" "[DS perspective]…at rounds they're like 'well what about this margin' and you're like 'oh I can't believe I have to go through the slides again. It would be much easier if they told us ahead of time what the specific question was because you have to do a total review of the case, which could take hours"
	No standard format for case presentation	☐	☐	☐	"So I find that having a structure to the

					presentation so you know what is your question, a very brief history…this is the scan and this is the imaging…when people ramble you don't even know what they're asking you just lose focus and you probably don't even get as much information."
	The right specialists are not in the room	■	☐	☐	"I've seen that…if nobody from rad onc happened to be there, then that case has to be skipped over and it can't be discussed...that just completely limits the discussion"
	No documentation standards	■	☐	n/a	"(At rounds) there is somebody writing and they will ask me, what did you say….and this piece of paper, I'm like where does this paper go? I wish…sometimes I know some patients have been discussed and I don't know where to get that information"
Environment	Inadequate time within MCC to discuss all desired cases	☐	☐	☐	"there is never enough time for anything, everything is pushed to the limits"
	Lack of time to prepare for MCC	☐	☐	☐	"There should be a little column to what the pathologic issue is (ie: what the specific question is), especially for pathology – radiology can scroll up and down in the films where have to look at slides. We can't do it on the spot"
	MCC times limited by specialist availability	☐	☐	☐	"There is never a Monday at 12 o'clock (time of MCC) that I am free, so I would have to plan for well in advance and completely rearrange a weekly schedule to be available…it's a tough (meeting) time that doesn't consider the challenges surgeons face. If they put it Monday at 7 am or 5 am I would be there every week"
	Inadequate administrative supports	☐	☐	☐	"We have zero administrative support. Resources are an issue, that is a huge thing"
	Inadequate physical resources	☐	☐	☐	"Technology is always an issue…..always….a lot of wasted time – we definitely have inadequate support for that" "A construction worker broke the microscope, so we have no microscope. I don't know whose

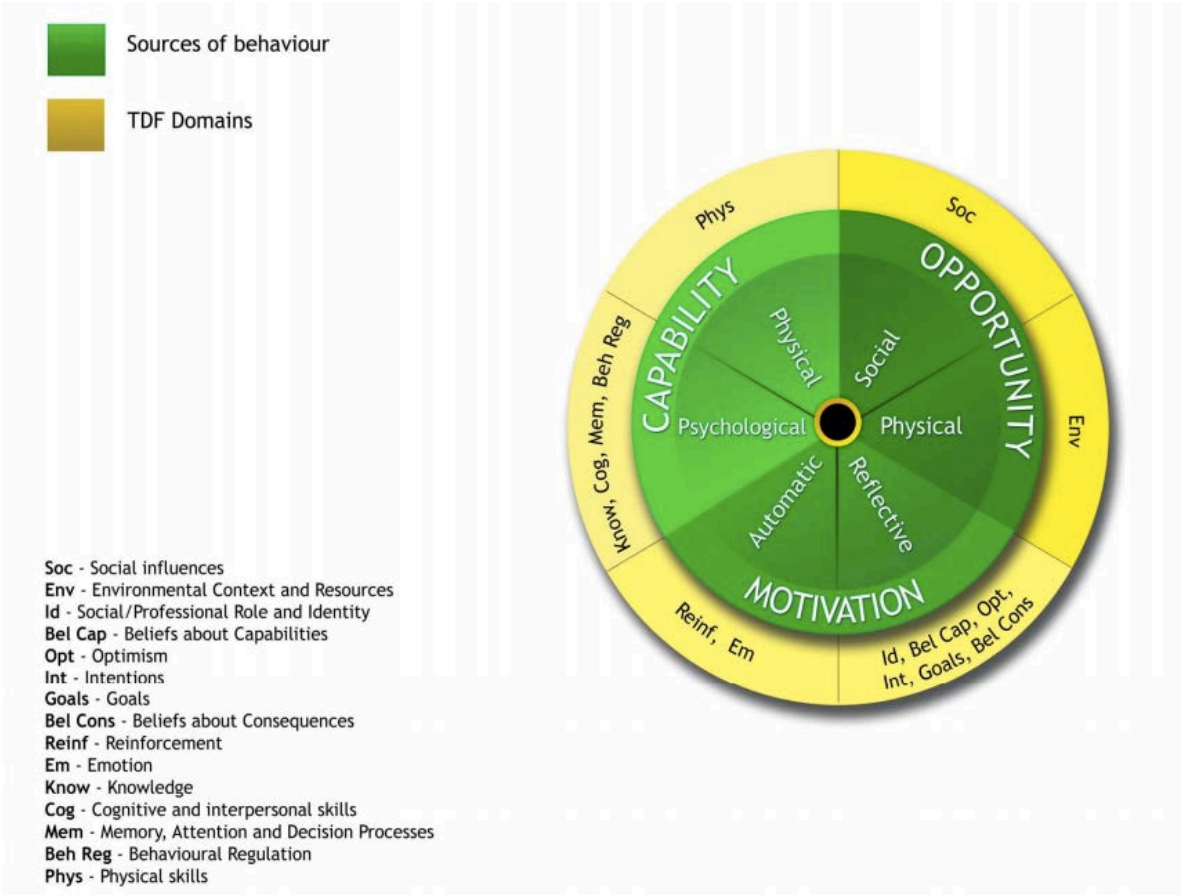
					responsibility it is to replace it but it hasn't been there for eight months"
Social Influence	Ineffective communication	☐	☐	☐	
	Negative group dynamics	☐	☐	■	"It's petty…you know the personalities and what happens, so it can be uncomfortable"
	Bullying	■	☐	☐	"I have been belittled at those rounds" "It's to a point in this disease site where one of the surgeons walked out because of the way they were treated"
	Lack of psychological safety	☐	☐	☐	"We are supposed to come in like it's a safe place and residents always feel like they are being judged"
	Certain individuals dominate the conversation	☐	☐	☐	"whoever would yell the loudest was ultimately (listened to)"
Knowledge	Limited evidence to guide treatment plans	☐	☐	☐	"(A lack of evidence) enhances the discussion. Part of the impetus behind MCC in the first place is there is not a perfect answer for every single scenario"
	Conflicting recommendations (art of practice)	☐	☐	☐	"It's the nebulous stuff…that makes it hard"
	Belief that use of email is equivalent to discussing case in MCC	☐	☐	n/a	"Email is not a sufficient way to discuss patients"
Goals	Lack of consensus regarding MCC purpose	☐	☐	☐	"This gets to the heart of why certain rounds may have more tension…it depends on whether you are obliged to have consensus (regarding treatment plan) at the end…if you are obliged to have a consensus things might be more heated because then you are bound to following through (on the plan) that you may not agree to"
Social/Professional Role and Identity	Intrinsic belief that participation in MCC is outside of the scope of treating physicians' professional role	☐	■	☐	"That option is not available as a (diagnostic specialist). You must be present" "Not all of the surgeons always attended"
Beliefs about Consequences	No consequences to physicians who do not attend or participate in MCC	☐	☐	n/a	"it's a barrier when they put on a case and then they don't show up"

Table 4: Focus group findings compared to key informant data – Facilitators

TDF Domain	**Key Informant Themes identified as Facilitators**	**☐ group thinks this is not a facilitator ☐ group agrees this is a facilitator ■ group divided**			**Sample Quote**
		Surgery	Oncology	Diagnostic Specialists	
Social Influence	Strong collegiality and teamworking	☐	☐	☐	"those (rounds) are valuable to me and I think I speak for my colleagues…you are there to be collegial to your other colleagues…you are there because it is part of your role as a professional collaborator"
Environment	Standard case submission (intake form) increases efficiency	☐	☐	☐	"I think this is where you would have a stick, right. This is where you have to stick to say 'if you do not meet this minimum standard for submission then the case isn't going to get discussed…if you are not uploading your images, the radiologist is not going to look at them'"
	Rotating attendance schedule reduces MCC participant burnout	☐	☐	☐	"if we did have rotated priority that would be helpful, we are always kind of scrambling…we do have a sort of rotating schedule because if we don't then someone is missing around somewhere"
	Adequate administrative supports improve efficiency of MCC	☐	☐	☐	"for years, we had every single brain tumor patient in the book written down, it was all in there and what the decision was, so it was a central repository…that is where you need administrator's support"

Beliefs about Consequences	MCC allow for opportunities of learning	☐	■	☐	"learning opportunities for residents could be improved"
	MCC empower physicians to make treatment decisions	☐	☐	n/a	"I had a contentious case where the patient is going to say, I want to see the multidisciplinary team's opinion…in two cases I was able to show them (the MCC's decision) and that stopped all of the argument"
	MCC can standardize decision-making for complex cases	☐	☐	n/a	"MCCs help create a framework for decision making"
	MCC allow physicians to obtain second opinions from colleagues efficiently	☐	☐	n/a	"it is just like having a curbside counsel with one of your colleagues or something like that"
	Decisions made in an MCC setting mitigate medico-legal risk	■	■	n/a	"That's more of an American issue…I don't think (documentation) is a big issue from a medico-legal perspective" "You want insurance more than anything, that is sort of an impetus to – sorry about my French – but CYA"
Reinforcements	CME (continued medical education) credits promote MCC participation	■	■	■	"if you are relaxing on Friday and you have absolutely nothing to do then I think yeah then you would show up to get CME credits. And listen to the discussion. But I agree with you that I don't think anybody because of that I think people who go because they get value out of getting their cases discussed" "getting CME credits for something that you do is always nice…but I don't think anybody would go just because of that"
	Billing codes (i.e.: remuneration) promote MCC participation	■	■	■	"we don't get paid for it, but we don't miss it, even if we have no cases to present…I billed for a case which is like $11" (implying that the billing is not an incentive) "lack of payments is a barrier" "everyone can bill except for pathologists. We treat it as our job and we are delighted to do it because there is no financial and we cannot bill because we are salaried"

APPENDIX A: TDF and COM-B



Taken from Michie, Development and Validation of the Theoretical Domains Framework. Available at: https://ktcanada.ohri.ca/workshop_tdf/TDF_Michie.pdf

CHAPTER 5: KT-MCC STRATEGY PILOT

Background

There is a paucity of RCTs that evaluate quality improvement interventions targeting cancer speicalists.[1] Coory et al. screened 5,781 articles to identify just 12 studies that evaluated quality improvement interventions directed at cancer specialists. Of the 12 identified studies, only three trials were randomized.[2] The randomized trials, respectively, aimed to address underuse of total mesorectal excision for rectal cancer[3], low rates of lymph node sampling by colorectal surgeons[4], and underuse of chemotherapy agents by medical oncologists[5]. None of the randomized trials found a positive clinically or statistically significant effect of the quality improvement interventions on the outcomes of interest. For instance, Simunovic et al. found no effect on rates of permanent colostomy and local recurrence following a surgeon-directed, multi-component quality improvement intervention to promote the use of total mesorectal excision for rectal cancer.

KT experts posit that most RCTs evaluating quality improvement interventions have demonstrated minimal positive impacts due to methodological flaws in study design.[6] For example, experts now recommend the use of theory and integrated KT (iKT) approaches to inform the design and implementation of quality improvement/KT strategies. It is posited that the use of theory ensures the identification of salient constructs that influence behaviour change; that identified constructs can inform the selection of appropriate interventions; and, that theory can provide testable models to explain the success or failure of a strategy, which in turn provides information that can be used for additional efforts.[5-8] iKT approaches demand the inclusion of targeted stakeholders in the design, implementation and evaluation of a KT strategy, and are thus believed to better engage target populations and improve the chances of strategy success.[9] For the purposes of this thesis we define the use of theoretical frameworks, models, and an iKT approach as progressive KT methods.

Our current project used such progressive KT methods to develop the KT-MCC Strategy, a set of quality improvement interventions aimed at improving the quality of decision making for Ontario MCCs. The selection of interventions was guided by the Theoretical Domains Framework and the COM-B Behaviour Change Wheel. We also used iKT; MCC participants were involved in the design, implementation and evaluation of the KT-MCC.

It is our intent to eventually evaluate the effectiveness of the KT-MCC on quality of Ontario MCC decision making using a stepped-wedge randomized trial. We hypothesize that the use of progressive KT methods will increase the uptake of the KT-MCC and improve the likelihood of a positive impact on MCC decision making. However, to justify the significant monetary and time resources required to conduct such a RCT, we first piloted the KT-MCC. Pilot studies can be used to test study procedures, the validity of assessment tools, overall feasibility of implementation, and to provide estimates of effect sizes (i.e., impact).[10,11] We piloted the KT-MCC to assess feasibility of implementation and potential impact on MCC decision making quality. The KT-MCC was piloted in four MCC groups using a before-and-after, prospective study design.

We hypothesized that the KT-MCC would be easily implemented (i.e., is feasible) and would have a statistically significant positive impact on MCC decision making quality.

Methods and Design

Study Design

This study was a prospective, before-and-after pilot study conducted from January – July 2017. Baseline data (before phase) were collected for a period of two months. Study participants were then offered the multi-pronged KT-MCC. Post-intervention data (after phase) were collected for an additional two months.

Setting and Participants

Four MCC groups in the Hamilton area participated in the pilot. Three of the four participating MCC teams were located at a single, academic hospital. One MCC team was located at a community hospital. MCC participants included surgeons, medical and radiation oncologists, radiologists and pathologists. Some rounds were attended by nurses, pharmacists and residents.

Intervention

The KT-MCC was developed using theoretical frameworks, models, and an iKT approach. Key informant interviews, guided by the Theoretical Domains Framework (TDF)[7], were used to identify barriers and facilitators to optimal decision making (see Chapter 3). Identified domains of behaviour change were mapped to the COM-B Behavioural Change Wheel[8] to identify corresponding intervention functions (see Chapter 4). The initial iteration of the KT-MCC was comprised of workshops, MCC team training, MCC chair training, use of a standard intake form and synoptic discussion forms, and, audit and feedback (see Chapter 4). A description of each intervention component of the KT-MCC is provided below.

Workshops: Informant data showed that MCC processes and goals differed by the type of MCC team the interviewee was associated with. For the pilot study we therefore determined that a workshop to develop local consensus processes for each participating MCC team would be a necessary first step to the KT-MCC. There were three main goals to the workshops: first, to define the site-specific purpose of MCCs; second, to select intervention components of the KT-MCC for implementation; and third, to develop local consensus processes. Local consensus processes refer to a set of agreed upon actions or rules that are developed to facilitate a group's objectives.[12] Essentially, local consensus processes are the "MCC rules" developed by each MCC team that would dictate MCC functioning. For example, local consensus processes can include (but are not limited to) the maximum number of cases discussed per round, deadline to submit cases to MCC administrator, required attendance by the most responsible physician (MRP) who submitted a case, submission of a clear clinical question, submission of an

original treatment plan, and articulation of the final treatment plan. The workshops were to be offered in either a face-to-face meeting or electronic format.

Team Training: Interviewees identified gaps in MCC decision making processes that stem from a lack of soft skills (e.g., effective communication and teamworking). Team training can be used to improve the collaboration of health professionals for the care of patients.[13] A team training expert was identified to guide the training sessions. The expert is an academic professor and director of health care leadership, who has previously led national and international training on decision making and communication for health care providers and business managers.[14] The team training expert had no previous relationship with the research team or the pilot study MCC participants. The expert was meant to guide MCC teams to improve teamworking and communication, and to provide the team with actionable strategies to engage in efficient and high quality decision making. The training session(s) was meant to identify "core values" required to build a strong foundation of teamwork and to provide demonstrations of successful teamworking to the team.[15,16] Following the team training session, MCC participants were to complete a survey to describe their perceptions of team functioning. This survey was to be completed again at the end of the intervention to identify whether participant perceptions of teamworking improved following the KT-MCC.[17]

MCC Chair Training: Interview data demonstrated that the MCC chair serves as the gatekeeper to MCC processes. The chair ultimately determines how MCCs are organized, run, and recorded. Interviewees and focus group participants correlated a lack of MCC leadership with cyclical case discussions, unclear final treatment plans, and an unequal degree of participation by seminal specialties or individual physicians. Chair training is important, as chairs are well positioned to influence the conduct of MCC decision making. The purpose of the chair training session was to identify challenges unique to MCC chairs and provide actionable solutions on how to engage an MCC team in an efficient and comprehensive MCC discussion. Chairs were to be taught to effectively manage team conflict and

to ensure all members of the MCC team are equally engaged in MCC decision making process. The same expert conducting the potential team training intervention was to also lead the potential chair training.

Intake Form and Synoptic Case Discussion Form: Lack of imaging at time of discussion, gaps in patient case history presentation, and lack of preparation by the presenting physician were identified as barriers to MCC decision making. A standard intake form was meant to improve the quality of information available at time of MCC discussion. The proposed intake form for the pilot study would require participants to submit details regarding the following: patient demographics, clinical history, comorbidities, and whether a detailed review of pathologic or radiologic findings was required. Participants were to use the intake form to provide a clear clinical question, an original treatment plan and to rate their confidence in this original plan (using an anchored Likert scale).

A synoptic discussion form was also developed to organize case discussion and encourage contributions by all core specialties. The synoptic case discussion form was adapted from a synoptic form previously developed by the Lamb et al.'s research team in the United Kingdom.[18] The purpose of the synoptic form was to prompt the chair to encourage the following: all core specialists to be in attendance at time of discussion; the MRP (or an appropriate surrogate) to be in attendance; all pertinent information to be available and presented efficiently; and, that all members of the MCC team (e.g., surgeons, medical oncologists) be provided an opportunity to comment on the case. Finally, the form was also meant to prompt the MCC chair to articulate final consensus treatment recommendations of the MCC team, to describe any objections to the treatment plan, and to indicate whether the case would warrant further discussion at the subsequent MCC round.

Audit and Feedback: Audit and feedback involves measuring the performance of an individual or team, comparing this performance to a target, and providing this information back to encourage improvement.[19] Feedback on MCC quality is currently provided to hospitals via CCO at the hospital

disease site level; however, this feedback only includes measures regarding frequency of MCCs and attendance by seminal specialties. There is no feedback regarding the quality of MCC decision making – the focus of this thesis. We intended for MCC teams to be provided with monthly feedback on the following: average quality per case of information presented and quality of teamworking (as evaluated by the MTB-MODe, see *Outcomes*); number of cases presented per round; and average per case time spent on history presentation and overall discussion. MCC teams would have the option of selecting additional quality markers to be evaluated for audit and feedback. We planned to provide the feedback in writing to the MCC chairs, who would then be responsible for disseminating the findings to their respective MCC teams.

Implementation

We performed a baseline assessment of MCC decision making quality at each of the sites for a period of two months. Following the two month baseline period, the following information was presented to MCC chairs: decision making quality scores; a list of strengths and weaknesses specific to each team (generated based on the quality of decision making assessment forms and observations); and, the proposed KT-MCC intervention components. MCC teams were offered all components of the KT-MCC. In keeping with an integrated KT approach, the intent was to have teams and chairs consider the data and all potential KT-MCC interventions and select the components of the KT-MCC they wished to engage with. To guide selection of interventions by each team, we also canvassed the attitudes of individual MCC participants using a survey. Individuals were asked to rate each intervention on a scale of 1-5 (where 1 is *Strongly Disagree that this intervention component is needed* and 5 is *Strongly Agree that this intervention component is needed*). We assumed we would be given access to team members during an introductory session to present the KT-MCC. A priori, we decided that interventions with a score of four or more would be strongly recommended to the chair for

implementation. However, we also decided in accordance with iKT principles that MCC chairs and teams would make all final decisions regarding intervention selection regardless of Likert scale scores.

Outcomes

Our intent was to evaluate the feasibility of implementation and impact of the KT-MCC in four Ontario MCCs. We used four areas of assessment to evaluate feasibility of implementation: site selection; data collection; participation by MCC teams and chairs in various aspects of the study; and compliance. We defined compliance by respective teams as participation in the interventions selected for implementation. All areas of feasibility were evaluated using direct observation, with the exception of compliance, which was quantitated. Impact of the KT-MCC was evaluated using quantitative measures for the quality of decision making. We expand on these measures below.

<u>Feasibility of Implementation</u>

- Site selection: Defined as the ability to obtain study approval by the research ethics board and gain access to MCCs by the MCC chairs.
- Data collection: Defined as the research team's ability to collect relevant study data
- Participation by MCC teams and chairs: Defined as the MCC teams and chairs' agreement to participate in the overall study, to select KT-MCC interventions, and to implement these interventions.
- Compliance with use of the synoptic reporting form and standard intake form (if selected): A priori, we defined acceptable compliance for these interventions as implementation at a minimum rate of 80% (e.g., if synoptic reports were selected, they should be used for at least 80% of cases). As further indicators of compliance, we determined whether teams abided by their selected local consensus processes (e.g., how often did the MRP present their own case).

<u>Impact – Quality of Decision Making per Case</u>

We used the Multidisciplinary Tumor Board Metric of Decision Making (MTB-MODe) assessment tool per case to evaluate our primary outcome of impact of the KT-MCC on decision making quality. The MTB-MODe evaluates the per case quality of decision making in two domains: quality of information presented (six items) and quality of teamworking (five items), all anchored on a Likert scale of 1-5.[20] Quality of information items are scored on a scale of 1-5, where 1 indicates *no information provided* and 5 indicated *a comprehensive presentation of information*. Quality of teamworking items are scored on a scale of 1-5, where 1 indicates *nil contribution/contribution hinders the MCC discussion* and 5 indicates *clear, articulate recommendation* provided by the specialist group or chair. Non-attendance by a core specialty was recorded as N/A on the MTB-MODe tool (as opposed to a score of 1) to allow the research team to distinguish between non-attendance and low teamworking contribution (see Appendix A for tool). Iterations of the MTB-MODe tool were previously validated for urology and gastrointestinal MCCs in the United Kingdom and by our research team (see Chapter 2).[20-23] Our previous research demonstrates that the MTB-MODe can be reliably implemented using a single rater (see Chapter 2). MTB-MODe items were summed for a minimum score of 6 and a maximum score of 55 (maximum scores of 30 and 25 for quality of information presented and quality of teamworking, respectively). In keeping with previously published literature by Lamb et al., we anticipated a 10% minimum improvement in the quality of teamworking and quality of information presented, respectively.[21]

We were also interested in obtaining insights on factors that may improve MTB-MODe scores separate from our KT-MCC. We therefore assessed if the presence of the following correlated with increased MTB-MODe scores: clear clinical question articulated at time of case presentation, case submitted using standard intake form, chair articulated a final treatment plan (see Appendix A).

Secondary Outcomes for Impact of the KT-MCC on MCC Decision Making Quality

1. In addition to evaluating per case decision making quality, we evaluated the per round decision making quality using the Multidisciplinary Team Observational Tool (MTOT).[24,25] The MTOT (previously MDT-OARS)[24] identifies 17 aspects of multidisciplinary teamworking that impact MCC decision making. Items include team characteristics (e.g.: attendance, teamworking); infrastructure (e.g.: availability of equipment, physical space to conduct MCC); meeting organization and logistics (e.g.: availability of a clear case agenda); and patient-centered decision-making (e.g.: awareness of patient-centered factors; documentation of final recommendation). The tool is based on *The Characteristics of an Effective Multidisciplinary Team* guideline published by the English National Cancer Action Team.[25] The tool has previously been validated for a number of MCC sites including upper gastrointestinal, colorectal, head and neck, dermatology, and urology.[25] Developers of the MTOT tool report strong inter-rater reliability (>80%) and construct validity ($p<0.05$) for the tool.[25] All items on the MTOT are anchored and scored on a scale of 1-3 or 1-4 (see Appendix B for tool). One item, presence of conflict among team members, is scored on a scale of 0 (*no conflict*) to -4 (*conflict persisted throughout the round*). All items are summed to report a single quality of decision making per round score. The maximum score that can be awarded to an MCC round is 57 and the lowest is 15.
2. Time spent per case
3. Number of cases presented per round
4. Rate of decision change
5. Physician confidence in original treatment plan presented prior to case discussion vs. rate of change from original to final treatment plan. Where possible, physician confidence was measured prior to case discussion on a 5-point Likert scale (1=little confidence in original treatment to 5=very confident in original treatment plan).

Data Collection

A single researcher collected field notes regarding the feasibility of implementing the KT-MCC and collecting study data. Data regarding the types of patients discussed, which participants participated in the discussion, whether some participants seemed to exert more dominance in the MCC discussion, occurrences of tension, time barriers, and technological challenges were noted. Surveys were used to determine MCC teams' preferences regarding which of the KT-MCC intervention components should be implemented. MCC teams' compliance data with local consensus processes were collected using MCC intake forms and direct observations of MCC rounds. Rate of decision change and confidence in original plan data were obtained from the intake forms and MCC chairs. The researcher observed MCCs and evaluated MCC decision making quality per case and per round using the MTB-MODe and MTOT assessment tools, respectively. In addition, the data were collected pertaining to other key factors associated with improved decision making quality, as described above.

Statistical Analysis

Feasibility

Feasibility measures were described using observational, qualitative data. Compliance with use of the synoptic reporting form and standard intake form was calculated as percentages. Field notes were analyzed using thematic analysis by a single researcher trained in qualitative research.

Impact

Descriptive statistics were generated using means with standard deviations and percentages. Univariate analyses using independent samples student's t-tests (two-tailed with a significance level of 0.05) were used to compare the before-and-after quality of decision making scores (MTB MODe - score per case, MTOT - score per round) for each MCC team and across MCC teams.

A multivariate analysis using a generalized linear model (GLM) was used to determine whether the KT-MCC had a significant impact on per case MTB-MODe scores. A generalized linear model is a form of regression analysis that can accommodate independent data that violate assumptions of linear regression or ANOVA models. Unlike a traditional ANOVA, the GLM can account for data that violates the homoscedasticity assumption (i.e., there is an equal distribution of error across a predicted value) or the normality assumption. Each GLM model defined the dependent variable as the MTB-MODe aggregate score. The independent factors were: the before/after label (1= pre-intervention scores; 2= post-intervention scores) and the MCC team ID (1, 2, 3 or 4). Analysis was completed using a main effects model. A significant beta value for the before/after label would demonstrate that the before and after scores were significantly different for the MTB-MODe scores. A significant beta value for the MCC ID would demonstrate that one of the teams was significantly impacting the aggregate decision making scores. To further explore these effects, any teams found to overly influence the aggregate score were removed from the model and a sensitivity analysis was performed.

Finally, multivariate analyses using a multiple linear regression were performed to determine whether quality markers (most responsible physician presented their own case, a clear clinical question was articulated, an original treatment plan was provided, case was submitted using the intake form, and time spent per case) impacted the quality of MCC decision making, as measured by MTB-MODe scores.

Other outcomes

Descriptive statistics were provided for: time spent on case history and overall discussion, rate of decision change, and confidence in decision versus rate of change. All data were analyzed using SPSS 23 software.[26]

Results

Feasibility of Implementation

Site Selection

Seven MCC teams (four teams at single academic institution; three teams within three different community hospitals) were approached to participate in the KT-MCC and all agreed. Of the three community sites, one returned a quick study approval and participated, and two ethics boards requested more detailed study information precluding participation due to time constraints. Similarly one academic team enthusiastically requested involvement, but through a detailed and lengthy process that did not align with study timelines. The MCC chairs for the remaining four teams were agreeable for our research team to observe MCCs and collect study data. This study was approved by the Hamilton Integrated Research Ethics Board and the Brant Community Healthcare System Research Ethics Board.

Data Collection

We did not encounter any challenges with the data collection process. There were a total of 149 cases and 23 MCCs observed in the before phase and 165 cases and 29 MCCs observed in the after phase. All data were successfully organized and managed using an Excel database.

Participation by MCC teams and chairs

Chairs expressed a desire to review all KT-MCC interventions (workshops to determine local consensus processes, team training, chair training, synoptic reporting form and standard intake form, and, audit and feedback) prior to implementation. All chairs were agreeable for our research team to present select baseline data regarding quality of decision making. Chairs were also agreeable to implement the standard intake forms and synoptic reporting forms. We presented baseline performance data to MCC teams between April 13-May 11 (see Table 1). At the time that baseline data were presented, we distributed a survey to determine which additional KT-MCC interventions (workshops to

develop local consensus processes; team training; chair training; audit and feedback) the teams wished to implement. Results of each team's survey are provided below and in Table 2.

Selected Interventions

MCC 1: The chair agreed to implement the standard intake form and synoptic reporting form. The chair selected a face-to-face workshop to determine local consensus processes and audit and feedback for implementation. The teams scored these interventions at 4.1 and 3.9, respectively. The team scored team and chair training at 2.8 and 3.5, respectively. The chair did not select the training interventions for implementation.

MCC 2: The chair agreed to implement the standard intake form and synoptic reporting form. The chair selected an online workshop to determine local consensus processes and audit and feedback for implementation. The teams scored these interventions at 4.4 and 4.1, respectively. The team scored team and chair training at 3.0 and 3.3, respectively. The chair did not select the training interventions for implementation.

MCC 3: The chair agreed to implement the standard intake form and synoptic reporting form. The team scored the workshop at 3.6 and audit and feedback at 4.0. Despite the slightly lower scores for the workshop, the chair wished to hold an online workshop to develop consensus processes. The chair also selected audit and feedback. Team and chair training were scored at 2.8 and 4.1, respectively. Despite the high score for chair training, the chair did not select either of the training interventions for implementation.

MCC 4: The chair agreed to implement the standard intake form and synoptic reporting form. The team scored the workshop at 3.6 and audit and feedback at 4.2. As per team 3, the chair selected both of these interventions for implementation, despite the slightly lower score for the workshop. The team

scored team and chair training at 2.7 and 3.5, respectively. The chair did not select the training interventions for implementation.

In summary, all teams selected workshops to determine local consensus processes, use of a standard intake form and synoptic reporting form, and audit and feedback. A summary of each team's selected local consensus processes, which refer to 'rules' of MCC functioning, is provided below (see Table 3).

Selected Local Consensus Processes

MCC 1: The chair defined a weekly submission deadline and maximum number of cases per round. A maximum discussion time of 6 minutes per case was established. MCC participants from each seminal specialty were required to attend MCCs on time and MRPs were required to present their own case or send a surrogate representative. Using the standard intake form, the MCC team was required to: articulate a clear clinical question, original treatment plan, and indicate confidence in original treatment plan.

MCC 2: The chair defined a weekly deadline for case and imaging submission and a maximum number of cases per round. The chair defined the types of cases to be discussed at the MCC. MCC participants from each seminal specialty were required to attend MCCs on time and MRPs were required to present their own case or send a surrogate representative. Teams were required to articulate a clear clinical question. The team was not required to articulate an original treatment plan.

MCC 3: The chair defined a weekly submission deadline and maximum number of cases per round. A maximum discussion time of 10 minutes per case was established. MCC participants from each seminal specialty were required to attend MCCs on time and MRPs were required to present their own case or send a surrogate representative. Using the standard intake form, the MCC team was required to:

articulate a clear clinical question, original treatment plan, and indicate confidence in the original treatment plan.

MCC4: The chair defined a weekly deadline for case and imaging submission. A maximum case volume per round was not established. Using the standard intake form, the MCC team was required to: articulate a clear clinical question, original treatment plan, and indicate confidence in original treatment plan.

Compliance

Three of the four teams (MCC 1, 3, 4) were 100% compliant with implementation of the standard intake form. MCC 2 was not compliant, and only implemented the form for 25% of rounds. None of the teams were compliant with the synoptic reporting form – we did not observe any formal implementation of the form to guide MCC discussion or decision making.

To further explore whether MCC teams adhered to their selected local consensus processes (or MCC 'rules' of functioning), we describe compliance with the following items below: weekly attendance by seminal specialties, maintenance of defined maximum number of cases per round, submission of cases by weekly deadline, presentation of case by MRP, articulation of a clear clinical question, articulation of an original treatment plan, and articulation of a final treatment plan by MCC chair. Results are presented by MCC team.

MCC 1: There was full attendance by all seminal specialties. The team maintained their maximum number of cases for 100% of their rounds. Eighty-eight percent of cases were submitted for MCC discussion using the intake form. The MRP presented their own case, asked a clear clinical question, and articulated an original treatment plan for 97%, 100%, and 71% of cases, respectively. Confidence of original treatment plan was only provided for 19/40 cases (48%). The final treatment recommendation was articulated for 86% of cases.

MCC 2: One seminal specialty did not attend 43% of rounds. The team maintained the maximum number of cases for 20% of their rounds. The team never formally implemented the standard intake form. Ninety-four percent of cases were submitted using the team's original intake form for discussion. The MRP presented their own case for 74% of cases and asked a clear clinical question for 46% of cases. The final treatment recommendation was articulated for 74% of cases.

MCC 3: Two seminal specialties were absent for 13% and 50% of rounds, respectively. The team maintained the maximum number of cases for 100% of rounds; however, 80% of rounds were significantly below the maximum number of defined cases (>3 cases below max). Ninety-seven percent of cases were submitted using the intake form for discussion. The MRP presented their own case, asked a clear clinical question, and articulated an original treatment plan for 83%, 86%, and 91% of cases, respectively. Confidence of original treatment plan was provided for 31/38 of cases (82%). The final treatment recommendation was articulated for 97% of cases. MCC 3 was the only team to feed back the final treatment recommendation to MCC participants in writing, following the MCC round.

MCC 4: There was full attendance by all seminal specialties. The team did not choose to define a maximum number of cases per round. One hundred percent of cases were submitted using the intake form for discussion. The MRP presented their own case, asked a clear clinical question, and articulated an original treatment plan for 65%, 65%, and 75% of cases, respectively. Confidence of original treatment plan was provided for 12/20 cases (60%). The final treatment recommendation was articulated for 95% of cases.

Other Observations

Rounds took place on a weekly or biweekly basis. All MCCs were intended to last 60-80 minutes; however, MCC rounds lasted for an average of 40.7 minutes (range 8 minutes – 93 minutes; median: 36.5 minutes). It took teams 3-5 weeks to hold the workshops, implement the local consensus processes and tailor the standard intake forms. Technological improvements were made to the

academic hospital hosting MCCs (e.g., provision of a microscope to view pathologic slides) and an information technology expert was available at the start of each round to ensure MCC teleconferencing ran smoothly.

Summary

The KT-MCC was feasibly implemented at four Ontario MCC sites, although there were some issues regarding compliance with selected interventions. There were no challenges pertaining to MCC team access or data collection. Access to the MCC chair, and familiarity with MCC participants, MCC nomenclature, and disease-site terminology were critical to feasibility of implementation and assessment. All MCC chairs and teams were agreeable to participate in the KT-MCC and workshop to select intervention components and define local consensus processes. Three of four MCC teams were compliant with implementation of the standard intake form. None of the chairs were compliant with implementation of the synoptic reporting form or dissemination of the audit and feedback data provided by our research team. Adherence with selected local consensus processes varied by team. There was lack of attendance by seminal specialties in up to 50% of cases. Adherence with the defined weekly maximum number of cases ranged from 20-100%. Completion of the items on the intake form ranged from 46-100%.

Impact – Quality of Decision Making per Case (Evaluated using MTB-MODe)

Descriptive and Univariate Statistics

MTB-MODe scores did not change from the pre to post study period (See Tables 4, 5). In the pre and post study periods, the mean scores for quality of information provided were 17.1 and 16.55 (p=0.421), respectively, and for quality of teamworking were 15.2 and 14.8 (p=0.492), respectively. The pre and post composite scores for decision making quality were 32.3 to 31.2 (p=0.419), respectively.

Scores for individual teams provided interesting findings (see Table 5). In regards to the individual MTB-MODe items, MCC 1 improved their mean score for all items except for patient views (2.09 to 1.34). The scores for MCC 2 decreased for all items except for presentation of comorbidities (2.67 to 2.93) and radiologists' contributions (4.19 to 4.30). For MCC 3, the scores for case history, presentation of comorbidities, patient views, psychosocial views, and contribution by surgeons, oncologists and the MCC chair contribution improved; however, scores for pathologic information and contribution by radiology and pathology decreased. The quality of radiologic information was unchanged. Finally, all scores for MCC 4 improved except for radiologic information, patient views, psychosocial views, and contribution by oncologists, which all decreased.

We then used univariate analyses to compare pre and post data for the quality of information presented and quality of teamworking by team. Quality of information scores increased for MCC teams 1, 3, and 4, however, none of these improvements were statistically significant (see Table 6). Quality of teamworking scores also improved for MCC teams 1, 3 and 4; however, only MCC team 4 had a statistically significant improvement (14.1 to 16.6, p=0.051). Quality of information presented and quality of teamworking scores for MCC 2 both decreased significantly (16.5 to 14.09, p=0.041 and 16.3 to 13.0, p=0.002, respectively).

Multivariate Analyses

Finally, we used a GLM to determine whether there was a significant difference in the pre and post decision making scores. The GLM showed that aggregate pre-intervention scores were associated with marginally lower quality of decision making (~1 point), compared to the aggregate post-intervention scores. However, this finding was not significant (p=0.884), demonstrating that the KT-MCC did not improve per case quality of decision making scores.

A priori, we determined that we would perform a sensitivity analysis if any MCC teams were found to significantly influence the aggregate post-intervention scores. The GLM demonstrated that

MCC 2 was associated with decreased quality of decision making scores, while the remaining MCC teams were correlated with increased quality of decision making scores. While these data were not statistically significant (p=0.073), the near-significant correlation suggests MCC 2 may have impacted decision making scores. To further explore these data, a sensitivity analysis that excluded MCC 2 data from the GLM model was performed. A re-analysis of the before-and-after scores for MCC teams 1, 3 and 4 revealed a significant difference between pre and post intervention scores (p=0.047), meaning that the KT-MCC was associated with increased decision making quality for MCC teams 1, 3 and 4.

A subsequent analysis of mean scores for MCC1, 3 and 4 was completed using an independent samples t-test. The same trend was demonstrated, with the quality of MCC decision making per case improving significantly from 32.07 (SD 9.38) to 35.06 (SD 9.73) out of a possible 55 points (p=0.035),which correlates with a 6% absolute improvement of in per case decision making quality. Quality of teamworking scores also improved significantly (p=0.021), from a baseline mean of 14.65 (SD 4.81) to 16.36 (SD 5.20) out of a possible 25 points, which correlates with a 7% absolute improvement. The quality of information presented improved slightly from a mean score of 17.41 (SD 5.67) at baseline to 18.69 (SD 5.42) post-intervention (4% absolute improvement); however, this finding was not statistically significant (p=0.120).

Correlation of MTB-MODe scores with other quality indicators

Presentation of a case by the most responsible physician, provision of an original treatment plan by the most responsible physician, and submission of the case by the MCC deadline were positively correlated with increased quality scores for MCC decision making (p=0.004, p=0.015, and p=0.003, respectively). Articulation of a clear clinical question by the most responsible physician prior to case discussion was not significantly correlated with an increased quality decision making score (p=0.401).

Impact – Quality of Decision Making per Round (Evaluated using MTOT)

Table 7 depicts the effect of the KT-MCC on MCC decision making per round, as measured by the MTOT (team characteristics, infrastructure, meeting organization and logistics, and patient centered decision making). The summary score of decision making per round was 41.6 at baseline (SD 4.91) and increased significantly to 47.7 (SD 10.1, p=0.013), following the intervention. Mean scores for 13 of the 15 items on the MTOT demonstrated a slight increase following the KT-MCC, with the exception of *personal development* (i.e., observable communication of research evidence and/or instances of learning) and *availability of patient notes*, which did not change following the KT-MCC. There appeared to be less tension and conflict following the KT-MCC (-0.41 pre-intervention to -0.04 post-intervention).

The findings of the MTOT (decision making per round) paralleled the findings of the MTB-MODe (decision making per case). MCC teams 1, 3 and 4 demonstrated a significant increase in decision making quality scores per round. MTOT scores increased from 39.9 to 51.1 for MCC team 1 (p=<0.000), 42.7 to 52.8 for MCC team 3 (p=<0.000), and 38.6 to 47.0 for MCC team 4 (p=0.027). MTOT scores for MCC team 2 decreased from 44.1 to 39.2; however, this finding was not statistically significant (p=0.479).

Time Per Case

The KT-MCC did not improve time spent per case discussion. Time spent per case was 6 minutes at baseline and decreased by 10 seconds in post-intervention mean (before=359.5 seconds, SD 204.6 seconds; after=350.6 seconds, SD 206.7 seconds, p=0.70). The time spent per case discussion and time spent on case history had a significant inverse correlation with the order in which the case was presented (p=0.000, p=0.022, respectively, see Figures 1 and 2).

Rate of Change

Post-intervention data regarding rate of change in treatment plan were provided for 80/165 cases. Rate of change was 48%. Of these 80 cases, confidence in original treatment plan was reported

for 43 cases. Fifteen of these 43 cases had a change from original to final treatment plan. For the 15 cases with a change and the 28 cases with no change, MRPs were confident in their original plan for 33% and 61% of cases, respectively.

Discussion

We successfully implemented the KT-MCC among four Ontario MCC teams. We did not experience any challenges with site selection or data collection for this study. All MCC teams and chairs were agreeable to participate in workshops to select intervention components and define local consensus processes. MCC teams were compliant with some, but not all, of the selected intervention components. Three teams were compliant with implementation of the standard intake form; however, none of the teams formally implemented the synoptic discussion form. We did not observe the formal dissemination of any audit and feedback data by the MCC chairs.

Aggregate data across MCC sites showed no significant effect of the KT-MCC on the quality of information presented (17.1 to 16.7, p=0.421) or the quality of teamworking (15.2 to 14.8, p=0.492) when measured using the MTB-MODe. We had determined a priori that any team exhibiting influence on the overall quality of decision making scores on the GLM model would be removed, to allow for a sensitivity test to further explore data trends. MCC 2 appeared associated with lower decision making scores on the GLM model. Descriptive statistics confirmed that this team demonstrated statistically significant decreased quality scores in the post-intervention period. Once this team was removed from the GLM, we noted a 7% significant absolute improvement in the quality of teamworking, and a 4% absolute, but statistically non-significant, improvement in the quality of information presented. These improvements were not aggregate of course, and still fell below the 10% minimum difference in effect we had anticipated. We did note a significant 11% absolute improvement in MTOT per round quality scores.

In the current Ontario model, chairs are the gatekeepers to MCC processes, and in this study, were ultimately responsible for selecting intervention components. All chairs selected the following interventions for implementation: a workshop to determine local consensus process; audit and feedback on quality markers; and use of standard intake form and synoptic discussion form. None of the MCC chairs selected the team or chair training intervention components, despite being presented with key informant and focus group data that suggested quality gaps in teamworking and leadership exist. We postulate that the level of engagement of the MCC chair was correlated with compliance with selected interventions. For instance, the MCC 1 chair was engaged in the establishment of local consensus processes and aimed to enforce them at each round. In turn, MCC 1 demonstrated high compliance scores with most local consensus processes, such as submission of a clear clinical question (100%) and presentation of case by the MRP (97%).

In their role as gatekeepers, MCC chairs may have acted as opinion leaders. In the KT literature, opinion leaders are defined as individuals who are 'credible, likeable and trustworthy' and are able to influence behavior change.[27] While a chair can certainly act as opinion leader, it is important to distinguish the roles of gatekeeper versus opinion leader. We observed non-chair opinion leaders intervening to ensure compliance with local consensus processes. For instance, these MCC participants constantly prompted their colleagues to articulate a clear clinical question to facilitate the case discussion. It is likely important to engage both gatekeepers (MCC chairs) and MCC opinion leaders to ensure improved compliance with the KT-MCC. Finally, MCC coordinators should also be engaged in quality improvement processes, as they can play a significant role in ensuring compliance with selected interventions. For instance, some coordinators highlighted that they did not accept a case for discussion unless the MRP completed the standard intake form in full. KT evidence further supports the need to engage administrators and coordinators to promote intervention uptake. Rosenthal et al. evaluated the effect of administrative support on uptake of a handwashing initiative and found a positive correlation

between administrative engagement and rate of compliance with handwashing.[28] We hypothesize that additional engagement of MCC chairs, opinion leaders, and coordinators can improve compliance with selected KT-MCC intervention components.

In summary, the KT-MCC was feasible, although there were some gaps in compliance. The impact of the KT-MCC on per case quality scores was minimal, and below the anticipated 10%. Based on these findings, we do not recommend that the current form of the KT-MCC be tested for efficacy in a randomized trial.

There are a number of reasons we did not observe clinically and statistically important improvements in most study measures. First, we did not use an iterative approach due to the time limitations of this thesis project. It is possible that additional, iterative cycles of the KT-MCC, with or without the presentation of ongoing data results, would have improved compliance and seen teams and chairs select additional intervention components (e.g., team or chair training). The Knowledge to Action Framework (KTA Cycle), developed by Graham et al., outlines a series of eight cyclical, iterative steps that can be used to disseminate knowledge into practice.[29] The KTA cycle suggests that iterative cycles allow for intervention tailoring, or modifications, that can overcome barriers and leverage facilitators to behavior change. With each iteration of the cycle, the evidence to practice gap is expected to narrow and quality is expected to improve. For example, we noted lack of compliance with synoptic reporting form use, despite chairs' agreement to implement it. An additional iteration may have seen this form implemented, and related measures improve.

Although the KT-MCC intervention impact was lower than anticipated, our findings from the sensitivity analysis are comparable to those of Lamb et al., who were the first research team to develop and evaluate a quality improvement strategy to improve MCC decision making. Their strategy, tested on a single urology MCC team in the United Kingdom, included a synoptic reporting form, team

training, and written guidance on how to optimize MCCs. Lamb et al. noted a significant 9% and 5% absolute improvement in the quality of teamworking and information presented, respectively. We first wished to compare our baseline MTB-MODe scores with Lamb et al.'s, as KT literature dictates that quality improvement interventions are most effective when implemented among teams of lower quality.[19] This suggests that teams with lower baseline scores are more likely to demonstrate a larger absolute intervention effect. We noted that Lamb et al.'s baseline quality scores were considerably lower than ours. For instance, baseline quality of teamworking for our sites was rated at 61% compared to Lamb et al.'s 33% (where a perfect score is 100%). Similarly, quality of information presented was 57% compared to Lamb et al.'s 30%. Despite our considerably greater baseline scores, our results were not dissimilar. This suggests that our absolute difference of improvement may have been diminished due to our higher baseline scores.

There were also a number of notable contextual differences that should have resulted in better impact for Lamb's intervention. First, Lamb et al.'s intervention was piloted within a single MCC site, in which the study authors were also MCC participants. This likely resulted in increased engagement of quality improvement strategy within the MCC team. Second, their intervention components were delivered over a period of 16 months, as opposed to the KT-MCC intervention components, which were piloted for a two month period. Third, Lamb's quality of information scores likely improved due to resident contribution to case preparation. Our ability to achieve similar quality improvements for MCC teams 1, 3 and 4 despite these notable contextual limitations may be attributed to the use of progressive KT methodology. We suggest that use of the TDF, COM-B behaviour change wheel, and an iKT approach was an effective method to design and implement a quality improvement intervention. As per the KTA cycle, we hypothesize that additional iterations of the KT-MCC, with appropriate tailoring as needed, would have significantly improved intervention uptake, compliance and impact.

This study revealed a number of other interesting findings that can be further explored in future research. First, our data suggests that simple modifications to MCC functioning can improve the quality of MCC decision making. We found that presentation of the case by the MRP, provision of an original treatment plan by the MRP, and submission of the case by the MCC deadline were correlated with improved MTB-MODe quality scores. The simple requirement of such processes by MCC chairs may improve overall decision making quality, and should be considered for implementation.

Second, the findings of the MTB-MODe tool paralleled those of the MTOT tool, showing significant improvements in quality of decision making for MCC teams 1, 3 and 4, but not for MCC 2. These findings suggest strong parallel, construct validity of the MTB-MODe and MTOT tools. While we recommend evaluating decision making quality at both the per case and per round level, we suspect that the MTOT is less sensitive to weekly variation, and that fewer round-level evaluations are needed, compared to case-level evaluations. Additional psychometric testing to confirm these hypotheses are warranted.

Third, our data show that treatment plans changed in up to 48% of cases presented, despite MRPs having reported being ‘confident’ or ‘very confident’ in their original plan for 33% of these cases. These data are similar to the findings of Oxenberg et al. who evaluated 101 consecutive cancer cases presented at a modified MCC at a leading US cancer center.[30] The study authors found a 36% change in original treatment plan, where 72% of changes were considered major. High physician confidence in the original treatment plan (reported at 84%), as well as patient and tumor characteristics, were not found to be significant predictors of treatment change. This suggests that physicians are unable to predict the cases that are likely to result in a change from original to final treatment recommendation. This further suggests that consecutive cancer cases should be discussed in a collaborative forum. The ability to discuss consecutive cases is predicated on the efficiency of MCC discussion, which will likely require other changes, such as mandated team and chair training.

Finally, this study demonstrates that use of progressive KT methods, specifically the use of the Theoretical Domains Framework, COM-B Behaviour Change Wheel, and an integrated KT approach, is feasible. We were able to successfully identify barriers and facilitators to MCC decision making, and select corresponding interventions. However, additional research to determine the impact of such progressive KT methods on process and clinical outcomes is still needed.

Limitations

Our study has limitations. Most significantly, given the time and resource constraints of this doctoral thesis, we were unable to conduct multiple iterations of the KT-MCC among MCC teams. As per the knowledge-to-action cycle, we anticipate that additional, iterations with appropriate tailoring of the KT-MCC may result in clinically significant improvements in study measures.

Second, there is a need to develop a strategy to better engage MCC chairs in quality improvement processes, given that they act as gatekeepers to MCC functioning. For instance, we provided two rounds of audit and feedback (which outlined MTB-MODe scores and other quality metrics) to chairs in the post-intervention phase, but are aware that the chairs did not disseminate these data to MCC participants. Similarly, while chairs agreed to utilize the synoptic discussion form, none formally implemented it for case discussion. There should be increased support for MCC chair training, given their significant role in MCCs.

Third, reliability tests were not performed for the MTOT at our site due to logistical limitations (e.g., time availability of a second rater). However, the MTOT previously demonstrated strong reliability and validity in a UK setting using multiple MCC disease sites.[25] This thesis suggests similar data trends for MCC functioning in Canada, the UK and Australia. We anticipate that similar reliability and validity scores for the MTOT would be observed in an Ontario setting. Further, MTOT scores paralleled those of the MTB-MODe tool, which suggests strong parallel, construct validity of the instruments.

Finally, this pilot study implemented the KT-MCC at four MCCs, three of which took place within the same academic institution. As a result, hospital-level factors may have influenced the feasibility of implementation and observed impact of the KT-MCC. For example, the academic hospital in which three of the MCC teams were located purchased new teleconferencing screens and a microscope for pathology review, which improved MTOT scores. However, it is unclear whether these policy changes were made because of the KT-MCC or were coincidental with our pilot study. Any future randomized trials to evaluate the KT-MCC should stratify sites at the hospital level, to account for such possible confounding.

Conclusion

There is a need for more randomized trials to evaluate the effect of quality improvement interventions, particularly those that target cancer specialists. To the best of our knowledge, this is the first study to evaluate the effectiveness of an MCC quality improvement intervention developed using progressive KT methods. Our intervention, the KT-MCC, is comprised of workshops, team and chair training, use of a synoptic reporting form, use of a standard intake tool, and audit and feedback. We piloted the KT-MCC in the form of a before-and-after study to evaluate feasibility of implementation and to detect initial signals of effect, prior to evaluation using a randomized trial. Our findings demonstrate that the KT-MCC can be feasibly implemented at Ontario MCCs. MCC teams selected some, but not all, of the KT-MCC intervention components. Compliance varied by MCC team.

The impact of the KT-MCC on MCC decision making quality was minimal. Initial signals of effect on decision making quality, while comparable to those reported in the literature (i.e., Lamb et al.), were marginal. Our feasibility and impact evaluation of the KT-MCC suggests that it is likely premature to invest time and resources to formally evaluate the KT-MCC using a randomized trial.

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Table 1: Strengths and Weaknesses for each MCC site, presented to chairs following baseline data collection period

MCC 1	MCC 2	MCC 3	MCC 4
STRENGTHS -Attendance by 3 seminal specialties -Cases submitted by mandated deadline using intake form -Availability of electronic patient notes -Availability of technology and regular review of imaging	**STRENGTHS** -Attendance by all seminal specialties -Cases submitted by mandated deadline using intake form -Availability of electronic patient notes -Availability of technology and regular review of imaging -Team sociability/ respect for speaker	**STRENGTHS** -Attendance by 3 seminal specialties -Availability of electronic patient notes -Availability of intake form -Regular review of imaging -Team sociability/respect -Input from team members actively encouraged -Final treatment plan articulated and fed back to group -Chair actively leads MCC -Appropriate time spent on each case	**STRENGTHS** -Attendance by all seminal specialties - Availability of electronic patient notes -Availability of technology and regular review of imaging -Respect for speaker
WEAKNESSES -Lack of involvement by 1 seminal specialty -Lack of attendance by 1 seminal specialty -Team sociability/ respect for speaker -Input from team members not actively encouraged -Little acknowledgement of patient-centered factors in discussion -Little articulation of research evidence/ practice guidelines -Final treatment plan not articulated -Appears to be a negative correlation between order of case presented and time spent on case (more time spent on earlier cases)	**WEAKNESSES** -Input from team members not actively encouraged - Little acknowledgement of patient-centered factors in discussion -Little articulation of research evidence/ practice guidelines -Final treatment plan not articulated -Appears to be a negative correlation between order of case presented and time spent on case (more time spent on earlier cases)	**WEAKNESSES** -Lack of attendance by 1 seminal specialty -Cases not submitted by mandated deadline -Technological challenges with teleconferencing sites	**WEAKNESSES** -MCC dominated by one seminal specialty -No intake form to submit cases -Input from team members not actively encouraged -Final treatment plan not articulated

Table 2: Results of Survey – Intervention Selection

KT-MCC Strategy Component	**MCC Team 1 (n=13)**	**MCC Team 2 (n=8)**	**MCC Team 3 (n=15)**	**MCC Team 4 (n=9)**	**Overall**
Local consensus processes	✓ 4.07	✓ 4.38	✓ 3.60	✓ 3.56	**3.90**
Team Training	2.76	3.00	2.80	2.67	**2.81**
Chair Training	3.54	3.25	4.07	3.45	**3.58**
Audit and Feedback	✓ 3.92	✓ 4.13	✓ 4.00	✓ 4.22	**4.07**
Standard intake form & Synoptic Reporting Form	✓ --	✓ --	✓ --	✓ --	**N/A:** intervention selected by chairs at baseline

✓ Denotes chair decision to implement intervention; Data presented in means

Table 3: Selected components of KT-MCC Strategy and local consensus processes, by MCC team

KT-MCC Strategy Component	MCC Team 1	MCC Team 2	MCC Team 3	MCC Team 4
Local Consensus Processes	-Deadline for case submission -Maximum number of cases defined -Maximum discussion time per case defined -Requirement to attend MCCs on time -Requirement for MRP to attend (or send surrogate) in order to present case	-Deadline for case submission -Maximum number of cases defined -Deadline to submit imaging -Requirement for MRP to attend (or send surrogate) in order to present case -Types of cases to be discussed defined	-Deadline for case submission -Maximum number of cases defined -Maximum discussion time per case defined -Requirement to attend MCCs on time	-Deadline for case submission -Deadline to submit imaging
Standard Intake Form; Synoptic Discussion Form	-Agreed to use synoptic form -Clear clinical question and original treatment plan required on intake form -Agreed to collect data regarding rate of decision change -Treatment plan to be articulated by chair -Chair agreed to invite members of each specialist group to participate in discussion	-Agreed to use synoptic form -Chair to control discussion to a moderate extent -Treatment plan to be articulated	-Agreed to use synoptic form -Clear clinical question and original treatment plan required on intake form -Agreed to collect data regarding rate of decision change -Treatment plan to be articulated by chair and disseminated back to group	-Agreed to use synoptic form -Clear clinical question and original treatment plan required on intake form -Agreed to collect data regarding rate of decision change -Treatment plan to be articulated by the chair -Chair agreed to invite members of each specialist group to participate in discussion
Chair Training	--	--	--	--
Team Training	--	--	--	--
Audit and Feedback	A&F for -Rate of decision change -Time spent per case -Cases discussed per round -Quality of information -Quality of teamworking	A&F for -Rate of decision change -Time spent per case -Cases discussed per round -Quality of information -Quality of teamworking	A&F for -Rate of decision change -Time spent per case -Cases discussed per round -Quality of information -Quality of teamworking	A&F for -Rate of decision change -Time spent per case -Cases discussed per round -Quality of information -Quality of teamworking

Table 4: Engagement with local consensus processes before/after KT-MCC Strategy

MCC team	**Max. number of cases maintained (proportion)**		**Cases submitted using intake form (%)**		**MRP presented case (%)**		**Clear clinical question articulated (%)**		**Original treatment plan provided (%)**		**Final treatment plan articulated (%)**	
	Before	***After***	***Before***	***After***	***Before***	***After***	***Before***	***After***	***Before***	***After***	***Before***	***After***
1 Before n=46 **After n=32**	<Max: 3/6 Max: 2/6 >Max: 1/8	**<Max: 8/8** **Max: 0/8** **>Max: 0/8**	82.22	**87.50**	89.13	**96.88**	82.61	**100.00**	35.71	**70.97**	78.57	**86.21**
2 Before n=51 **After n=77**	<Max: 6/6 Max: 0/6 >Max: 0/6	**<Max: 4/7** **Max: 0/7** **>Max: 3/7**	79.49	**93.51***	68.63	**73.68**	60.42	**45.45**	N/A	**N/A**	76.09	**73.61**
3 Before n=25 **After n=36**	<Max: 6/6 Max: 1/6 >Max: 0/6	**<Max: 6/6** **Max: 3/6** **>Max: 0/6**	100.00	**97.22**	80.00	**83.33**	88.00	**86.11**	33.33	**91.43**	80.00	**97.22**
4 Before n=27 **After n=20**	N/A	**N/A**	88.89	**100.00**	62.96	**65.00**	62.96	**65.00**	48.15	**75.00**	66.67	**95.00**

*KT-MCC Strategy standard intake form not used – team reverted to original intake form

Table 5: Descriptive statistics for quality of MCC decision making per case

	MTB-MODe Item	MCC 1		MCC 2		MCC 3		MCC 4	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post
Quality of Information	Case History	3.74 (1.17)	4.47 (0.94)	3.00 (0.97)	2.93 (1.59)	3.88 (1.33)	4.20 (1.02)	3.89 (1.09)	3.90 (1.30)
	Comorbidity	3.38 (1.50)	4.63 (1.03)	2.67 (1.36)	2.93 (1.67)	3.68 (1.41)	4.31 (1.08)	3.48 (1.28)	3.95 (1.40)
	Radiologic Information	4.81 (0.71)	4.87 (0.73)	4.49 (1.33)	4.42 (1.42)	5.00 (0.00)	5.00 (0.00)	4.56 (1.16)	4.00 (1.66)
	Pathologic Information	1.88 (1.04)	2.27 (1.29)	3.29 (1.65)	2.82 (1.79)	2.17 (1.27)	2.06 (1.30)	1.93 (1.27)	2.65 (1.46)
	Patient Views	2.09 (1.62)	1.34 (1.08)	1.84 (1.53)	1.32 (1.03)	1.92 (1.55)	2.00 (1.53)	2.56 (1.85)	2.20 (1.88)
	Psychosocial Views	1.69 (1.33)	2.10 (1.68)	1.92 (1.53)	1.47 (1.10)	1.96 (1.51)	2.03 (1.60)	2.30 (1.64)	2.05 (1.54)
Quality of Teamworking	Radiologists	3.83 (1.34)	4.64 (0.91)	4.19 (1.47)	4.30 (1.43)	5.00 (0.00)	4.89 (0.68)	3.85 (1.56)	4.60 (1.23)
	Surgeons	3.81 (1.49)	4.35 (1.29)	3.74 (1.36)	3.33 (1.70)	3.76 (1.75)	3.94 (1.64)	3.22 (1.34)	4.15 (1.57)
	Oncologists	3.74 (1.40)	4.10 (1.66)	3.53 (1.47)	2.99 (1.77)	3.96 (1.37)	4.49 (1.10)	3.22 (1.60)	2.40 (1.96)
	Pathologists	1.85 (1.22)	2.00 (1.63)	3.15 (1.95)	3.07 (1.99)	2.35 (1.80)	1.71 (1.58)	1.67 (1.30)	2.35 (1.90)
	Chair	2.95 (1.29)	4.07 (1.00)	3.16 (1.06)	2.54 (0.89)	4.00 (0.78)	4.22 (0.88)	2.76 (0.44)	3.10 (1.21)

Denotes improvement in quality scores

Denotes regression in quality scores

Denotes no change in quality scores

Table 6: Effect of KT-MCC Strategy on Decision Making Quality

	Scores for MCC1-4		
	Pre (n=149)	**Post (n=165)**	**p**
Composite Score for Decision Making Quality	32.30 (9.39)	31.21 (11.80)	0.419
Quality of Information	17.10 (5.63)	16.55 (6.58)	0.421
Quality of Teamworking	15.20 (5.03)	14.78 (5.94)	0.492

	MCC 1			MCC 2			MCC 3			MCC 4		
	Pre (n=42)	**Post (n=31)**	**p**	**Pre (n=51)**	**Post (n=77)**	**p**	**Pre (n=25)**	**Post (n=36)**	**p**	**Pre (n=27)**	**Post (n=20)**	**p**
Composite Score for Decision Making Quality	33.19 (6.42)	36.55 (9.83)	0.082	32.75 (9.47)	27.05 (12.56)	0.007*	34.52 (7.79)	34.58 (8.76)	0.977	32.82 (6.40)	35.35 (8.42)	0.247
Quality of Information	17.60 (4.62)	18.97 (5.15)	0.236	16.49 (5.57)	14.09 (6.96)	0.041*	18.52 (4.45)	18.94 (5.19)	0.741	18.70 (4.27)	18.75 (4.90)	0.973
Quality of Teamworking	15.60 (3.59)	17.58 (5.49)	0.066	16.26 (5.31)	12.96 (6.23)	0.002*	16.00 (4.13)	15.64 (4.40)	0.748	14.11 (3.71)	16.60 (4.79)	0.051*

Data presented in means (SD)

*Denotes a significant p value

Table 7: Overall MCC quality scores, as per the Multidisciplinary Team Observational Tool

	Attendance	Leadership	Inclusion of team members	Team Sociability	Mutual Respect	Personal Development	Meeting Venue	Technology & Equipment	Agenda	Prioritization of Case presentation	Availability of Patient Notes	Case Presentation	Patient Centered Care	Clarity of treatment plans	Presence of tension/conflict*	**Summary Score of Overall MCC Quality**	p-value for summary MCC quality score
Pre	3.14 (1.17)	2.41 (1.05)	3.14 (0.83)	3.59 (0.59)	3.23 (0.92)	1.50 (0.51)	3.77 (0.53)	5.00 (0.00)	2.62 (0.67)	3.55 (0.80)	4.00 (0.00)	2.16 (0.61)	1.32 (0.57)	2.17 (1.13)	-0.41 (0.96)	**41.59 (4.91)**	**0.013**
Post	3.21 (1.23)	2.82 (1.28)	3.46 (0.96)	3.64 (0.73)	3.64 (0.78)	1.52 (0.60)	4.00 (0.00)	7.14 (1.38)	2.82 (0.48)	3.79 (0.57)	3.96 (0.19)	2.64 (0.62)	1.50 (0.79)	3.16 (0.78)	-0.04 (0.19)	**47.66 (10.11)**	

Data presented in means (standard deviation)

*Evaluated on a negative scale (lower scores demonstrate greater levels of tension/conflict)

	MCC 1	**MCC 2**	**MCC 3**	**MCC 4**
Pre-Intervention MCC Quality Score	39.92 (4.20)	44.17 (4.62)	42.67 (5.16)	38.63 (5.15)
Post-Intervention MCC Quality Score	51.14 (2.73)	39.19 (16.04)	52.83 (2.60)	47.00 (3.94)
p-value	<0.000	0.479	<0.000	0.027

Data presented in means (standard deviation)

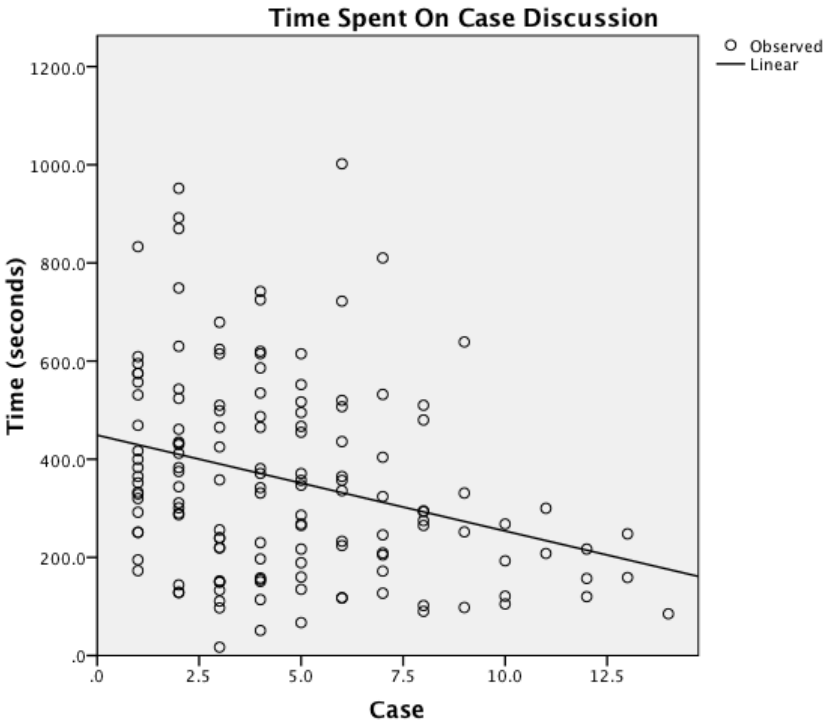

Figure 1: Correlation between order of case presented and time spent on case discussion (post intervention data)

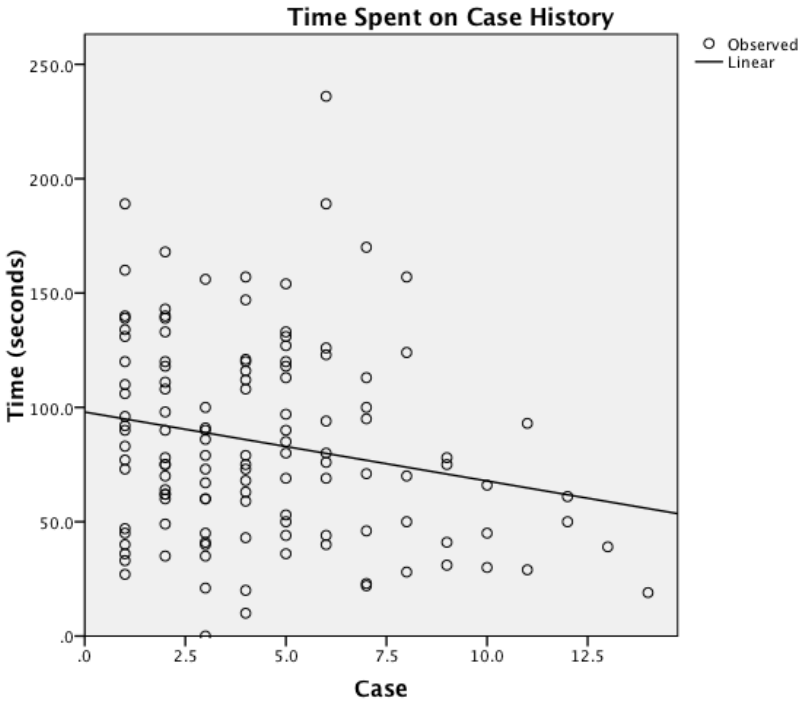

Figure 2: Correlation between order of case presented and time spent on case history (post intervention data)

APPENDIX A: MTB-MODe Tool and Other Quality Indicators

Case #

Patient name/MRN: **Referring Physician:**

Time spent on case history (mm:ss): Time spent discussing case (mm:ss):

Did MRP ask a clear clinical question? (Specify)		Yes	No			
Did MRP provide an original treatment plan? (Specify)		Yes	No			
Category	**1**	**2**	**3**	**4**	**5**	
Case history Info	No patient case history presented	2	Partial case history	4	Fluent, comprehensive case history	
Co-morbidity	No knowledge of past medical history or performance status	2	Vague first hand knowledge or good second hand knowledge of past medical history and performance status	4	Comprehensive first-hand knowledge of past medical history and performance status	
Radiological Information	No provision of radiological information	2	Radiological information from a report/account	4	Review of radiological images	
Patient Views	No knowledge of patient wishes	2	Vague first-hand knowledge, or good second-hand knowledge of patient wishes or opinions	4	Comprehensive first-hand knowledge of patient's wishes or opinions regarding treatment	
Psychosocial	No knowledge of patient's personal circumstances, social and psychological issues	2	Vague first-hand knowledge or good second-hand knowledge of circumstances, social and psychological issues	4	Comprehensive first-hand knowledge of patients personal circumstances, social and psychological issues	
Pathological Information	No provision of pathological information	2	Pathological information from a report/account	4	Review of pathological images	
	Nil/ Impedes contribution of others		***Contribution inarticulate or vague***		***Articulate and precise specialty related contribution***	**N/P not present**
Radiologists	1	2	3	4	5	
Surgeons	1	2	3	4	5	
Oncologists	1	2	3	4	5	
Histopathologists	1	2	3	4	5	
MCC chair	Leadership impeding information/presentation/discussion/decision making	2	Leadership neither enhancing or impeding information/presentation/discussion/decision making	4	Leadership enhancing information/presentation/discussion/decision making	

Was the final plan clearly articulated by the chair?	Yes	No
What is the final determined plan?		
Was the case submitted by the deadline?	Yes	No

Please note additional comments/observations:

Post Intervention Data Included:

Did the treatment decision change from original plan?	Yes	No

APPENDIX B: MTOT Tool

Characteristic	Quality Criteria	Very Poor	Poor	Good	Very Good
The Team					
Attendance	-Presence of relevant core team members at the meeting	At least one core team member (and deputy) is not present for the whole meeting (1)	At least one core team member (and deputy) is absent for most of the meeting (≥3 cases) (2)	At least one core team member (and deputy) is absent for part of the meeting (≤2 cases) (3)	All core team members (or deputy) present for whole meeting (4)
Leadership: chairing of meeting	-Keeps meeting to agenda (ie moves on to next case) -Encourages overall participation -Encourages focused discussion -Articulates recommendation	Satisfies none of the criteria (1)	Only satisfies 1-2 of criteria (2)	Satisfies 3 of criteria (3)	Evidence of all the criteria (4)
Teamworking and Culture					
a) Inclusion of relevant team members	-All relevant core members are actively and appropriately involved -Meeting not dominated by 1-2 people -Input/questions volunteered and encouraged -Contributions facilitate decision-making and/or inform discussion -Consensus of decision-making	Satisfies 1/none of criteria (1)	Satisfies 2-4 of criteria (2)	Satisfies "all relevant core members are actively and appropriately involved" and at least 3 other criteria (3)	Satisfies all the criteria (4)
b) Team Sociability	-Evidence of humor -Team appear relaxed with each other -Warm and supportive team environment -Friendly and cooperative communicative style	Satisfies none of the criteria (1)	Satisfies 1 of criteria (2)	Satisfies 2-3 of criteria (3)	Satisfies all of criteria (4)
c) Mutual respect	-Focussed attention Respect for speaker -No concurrent discussions -Asking and valuing relevant contributions -General sense of politeness/courtesy (inc mobile phone etiquette)	Only satisfies 1 or none of criteria (1)	Satisfies 2-3 of criteria (2)	Evidence of respect, evidence of at least 4 criteria (3)	Strong evidence of respect in all/almost all cases (4)
Personal development & training	Observable communication of research evidence and/or instances of learning	No observable communication of research evidence or instances of learning (1)	Minimal communication of research evidence or instances of learning (2)		Structured presentation of research evidence and/or learning through formal discussion (eg: of audit findings) (3)
Infrastructure for meetings					
Meeting Venue	-Room size appropriate for number of team members -Layout of chairs enables accessible viewing of diagnostics -Layout of room allows accessible viewing of other team members -All members seated on a chair -Suitable venue in terms of location, temperature, lighting, etc.	Satisfies only 1 or none of criteria (1)	Satisfies 2 of the criteria (2)	Satisfies 3 of the criteria (3)	Satisfies all of the criteria (4)
Technology & Equipment	-Availability of diagnostic equipment to view and share images and pathology with the team (one score for radiology/one score for histopathology)	No radiology imaging facilities (1)	Light box available with hard copy film (2)	Current images available digitally with facilities for projecting/viewing images (3)	Current images available digitally with facilities for projecting/viewing images and capability of accessing retrospective images (eg: use of PACS)

					(4)
	-Availability of multiple screens scores extra 1 point. ***(check here if applicable)***	No histopathology facilities (1)	Microscope (2)	Microscope with facilities for projecting/viewing specimen/biopsy (3)	Microscope with facilities for projecting and viewing specimen/biopsy and accessing retrospective data (4)
Meeting organization and logistics					
Preparation prior to meetings a) agenda	Availability and content of agenda	No available agenda (1)	Agenda, but limited info (2)		Comprehensive agenda (3)
b) prioritization of complex cases	Prioritization of complex cases on agenda to enable sufficient time for their discussion	No attempt is made to order cases in terms of complexity and an inappropriate time is spent on cases (ie to much or too little) (1)	Some attempt is made to order cases in terms of complexity but an inappropriate time is spent on cases (ie to much or too little) (2)	Patient cases are discussed in a clear order but time is used inappropriately in some cases (3)	Patient cases are discussed in a clear order and an appropriate amount of time is spent discussing each case (4)
Organization/admin during meetings: a) patient notes	Availability of patient notes	No patient records available at meeting (1)	Some required past/current reports not available (2)	Hardcopy and all necessary past/current reports available (3)	Electronic access to patient records and all necessary past/current reports available (4)
b) case presentation	Comprehensiveness and coherence of case presentation	Rambling, entirely reading from notes; does not seem familiar with patient (1)	Some evidence of familiarity with patient and info presented in reasonable fashion (2)		Comprehensive succinct coherent presentation (evidence of familiarity with patient and findings) (3)
Clinical decision making					
Patient centred care	Includes mention of patient-baesd information (eg demography; co-morbidities; psycho-social or supportive needs; patient wishes/family preferences)	Patient-centred factors sufficiently acknowledged in less than 20% cases (1)	Patient-centred factors sufficiently acknowledged in less than 50% cases (2)	Patient-centred factors sufficiently acknowledged in 50% +cases (but not all cases) (3)	Patient-centred factors sufficiently acknowledged in all cases (4)
Treatment plans	Clarity of treatment plan	Treatment plan not discernable (1)	Treatment plan communicated verbally (2)	Treatment plan communicated verbally and recorded (3)	Treatment plan communicated verbally, recorded with a clearly articulated plan regarding the next steps (4)

Different Scale

D tension/conflict	Extent of tension and/or conflict observable in the team	≥1 clear example of conflict observed which persists throughout meeting (-4)	≥1 clear example of conflict observed does not persist throughout meeting (-3)	≥1 instance of tension observed which persists throughout meeting (-2)	≥1 instance of tension observed but does not persist throughout meeting (-1)

Please record any unusual circumstances/ additional notes/ observations, below:

CHAPTER 6: SUMMARY AND LESSONS LEARNED

Multidisciplinary cancer conferences (MCCs) play an important role in the care of patients with cancer. MCCs have been shown to change treatment plans in up to 52% of cases, lead to increased adherence with clinical guidelines (e.g., use of neoadjuvant therapy, referrals to palliative care) and increased coordination of care by cancer specialists.[1] Cancer Care Ontario, the agency charged with ensuring quality care for patients with cancer in the province, championed an initiative to increase the uptake of MCCs across Ontario. Recent data shows that while over 80% of hospitals in Ontario now routinely participate in MCCs, only half of new cancer cases are discussed in a multidisciplinary forum.[2] There is a need to improve MCC access, without compromising MCC quality. In Ontario, the quality of MCCs has only been evaluated by CCO using rudimentary markers, such as MCC frequency and rate of attendance by seminal specialties. There has been no evaluation of the contribution by team members, quality of information presented, quality of the MCC discussion, or access to pertinent resources (e.g., technology).

To date, only one research group, led by Lamb, has aimed to improve the quality of MCC decision making using deliberate interventions.[3] The research team implemented a strategy that included team training, written guidance on 'optimal MCCs' and an evidence-based checklist to guide case discussion.[3] The effect was a 9% improvement in teamworking quality and a 5% improvement in the quality of information presented, as measured by the MTB-MODe tool.[3] These effect sizes are generally comparable to other knowledge translation interventions. For instance, EPOC reviews have demonstrated effect sizes of 12-19%, 4-14%, and 2-11% for team training interventions, workshops and printed educational materials, and audit and feedback, respectively.[4-6]

Lamb et al.'s team likely benefited from a number of factors that improved intervention uptake, and subsequent impact. First, the intervention was piloted at a single MCC site, in which the study authors were also MCC participants. Second, the intervention was delivered over a 16 month period.

Third, the study team used residents to prepare weekly case information. Despite these factors, the post-intervention quality scores remained relatively low, improving from 30% to 38% for quality of information presented and from 38% to 43% for the quality of teamworking (where 100% indicates a perfect score), respectively.[3]

KT experts have increasingly called for the use of progressive KT methods, such as the use of theory and an integrated KT approach to enhance uptake and impact of quality improvement interventions.[7] Lamb et al. did not employ such methods. We posited that the use of progressive KT methods to develop and implement a quality improvement intervention to improve MCC decision making would result in improved impact, as compared to Lamb et al.'s findings. In this thesis, we referred to progressive KT methods as the use of theory, models, and an integrated KT approach to promote uptake and impact of our quality improvement intervention. Use of theory in intervention design is beneficial because it systematically identifies the various behavioural components that affect an outcome of interest.[8] Researchers that do not use theory and theoretically-rooted models may overlook important mediators during intervention design, which can result in the development of less effective interventions.[9] Use of an iKT approach is believed to increase the likelihood of uptake and success of a KT intervention by involving members of the target population in the design, implementation and evaluation of a quality improvement intervention.[7]

Therefore, in this thesis, we sought to design and evaluate a quality improvement intervention, titled the KT-MCC, that integrated progressive KT methods and that was aimed at improving the quality of MCC decision making in Ontario.

We designed a four part study to meet this thesis objective. First, we tested the reliability of the MTB-MODe tool in an Ontario setting. Next, we used interviews based on the Theoretical Domains Framework with MCC participants to identify barriers and facilitators to optimal decision making.[10] Identified domains were then mapped to the COM-B Behaviour Change Wheel to identify corresponding intervention functions.[11] KT interventions designed to optimize MCC decision making

and that responded to identified functions were combined to create the KT-MCC. We piloted the KT-MCC among four MCC sites in a before-and-after study to evaluate feasibility of implementation and potential impact. Findings would inform a subsequent randomized trial. Findings from these four studies are summarized below.

Thesis Findings

Part 1 – Measurement Study

The reliability of the Metric for the Observation of Decision making Tool (MTB-MODe) was evaluated using generalizability theory. Generalizability theory provides an overall reliability estimate that accounts for various sources of variance that impact a reliability score (e.g., test subjects, raters, items on the assessment tool, and random error).[12] The MTB-MODe assessment tool evaluates decision making quality per case using two domains: quality of information presented and quality of teamworking exhibited.[3]

Evaluations of decision making quality for two Ontario colorectal MCCs showed gaps in decision making quality, particularly in regards to chair leadership, contributions by pathologists, and presentation of patient preferences and psychosocial considerations during case discussion. Overall reliability scores for the MTB-MODe were high, at 0.72-0.74. Inter-rater reliability was fairly high (0.56-0.58), meaning that raters did not contribute significantly to the variance in scores. Internal consistency of the items was low (0.15-0.19), which means that high scores for one item do not necessarily correlate with high scores for another item. This demonstrates that each item of the tool evaluates a different component of decision making quality (e.g., a high quality score for presentation of radiologic information does not necessarily correlate with a high quality contribution by radiologists). The greatest source of variance (50.1% of total variance) was found for items nested in domains, which means that decision making quality scores could be significantly impacted by each individual item on the MTB-MODe tool.

This study confirms the presence of quality gaps in decision making at two Ontario MCCs. More importantly, our findings suggest the reliability of the MTB-MODe was high in an Ontario setting – something never previously evaluated. Raters did not contribute significantly to variance scores, meaning that the tool can be reliably implemented using a single rater. The low internal consistency of the tool suggests that the MTB-MODe can be used to generate feedback for MCC participants on quality gaps in information and teamworking. Based on these findings, we recommended the use of the MTB-MODe to evaluate MCC decision making quality in an Ontario setting.

Part 2 – Identifying Barriers and Facilitators to Optimal MCCs using the TDF

KT experts recommend the use of theory to design quality improvement interventions that target mediators of behaviour change.[8,10,11] Due to the plethora of individual, group or systems level theories available, it is difficult to justify the prioritization of one theory over another. The TDF synthesizes 33 psychological theories into just 14 theoretical domains.[10] The framework can be used to comprehensively identify barriers and facilitators to a behaviour change of interest. We used the TDF to conduct 21 key informant interviews with MCC participants to identify barriers and facilitators to optimal decision making. We defined optimal decision making as the ideal processes and components of MCC case presentation, discussion and final selection of treatment plans.

Themes identified as barriers and facilitators to optimal MCC decision making were categorized in ten and ten theoretical domains, respectively. Barriers included gaps in leadership, participant attendance, MCC preparation, unorganized case discussion, teamworking and soft skills, technological resources and a lack of time to prepare for and participate in MCCs. These identified barriers were concordant with previously published MCC evidence. The converse of seven domains that identified barriers were facilitators to MCC decision making (e.g., lack of knowledge is a barrier to decision making, while availability of knowledge is a facilitator). The TDF domains of *Skills; Intentions;* and *Goals* were identified uniquely as facilitators to MCC processes. Participants reported a desire to

participate in MCC decision making to increase knowledge, skills, and familiarity with the preferences and practices of their colleagues. Patient preference, a desire to collaborate with peers, and increased confidence in the final treatment recommendations were facilitators to MCC decision making. There was some variance in the identification of barriers by specialist group; however, these group differences were not observed for facilitators.

The literature suggests that the use of theoretical frameworks can elicit more findings about behavioural mediators compared to traditional interview or survey methods.[8,9] Our study did not identify new mediators to MCC decision making that were not previously reported in the MCC literature. However, use of the TDF was advantageous for a number of reasons. First, it allowed us to efficiently identify the underlying behavioural constructs of barriers and facilitators. For instance, TDF interviews demonstrated that MCC attendance was influenced by a number of behavioural domains, including professional identity, beliefs about the consequences of MCC participation, and environmental factors (such as time). Such information can guide implementation scientists to appropriately identify and target underlying behaviours that influence MCC decision making.

Second, we identified overlap of behavioural domains for individual themes. For example, MCC decision making was affected by social interactions, professional identity, emotions, and environmental factors. Therefore, improving decision making requires targeting multiple behavioural domains. Finally, use of the TDF ensured that all potential mediators to MCC decision making were identified systematically. As compared to traditional interviewing and survey techniques, which apply a 'selective' approach in the design of interview guides (i.e., the researcher can restrict answers through the design of a narrow interview or questionnaire), the TDF allows for an 'inclusive' approach to questioning, that elicits beliefs on both cognitive behaviours (i.e., what people do) and emotions towards behaviours (i.e., how people feel).[8]

Despite these advantages, the TDF also posed a number of execution challenges. We posited that use of the TDF would allow us to pinpoint the domains of behaviour requiring intervention.

However, our findings revealed that MCC decision making is a complex behaviour mediated in some way by all 14 TDF domains. The TDF does not provide any guidance on how to rank the strength of an identified barrier or facilitator, which left us unable to determine whether some barriers were more significant than others. We suggest there is a need for a validated weighting system to quantify the strength of identified mediators of behaviour change. Finally, as previously reported by other KT researchers, implementation of the TDF was a relatively time consuming process. The average length of time for our interviews was 33 minutes, with some interviews lasting >70 minutes. We consulted KT experts to determine if there was an abbreviated version of the TDF that could be used among our sample of busy clinicians, but were unable to identify any abbreviated versions of the framework.

Part 3 – TDF to COM-B Mapping Process to Develop the KT-MCC

We confirmed the trustworthiness of the TDF key informant data using focus groups and surveys. The surveys presented MCC participants with every theme identified using the TDF-interviews. Participants were asked to rate each theme on a scale of 1-5 to indicate whether the theme was a strong barrier or strong facilitator. While this approach has not been validated, it was synchronous with our commitment to using an iKT approach. Use of the surveys allowed us to weight the strength of identified barriers and facilitators, while focus groups provided salient descriptions of how the barriers and facilitators impacted MCC decision making.

We then mapped the identified TDF-domains to the COM-B Behaviour Change wheel to identify evidence-based interventions that could be potentially included in the KT-MCC. The COM-B is a categorization model that guides researchers to select interventions that best correspond with the mediators of a behaviour change of interest.[11] For example, the *Social Influences* domain of the TDF corresponds with the COM-B intervention functions of *education* and *persuasion*.

Given that all 14 domains from the TDF were identified as mediators to MCC decision making, we anticipated a myriad of intervention functions to be identified using the COM-B. Indeed, the mapping process revealed that all six sources of behaviour change on the COM-B behaviour change

wheel (psychological and physical Capabilities; social and physical Opportunities; automatic and reflective Motivation) required intervention. These sources correspond with the intervention components of *Modelling; Environmental restructuring; Restrictions; Education; Persuasion; Incentivisation; Coercion; Enablement; Training;* and *Coercion.*[11] The resulting first iteration of the KT-MCC was comprised of workshops to develop local consensus process, MCC team and chair training, use of a synoptic discussion form and standard MCC intake form, and audit and feedback. MCC participants participating in the focus group were in favour of implementing the workshops to develop local consensus processes, chair training, standard intake form, and audit and feedback components. However, attitudes of focus group participants varied regarding the acceptability of the team training intervention and use of a synoptic reporting tool. We anticipated that each MCC team presented with the KT-MCC in the pilot study would select the intervention components that best suited the needs and preferences of their participants.

Part 4 – Pilot Study

We evaluated the feasibility of the KT-MCC using a number of parameters including the following: site selection; ease of data collection; team and chair participation; and, compliance with interventions selected by the MCC team for implementation. Impact of the KT-MCC was evaluated on a per case level using the MTB-MODe.[3] We also evaluated a number of secondary outcomes including: per round quality (using MTOT tool[13,14]), time per case, and rate of decision change.

We were able to successfully pilot the KT-MCC among four MCC teams. There were no challenges pertaining to data collection. MCC chairs selected some, but not all, of the intervention components. Compliance with selected interventions varied – chairs and teams did not formally implement all selected interventions (such as audit and feedback or use of a synoptic reporting form). Compliance with selected local consensus processes varied by item and team, and ranged from 20-100%. We posit that improved engagement of MCC chairs, along with opinion leaders and MCC

coordinators, may improve compliance with selected quality interventions. Moreover, iterative testing of the KT-MCC can be used to mitigate reasons for non-compliance and promote intervention uptake.

The impact of the KT-MCC was negligible, showing no impact of the KT-MCC. For example, overall decision making quality (i.e., quality of teamworking and quality of decision making) went from 32.3 to 31.2 ($p=0.419$). Scores for individual teams provided interesting findings. Quality of information and quality of teamworking scores increased for MCC teams 1, 3 and 4; however, only MCC 4 demonstrated a statistically significant improvement in quality of teamworking. Quality of information and quality of teamworking scores decreased significantly for MCC 2.

We assessed whether the characteristics of any one MCC team may have overly influenced the MTB-MODe post-intervention quality scores. We decided a priori to remove these teams from the GLM model, to allow for a sensitivity test to further explore data trends. One team was removed from the GLM model. Once this team was removed from the model, we observed a 7% significant improvement in the quality of teamworking scores, and, a non-significant 4% improvement in teamworking. Our findings were comparable to those of Lamb et al., despite a number of contextual advantages that should have resulted in better impact for Lamb's intervention. These included local opinion leaders being the main investigators for the study, use of residents to collect information before rounds, and a prolonged time period for implementation. Our ability to achieve similar improvements in quality despite these notable contextual limitations potentially demonstrates the benefits of progressive KT methods. We conclude that use of progressive KT methodology to design, implement and evaluate quality interventions is feasible. We hypothesize that additional iterative, tailored implementation of the KT-MCC can improve intervention uptake, compliance and impact, over time.

Methodological Findings and Lessons Learned

We used progressive KT methods (specifically the TDF, COM-B and an integrated KT approach) to design, implement and evaluate a quality improvement intervention designed to improve the quality of MCC decision making. We evaluated the intervention using a prospective before-and-after study. We present below a brief commentary on the 'lessons learned' in this thesis.

Weighted Analysis of TDF Findings

We were unable to determine whether some barriers identified using the TDF were more significant than others using the key informant data. Most studies that cite the TDF use it to conduct interviews or focus groups to generate qualitative data. We were unable to find any relevant literature that weighted the strengths of qualitatively-generated barriers or facilitators. In the absence of any validated methods, we chose to weight emergent TDF themes using a survey distributed among MCC participants. Surveys were completed during focus group sessions to a) allow triangulation of the qualitative and quantitative data and b) identify the most pressing barriers to optimal quality of MCC decision making.

There were a number of challenges with this approach. First, there was discordance between the qualitative focus group data and quantitative data from the survey. For instance, the oncologist group did not report the presence of 'bullying' to be a significant problem in MCCs, yet rated this item strongly using the Likert scale. In such instances of discrepancy, we sought additional follow-up validation. Second, we hypothesize that varied interpretations of the survey may have influenced the answers (for example: *Is this a general barrier to MCC decision-making processes versus Is this a barrier in my MCC team's processes of decision-making?).* Additional face and content validation of this approach to ensure consistent interpretation of the identified themes would have been prudent.

In summary, use of a survey to triangulate qualitative TDF-key informant data and weight the strength of identified themes is efficient, requires few resources and can be disseminated with each iteration of a behavioural intervention to identify outstanding barriers to intervention implementation.

However, additional psychometric testing to determine the reliability and validity of this approach is needed.

Operationalization of the COM-B

There are examples in the KT literature that develop a quality improvement strategy using the COM-B model, but the operationalization of how this was done is not described in any accompanying papers.[16] We found it challenging to use the COM-B to identify specific quality improvement interventions. For instance, the COM-B recommended the use of 'modeling' to mitigate gaps in MCC participants' knowledge and processes of decision making. However, the main articles describing the development and use of the COM-B do not provide explicit guidance on how identified intervention functions from the COM-B can be linked to specific interventions. We supplemented the findings of the COM-B with Cochrane EPOC evidence, and evidence from the business and aviation literature to develop the KT-MCC. Identification of such evidence was labor-intensive, and researchers unfamiliar with quality improvement taxonomies may overlook important evidence. For instance, EPOC evidence shows that opinion leaders can influence behaviour change by up to 12%, suggesting opinion leaders would be effective vessels to 'model' the behaviour of interest.[4] The COM-B would benefit from the addition of explicit links that map intervention functions to specific interventions, specifically interventions where evidence has been summarized through high quality systematic reviews (e.g., Cochrane reviews). The addition of such components would help users link the COM-B intervention functions with pragmatic KT interventions. In the initial publication of the COM-B, Michie et al. note that,

> *"reliable taxonomies for behaviour change techniques within these [COM-B] intervention functions have yet to be developed. An ongoing programme of research is developing an 'intervention design tool' based on the BCW. It starts with a theoretical understanding of behaviour to determine what needs to change in order for the behavioural target to be*

achieved, and what intervention functions are likely to be effective to bring about that change."[17,p.9]

Data from a recent Behaviour Change Technique Symposium shows that Michie et al. have begun the process of developing an interactive online tool that will link behavior change techniques to mechanisms of action, as per the above proposal.[15] Hundreds of volunteers and behavioural experts have collaborated to develop a taxonomy of behavioural change techniques (BCCTv1 and BCCTv2).[17] These techniques will be linked to mechanisms of action (e.g., the behavioural technique of *social support* can influence the mechanism of action of *social influences*). In the final tool, users can click on a cell to find data regarding the strength of the behavioural intervention and all corresponding empirical evidence. We anticipate that this interactive online tool - if and when available - may address some of the concerns we present above. The team should ensure that explicit linkages between the COM-B intervention functions, corresponding behaviour change techniques (e.g., BCCTv1), and evidence (e.g., EPOC systematic reviews) are provided. This will be a significant contribution to the literature, and will aid implementation scientists in the practical development and implementation of quality improvement interventions using the COM-B. Such a tool would have been extremely helpful to this thesis.

Unrealized promise of Integrated KT on Participant Engagement

The premise of integrated KT is that by involving the target population in the identification of barriers and facilitators, they will be more engaged in the corresponding quality improvement intervention. KT experts consistently highlight the importance of iKT to ensure participant engagement and improved impact of quality improvement interventions. For example, Bowen and Graham cite an example of how a Canadian Health region used administrative data to identify patient safety concerns, but failed to involve the staff responsible for this administrative data.[7] This led the region to inaccurately identify gaps in patient safety, and overlook important contextual issues.

While experts are in consensus regarding the importance of participant engagement to the success of KT interventions, there is little evidence to suggest that use of iKT actually results in improved clinical or systems outcomes.[7] There is also a paucity of evidence describing effective strategies for implementing and sustaining an iKT approach.[7] Gagliardi et al. recently completed a scoping review to describe conditions for optimal uptake of iKT interventions (i.e., KT interventions that utilized an integrated KT approach), but were unable to identify conditions for intervention uptake due to low quality reporting of iKT interventions.[18] The authors note three gaps in the iKT literature: iKT interventions are not clearly described, reported or evaluated in research studies; there is a lack of reporting that describes how theory was used to develop iKT interventions; and the nature of participant engagement in the intervention is often unknown.[18]

Our pilot study suggests that using an iKT approach to develop a quality improvement intervention is feasible; however, it does not guarantee compliance with, or impact of, selected interventions. For instance, focus group participants confirmed barriers pertaining to teamworking, yet most participants did not confirm the need for the corresponding interventions of team training. Researchers should be aware that use of an iKT approach does not guarantee the target population will implement all proposed interventions. Additional research should formally evaluate the effectiveness of iKT versus traditional design of KT strategies on intervention uptake, compliance and study outcomes.

The Need for Iterative Testing

The Knowledge to Action Framework (KTA Cycle), which was developed by Graham et al., outlines a series of eight cyclical, iterative steps that can be used to disseminate knowledge into practice.[19] The steps of the cycle include: *Identify problem, Identify review and select knowledge, Adapt knowledge to local context, Assess barriers to knowledge use, Select, tailor, implement intervention, Monitor knowledge use, Evaluate outcomes,* and *Sustain Knowledge Use.*[19] The KTA cycle suggests that iterative cycles of intervention implementation allow for intervention tailoring, to

overcome barriers and leverage facilitators to behavior change. With each iteration of implementation, quality gaps are expected to narrow, and intervention uptake and compliance is expected to improve.

In our pilot study, we evaluated a single iteration of the KT-MCC for a period of two months. Compliance varied by MCC team and the impact of the KT-MCC on decision making quality was minimal. Resource constraints precluded our ability to conduct multiple iterations of the KT-MCC among MCC teams. We anticipate that additional iterations, with appropriate tailoring of the KT-MCC, would have resulted in improved MCC chair and team engagement and compliance. Further iterative testing of the KT-MCC may also have led to the selection of additional intervention components, and improved intervention impact.

Re-thinking MCCs

In this study, we focused on improving the quality of decision making for cases discussed at MCCs. Recent data suggests that less than half of all new cancer cases in Ontario are discussed in a collaborative setting, and there has been no systematic evaluation of MCC quality. Our data showed a change in treatment plan for up to 48% of cases presented, despite over 50% of MRPs having reported being 'confident' or 'very confident' in their original plan. These data parallel the findings of Oxenberg et al. who evaluated 101 consecutive cancer cases presented at a MCC in a leading US cancer center.[20] The study authors found a 36% change in original treatment plan, and 72% of changes were considered major. Surprisingly, patient and tumor characteristics, and, physician confidence in the their original treatment plan, were not predictors of a treatment change recommendation following MCC review. This suggests that physicians are unable to predict the cases that will receive a treatment recommendation change. Yet in most Ontario MCCs, cases are brought forward at the behest of the most responsible physician - not all consecutive cancer cases are discussed in a multidisciplinary forum.

Our findings suggest consecutive cases should be reviewed, and resources are needed to evaluate and improve the quality of MCC decision processes. This would require significant restructuring of MCCs to ensure efficiency without sacrificing quality. MCC participants' ability to discuss consecutive cases is predicated on the efficiency of the MCC discussion, which would likely require mandated team and chair training to improve. CCO should consider the implementation of such training in addition to use of standardized case intake forms, which were found to be positively correlated with decision making quality. Other potential improvements can include use of a structured, synoptic discussion from to improve efficiency; a triaging model for all new cancer cases; or a quality improvement strategy that puts forward random, non-selected cancer cases for discussion. The latter can be used as a means of quality control to ensure all patients are receiving optimal care, in line with evidence-based practice.

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