

**Barriers and facilitators for using new national recommendations for preoperative endoscopic localization of colorectal neoplasms: Comparing the perspectives of gastroenterologists and surgeons in Winnipeg, Manitoba**

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## **Abstract**

**Background:** Many patients undergo repeat endoscopy before surgery for colorectal tumours. This is commonly due to non-standard documentation and inconsistent tumour marking during the initial endoscopy procedure. Repeat endoscopies delay surgery and put patients at risk of colonoscopy-related complications. Recommendations have recently been developed to standardize how colorectal lesions are localized and documented. This study identifies the barriers and facilitators to using these new recommendations in Winnipeg, Canada.

**Methods:** Gastroenterologists and surgeons were purposively sampled from every endoscopy suite and hospital in Winnipeg. Guided by the Consolidated Framework for Implementation Research (CFIR), a semi-structured interview guide was developed to determine participants' perceived facilitators and barriers to using these new guidelines. Transcribed interviews were analyzed and aligned to the CFIR using directed content analysis. Solutions to perceived barriers were categorized using the Expert Recommendations for Implementing Change (ERIC) framework.

**Results:** Ten surgeons and eleven gastroenterologists participated. Both specialty groups had four net facilitator constructs in common: 'Relative advantage', 'Triability', 'Complexity', and 'Design quality & packaging'. Surgeons identified 'Innovation source', 'Tension for change', 'Learning climate', and 'Self-efficacy' as net facilitators, which were not facilitators according to gastroenterologists. Unique to gastroenterologists, 'adaptability' was a net facilitator. Surgeons and gastroenterologists had many similar barriers. Barrier constructs common to both specialties included: 'External policy & incentives', 'Organizational incentives & rewards', and 'Available resources', 'Goals & feedback', 'Access to knowledge & information', 'Knowledge & beliefs about the intervention', 'Individual identification with the organization', 'Evidence strength and quality', and 'Costs'. Uniquely, gastroenterologists identified 'self-efficacy' as a net barrier, which was a facilitator for surgeons. Surgeons identified 'compatibility' as a barrier, which had more mixed perspectives for gastroenterologists. According to the ERIC framework, barriers from both specialties could be addressed through educational interventions, altering incentives/allowance structures, accessing new funding, and employing audit and feedback processes.

**Conclusions:** We identified barriers and facilitators to implementing new recommendations for documenting and marking colorectal tumours at endoscopy. Future research is needed to develop

implementation strategies based upon the present study results and test for feasibility and effectiveness outcomes.

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## Chapter 1. Introduction

Colorectal cancer is the third leading cause of cancer death in North America. The primary curative treatment for these tumours is surgery(1). However, the colon is a 1.5-meter-long organ that can be partially resected in a variety of different configurations(2). Therefore, the surgeon must accurately localize the tumor to properly plan and perform the procedure. Preoperative colonoscopy is the gold standard for colorectal lesion localization and is essential to surgical planning(3). Frequently the endoscopist is not the operating surgeon(4). Proper communication is therefore crucial to help the surgeon make appropriate treatment decisions based upon information obtained during the initial endoscopy(3). Without adequate preoperative information provided to surgeons, patients may risk resection of an incorrect bowel segment, prolonged operative times, or a laparotomy to locate the tumor(5,6). Adequate preoperative information is often not collected and/or is poorly communicated, requiring surgeons to frequently perform a repeat endoscopy prior to resection(7,8). Endoscopy is a finite resource and repeat endoscopies use valuable procedure time slots that could otherwise be used for diagnostic or therapeutic purposes. Endoscopies are uncomfortable for the patient and repeated testing places them at risk for colonoscopy-related complications. Repeat endoscopies also result in substantial treatment delays(5,6,8), which are in turn associated with worse patient outcomes(9–11). In Winnipeg, the repeat preoperative endoscopy rate was 29% between 2007-2020(7,8). Documented reasons for repeat endoscopies include unclear documentation or concern that the tumor was not appropriately marked for subsequent intraoperative identification(6,12). Many surgeons and gastroenterologists agree that with excellent communication and standard practices, most repeat preoperative endoscopies could be avoided(6,12,13).

New recommendations to help standardize and document endoscopic lesion localization for colorectal tumors and polyps have recently been developed(14). These recommendations were established based upon comprehensive literature review including a systematic review of previous relevant guidelines, and consensus between 23 Canadian experts(14). While Winnipeg endoscopists and surgeons agree that more standardized documentation and localization practices are needed(12), evidence shows that simply creating new guidelines is unlikely to substantially impact clinician care practices(15,16). According to knowledge translation science, meaningful changes in care practice are more likely to occur when guidelines are highly tailored to the local context in which they are implemented(17).

Guided by knowledge translation theory, this research identifies the barriers and facilitators, as perceived by endoscopists and surgeons in Winnipeg, to using the new guidelines designed to standardize endoscopic lesion localization for colorectal tumors and polyps. Data were collected using qualitative semi-structured interviews. Barriers and facilitators were mapped to theory-based implementation constructs according to the Consolidated Framework for Implementation Research (CFIR), and aligned with a previously validated expert recommendations for implementing change (ERIC) framework(18–22). Findings from the present research can be used to help develop and pilot test contextualized interventions designed to improve guideline adherence and reduce repeat endoscopic procedures.

## **Chapter 2. Review of Literature**

### Colorectal cancer detection and colonoscopy:

Colorectal cancer is a highly treatable disease, and survival is much better with early detection and treatment(23). Widespread screening programs have therefore been developed. In Canada, the most common method of screening is a stool test. There are two varieties commonly used in Canada: the fecal occult blood test (FOBT), and the fecal immunohistochemistry test (FIT)(24). Other methods of detecting colorectal cancer include abdominal imaging or colonoscopy(3).

The gold standard for diagnosis, localization, screening, and surveillance of colorectal cancer is colonoscopy(3). Colonoscopy is also used to evaluate symptoms such as rectal bleeding and for management and follow up of people with inflammatory bowel disease and conditions such as hereditary cancer syndromes(3). Currently most colorectal cancers are detected on evaluation of symptoms(25). Except in emergency, in current practice prior to the treatment of colorectal cancer, all patients will undergo a colonoscopy, even for lesions detected using one of the other techniques. Colonoscopy is essential as it not only detects the location of the primary tumor, but it also closely examines the colon for other abnormalities. A colonoscopy is used to obtain a tissue biopsy for diagnosis of a cancer prior to therapeutic attempts(3). In some cases, colonoscopy can be used to remove precancerous tumors or carefully selected early cancers entirely without the need for invasive surgery(26).

Despite the benefits of colonoscopy, it is not without its limitations. Colonoscopy can be uncomfortable. Patients may need to take two days off work for preparation and recovery from

the procedure. It can also lead to significant anticipatory anxiety prior to the procedure(27). Because of the memory-impairing effect of the sedative medications used for colonoscopy, a second person must escort the patient on the day of the procedure. Finally, the patient must take an osmotic laxative bowel preparation designed to empty the colon prior to the procedure. This can be difficult for some patients to manage, particularly those with mobility issues or those advanced in age(28). The incidence of colorectal cancer is increased in the elderly, therefore these limitations affect most colonoscopy patients(29).

The colonoscopy procedure also has some very rare, albeit serious risks. Some bowel preparation techniques can cause electrolyte imbalances and kidney injuries(30). Most patients in North America receive a sedative agent so that they may tolerate the procedure, which can cause low blood pressure and breath rate(31). Sedation can also impair patients' ability to maintain awareness and to protect their airway. Patients can aspirate gastric contents during the procedure or have cardiac issues(31). Other risks include bowel perforation from air insufflated into the colon during the procedure or from blunt trauma from the flexible endoscope itself(32). Bleeding is also a possibility. Fortunately, death during the procedure is extraordinarily rare(31).

Despite these limitations, colonoscopy is essential to properly diagnose and locate colorectal lesions before therapy(3). For invasive cancers of the colon and rectum, the only curative therapy is surgery(23). Colonoscopy is the most sensitive and specific test for diagnosing colorectal cancer(33). To facilitate the success of a surgical procedure to remove a colorectal cancer, the exact location of the lesion in the intestine must be known(6,13,34). A colonoscopy can map the inside of the colon. However localization errors can occur, and patients' anatomy can vary(34). The cancer is on the inside of the bowel lumen and often cannot be seen from the outside during surgery. During the operation, the bowel must remain intact to diminish infection risks(35). Fortunately, large tumors can be felt with a surgeon's hand through the bowel wall. In extreme cases, the tumor can even be seen outside of the lumen of the bowel. More recently laparoscopic surgery has become popular due to enhanced recovery benefits. However, this type of surgery uses long, thin instruments to manipulate the bowel rather than the surgeons hands, therefore the role of tactile feedback in intraoperative lesion localization has diminished(13). Furthermore, with widespread screening, lesions are caught earlier(36). Smaller cancers are more difficult to detect(34).

Tattoos are indelible injectable markers that can be placed inside of the bowel lumen during endoscopy, and can be seen from the outside of the bowel during surgery. Tattoos are the only tumor marking technique associated with decreased localization errors on systematic review/meta-analysis(34,37). However, there are a variety of ways that the bowel can be tattooed, all of which have implications for the surgeon. There is little agreement in the literature on when or how tattoos should be placed(14). For example, the base of the tumor itself can be injected with ink. However, this may cause fibrosis of the underlying tissue, necessitating a larger surgical resection than would be otherwise necessary(38,39). Therefore, most endoscopists have learned to inject tattoo just proximal (upstream) or distal (downstream) to the tumor(40). However, if the endoscopist doesn't note which side of the tumor was tattooed, or how far away from the lesion the spot was placed, the surgeon may not know how much colon to remove in relation to the tattoo position to get an adequate margin(37). To complicate matters further, the colon is covered on one side by an envelope of fat and blood vessels called the mesentery. A tattoo placed into the mesentery is potentially invisible during surgery. In the transverse colon, another side of the bowel is covered by an envelope of fat called the omentum. Again, this may obscure tattoos. This leaves nearly half of the circumference of the bowel covered in fat, and if tattooed in those locations, the tattoo is invisible and is therefore not helpful. The mesentery and omentum cannot be seen from the inside of the bowel during a colonoscopy, so an endoscopist cannot tell if their spot will be obscured. Therefore, multi-quadrant tattooing has been suggested, where 2-4 opposing segments of bowel are marked to ensure that regardless of which way the bowel is examined at least one tattoo spot will be visible(41,42). Drawbacks of this technique, however, are that tattoos can spill outside of the bowel and diffusely stain the abdominal viscera. If this happens, a whole section of the colon may be stained black, and it can be unclear where the tattoo was meant to be placed(37,42). This can be combated through very specific tattooing techniques such as pre-injection into the mucosa of the bowel with some sterile saline before injecting the tattoo ink(42), and tattoo ink injection at an oblique angle(43). Few of these aforementioned tattooing techniques have been examined prospectively, and there is no universally recognized standard(34,37,42). In practice a variety of techniques are utilized to mark the bowel, with little agreement on best practices(14).

Endoscopists document in the medical record which part of the colon they suspect the lesion is located, however literature suggests that this practice is at best 85% accurate(34). If a

tattoo is omitted, or otherwise placed unsuccessfully, there is at least a 15% chance that the location for the tumor suspected by the endoscopist is incorrect. Many patients and most surgeons would not accept those odds, therefore repeat preoperative endoscopy is exceedingly common for patients diagnosed with a cancer before undergoing resection(6–8).

#### Rates and rationale for repeat preoperative endoscopy:

To date only two research groups have examined the rates and reasons for repeat preoperative endoscopy. Using retrospective data on 299 patients between 2008-2011 from Toronto, Canada, research reported that 40% of patients undergoing surgical resection had two or more endoscopies. Reasons for repeated endoscopies included tattoo localization (e.g., variation in where the tattoo was placed, how many spots were marked, or tattoo distance from the tumor) and preoperative planning (e.g., to verify lesion location within the colon), which together accounted for 80% of repeat endoscopies(5,6). More recently in a large retrospective study of over 1400 patients in Winnipeg, Canada, between 2007-2020, the repeat preoperative endoscopy rate was 29%(7). There were slight differences in definition of repeat preoperative endoscopy between these two studies, therefore the rates between those two sites are thought to be quite similar. For example, the Toronto group excluded patients where the surgeon initially detected the cancer, and these patients are highly unlikely to undergo repeat endoscopy. Conversely, the Winnipeg group measured all patients who had elective surgery, including surgeons' own endoscopy patients(6,7). In Winnipeg, in depth perspectives of endoscopists and surgeons were examined through qualitative semi-structured interviews, and analyzed using inductive content analysis, to more richly understand the rationale for repeat endoscopy, localization practices and potential solutions(8,12). Authors found that most cases of repeat endoscopy were due to non-standard practices, varied documentation, lack of trust, and a concern for the well-being of patients. Surgeons would not accept a high risk of wrong site surgery. If they could not be assured by the preoperative endoscopy and imaging reports that the lesion was appropriately localized, and marked for easy intraoperative identification, then they would repeat the endoscopy. Similarly, endoscopists were uncertain what method was best for localization and documentation. Both groups reported using a range of lesion localization practices, and agreed that ideally a standard format both for tumor marking and tumor reporting should be established(8,12).

### New colorectal lesion localization recommended practices:

In response to the lack of specific recommendations regarding documentation standards and tumor localization practices, a group of Winnipeg surgeons and gastroenterologists (including myself) led a Canadian national consensus Delphi process to establish recommended practices(14). This group performed a comprehensive literature review, including a systematic review of previous guidelines. They then led a panel of 23 leaders in colorectal surgery and gastroenterology from across Canada to establish consensus recommendations for tumor localization practices, to minimize the need for repeat preoperative endoscopy. This expert group provided specific recommendations for three practice changes for endoscopists: 1) Standardized tattoo indications, 2) Standardized tattoo technique, and 3) Standardized documentation. The recommendations document provides an associated infographic for use as quick reference guide(14) (**Appendix**).

### Conceptual frameworks

The goal of this research is to prepare for the future implementation of these new national recommendations for endoscopic colorectal lesion localization practices, to help decrease unnecessary repeat endoscopies in Winnipeg. Past research demonstrates that simply generating new clinical practice guidelines and publishing results in a high impact medical journal, are insufficient to generate consistent change despite sound evidence, clear instructions, and clinician agreement with the recommendations(15,16,44,45). Implementation is thought to be more successful when strategies are highly tailored and responsive to local contexts(17). According to Nilsen, implementation science is the “scientific study of methods to promote the systematic uptake of research findings and other evidence-based practices into routine practice to improve the quality and effectiveness of health services and care” (Nilsen, 2015, pg. 2). Implementation is the process of integrating new practices within a setting(46). The goal of this project is to understand issues surrounding implementation of the new recommendations for providers specifically in Winnipeg. Commonalities and differences between providers can be identified to design interventions, rather than to generically implement processes that are used elsewhere. Implementation theories, models or frameworks have been recommended as tools to help guide the implementation process, as there are many purported benefits(46). First, theories

are explicit and are therefore easily subject to scrutiny, allowing for comparisons between settings, and peer review. Moreover, if portions of a theory are incorrect, that theory can be altered. Finally, theories can be extended, and contribute towards building an integrated body of knowledge. In this way, researchers can build upon the past innovations of others(46).

### *Knowledge to Action Framework*

The Knowledge-to-Action Framework was used to help plan and conduct this research(47). This framework was developed in Canada to unify the terminology used to describe the process of moving knowledge into action(48). Researchers had also identified that a growing number of research advances never made it into the hands of the practitioners who could make use of this information. This framework serves as a guide to prompt researchers to consider and develop strategies to have their research be used by their intended audience. This framework has been endorsed by the Canadian Institute for Health Research (CIHR), and has been used for nearly twenty years by researchers to plan knowledge translation and implementation strategies in healthcare systems around the world(48,49). The Knowledge to Action Framework comprises two distinct but related components: ‘Knowledge Creation’, and ‘The Action Cycle’. Knowledge creation involves the processes of knowledge inquiry, synthesis, and generation of products or tools. The action cycle includes processes for knowledge application, adapting/tailoring interventions and evaluating barriers and enablers to knowledge use. Monitoring knowledge use, evaluating outcomes, and sustaining knowledge are also included(47). According to this framework, myself and other Manitoba researchers have previously completed the identify problem phase(7,8). We have also performed a preliminary *context* assessment, which identified a lack of standardized guidelines as a possible modifiable element(12). In response, we turned to a *knowledge tool* and *literature synthesis* in the form of the new recommendations based upon a systematic literature review and consensus between national experts(14). However, the existence of new guidelines doesn’t always translate into uptake in practice. The present study focuses on the Action Cycle of the Knowledge to Action Framework, and specifically components of this cycle that assess barriers to knowledge use and strategies for tailoring interventions according to local context.



### *Consolidated Framework for Implementation Research*

While the Knowledge to Action Framework provides an excellent overview of the components of knowledge translation, it does not provide specific guidance for how each component should be developed or evaluated(47,48). The Consolidated Framework for Implementation Research (CFIR) was selected as an additional framework to guide this research. CFIR is a knowledge translation framework that allows for the structured evaluation of knowledge translation research processes according to key constructs. This framework was developed in 2009 as an amalgamation of evidence-based implementation strategies across multiple disciplines. It also has a firm foundation in behavioural theory. CFIR constructs allow for the structured evaluation of barriers and facilitators to implementation across five domains. These domains include the intervention characteristics, the implementation environment's inner setting (structural, political, and cultural contexts through which the implementation process will proceed), outer settings (economic, political, and/or social context within which an organization resides), characteristics of individuals involved, and the implementation process(18). While there are hundreds of published knowledge translation theories, models, and frameworks(46,50), CFIR excels in providing a foundation for evaluating multiple interacting components (i.e., the cumulative impact of these different constructs) in complex systems, rather than focusing solely on the intervention or characteristics of the individuals themselves(22).

Recently, a tool was developed and then subsequently refined to align CFIR constructs perceived as barriers to Expert Recommendations for Implementing Change (CFIR-ERIC). This matching tool was developed based on survey responses from 169 multidisciplinary implementation experts, and provides a list of prioritized implementation strategies to consider based on the CFIR-based barriers identified(19,51). The tool was designed to align 73 expert-recommended implementation strategies to overcome barriers categorized by CFIR constructs. Barriers identified in a study setting can be entered and the tool will report a prioritized list of expert-recommended strategies to consider, based upon the specific combination of CFIR barriers identified.

#### **Objectives:**

This project had three objectives:

1. To identify, from the perspective of gastroenterologists and surgeons in Winnipeg, the perceived facilitators and barriers of applying the new colonoscopy lesion localization recommendations
2. To compare and contrast these different perspectives as perceived by surgeons and gastroenterologists
3. To identify specific theory-based strategies to overcome barriers and facilitate implementation of the new recommendations in Winnipeg.

### **Research Questions:**

1. According to gastroenterologists and surgeons in Winnipeg what are the barriers and facilitators to implementing the new recommendations in their current practices?
2. What are the similarities and differences in perceptions between gastroenterologists and surgeons towards the new recommendations?
3. What strategies have experts previously recommended to overcome the barriers identified?

## **Chapter 3. Methods**

### Overview

This qualitative interview study was designed to investigate surgeons' and gastroenterologists' perceptions towards the barriers and enablers to using the new clinical practice recommendations for optimal endoscopic localization of colorectal neoplasms(14). We used qualitative descriptive methodology to explore participant perspectives on the new recommendations, and on the associated summary infographic tool were collected. Qualitative description is frequently used in health care implementation research, and consists of describing phenomena according to participants' perspectives in simple terms that can be easily understood. This methodology prioritizes fidelity to participants' perspectives, and also compliments a pragmatic epistemology (see overlying approach below)(52,53).

The Consolidated Framework for Implementation Research (CFIR) was used to guide these discussions using semi-structured interviews(18). CFIR provides a comprehensive framework for assessing multiple aspects of implementation strategies, has been used in multiple domains of health sciences research(22), and has a newly developed tool (called the CFIR-ERIC strategy matching tool) for matching expert-recommended interventions to barriers according to

each of the CFIR categories(19–21,51). Participants’ perceived barriers and facilitators were categorized according to constructs within the CFIR framework. Surgeon and gastroenterologist opinions were evaluated separately and compared. Finally, expert-recommended implementation strategies were identified for each strategy, by aligning study themes to the strategies presented in CFIR-ERIC.

### Research paradigm

Pragmatism was the overlying approach used to guide the design and conduct of this research. Epistemologically, pragmatism is premised on the idea that the researcher focus on practical understandings of concrete, real-world issues. The goal of pragmatism is to produce actionable knowledge. This paradigm emphasizes interrogating the value and meaning of research data through examining its practical consequences, and develop practical recommendations in response to research questions. Pragmatism views inquiry as an experiential process and recognizes the interconnection between experience, knowing and acting (54).

While classical pragmatism avoids metaphysical debates surrounding the nature of reality, the present research is positioned within a body of implementation science literature which guides the use of the chosen frameworks. While we attempt to find “what works” in the current context, we rely on past knowledge to guide the research process. Therefore, it is useful to define ‘what is knowledge’ and ‘what is reality’ for the purposes of this research and to position our new data within the broader literature. According to postpositivist ontology, there is theoretically one reality. Because perceptions of reality are subjective, socially constructed, and may change over time, reality can only be incompletely understood. In the pursuit of actionable knowledge, this requires the researcher to be highly reflexive about the data collection process, to acknowledge their biases in their understanding of reality, and to attempt to control and acknowledge these biases when attaining a picture of reality that is as accurate and objective as possible(55). Recognizing that people construct their own understanding of the world through their experiences and reflections, this research attempts to arrive at a practical solution (rather than “the” solution) to enhance knowledge translation of the new recommendations. This research process recognizes that, according to the limitations of human perceptions, alternate interpretations and solutions are also potentially valid. This overarching approach is consistent with the current state of the evidence for implementation science, where there is little

consistency in the efficacy of any given implementation strategy in a particular environment(56). Tailored approaches are recommended, but cannot guarantee success(17).

My? choice of pragmatism and postpositivism as overarching philosophical approaches was influenced by our desire to contribute useful, practically relevant, and actionable knowledge, anchored in respondent experiences. Pragmatism as an overarching approach to implementation research has also been used previously with qualitative interviews and the CFIR(52). Alternate methods of data collection and analysis, such as quantitative surveys, and validated assessment tools, provide less-flexible data compared to qualitative description when seeking practical answers through understanding a phenomenon from the perspective of those involved. Therefore, qualitative semi-structured interviews were selected as the data collection method for this research.

#### Study setting:

This study was conducted with gastroenterologists and surgeons from multiple practice settings in Winnipeg, Canada. The rationale for the target setting is multifold. The practice patterns of Winnipeg endoscopists have been well-described. There are high rates of redundant preoperative endoscopy (29%)(7,8,12,57), and poor endoscopy report quality(7,58). Winnipeg is the capital city of Manitoba, a province of 1.4 million people with approximately 800-900 colorectal cancers diagnosed and treated every year(59,60). Approximately 700-thousand individuals live in Winnipeg(61), and approximately 20 gastroenterologists and 40 surgeons treat colorectal cancers in the region(62). Most colorectal cancers are treated in Winnipeg(59), with the bulk of endoscopies occurring in Winnipeg hospitals(58). In Winnipeg, colorectal cancers are diagnosed in endoscopy suites across six hospitals and three outpatient clinics. These cancers are resected in one of three operating room sites throughout the city. This care is administered under the auspices of the Winnipeg Regional Health Authority (WRHA), and the provincial Shared Health organization. Most gastroenterologists and surgeons in Winnipeg are independent contractors to the province of Manitoba and operate under a “fee-for-service” billing model, whereby physicians are remunerated according to how much billable service they provide, rather than according to an hourly wage or salary. As in the rest of Canada, these specialists are regulated both by a national certification body called the Royal College of Physicians and Surgeons of Canada, and provincially licensed by the College of Physicians & Surgeons of

Manitoba. They also have various contracts and privileges with local organizations, such as the University of Manitoba, individual hospitals and clinics, individual health authorities, and even some private organizations.

Colon and rectal cancers are covered under the public health care act, and any treatments related to those diseases are covered by public insurance. Accordingly, many gastroenterologists and surgeons in Winnipeg work at multiple sites. As an exercise during study design, a simplified visual framework for the complex interactions that occur within endoscopy system in Winnipeg was created and is provided in the **appendix**. These characteristics of Winnipeg are comparable to other regions in Canada with one exception. Winnipeg has a high proportion of surgeons who perform screening colonoscopies(7), whereas elsewhere in North America screening colonoscopies are conducted primarily by Gastroenterologists. We hypothesis that this high proportion of surgeon-endoscopists may have mixed effects on the setting in Winnipeg. For example, surgeon endoscopists may historically have felt less urgency to strengthen communication with their gastroenterology colleagues as the bulk of their colon cancers may have come from patients they performed the index endoscopy on themselves. Therefore, fewer patients may have required a referral to an alternate provider after their scope, while simultaneously leading to poorer quality communication when a referral needed to occur. However, the rates of repeat preoperative endoscopy in Winnipeg are similar to other locations where this practice has been measured(6,7,63). While the vast majority of colonoscopies in rural Canada are performed by general surgeons, a substantial proportion of colonoscopies performed by surgeons in urban areas are performed by specialist surgeons—colorectal surgeons and surgical oncologists.

#### Study participants and sample:

Study sample size was guided by the concept of *theoretical sufficiency*. Theoretical sufficiency is best defined by the following question: “Given the framework, do we have *sufficient* data to illustrate it?”(64). According to this principle, interview transcripts were analyzed soon after each interview was completed, and mapped according to the CFIR framework. The research process concludes once all included categories from the CFIR analysis framework had sufficient illustrative examples. For the purposes of this research, data were considered ‘sufficient’ when there were multiple quotes across participants that consistently

illustrated an interpretation of the framework. Gastroenterologist and surgeon perspectives were analyzed separately, to ensure that theoretical sufficiency was achieved in each group. In advance, we anticipated recruiting approximately 10 gastroenterologists and 10 surgeons currently working in Winnipeg, for a total of 20 interviews. Based upon the timeframe of this project, and previous similar research, we anticipated that approximately 20 participants would be ample to attain sufficient information(12)

A core tenet of sampling in qualitative research is the “need to consider local, contextual, and macro-sociopolitical factors” in participant selection “with an attention to power and politics in both the specific environment and the broader society that shapes it”(65). Initial recruitment emails were sent to every endoscopist and general (abdominal) surgeon in Winnipeg (20 gastroenterologists, 36 surgeons), to ensure all eligible individuals felt invited and included. No individuals who wished to contribute were excluded from study participation. Follow-up emails were directed at specific groups of individuals who were under-represented after initial responses, to ensure that we had representation from providers from diverse practice patterns . Participants were initially contacted via e-mail with a personalized interview invitation and consent form on University of Manitoba letterhead. A reminder was e-mailed to select non-responders two weeks later, followed by a third email two weeks after that, if necessary. This strategy was previously used successfully to recruit Canadian surgeons and gastroenterologists to participate in qualitative research, yielding a 90% response rate after the third email(12,14).

Participants in this research were selected purposively to obtain feedback from practitioners working in each endoscopy suite and all hospitals across the city. We included endoscopists and surgeons from a variety of roles (e.g., leadership), and practice backgrounds. Important sub-populations that we purposefully selected were providers from ‘academic’ settings (who work in association with the University of Manitoba, and teach medical students and residents as part of their typical practice) and ‘community’ settings (minimal interaction with medical trainees). Gastroenterologist sub-populations included “general” gastroenterologists, and those with advanced skills in endoscopic procedures such as advanced adenoma (precancerous polyp/lesion) resection. We also included gastroenterologists with unrelated additional subspecialty training such as in inflammatory bowel diseases. Surgeon sub-populations included general surgeons who treat colorectal cancers electively, surgeons with subspecialisation in colorectal surgery or surgical oncology, and general surgeons who do not perform endoscopy as

part of their routine practice. This latter category was included, as these surgeons still treat colorectal cancers, but must always rely on another endoscopist's assessment, rather than repeat the procedure themselves, and therefore represent a distinct population of surgeons. We also recruited participants from various stages in their careers, although all participants were fully licenced attending physicians with at minimum one year of practice in Winnipeg.

### Data collection

Semi-structured interviews were selected as the data collection method for this research. Interviews are the ideal method for data collection in qualitative research when the researcher wants to explore participant thoughts, feelings and beliefs about a particular topic. Compared to quantitative methods such as surveys, interviews allow the researcher to delve deeper into relevant topics, and explore important themes that may not have been anticipated in advance. Compared to group interviews or focus groups, individual interviews also offer an opportunity for individual perceptions to be explored with less bias from the others(65). Furthermore, scheduling multiple physicians at the same time would have proven challenging.

A semi-structured interview guide was developed (**Appendix**) based upon questions recommended by the authors of the CFIR and available on <http://cfirguide.org/>. This framework was used to ensure information pertaining to all conceptual levels of guideline implementation were evaluated(18). The questions were refined through iterative discussions with thesis committee members comprised of a gastroenterologist, a surgeon, a knowledge translation expert, and an expert qualitative researcher and psychologist. Questions were also piloted on two senior general surgery residents to assess interview flow, length, content clarity and appropriateness of the questions. Revisions were made following the pilot interviews, but pilot data were not integrated into the analysis.

The authors of CFIR recommend that implementation researchers identify which CFIR constructs they will assess in advance based on the relevancy to the study, rather than to attempt to assess every construct at once(18). They also recommend that researchers report their rationale for which constructs are selected. We determined that four of the five CFIR domains aligned with the goals and objectives of this study: Intervention characteristics (e.g., perceptions of new lesion localization guidelines); Outer settings (e.g., relationships to external organizations, government policies); Inner setting (e.g., Winnipeg healthcare organizations, operating rooms

and endoscopy suites); and Characteristics of individuals (e.g., gastroenterologists and surgeons). Questions related to the process domain (aspects relating to planning, engaging, and executing) were deemed to be less relevant at this pre-implementation stage in the knowledge translation cycle. Most questions in the process domain aim to evaluate perceptions on how an intervention is working. Alternatively, for an implementation strategy being proposed, these questions may assess perceptions on how to facilitate that process. The recommendations we aimed to assess are new, and we have not developed a proposed implementation strategy yet, therefore the process domain questions do not apply at this stage and were not posed to participants. For the remaining four domains, there were CFIR constructs within each that were also difficult to assess at this stage of the implementation process, and those are highlighted in the table in the **Appendix**. Excluded constructs were not used in the determination of sufficient sample size, even if those constructs were later included in the analysis (i.e., participants going “off script” and addressing some additional concepts on their own).

Data were collected through a series of individual semi-structured qualitative interviews. Interviews were conducted by Zoom video teleconference (Zoom Video Communications, San José, California), due to concerns regarding COVID-19 virus transmission, and local/institutional pandemic-related restrictions. The main objectives of the interviews were to: 1. explore participants’ perceptions of the new endoscopic lesion localization recommendations; and 2. determine how existing workflows could be modified to augment lesion localization, enhance communication between providers, and improve compliance with the recommendations. Participants were provided with a copy of the recommendations both prior to and at the beginning of the meeting, and had the opportunity to ask questions. During the meeting, a visual infographic tool was used to help participants understand and refer to the recommendations(14). All interviews were audio-recorded and later transcribed by the investigator.

### Data analysis:

#### *Units of analysis:*

There were two units of analysis for this research according to provider speciality: gastroenterologist and surgeons. Gastroenterologists perform endoscopies only, whereas surgeons may perform endoscopy, but also operate to remove the cancers. Data are categorized according to the CFIR codes separately for both groups (i.e., gastroenterology and surgery).



Within each group, perspectives were subsequently categorized as facilitators or barriers according to CFIR construct. Findings from the two groups were then compared using a triangulation process to identify common and contrasting themes between specialties, and according to construct relative priority.

*Data coding:*

Interview transcripts were imported into NVivo software for Mac (version 12.2.0; QSR International, Melbourne, Australia) for coding and analysis. Coding was performed primarily by a single researcher using directed content analysis(66). This deductive qualitative research approach is best used when an existing theory has previously been established to explain an observed phenomenon(66), and has been used previously for analysis of qualitative interviews using the CFIR(67). Following this approach, transcripts were coded using a predetermined codebook and inclusion criteria (**Appendix**)(18). The codebook was modified iteratively during the data analysis process. Initially, the codebook definitions were taken verbatim from the CFIR “short definitions”. During analysis, the codebook inclusion criteria were expanded to include more detailed definitions from the CFIR paper to remove any ambiguity(18). Codebook items that aligned with multiple constructs were assigned to each construct. For CFIR constructs that are divided into sub-constructs, statements were automatically coded to both the umbrella construct and to the relevant sub-construct. The umbrella construct was not coded separately. For example, the ‘readiness for implementation’ construct includes codes from the sub-constructs ‘leadership engagement’, ‘available resources’, and ‘access to knowledge/information’.

Each transcript was first analyzed at the entire transcript level; these were reviewed repeatedly and coded deductively to the CFIR constructs according to the codebook. Data were then reviewed at the level of each interview question (which were designed *a priori* to elicit opinions specific to certain CFIR constructs) to check for additional information that was missed during the initial coding. Uncoded data were identified and analyzed later to determine if they represented a new category or a subcategory of an existing code. As a reliability check, a second researcher with expertise in social sciences, clinical care, and qualitative thematic analysis, reviewed and independently coded the data from two randomly selected transcripts. A summary of this analysis was shared with the primary analyst. This second analyst identified that some participants discussed themes that were best addressed within the process domain and its related

constructs (excluded *a priori* from the data collection and analysis as these constructs were felt to be irrelevant at this stage of implementation). These opinions were expressed only in a few interviews, therefore they were coded together using the code 'Process Domain' rather than to individual constructs within this domain.

#### *Construct relative priority:*

After interview transcripts were coded, I ranked participant perspectives according to whether a CFIR construct was perceived as a barrier or facilitator to implementing the new recommendations. Ranking criteria were adapted from previous work by the authors of the initial CFIR framework, and which have been used previously to differentiate high from low-performance implementation settings(68,69). Ratings were performed by a single analyst to determine whether the construct has a positive, negative, or neutral perceived effect on implementation, and the strength of the degree of influence. Ratings are integers ranging from -2 to +2, with negative and positive numbers indicating barriers and facilitators, respectively. Ranking criteria were based on the level of agreement among study participants' expressed views, language strength, and concrete examples used to emphasize responses (**Table 1**). Rankings were applied to entire CFIR constructs as an overall assessment incorporating all participants' opinions within a group, rather than to each individual participants' interview transcripts. Rankings were performed repeatedly throughout the data collection and analysis process using all data collected to date, to determine if additional interviews changed construct scores. When scores no longer changed following additional participants, this was used as a criterion for theoretical saturation. Rankings were stratified according to the two units of analysis (i.e., provider specialty) and compared in a matrix table. Constructs under the CFIR "process" domain were excluded from this part of the analysis.

#### *Validation strategies*

As recommended by qualitative research experts(70), multiple strategies were used throughout the research process to ensure validity (trustworthiness) of results and interpretation of the data. We used the concepts of triangulation, reporting disconfirming evidence, dialogic engagement, and reflexivity to guide this process. The goals of triangulation are: 1. To achieve convergence between multiple sources of information to verify codes/categories; and 2. To

create optimal conditions for challenging dominant perspectives, and to identify and report divergent opinions. There are multiple approaches to triangulation. In this study, we used the techniques of *methodological triangulation*, *data triangulation*, and *perspectival triangulation*(70). As defined by Ravitch, *methodological triangulation* has two categories: *within-methods triangulation*, and *between-methods*. We used *within-methods triangulation*, in which one method was used for data collection (interviews) but had multiple ways of assessing constructs *within* the interviews. For example, multiple questions were included to assess different aspects of the same construct (e.g., to assess compatibility: “What would you change about this guide?” and “What parts are different from your current practice?”). Questions were also designed to elicit a mixture of perceptions (e.g., “What do you think are the barriers?”) and example narratives (“Can you give an example of a time culture affected a past implementation effort?”). In this way, constructs could be assessed at multiple points throughout the interview and compared. Occasionally, participants’ responses would reflect one perception (e.g., facilitator), but when probed further for examples or when asked a different way, their responses would change. Those instances, when they occurred, are highlighted in the presentation of the results.

*Data triangulation* is related to the concept of purposive sampling, and occurs when researchers attempt to attain data (relevant to the research question) from as many sources as possible. According to this concept, data were triangulated according to differing participant perspectives (*perspectival triangulation*)(70). In reporting the results, multiple participant perspectives are illustrated with example quotes and attributed to their background (i.e., specialty) to demonstrate the diversity of the opinions expressed. This process is limited, however, in that only physician perspectives were sought for the present study.

Throughout the coding process, the validation strategy of *reporting disconfirming evidence* (i.e., discrepant information) was used to highlight the true diversity in personal experiences shared by participants. This was used both during the analysis for specific constructs, but also data were analyzed critically for entire cases (i.e., participants) whose opinions differed from the rest. As recommended by Ravitch, I also used these “outlier” perspectives to challenge my own preconceived or developing notions about the data, as well as my interpretation of the constructs that were developing(70). For example, when I came across interviewees that disagreed with or challenged my understanding of the others (e.g., a construct was consistently a barrier and then a

new participant said it was a facilitator), I deliberately went back to the previous transcripts to see if this perspective had been expressed before and I had missed it through my interpretation. I also reflected on reasons why this perspective might be different, which allowed me to identify important subgroups for further analysis.

*Dialogic engagement* was also used throughout the research design, data collection, and analysis process as a validation strategy. Dialogic engagement is a systematic processes for engaging in scheduled generative dialogue between the primary analyst and others, about the data collection, coding, and interpretation process(70). According to this process, I met with members of the advisory committee at regular intervals during the research design, data collection and analysis process to check assumptions, pose questions, and challenge my interpretations to ensure they were fairly presented.

Finally, throughout the research process, I attempted to *engage reflexively* with the data and the participants by examining the effects of my implicit biases and positionality on the interpretation of the results (see critical reflexivity statement below). I kept a diary of my reflections, and carefully documented the rationale for all decisions made during the analysis process (i.e., decisions regarding which quotes to place in each construct, and how constructs were identified as barriers versus facilitators.)

*Participant validation* (i.e., member checking) was not a dominant validation strategy used in the current project. I had initially planned to perform a member check using the synthesized analyzed data and asking participants to comment by email. The benefits of this approach were the decreased time commitment for participants compared to other member check strategies, while also providing an opportunity to validate results by seeking disconfirming voices, and providing participants the opportunity for reflection on personal experiences and create opportunities to add data(71). However, when I mentioned this aspect of the project to my participants at the end of the interviews, most were non-enthusiastic, and many suggested that they likely wouldn't have time to respond meaningfully. Therefore, while I chose to send a summary of the study results to participants following study completion as a knowledge sharing strategy, none responded, so their comments were not used as part of the data analysis. Therefore, the only participant validation strategy I employed in this research was *integrated* within the interviews(70). During our conversations, I would frequently synthesize my understanding of the information provided to me. This allowed for me to check my

understanding of what the participants had expressed, and allowed participants an opportunity for reflection in case their words did not adequately reflect their intended meaning.

**Table 1. Criteria to assign ratings to constructs**Adapted from Damschroder and Lowery(69), and Muddu *et al.*(68)

Rating	Criteria
- 2	The construct has a negative influence on the new guideline's use. This construct has an impeding influence in work processes and/or an impeding influence in implementation efforts. Most interviewees (at least two) described with explicit examples how the key or all aspects of a construct manifests itself in a negative way.
- 1	The construct has a negative influence on the new guideline's use. This construct has an impeding influence in work processes and/or an impeding influence in implementation efforts. Interviewees make general statements about the construct manifesting in a negative way but without concrete examples: <ul style="list-style-type: none"> <li>• The construct is mentioned only in passing or at a high level without examples or evidence of actual, concrete descriptions of how that construct manifests</li> <li>• There is a mixed effect of different aspects of the construct but with a general overall negative effect</li> <li>• There is sufficient information to make an indirect inference about the generally negative influence and/or</li> <li>• Judged as weakly negative by the absence of the construct</li> </ul>
0	A construct has neutral influence on the new guideline's use if: <ul style="list-style-type: none"> <li>• It appears to have neutral effect (purely descriptive) or is only mentioned generically without valence</li> <li>• Interviewees from the same unit of analysis contradict each other</li> <li>• Different aspects of the construct have positive influence while others have negative influence and overall the effect is neutral.</li> </ul>
+1	The construct has a positive influence on the new guideline's use. This construct has an impeding influence in work processes and/or an impeding influence in implementation efforts. Interviewees make general statements about the construct manifesting in a positive way but without concrete examples: <ul style="list-style-type: none"> <li>• The construct is mentioned only in passing or at a high level without examples or evidence of actual, concrete descriptions of how that construct manifests</li> <li>• There is a mixed effect of different aspects of the construct but with a general overall positive effect</li> <li>• There is sufficient information to make an indirect inference about the generally positive influence</li> </ul>
+2	The construct has a positive influence on the new guideline's use. This construct has a facilitating influence in work processes and/or a facilitating influence in implementation efforts. Most interviewees (at least two) described with explicit examples how the key or all aspects of a construct manifests itself in a positive way.

### *CFIR-ERIC intervention mapping:*

The tool also reports relative endorsement from experts for each ERIC strategy as a method to address a specific CFIR barrier (e.g., 61% of experts endorsed the ERIC strategy ‘Audit and feedback’ as a recommended strategy to address barriers in ‘Goals and feedback’ CFIR construct). Strategies that were endorsed by  $\geq 50\%$  of the experts were deemed as ‘Level 1’ strategies, and strategies that were endorsed by 20% to 49.9% of the experts were deemed as ‘Level 2’ strategies(19–21,51). Level 1 strategies are felt to be more likely to be effective in addressing the corresponding CFIR domains based on expert consensus. The authors of the CFIR-ERIC framework suggest selecting a combination of strategies, taking care to ensure that broadly applicable strategies, (i.e., general strategies with high cumulative endorsement across multiple constructs) are selected in addition to specific strategies that only work to address one or a few barriers that might not otherwise be addressed by the broadly applicable strategies(51). To ensure both approaches are addressed in this research, ERIC strategies with level 1 endorsement were selected for each CFIR barrier identified, and compared to the top strategies based on cumulative endorsement across constructs. ERIC strategies were stratified according to provider specialty.

Participants frequently proposed their own implementation strategies during the interviews. In *post-hoc* analysis, these opinions were deductively coded according to the ERIC framework by the primary analyst, and compared to those strategies identified via the CFIR-ERIC framework in a matrix table. Codebook definitions used for the ERIC deductive analysis were not modified from those proposed by the authors of that framework(19,21).

### Ethical considerations

This study was reviewed by the University of Manitoba Health Research Ethics Board (HREB) for approval prior to data collection. At initial study recruitment, and immediately prior to each interview, participants were provided with an emailed copy of a consent form (**Appendix**) to review and sign. At the beginning of each interview, the interviewer verbally explained the study and the potential risks and benefits. Participants also had the opportunity to ask any questions, and were informed that they could withdraw from the study at any time. Immediately following the interview, audio records were transcribed by the interviewer, all

participant identifying information was removed, and transcripts were assigned a unique numerical identifier.

Critical reflexivity statement:

Critical reflexivity is essential to ethical research practices. Reflexivity is a strategy for the researcher to recognize their own sociocultural location within their research so that they may analyze themselves and the research critically(65). In qualitative research, the researcher is the instrument for data collection. It is essential to assess how this instrument is calibrated. It is impossible therefore to remove the positionality of the researcher entirely from the research process. To aid with interpretation and collection of this research, as the interviewer and primary analyst of the data, I must acknowledge my positionality, assumptions, and biases.

I am a white cisgender heterosexual able-bodied male. I am a general surgery resident physician, and through the clinician investigator program (CIP) I am concurrently completing my Masters in Science in the Department of Community Health Sciences (CHS), University of Manitoba. I have a passion for helping others and for making positive change. This passion led me to medicine where I am able to help diverse people. These benefits, however, are limited to the individual patients and families with whom I interact. While rewarding, I recognize that my ability to provide excellent care is often limited by operational structures, processes and policies. I view a career as a clinician-scientist as a calling to help resolve these current shortcomings, enabling myself and others to provide excellent patient care more effectively. My goal is to use a combination of clinical and research skills to conduct practice-based research throughout my career, discovering ways to continually enhance patient care. Through the guidance of my mentors, I have identified the needs of colorectal cancer patients in Winnipeg as an area for quality improvement, and aim to find ways to enhance care deliver for these people.

Acknowledging these biases, throughout the course of this research I interviewed other physicians from diverse backgrounds, genders, ethnicities, and sexual orientations, who had different approaches to patient care than myself. Many of their perspectives and lived experiences were different from my own, and therefore I am unable to fully understand how their perspectives influence implementation of the current recommendations within their environment. Furthermore, I knew some of the participants through my work as a surgery resident in Winnipeg. I must acknowledge the ethical issues this raises. In particular, for qualitative



research, when research participants are known to the researcher, it may raise concerns of the trustworthiness of the data(72). However, I view my position in this regard as a strength. Being a physician positions me as an insider, which is an advantage that should not be underestimated(72). Furthermore, my relative familiarity with the terminology and clinical context facilitates these discussions. Being a physician provides me with access to the “hidden curriculum”; a collection of difficult-to-quantify professional roles and behaviours in medicine(73), which may potentially be uncovered as a factor in implementation of these new guidelines. Conversely, in some centers there is a culture of animosity between surgeons and gastroenterologists due to overlapping roles and responsibilities(74–76). In Winnipeg, there is a strong history of collaboration between these two groups(12,77), however it is possible that some gastroenterologists may have viewed me as in the “other” camp as a surgical trainee, and been less willing to participate or speak candidly with me. Being a surgical resident also potentially places me in a position of bias in relation to this work. As a surgical trainee, I bring with me more understanding from the surgeon perspective to the research process, and possibly less understanding of the endoscopist perspective. Finally, as a resident physician trainee, my participants have a position of authority over me. This is contrary to the usual research-participant interaction, and introduces its own ethical considerations. In general, conducting research in one’s own workplace is cautioned against, as the research may be compromised by perceived coercion, biased responses to questions for fear of retribution, or confidentiality breaches(78). Usually, these fears are in relation to protecting the research participants. I suspect the current reverse power dynamic in my relationship to the participants diminishes the threat of these occurrences somewhat. Rather, as a trainee, risk of coercion, or fear of retribution may have instead affected me as a researcher and student, and potentially limited my interactions with participants. For example, I may not have felt empowered to challenge my participants on contentious issues due to subconscious biases. All attempts were made during the research process to minimize the effect of these potential biases by acknowledging them throughout the research, and critically examining their effects on the knowledge generated.

## **Chapter 4. Results**

### Participant Demographics

There were 36 general abdominal surgeons who treat colorectal cancers, and 20 gastroenterologists identified as potential participants in Winnipeg. Three surgeons and one gastroenterologist were excluded from this cohort as they co-authored the new recommendations. Of the 52 remaining potential participants, 11 gastroenterologists and 10 general surgeons agreed to participate in the study. Interviews took place in Winnipeg from October 12, 2021 to January 11, 2022. The average interview time was 56 minutes and 55 seconds (range: 35 minutes to 72 minutes and 58 seconds). Participants had diverse subspecialty training backgrounds. 57% of participants reported working primarily in an “academic” environment alongside resident physicians and students, whereas 43% reported working primarily in a “community practice” with less trainee exposure. General demographic variables including number of years in practice, number of monthly colonoscopies completed, monthly number of colorectal tumors resected, age, gender, and training background are reported in **Table 2**. Individuals participated from every endoscopy suite, hospital, and operating room in the city (data not shown).

**Table 2 Participant characteristics (N=21)**

<i>Clinical specialty</i>	
<b>Gastroenterologists</b>	11
Academic	5
Community	6
<b>Sub-specialization</b>	
IBD	3
Therapeutic endoscopy	1
<b>General surgeons</b>	10
Academic	7
Community	3
<b>Sub-specialization</b>	
Colorectal	2
Surgical oncology	3
<i>Clinical experience</i>	
<b>Most recent residency/fellowship training</b>	
Canada	15
US	6
<b>Colonoscopies performed per month*</b>	
<20	3
20-40	9
41-60	5
61-80	2
<b>Colorectal cancer operations per month (surgeons only)</b>	
0-1	4
2	4
3-4	2
≥5	0
<b>Median years in practice**</b>	10.5 (IQR:3-21)
Mean age in years	46.8 (SD±11.1)
Gender (% female)	24

\*Excluding two surgeons who do not routinely perform colonoscopy as part of their clinical practice

\*\*As an attending physician (excluding fellowship)

### CFIR Content Analysis

A total of 27 CFIR constructs were assessed and deemed relevant to the research questions at this stage of implementation. Perceived barriers and facilitators to guideline use varied by participant speciality background (i.e., gastroenterologist versus surgeons), and are summarized according to construct relative priority in **Table 3**. In total, surgeons and gastroenterologists each identified ten constructs as net barriers to implementation of the new recommendations. Surgeons identified four major barriers, where as gastroenterologists identified three. Nine of the ten barrier constructs were held in common by both specialty groups: ‘external policy & incentives (major)’, ‘organizational incentives & rewards (major)’, and ‘available resources (major)’, ‘goals & feedback’ (major for gastroenterologists only), ‘access to knowledge & information’, ‘knowledge & beliefs about the intervention’, ‘self-efficacy’, ‘individual identification with the organization’, ‘evidence strength and quality’, and ‘costs’. Uniquely, gastroenterologists identified ‘self-efficacy’ as a net barrier, which was a facilitator for surgeons. Surgeons identified ‘compatibility’ as a barrier, which had more mixed perspectives for gastroenterologists.

Both major (n=4) and total facilitators (n=10) were more numerous for surgeons compared to gastroenterologists (7 total, 2 major). Gastroenterologists identified the constructs of ‘trialability’ and ‘cosmopolitanism’ as major facilitators, whereas surgeons identified ‘relative advantage’, ‘trialability’, ‘complexity’, and ‘structural characteristics’. Gastroenterologists’ five mixed facilitators included: ‘relative advantage’, ‘adaptability’, ‘complexity’, ‘design quality & packaging’ and ‘structural characteristics’. Surgeons had six mixed facilitators: ‘intervention source’, ‘design quality & packaging’, ‘cosmopolitanism’, ‘tension for change’, ‘learning climate’, and ‘self-efficacy’. Gastroenterologists and surgeons had four net facilitator constructs in common: ‘relative advantage’, ‘trialability’, ‘complexity’, and ‘design quality & packaging’. Uniquely, surgeons identified ‘innovation source’, ‘tension for change’, ‘learning climate’, and ‘self-efficacy’ as net facilitators, which were not facilitators according to gastroenterologists. Unique to gastroenterologists, ‘adaptability’ was a net facilitator.

A summary of barriers and facilitators identified within each construct according to gastroenterologists and surgeons is provided in **Table 4**. Detailed descriptions of barriers and facilitators organized according to CFIR domains and constructs are elaborated on in subsequent text.



**Table 3. CFIR rankings stratified by participant specialty**

	Gastroenterology	Surgery
<b>1. INTERVENTION CHARACTERISTICS</b>		
Intervention Source	0	+1
Evidence Strength & Quality	-1	-1
Relative advantage	+1	+2
Adaptability	+1	0
Trialability	+2	+2
Complexity	+1	+2
Design Quality and Packaging	+1	+1
Cost	-1	-1
<b>2. OUTER SETTING</b>		
Patient Needs & Resources	0	0
Cosmopolitanism	+2	+1
Peer Pressure	0	0
External Policy & Incentives	-2	-2
<b>3. INNER SETTING</b>		
Structural Characteristics	+1	+2
Networks & Communications	0	0
Culture	0	0
<i>Implementation Climate</i>		
Tension for Change	0	+1
Compatibility	0	-1
Relative Priority	0	0
Organizational Incentives & Rewards	-2	-2
Goals and Feedback	-1	-2
Learning Climate	0	+1
<i>Readiness for Implementation</i>		
Leadership Engagement	0	0
Available Resources	-2	-2
Access to knowledge and information	-1	-1
<b>4. CHARACTERISTICS OF INDIVIDUALS</b>		
Knowledge & Beliefs about the Intervention	-1	-1
Self-efficacy	-1	+1
Individual Identification with Organization	-1	-1

-2 = “major” barriers, universally recognized as barriers by all participants with specific illustrative examples; -1 = minor barriers, mixed opinions with overall barrier effect; ‘0’ = mixed perceptions; +1 = minor facilitator, mixed opinions with overall enabling effect; +2 = major facilitator, universally recognized as a facilitator by all participants, with specific illustrative examples.

**Table 4. CFIR barriers and facilitators to implementation of the new endoscopic lesion localization recommendations according to gastroenterologists and surgeons**

Constructs	Gastroenterologist perspectives		Surgeon perspectives	
	Barriers	Facilitators	Barriers	Facilitators
<b>INTERVENTION CHARACTERISTICS</b>				
Intervention Source	<i>Wanted local surgeon and organizational endorsement</i>	Joint gastroenterology and surgery initiative		Joint gastroenterology and surgery initiative
Evidence Strength & Quality	Unaware of evidence for some key practices	Familiar with evidence for many recommendations. <i>Willing to adopt practices simply because they were recommended.</i>	Unaware of evidence for some key practices	Familiar with evidence for many recommendations
Relative Advantage	Preferable solutions identified: video-record scopes, surgeons do index scope, <i>build trust between specialties, CT scans.</i>	Most participants could not think of a preferable solution.	Preferable solutions identified: video-record scopes, surgeons do index scope	Most participants could not think of a preferable solution.
Adaptability	Some adaptations were suggested, unclear if these are possible.	Recommendations could be easily adapted or would not need to be adapted at all	Some adaptations were suggested, unclear if these are possible.	Recommendations could be easily adapted or would not need to be adapted at all
Triability		Pilot trial was felt to be possible with many examples for how this could be accomplished		Pilot trial was felt to be possible with many examples for how this could be accomplished
Complexity	<i>Polyp classification systems (Paris, NICE) too difficult to use.</i>	Recommendations are simple and easy to follow		Recommendations are simple and easy to follow
Design Quality & Packaging	Full-length manuscript too long to use	Excellent design quality of the infographic	Full-length manuscript too long to use	Excellent design quality of the infographic
Cost	Takes longer to follow the recommendations, resulting in reduced income. Get paid to do repeat scopes	Many thought new recommendations had low cost and adds net value	Takes longer to follow the recommendations, resulting in reduced income. Get paid to do repeat scopes	Many thought new recommendations had low cost and adds net value
<b>OUTER SETTING</b>				
Patient Needs & Resources	Rare perception that repeat endoscopy is not an issue. Organization doesn't understand endoscopy patient needs or prioritize QI	Participants had a good understanding of patient needs within their organization.	Rare perception that repeat endoscopy is not an issue. Organization doesn't understand endoscopy patient needs or prioritize QI	Participants had a good understanding of patient needs within their organization.
Cosmopolitanism		Strong connections with external institutions (conferences, courses, informal networks)	<i>Some had minimal networking related to endoscopy or colorectal cancer</i>	Strong connections with external institutions (conferences, courses, informal networks)
Peer Pressure	Unaware of other institutions improving their own repeat endoscopy rates to provide pressure to follow suit	<i>Winnipeg falling behind other institutions in endoscopy QI as a motivator to adopt the new recommendations</i>	Unaware of other institutions improving their own repeat endoscopy rates to provide pressure to follow suit	<i>Valued being the first to adopt new recommendations.</i>
External Policy & Incentives	No policies exist to encourage recommended practices. Fee-for-		No policies exist to reinforce recommended practices. Fee-for-	

	service policy reinforces repeat endoscopy	service policy reinforces repeat endoscopy	service policy reinforces repeat endoscopy
<b>INNER SETTING</b>			
<b>Structural Characteristics</b>	<i>Nursing and manager turnover preventing sustained improvements</i>	Small, well integrated community of providers with central organization	Small, well integrated community of providers with central organization.
<b>Networks &amp; Communications</b>	Past endoscopy initiatives were poorly communicated. Performance feedback is rare between providers	Strong collegial networks between providers, multiple venues of multidisciplinary communication identified	Strong collegial networks between providers, multiple venues of multidisciplinary communication identified
<b>Culture</b>	Individuals resistant to change. Organization doesn't value or support endoscopy QI, stresses costs over quality.	Individuals believed the culture was a facilitator	Individuals believed the culture was a facilitator
<b>Implementation Climate</b>			
<b>Tension for Change</b>	<i>Perception that individuals already follow all the recommendations. Repeat endoscopy only an issue for surgeons.</i>	Viewed implementation as important	Viewed implementation as important
<b>Compatibility</b>	Organization does not value endoscopy QI. Recommended practices differ from current practices and equipment.	Recommendations compatible with individuals' goals/values (valued standardization and endoscopy QI). Some thought organization values QI, and therefore the new recommendations	Recommendations compatible with individuals goals/values (valued standardization and endoscopy QI). Some thought organization values QI, and therefore the new recommendations
<b>Relative Priority</b>	<i>A few gastroenterologists had alternate priorities (e.g., COVID)</i>	Recommendations viewed as high priority.	Recommendations viewed as high priority.
<b>Organizational Incentives &amp; Rewards</b>	No relevant organizational incentives	No relevant organizational incentives	No relevant organizational incentives
<b>Goals and Feedback</b>	No formal relevant feedback processes	<i>Informal feedback from surgeons occurs (rarely)</i>	No formal relevant feedback processes
<b>Learning Climate</b>	Organization leadership does not value or encourage endoscopy QI. There is insufficient time for reflective thinking and evaluation	Individuals empowered to institute change and described many past examples. Endoscopy leaders value and encourage QI.	Individuals empowered to institute change and described many past examples. Endoscopy leaders value and encourage QI.
<b>Readiness for Implementation</b>			
<b>Leadership Engagement</b>	Unable to identify endoscopy site leaders. Organizational leadership viewed as a likely impediment to implementation. No tangible	Described actions they could reasonably foresee leadership taking to facilitate implementation	Described actions they could reasonably foresee leadership taking to facilitate implementation



	commitments from leaders interviewed	commitments from leaders interviewed	commitments from leaders interviewed	
Available Resources	Many resources were missing for full-scale implementation	Many recommendations useable with current equipment/resources.	Many resources were missing for full-scale implementation	Many recommendations useable with current equipment/resources.
Access to Knowledge & Information	No resources or information on the new recommendations currently available to providers	No additional training needed to follow all recommendations for most providers	No resources or information on the new recommendations currently available to providers	No additional training needed to follow all recommendations for most providers
<b>CHARACTERISTICS OF INDIVIDUALS</b>				
Knowledge & Beliefs about the Intervention	Providers minimized the importance of the recommendations they chose to ignore.	Positive perceptions of the recommendations and valued their implementation.	Providers minimized the importance of the recommendations they chose to ignore. <i>Repeat endoscopy for rectal cancers to continue despite new recommendations</i>	Positive perceptions of the recommendations and valued their implementation.
Self-efficacy	<i>Multiple providers had skill deficiencies in polyp characterization</i>	Posessed the skills to follow most recommendations	<i>One surgeon said other surgeons could not follow polyp characterization recommendations.</i>	Posessed the skills necessary to follow all recommendations
Individual Identification with Organization	Little identification with organizational goals. <i>Some thought the organization unfairly prioritized other aspects of patient care over endoscopy</i>	High degree of identification with job role as a patient care provider.	Little identification with organizational goals. <i>Some said their own patient care goals misaligned with the organization's goals. Burnout impeding implementation.</i>	High degree of identification with job role as a patient care provider.

Abbreviations: COVID - Coronavirus infectious disease 2019; CT – Computed tomography, NICE - Narrow band imaging international colorectal endoscopic; QI - Quality improvement.

*Italics* signify a perception that was unique to one specialty group

### *Intervention Characteristics*

Three gastroenterologists provided perspectives on the *innovation source* construct, for an overall mixed perspective. One gastroenterologist noted that the recommendations are “a joint statement and that would help gain the respect of the community members that are in this field,” and suggested that this aspect of the recommendations should “be highlighted” (Gastroenterologist 4). Another gastroenterologist felt this construct could be improved by “putting a WRHA or something on there to say something like WRHA endoscopy, or whatever, again, just so that people see it's kind of official and expected of people” (Gastroenterologist 12). Another expressed that seeking the endorsement of local surgeons was important: “if there was something that [the surgeon I refer to] was like, do this every single time, I would do it every single time” (Gastroenterologist 14).

Two surgeons addressed the innovation source. One remarked on the value of the “multidisciplinary” and “collaborative” approach taken by these recommendations (Surgeon 3). The other said, “just the fact that you're doing it through both [gastroenterology and surgery] is kind of a good indicator of why this would probably work” (Surgeon 10). The remaining participants didn't address this construct.

Perceptions of the *evidence strength and quality* of the recommendations were mixed for gastroenterologists and surgeons, with an overall net impeding effect in both groups. Both gastroenterologists and surgeons had a good understanding of the evidence and rationale for many of the recommended techniques. However, providers from both specialty groups frequently identified recommended practices that they were not familiar with or were not convinced of their necessity based upon their perception of the evidence. Which practices were perceived as less valid varied by participant. The most common recommendation of concern for both groups was the suggestion to raise a saline bleb prior to tattoo placement, although the rationale differed between groups. One gastroenterologist asked, “what's the harm if the tattoo goes transmural?”. They then elaborated that they didn't believe transmural injection caused “an issue,” explaining, “I don't think it will stain the colon” (Gastroenterologist 8). Another was concerned that raising a saline bleb would make tattoo visualization more difficult; “when you raise the saline bleb, won't that make the tattoo stay in the lumen and not go through to the serosa?” (Gastroenterologist 4).

Some surgeons also expressed that they “hadn’t heard about the saline bleb technique before” (Surgeon 4), but none argued the importance for preventing transmural injection. Rather, surgeons’ hesitation with saline bleb injection stemmed from their perception that it would take them “a lot of extra time” or that they could get the same results with an “oblique” (Surgeon 15) angle of tattoo injection (another recommended practice). One surgeon raised concern that there wasn’t “some [evidence] that was strongly behind it” (Surgeon 15).

Not all participants were opposed to saline bleb, however. One gastroenterologist suggested they had little familiarity with the concept but “[had] nothing against doing it” (Gastroenterologist 6). After reading the recommendations during the interview, one gastroenterologist said, “I think I’m actually going to try that because I really have a hard time getting a good tattoo” (Gastroenterologist 11). Many other providers from both specialties described using a saline bleb in their current practice already and were very familiar with this technique.

Other controversial recommendations based upon perceptions of the evidence for both gastroenterologists and surgeons were the role of tattoos for rectal tumors, and the use of the ScopeGuide® real-time, three-dimensional magnetic imaging (Olympus Corporation, Shinjuku City, Tokyo, Japan) for lesion localization. Many providers in both groups asked some variation on “what was the reason for not tattooing low to mid rectal cancers?” (Surgeon 16) and most described a reluctance to change this practice without being presented with additional evidence or local data. Providers in both groups stated the ScopeGuide was “useless” (Surgeon 1) or “unhelpful” (Gastroenterologist 4). One surgeon, who does not routinely perform endoscopy, had never heard of the technology, asking “what is this ScopeGuide?” (Surgeon 3) at the beginning of the interview.

Other recommendations were only mentioned as of poor-quality evidence by participants in single interviews. For example, one gastroenterologist debated the merits of multiple quadrant tattoo placement, stating “if there is data showing that it’s an issue, people going in to find colon cancer, they can’t find them because it’s only been [tattooed] in one spot, you know, I can change what I do” (Gastroenterologist 6). Another gastroenterologist said they didn’t “routinely tattoo if it’s a huge honking cancer” because “if it’s pretty obvious, then I generally just assume that the surgeon will see it” (Gastroenterologist 17). One surgeon, who does not perform endoscopy, asked “why does [tattooing into the lesion] make it more difficult [to resect]?” (Surgeon 3). Most

other providers did not ask about the rationale for these recommendations, and many specifically remarked how these practices were important.

Both gastroenterologists' and surgeons' perceptions reflected on the *relative advantage* that implementing the new recommendations had compared to alternate theoretical or existing solutions to repeat preoperative endoscopy and colorectal lesion localization. For example, participants expressed implementation of the new recommendations was "the right solution" (Surgeon 10), or that "this is a good way to go" (Surgeon 15). When asked, most participants in either group "[couldn't] think of anything else" (Gastroenterologist 5) as potential solutions to repeat endoscopy. However, a minority of providers had suggestions for complementary or alternate interventions that they might prefer. One gastroenterologist and one surgeon suggested "recording the endoscopies" (Gastroenterologist 18), like a "black box" (Surgeon 9), referring to the technology used in the airline industry. However, this option was undermined by both providers. One mentioned they "don't see it happening" (Gastroenterologist 18), and the other said that implementation of the recommendations were preferable "from a feasibility standpoint" (Surgeon 9). One gastroenterologist and one surgeon each mentioned selective triage of patients from the central intake endoscopy system as a possible solution. The surgeon suggested that "all of the tumors go just to surgeons and send all the whatever to gastroenterologists, like diarrhea and IBS [irritable bowel syndrome]" (Surgeon 20). As further rationale, one gastroenterologist stated: "if this is something that's going to be surgical, then there's no point in me being involved" (Gastroenterologist 13).

Gastroenterologists had more suggestions for alternate solutions than surgeons. One gastroenterologist suggested that building better relationships with surgeons was a preferred strategy and that "maybe if the surgeons trust the person who scoped them, then they don't repeat it" (Gastroenterologist 6). When asked for potential solutions one gastroenterologist suggested to "get a CT scan, presumably the cancer's going to show up" (Gastroenterologist 8). One gastroenterologist spoke at length about putting the endoscopy reports on "eChart" (eChart Manitoba; the province's digital repository for prescriptions, lab results, immunizations, and diagnostic imaging) as a way to reduce repeat endoscopy, explaining that when this was done for lab results "a lot of repeat lab testing was decreased because it was accessible" (Gastroenterologist 4). Although when asked if this solution was better than the new guideline

implementation, their response was, “no, I think the guideline is important, but the complementary piece is the data [access]” (Gastroenterologist 4).

*Adaptability* was perceived as a facilitator for gastroenterologists but had more mixed perceptions from surgeons. One gastroenterologist stated that “you wouldn't have to change the guidelines” at all so that they would fit within their current practice (Gastroenterologist 2). Another said they “don't think [the recommendations] would be difficult at all” to adapt (Gastroenterologist 13). Many surgeons had similar perceptions. One surgeon stated, “I think it would be pretty easy because, you know, my experience is that this is, for the most part, already being done” (Surgeon 10). Another said, “everything that we're talking about here, is just minor changes in practice” (Surgeon 9). However, some surgeons disagreed and felt there would be challenges. One surgeon said, “I think the only way you have you could change [practice] or the easiest way to changing it is make [the recommendations] mandatory”, but that this could be problematic because there would be “coding issues” with the endoscopy reporting software, or that other providers might “complain” (Surgeon 1). Other providers from both groups had suggestions for how the guidelines might be improved, usually reflecting providers' perceptions of the lack of evidence for specific recommendations described above. For example, one provider suggested that we “boot the ScopeGuide part” from the list of recommendations in the infographic (which is listed as optional in the full-length recommendations document) (Surgeon 9). Others had suggestions to “more carefully define the cecum” (Surgeon 15), that “mid rectum should be a standard definition” (Surgeon 16), and to add recommendations from the full-length guideline onto the infographic relating to rectal landmarks and polyp characterization, or otherwise rephrase some of the recommendations to make them clearer.

*Trialability* was perceived as a clear facilitator for both gastroenterologists and surgeons. Both groups stated that piloting the new recommendations locally would be possible, although many expressed that a pilot study was “unnecessary” as they would prefer to move forward to full scale implementation. For example, one surgeon said, “the recommended changes in the guideline are so simplistic and common-sense that I don't think a pilot study is likely needed” (Surgeon 7). Another surgeon said, “I would be comfortable adopting this without any type of significant pilot or anything” (Surgeon 9). Some providers thought that a pilot study was a good idea, and some had suggestions for how they would organize a pilot in their current environment. For example, one gastroenterologist suggested that an ideal location for a trial implementation of

the recommendations locally was “the ColonCheck program” (ColonCheck Manitoba; The CancerCare Manitoba colon cancer screening program, where individuals are referred for colonoscopy after a positive FOBT result) because it is “a set group of practitioners” that are “engaged and interested in colon cancer” and “every second person has some sort of polyp” (Gastroenterologist 11). Another gastroenterologist expressed a willingness to participate in a pilot if one were to occur, stating, “If you guys did one and you needed people to do it, I would” (Gastroenterologist 17). Compared to gastroenterologists, fewer surgeons desired a pilot study, and no surgeons volunteered to participate.

*Complexity* of the recommendations was a facilitator for both gastroenterologists and surgeons. Almost all providers remarked how the recommendations were “simple” and “easy to follow” (Surgeon 15). However, only the minority of participants accessed the full 24-page recommendations manuscript, preferring to use the attached infographic instead. Gastroenterologists had slightly more mixed perceptions, although still positive. For example, one of the gastroenterologists who accessed the full-length text noted that polyp classification systems that are recommended (Paris(79) and NICE(80)) are too “cumbersome” for some endoscopists to use (Gastroenterologist 5). Another gastroenterologist and one surgeon also mentioned that endoscopists wouldn’t use those classification systems due to “lack of familiarity” (Gastroenterologist 2).

*Design quality and packaging* of the recommendations was another facilitator construct for both gastroenterologists and surgeons. Most providers commented on the design of the associated infographic. One gastroenterologist said, “I like that it's high yield. You can read it. It's very easy to see” (Gastroenterologist 17). Another said, “It's very clear how it's all put. It's just got really neat pictures” (Gastroenterologist 19). Similarly, surgeons appreciated the design, with one stating: “I love how it's just laid out and it's simple and it's, you know: ‘The indications’. Boom! ‘How to do it.’ And then ‘what kind of documentation you want’. It's just, it's elegant the way it's laid out” (Surgeon 14). A few perceptions were mixed. Those who looked at the full-length document felt that it was a bit too long. One gastroenterologist remarked, “You've got a lot of good information here, but it's twenty-four pages for someone to wade through. It's a challenge for even the most dedicated person to digest” (Gastroenterologist 4). A surgeon agreed, stating that the full manuscript was “a lot”, and “I think if you read the guideline as a document, then obviously it's going to be hard to read all of that. I think your best bang for

your buck is going to be that diagram” (Surgeon 1). There were also some suggestions for improvements. One gastroenterologist suggested adding “a photo of an actual lesion done the way you want it” rather than a color drawing (Gastroenterologist 11). Another said, “the documentation part is a little wordy” (Gastroenterologist 6). A third suggested “to kind of simplify [the documentation section] a little bit” (Gastroenterologist 19). Conversely, one surgeon wanted more information on the infographic, stating: “you might want to do a two-panel and say ‘colon’ and ‘rectum’. For the rectum, you could say, like, relationship to anal verge or anorectal ring, [and] relationship to rectal folds” (Surgeon 1).

*Costs* associated with implementing the new recommendations were perceived as a barrier by both gastroenterologists and surgeons. Providers in both groups perceived significant opportunity costs associated with adherence to the recommendations. Firstly, repeat preoperative endoscopy was viewed as a revenue-generating procedure for surgeons. One gastroenterologist remarked, “it is still a fee for service system and repeat procedures result in payment for surgeons” (Gastroenterologist 4). Another gastroenterologist stated, “if [the surgeons] weren't billing for it, they wouldn't do it. But it is a billable procedure, so they'll do it” (Gastroenterologist 8). Some surgeons reiterated this perception of costs. One surgeon remarked, “if we're paid for per scope, right, then there's an incentive to be able to re-scope,” but made sure to clarify that this wasn't the only reason for a repeat endoscopy; “I'm not saying that people are like, ‘oh my God, I'm going to go make money so I'm going to scope a bunch more people needlessly, so to speak’” (Surgeon 3). Conversely, some surgeons felt that “there are some people who re-scope just for the billing code” (Surgeon 15), although none of the participants described money as being their own primary motivator for repeat endoscopy.

From the point of view of performing the initial endoscopy, both surgeons and gastroenterologists described a perception that following all aspects of the guideline may also cost them in the form of time. One gastroenterologist stated, “this might be slightly more time consuming, and if you have a busy slate of six colons and you take an extra five minutes per colon, you know six times five is an extra 30 minutes. That's an extra colon, that's an extra few hundred bucks that you're potentially not getting in your pocket at the end of the day” (Gastroenterologist 2). Time was felt to be especially pertinent if providers were not already following most of the recommendations. One surgeon remarked: “this isn't going to slow me down” but “if you're not doing any of this, though, and now you're like, you might be adding

another five minutes to your scope, and there is a small group of people who want to get those scopes done as quick as possible” (Surgeon 15). However, not every participant shared these perceptions. Regarding the risk of having subsequent procedures cancelled because one took longer, one gastroenterologist explained, “from the stories you hear, [there are] people who are habitually always late and that never happens” (Gastroenterologist 18). Another gastroenterologist confirmed this perspective, by noting that “the reality is our slates are such that they're set. So really there should be no disincentive for having a colonoscopy that takes you, you know, 10 more minutes” (Gastroenterologist 13). Nearly all recommendations on the infographic were specifically identified as potentially time consuming by at least one participant in at least one of the interviews. Although one gastroenterologist expressed that following these recommendations were “just part of doing the test,” that “this is part of your job,” and therefore “this should not cost anyone anything” (Gastroenterologist 8).

#### *Outer Setting:*

There were mixed perceptions towards *patient needs and resources* as they relate to the goals of the current recommendations. The first way used to evaluate this construct was through the perceptions of the individuals within the organization, which were used to infer the overall organizational perception of patient needs and resources. These individual perceptions were mostly facilitators. Gastroenterologist and surgeon interviews reflected that most participating individuals had a good understanding of patient needs, and could describe those needs in terms of the following: “you’re potentially putting the patients at risk for a procedure that they don't need” (Surgeon 9); “the resource is precious” (Surgeon 10); “now another patient can be scoped in that place” (Surgeon 10); “you’re potentially delaying surgery” (Surgeon 10); and “no one wants to go through any more colonoscopies than they absolutely have to” (Gastroenterologist 2). Gastroenterologist 13 provided the following anecdote to describe the significant concerns repeat endoscopy causes from their patient’s perspective:

I actually have a guy who had a rectal tumour and it was a bit of a whatever like it happened. I think it was right before the summer holidays, and I sent him to one colorectal surgeon who thought that maybe it could be removed with a TEMS (transanal endoscopic microsurgery). And so, then he was sent to [another surgeon], who thought it couldn't be. And so he got sent back to the first surgeon. And it wasn't a huge delay when they ended up doing his surgery. He had, I don't even remember what he was staged at, but you know, his belief is that six-week delay made the difference between him having this. And I said to



him, that's not the case. Things don't change in six weeks. But for him, you know, he still talks about it. It's been seven years, and I actually saw him yesterday.

However, one gastroenterologist and one surgeon (who does not routinely perform endoscopy in their practice) disagreed with the patient needs described by their colleagues. Surgeon 7 stated, "I'm not sure that I believe that all surgeons routinely repeat endoscopy or that surgeons frequently repeat endoscopy. That might be so, and I'm sure you have data that says so. I just I'm biased and disinclined to believe that." Similarly, gastroenterologist 6 said, "I am very surprised, very surprised because, you know, I see the reports from the surgeons I refer to, and I don't recall, other than distal tumors, anyway, repeating the colonoscopy".

The perceptions of whether patient needs and resources are known and prioritized by the organization were also evaluated through providers' statements addressing their organizational leadership, or the healthcare system's ability as a whole to prioritize endoscopy quality improvement initiative similar to the present guideline implementation. Many providers had no opinion on this topic or stated that they "don't know". Others described past examples that illustrated that the organization did not understand or prioritize patients' needs within endoscopy. One gastroenterologist explained, "it's not cancer care Manitoba, and it's not cardiac. So that's where all the dough [is]. Or dialysis in Manitoba. That's where all the dough goes" (Gastroenterologist 8). Regarding endoscopy research, one gastroenterologist described many examples of failed innovation due to lack of institutional support, stating that, "Shared Health is a disaster when it comes to research. They don't understand that research drives good clinical care. So, you know, I don't know whether they're paying for quality improvement or quality assurance programs in other areas of medicine" (Gastroenterologist 8). Similarly, surgeons had few opinions on whether the organization prioritizes endoscopy quality improvement. Those that did address this construct described only barriers. One surgeon stated, "I would like to see an administrative structure where they value clinicians who want to do quality improvement and they facilitate it rather than just be blind to it or let these processes continue, like you pulling your hair out" (Surgeon 15). Another said, "I think leadership in the current era, you know, current era, meaning the ongoing COVID era and human resource crisis in the health care system probably values efficiency more than QI innovation" (Surgeon 7).

*Cosmopolitanism*, the degree with which gastroenterologists and surgeons are networked with providers at external institutions, was a strength. Most providers in both groups described frequent attendance at national and international meetings. Both groups' members listed

participation in educational workshops related to endoscopy such as the Canadian Association of Gastroenterology's Skill Enhancement for Endoscopy (SEE) courses. One gastroenterologist and multiple surgeons also mentioned attending the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) annual meeting. Other meetings were only mentioned by providers in a single specialty. For example, only gastroenterologists described annual attendance at Digestive Diseases Week, American College of Gastroenterology's Annual Scientific Meeting & Postgraduate Course, American Gastroenterology Association Crohn's and Colitis Conference, and Canadian Digestive Disease Week. Conversely, only surgeons described attendance at the Canadian Surgery Forum, the American Society of Colon and Rectal Surgeons meeting, and the European Society of Coloproctology meeting. Subspecialty surgeons also described attendance at a variety of meetings with unrelated subjects such as trauma, burns, or bariatrics. Similarly, a few surgeons mentioned no networking at all related to endoscopy or colorectal tumors, stating that they do not typically attend "endoscopy related conferences" (Surgeon 16), preferring to focus on other aspects of their practice.

Providers in both groups described local incentives related to networking as helpful. Doctor's Manitoba, a local physician organization with functions similar to a union, was noted by multiple participants for providing a program where physicians "get reimbursed financially for going to these conferences and it counts a lot towards your CME (continuing medical education credits] for the year" (Surgeon 10). However, individuals in both groups also described structural disincentives to conference attendance related to small practice groups that were unable to accommodate their absence. A gastroenterologist mentioned, "sometimes it's difficult to know when you're going to go to a conference or, you know, something comes up and you're like, 'Oh, actually, that'd be great. But it's only four weeks away and if I cancel my endoscopy now, I'm going to have to pay'" (Gastroenterologist 13). Similarly, surgeon 7 stated that they work in "a very subspecialized niche" and if "everybody wants to go to the same conferences, then it's hard to encourage everyone to attend".

Outside of conference attendance, some gastroenterologists and surgeons again described both formal and informal networks with individuals outside of their local practice group; primarily with individuals at organizations where they had previously worked or trained. Again, some surgeons described no informal networking with gastroenterologists or other providers

related to endoscopy at all. Surgeon 3 stated, “endoscopy and endoscopic markings? Bupkis. I don't network with anybody about this. I barely network with the people next door.”

*Peer pressure* from external institutions to spur adoption of the new recommendations had mixed effects for both gastroenterologists and surgeons. Neither group could identify other institutions that had previously looked at their own repeat preoperative endoscopy rate to motivate them to follow suite, which was a potential barrier. However, a few gastroenterologists expressed a perception that “Winnipeg is behind the rest of the country” in quality improvement in endoscopy, or that other institutions were “really ahead of Winnipeg by many years” (Gastroenterologist 17), which would act as a motivator. This perception was not shared by surgeons, however. Rather, more surgeons liked the idea of being the first to adopt these recommendations compared to gastroenterologists. For example, surgeons stated, “it makes it look like we're staying on top of things” (Surgeon 14); and “it'd be something that people would want to say, yeah, Winnipeg was the first people to do this because there's really there's no downside to it” (Surgeon 9). However, surgeon 7 felt that being first for this particular area was not important. This surgeon said, “if the question is would it be valuable to us from the perspective of our reputation and admiration of our peers? I think the answer is probably not within the realm of surgery.” Gastroenterologist had more mixed views on whether staying ahead of the competition was a motivator to adopt the new recommendations. One gastroenterologist said, “I'd be kind of neutral on that. I don't know that we're necessarily going to be late adopters, but I don't know how many people make it their priority to be an early adopter either” (Gastroenterologist 18). Another gastroenterologist said, “if somebody else has done it and proven it reduces the repeat scopes by ‘X’-percentage, then that's a much easier sell. If not, it might be a little bit challenging” (Gastroenterologist 19). Some others agreed with the surgeons. One gastroenterologist said, “certainly, being on the forefront of making those types of changes is certainly a good thing and would only be looked at favourably” (Gastroenterologist 2).

Relevant *external policies and incentives* were non-existent for gastroenterologists and surgeons; therefore this construct was a barrier. There are no external policies, mandates or regulations in place to incentivize following the new recommendations or disincentivize repeat endoscopy. Rather, fee-for-service, which is the current payment scheme for most providers, was viewed as a perverse incentive by both groups that incentivizes repeat scopes and faster procedures. This concept overlapped substantially with the ‘costs’ construct under the

‘intervention characteristics’ domain above. Regarding incentives, gastroenterologists 4 stated “repeat procedures result in payment for surgeons”; and surgeon 3 stated, “there's an incentive to be able to re-scope.” Both groups had many suggestions for policies and incentives that they would like to see (and do not already exist), including published benchmarks, official recommendations, mandates, audit and feedback, or peer performance review. These incentives could be administered either externally (government or regulatory body) or through the internal (hospital or practice groups) setting. Details of these recommendations are addressed in our analysis of the ERIC framework in the following section.

*Inner setting:*

The *structural characteristics* of the organization relating to endoscopy and colorectal surgery were perceived as strengths, with gastroenterologists expressing slightly more mixed (albeit still positive) perceptions than surgeons. Relating to the social architecture and size of the organization, providers in both groups expressed that Winnipeg is a “smaller”, “better-integrated community” with “a nice relationship between surgeons and gastroenterologists” (Surgeon 3), a small number of sites, a limited number of endoscopists and surgeons, and “central intake for endoscopy [that] has leveled that field and people don't feel like they're under attack [for endoscopy time]” (Surgeon 15). These were all perceived as facilitators for the new recommendations’ uptake. Some older gastroenterologists and surgeons described an “antagonistic relationship” that existed “10 years ago” (Gastroenterologist 8) or “15 to 20 years ago between surgeons and gastroenterologists” (Surgeon 15), but that presently they were at a “lull for antagonism” (Surgeon 15) between specialties, which created the present ideal environment for collaboration. While most providers described the structural characteristics of the organization in terms of facilitators, one gastroenterologist addressed this construct in terms of stability of the organization, which was a barrier in their opinion. When this gastroenterologist had attempted to implement improvements in the past, their perception was that “the nurses turnover, managers turnover” preventing sustained changes (Gastroenterologist 5).

The nature and quality of local *networks and communications* within the organization related to endoscopy and colorectal cancer treatment were mixed. Many gastroenterologists and surgeons described strong networks of providers from both specialties with whom they referred patients, and communicated formally and informally about topics related to endoscopy.

Providers all know each other, and participate in “joint rounds”, “GI journal clubs”, and cooperate between specialties “on lots of patient care and research related initiatives” which could potentially facilitate implementation efforts (Gastroenterologist 2). One surgeon said: “I think because everyone is kind of under the Shared Health umbrella, we have a lot of communication between our groups” (Surgeon 9). However, some providers in both groups expressed that there was room for improvement. One surgeon noted that perhaps engagement with some of the joint sessions was not ideal; “my sense is that a lot of people log into these rounds sessions and perhaps check their emails and do whatever else on their phone in the virtual format” (Surgeon 7). A gastroenterologist noted that the joint gastroenterology-surgery rounds were a recent development, and that some interested parties likely “miss out” because they are unaware; “we need to make sure that we are advertising that more widely, right? Like, we need to make sure that all the potential interested stakeholders at least have the opportunity to participate” (Gastroenterologist 2). Relating to communication surrounding past quality improvement initiatives in endoscopy, gastroenterologists and surgeons described common modalities for information transfer within their groups, including “section meetings” (Gastroenterologist 11), “grand rounds” (Surgeon 7), “word of mouth” (Gastroenterologist 18), “GI journal club”(Surgeon 14) and “group emails” (Gastroenterologist 11).

Some providers also described recent developments in endoscopy that were poorly communicated, and were seemingly implemented without notice, which was described as “not ideal”. Gastroenterologist 2 provided the following anecdote to explain how past initiatives had been poorly communicated:

Some quality improvement initiatives in endoscopy just kind of started happening one day, which is good that they happened, but there was no sort of rollout of what was happening and why it was happening, which is perhaps problematic. We started doing, you know, endoscopic timeouts recently, similar to surgical timeouts. Just kind of people just started doing that one day without ever talking to anyone. This sounds great. I think this is important. There's lots of research literature, but I didn't realise we were starting this here.

Some surgeons agreed with this gastroenterologist, explaining, “oftentimes people don't tell us in advance” and “there are still elements sometimes where people change process and don't tell anyone” (Surgeon 15). Another surgeon said, “this type of thing, I never hear about it,” referring to the new guidelines, and how previous similar initiatives were implemented in the past (Surgeon 3). Finally, both gastroenterologists and surgeons described a general lack of communication regarding performance feedback related in endoscopy, which was double coded

as a communication barrier. Feedback is addressed further under the ‘Goals and Feedback’ construct below.

Both specialties had mixed perceptions on the *culture* within Winnipeg, as it relates to endoscopy quality improvement, and implementation of past and future interventions within Winnipeg endoscopy. Most providers said culture would be a strength when asked about it initially, but then gave examples that demonstrated some cultural barriers when probed further. Examples of positive aspects of culture identified in both groups were that individuals value quality patient care, they value standardized practices, and are open to trying new things. One gastroenterologist said, “I think culturally people are open to these types of concepts, at least academically” (Gastroenterologist 2). A surgeon said, “I think the specific culture associated with endoscopy will facilitate these guidelines being implemented” due to “the collaborative approach to this, the recognition that there's expertise on both sides of the fence” (Surgeon 3). Another gastroenterologist described the culture as one in which “people want to be good, people want to improve, and people want to be doing what's appropriate. No one wants to be doing crappy work” (Gastroenterologist 11).

Gastroenterologists and surgeons also gave many examples of how the culture previously impeded innovation because individuals were “resistant” (Surgeon 9) or “apathetic” (Surgeon 10) to change. When asked if they had ever tried to improve something within endoscopy, one gastroenterologist laughed and said, “it tends to flow back to the way it was being done for years” and that “the culture doesn't change” (Gastroenterologist 5). Another gastroenterologist explained how culture had prevented the widespread use of ScopeGuide (a practice also recommended in the current guideline); “a lot of the reason why, ScopeGuide was not being used is not because it wasn't like super available. It's the fact that people just didn't want to use it” (Gastroenterologist 17). In reference to other practices recommended by the guideline, one gastroenterologist stated, “I think some of the older endoscopists are, you're not going to change what they do. Or they think they already do it already, but they don't” (Gastroenterologist 12). A surgeon went so far as to say; “they're all independent practise people, right? You know, the only way to get them to listen is if there's a punishment, or by just not giving them a choice” (Surgeon 1).

Another cultural barrier identified by some gastroenterologists and surgeons was the perception that the organization does not sufficiently value endoscopy quality improvement, and

rather prioritized “financial efficiency and optics” over quality (Surgeon 7), which is a theme that permeates other constructs such as ‘patient needs and resources’ above and ‘compatibility’ and ‘relative priority’ below. One gastroenterologist explained: “There have been lots of things that, you know, we wanted to change that we just hit a wall with the hospital” (Gastroenterologist 8). Gastroenterologists and surgeons provided many examples of failed or delayed innovation related to endoscopy due to the organization’s perception of costs. Examples of delayed innovation brought up by participants included: “to change central intake”; “to change the way the nurses worked at HSC”; “to buy Endoworks”; “capsule endoscopy” (Gastroenterologist 8), and large bore intravenous lines (instead of the less reliable “butterfly” needles; Gastroenterologist 6). One gastroenterologist explained that some changes were brought forward by the providers “years ago” but “didn't happen [in Winnipeg] until it became generally how it was normally done all over” (Gastroenterologist 6). While some providers felt that the organization did value quality improvement, one of the gastroenterologist explained, “it’s a glacial process that doesn't sit well with patients’ needs and providers’ desires” (Gastroenterologist 4).

The *implementation climate* is a broad construct that includes six sub-constructs that were evaluated in this study. The first was *tension for change*, a unique construct in that it is rated as a barrier unless individuals perceive the current situation as untenable. Gastroenterologists’ and surgeons’ perspectives differed on this construct somewhat. Gastroenterologists had more mixed perceptions. Some expressed a strong need for the new recommendations. For example, one gastroenterologist stated, “it's really important work” explaining “you know, even I sometimes don't always do it to the exact standards that I want to, which I think is largely to the same sort of type of standards that you sort of outline here” (Gastroenterologist 2). No gastroenterologists said that the new recommendations were unneeded, however some were less enthusiastic. One stated, “yes, I guess we need that” (Gastroenterologist 11), whereas another said, “I don't know [if these are needed] because I'm not a surgeon” (Gastroenterologist 6). Some gastroenterologists expressed that they felt most of theirs and their colleagues’ practices were already in line with the recommendations, and thus there was less need for a change, “I mean, maybe they're not. I think so. I think anybody who's trained in the last five years is [following these recommendations already]” (Gastroenterologist 8).

Compared to gastroenterologists, more surgeons expressed a strong need for change related to the topics covered in the guidelines. For example, one surgeon stated, “Yes, I think there is a need. And certainly, we've already talked about where I've been in this scenario where you've re-scoped someone, and then you find out that they have been tattooed and it's not clear in the report, or other stuff. But I think my own personal interaction with this, again, it sounds like I could do better with a couple of these techniques” (Gastroenterologist 3). Another surgeon said, “it's very, very worthwhile and very exciting” (Surgeon 14). However, two surgeons also expressed alternate perspectives. One non-endoscopist surgeon (as mentioned previously related to *patients needs and resources* above), did not “believe that all surgeons routinely repeat endoscopy or that surgeons frequently repeat endoscopy” (Surgeon 7). Another surgeon described a very privileged referral base where most of their patients come from a single gastroenterologist, and remarked: “Do I have a huge bunch of issues with this? No. But if I step out of that and go more globally, yes, I think there is a need” (Surgeon 16).

*Compatibility* is a large construct with multiple parts. Compatibility between meaning ascribed to the new guidelines, and individuals' values were similar between gastroenterologists and surgeons. Therefore, for both groups, compatibility with individuals' values was a facilitator. Both gastroenterologists and surgeons valued standardized, evidence-based practices that would decrease repeat endoscopy and these recommendations fit within that concept. For example, one gastroenterologist said, “I think a guideline is great. I mean, I think the more stuff that we have standardized, the better” (Gastroenterologist 13). Another gastroenterologist explained, “I think people want their practice to be consistent with everybody else's” (Gastroenterologist 11). A third gastroenterologist said, “I'd say most people aren't happy when their patient gets re-scoped” (Gastroenterologist 18). Similarly, surgeons said; “I think the consistency is probably the most important thing because there's a lot of reasonable different approaches” (Surgeon 9). Another said, “having everyone do things similarly and with a standardised format makes it a lot easier” (Surgeon 3).

Compatibility with the institutional and organizational values was perceived as variable, and many of the statements related to the ‘culture of the organization’ (above) were double coded to this aspect of compatibility. For example, some individuals thought quality improvement was important to the organization, whereas others disagreed with that, for an overall mixed effect within both specialty groups.



Finally, the recommendations' compatibility with existing practices, workflows and systems was a barrier, particularly for surgeons. This aspect of the compatibility construct overlaps with 'adaptability' above and 'available resources' below. Many providers in both groups could identify recommended practices that differed from what they already do (e.g., ScopeGuide use, saline bleb injection, three-quadrant tattoo), which was a potential barrier in that providers sometimes described that these practices may not fit within their current workflow because of lack of time, or a perception that they were unnecessary (barriers overlap with 'evidence strength and quality'). The major barrier with surgeons under this aspect of the compatibility construct was that most rectal cancer surgeons expressed that they wished to tattoo their own rectal cancers before surgery. These surgeons also generally agreed with the recommendation for the index endoscopists not to tattoo rectal lesions, stating: "I prefer to do that myself" (Surgeon 21). However, according to these surgeons, these patients would then all require a repeat endoscopy by their rectal cancer surgeon, which is counter to the goals of the project. Even for colon cancer, one surgeon said, "prior to surgery, if I didn't do the scope, or one of my surgical colleagues didn't do the scope, I do it. Like, I repeat it [regardless of the preoperative information provided]" (Surgeon 20), indicating a disparity between that surgeon's workflow, and the goals of this guideline document. Although that same surgeon said the recommendations were needed because they "would definitely help standardize localization across individuals".

There were mixed perceptions regarding *relative priority* of implementing the new recommendations. Generally, gastroenterologists and surgeons expressed that the goals of the recommendations, which are to standardize endoscopy practices and reduce repeat endoscopy, were important for them. Many of the quotes demonstrating the perceived importance of the new recommendations were discussed under *tension for change* and *relative advantage* constructs above. Unique to the present construct were participants' opinions regarding relative priority compared to other issues within their organization. For example, multiple gastroenterologists and surgeons addressed the implementation of the recommendations in relation to COVID-19. One gastroenterologist and one surgeon felt that COVID had increased the importance of reducing repeat endoscopies because of the backlog. One gastroenterologist noted, "in the last few months, I don't know about what others have told you, but in my practice, I'm finding way more malignancies than not" and that "the timing would be perfect [for a solution]"

(Gastroenterologist 19). A surgeon explained, “[in] the ongoing COVID era and human resource crisis in the health care system probably values efficiency more than QI innovation. I think the way I would pitch that as a sales tactic is that minimizing repeat endoscopy is efficiency” (Surgeon 7). Conversely, one gastroenterologist, who themselves felt the recommendations were “transformational” and “important”, mentioned that “before COVID, [repeat endoscopy] wasn't a priority [to the organization]. Now with COVID, they will always say, well, once we get through COVID, we'll consider it” (Gastroenterologist 4). Some surgeons, particularly those in which endoscopy was not part of their typical practice, mentioned that repeat endoscopy was not an issue for them, however many acknowledged “at a purely administrative level, it's an expensive problem. Obviously, it means another invasive test for patients, which is a relatively safe test, but it's always accompanied by some non-negligible risk. So I think it is important” (Surgeon 7)

Surgeon-endoscopists also noted alternate priorities, however. One surgeon mentioned within their current practice, “greater than 90 percent of my colon cancers come from either myself or [one gastroenterologist]. So, it is biased by its generation. So, do I have a huge bunch of issues with this? No.” But this provider acknowledged that “if I step out of that and go more globally, yes, I think there is a need” (Surgeon 16). Two surgeons felt lesion localization and documentation was more of an issue related to referrals when the “index endoscopy is not done within Winnipeg” (Surgeon 7) where “they don't have EndoSoft” (Surgeon 1; EndoSoft LLC, Schenectady, NY; The organization that provides the digital synoptic endoscopy reporting software called EndoVault, used in Winnipeg since 2019).

Just as there were no external incentives, *organizational incentives and rewards* were also missing. Only one gastroenterologist mentioned an existing organizational incentive that could potentially be applied in relation to the new recommended practices, which was the “duty to report colleagues who are practicing in an unethical way” but tempered this statement by explaining, “it's a bit of a tough one. You don't want to sort of tell people that you're going to be telling the payer what this person is doing” (Gastroenterologist 4). Others expressed that following the recommendations are “just part of your job” but that “there's no penalties if you don't follow it” (Gastroenterologist 8). While many providers listed organizational incentives that they would support (discussed below according to the ERIC framework), individuals in both groups expressed that they thought no organizational incentives were necessary. For example, one surgeon stated, “you appeal to a doctor's desire to be good for his patients and for patients in

general, and that's all you really need to do for incentives" (Surgeon 15). Similarly, a gastroenterologist said, "I don't think there should be an incentive. This is like, if you said this is standard of care, you should follow it" (Gastroenterologist 19).

*Goals and feedback* related to topics covered in the new guidelines were also non-existent according to participants. This lack of feedback was perceived as a barrier by both gastroenterologists and surgeons. Gastroenterologist 2 noted, "How else do you know if there's a problem, or that you're even doing that well, unless you get some sort of feedback?" Some gastroenterologists described occasionally receiving informal feedback from "the surgeon that we refer to and they say, you know, I didn't see the tattoo or where you tattooed was totally way off the site that you said it was. So that kind of feedback actually helps me personally" (Gastroenterologist 5). Similarly, surgeons said they sometimes provide feedback; "if I get a referral and it's not documented, I'll call the person" (Surgeon 10). Although another said, "chances are [currently] they're only going to get feedback if it's egregious, right, which is pretty rare" (Surgeon 9). Another surgeon said they "usually just deal with it" when they encounter issues, and that they "haven't called anyone up or something at this point, but that would probably be the right thing to do to" (Surgeon 21). Both gastroenterologists and surgeons described a desire for feedback that was structured, at regular intervals, and non-judgemental, and pointed to other programs where feedback was provided as a model. For example, one gastroenterologist identified the ColonCheck program as a platform for feedback, which already provides unrelated feedback to participating endoscopists on their endoscopy quality indicators. Another gastroenterologist identified "the Endoscopy Standards Committee," a provincial agency tasked with measuring and maintaining high quality endoscopy in Manitoba, explaining it "would be a natural area to do an audit because it's evidence act protected, and it's supposed to be educational, and it gets people away from the fear that the word audit tends to engender" (Gastroenterologist 4). Other gastroenterologists felt the surgeon should be the one to collect and provide the feedback. One suggested this could be done using a "centralized referral form" using CancerCare Manitoba as an example. "No one's going to see your patient in CancerCare unless you've checked off the history, the X-ray, the CBC (complete blood count) and the pathology report" (Gastroenterologist 8). Another stated feedback could be provided through a letter; "a cordial thank-you, this worked, to close the loop. I'm demanding information out of you. I'm closing the loop by sending it back. Thank you for the information. Or the information was

inadequate, I had to repeat the scope” (Gastroenterologist 11). Another gastroenterologist thought that “some provincial audits [already occur], but we never hear about them” (Gastroenterologist 6), which could potentially be a source of feedback for providers. One surgeon identified the synoptic operative report currently used for colorectal cancers as a future possible method to provide feedback; “we do not have that [feedback] currently [built in]” but “using that as a platform [to provide feedback] would definitely have some advantages and some symbiosis” (Gastroenterologist 2).

The *learning climate* is a construct with many components, of which both gastroenterologists and surgeons had mixed perspectives. The first aspect of this construct evaluates perceptions of whether leaders express their own fallibility and need for team members’ assistance and input. According to both gastroenterologists and surgeons, the head of Winnipeg endoscopy, Dr. Dana Moffatt, embodies this concept, which was a strength. One surgeon stated, “Dana Moffatt is approachable, completely 100 percent approachable. And so that, I think, has opened up new avenues of conversation that this [endoscopy quality improvement] falls into” (Surgeon 14). Similarly, a gastroenterologist stated, “Dana is very open if we need things or asking about certain equipment” (Gastroenterologist 12). Perceptions on leadership at specific endoscopy sites relating to this construct were also positive. A gastroenterologist noted, “I think at St. Boniface, perhaps we're blessed because I can just go to the charge nurse, the lead there, [or] I can go to Dana [to suggest changes]” (Gastroenterologist 11). Another described leadership at other sites as “always open to trying to do things better, for the most part, in my experience” (Surgeon 9). While many gastroenterologists and surgeons felt individual site leads would be supportive, others felt they would have less of a role in implementation due to a perceived lack of “power” (Gastroenterologist 13). Some gastroenterologists and surgeons said they “have no idea who the site leaders are” (Gastroenterologist 18).

Conversely, perceptions of broader regional and organizational leadership were negative. Some gastroenterologists and surgeons made vague statements about how organizational leadership valued quality improvement, although when asked for examples, they could only list barriers they would create. For example, one surgeon explained, “If you go the route of saying to management, this is the new way of doing it, you're going to get stymied. You're going to get bogged down in the bureaucracy” (Surgeon 14). Many providers cautioned that if change

required input or support from “Shared Health” (Gastroenterologist 19), “e-health” (Gastroenterologist 4), “the hospital” (Gastroenterologist 8), or broader WRHA leadership, then there would be barriers. One surgeon described the current system as lacking “an administrative structure where they value clinicians who want to do quality improvement” (Surgeon 15). Another described “the system in Manitoba to be challenging to implement new innovative technique in some ways,” as change typically occurs “because somebody becomes a champion for it” and “not because we have, you know, a clear documented evidence that the new product is better than the old product” (Surgeon 3).

Included within the construct of the learning climate are providers’ perceptions of feeling essential, valued, and knowledgeable partners in the change process, and safe to try new methods. Most gastroenterologists and surgeons reported past changes they had made to their own endoscopy programs and practices, and described feeling empowered and able to do so. One gastroenterologist stated, “whenever I have to change anything in my endoscopy suite, there has been no barriers. It's said and done. Anything through the Shared Health or Northern region, it's, yeah, just stupid bureaucracy” (Gastroenterologist 19). Regarding changes within their practice, another gastroenterologist said, “I don't need to involve anyone, I just start doing it” (Gastroenterologist 2). This concept was even more prominent for surgeons, most of whom remarked that there was “no oversight” (Surgeon 1). One surgeon mentioned that “[surgeons are] going to the conferences and picking up the new techniques and just doing them” (Surgeon 14). Another said they could simply adopt the practices recommended by this guideline, and that there was “no oversight about what you do” and that “in fact, nobody would really question it” (Surgeon 7). However, one surgeon tempered their statement about a lack of oversight by saying that individuals were being judged by their peers, therefore “if you screw up and you're doing something weird or wacky, everybody knows about it” (Surgeon 14).

The final part to the learning climate construct is providers’ perceptions of whether they have time and space for reflective thinking and evaluation, a concept that overlaps with the ‘costs’ construct(above) and the ‘available resources’ construct (below). Time for reflection was perceived as a barrier for providers in both groups. A gastroenterologist noted, “it's easy to get in a routine, and that's why people don't change because you're so against the clock all the time” (Gastroenterologist 12). Another gastroenterologist remarked that while they technically had the ability to slow down their practice to provide more time to reflect or practice new skills, this

came with a financial loss; “[your practice needs] flexibility such that your quarter can be lesser earning this quarter, and you can see it as an investment” (Gastroenterologist 11). One gastroenterologist described an example of a surgeon-endoscopist colleague who had previously slowed down temporarily to allow time for implementation; “he was listening to this guy explain these techniques, and he immediately called CI (central intake) and told them, going forward, just change all of my colons to 45 minutes. Because he wanted to have, you know, the time to integrate these techniques” (Gastroenterologist 11). No other providers described voluntarily taking a financial loss to integrate more time for innovation into their workflow, and many described time as a barrier to implementation due to financial stresses and also a concern for patient “backlogs” (Gastroenterologist 2).

*Readiness for implementation* is another broad construct that evaluates the tangible and immediate indicators of an organization’s commitment to its decision to implement an intervention. There are three sub-constructs within readiness for implementation that were evaluated. The first is *leadership engagement*. This sub-construct was not thoroughly assessed at this stage, as although some participants held leadership positions in endoscopy, we did not systematically set out to interview all the relevant leadership. Furthermore, the recommendations evaluated in this study are novel, with no proposed implementation strategy, so we were unable to evaluate whether leadership within the organization was committed to a specific intervention yet. Rather, under this construct we included general perceptions of participating physicians towards leadership regarding readiness for implementation of the recommendations, with illustrative examples from past similar quality improvement initiatives in endoscopy/surgery. Accordingly, perceptions towards leadership within this sub-construct overlap substantially with those expressed regarding leadership under the ‘learning climate’ (above).

As discussed under the ‘learning climate’, most gastroenterologists and surgeons identified Dr. Moffatt, the regional lead for endoscopy, as an ally who they could easily approach, and who was active and engaged in quality improvement initiatives and would likely support the current initiative. Participants also provided many examples of how Dr. Moffatt, or individual site endoscopy leaders, might help facilitate implementation of this guideline in the future. For example, multiple gastroenterologists expressed that if “Dr. Moffatt was to send out a memo” (Gastroenterologist 5) or “circulated [the recommendations] among us” (Gastroenterologist 6), “that would be very useful. I think that catches my attention and I’ll print it out and stick on my

wall” (Gastroenterologist 5). Others suggested that the endoscopy site leads should “place the infographic on the wall in each endoscopy suite” (Surgeon 16) and should act as “executive sponsors” (Surgeon 15) or “champions” (Surgeon 14) for the new recommendations. Finally, others suggested that feedback on endoscopy performance in relation to the new recommendations should come from the endoscopy leadership.

Individual endoscopy leaders who self-identified while participating in the interviews made statements that demonstrated their own support for implementing the recommendations as well. One gastroenterologist stated, “I’m the endoscopy lead at [one hospital]. I could fairly easily tell the endoscopists there to, you know, try to tattoo better and maybe ask the nurses who is not doing tattoos and then have a chat with the person” (Gastroenterologist 5). A surgeon site leader said, “I’m site lead at [a hospital] for surgery, and I guess by extension, endoscopy, and so I could certainly see, you know, bringing it up at a site meeting or, you know, sort of an endoscopy standards type meeting” (Surgeon 10).

A few gastroenterologists and surgeons highlighted the importance of engaging nursing leadership in the implementation process of these recommendations. One gastroenterologist noted, “the most influential person is going to be the CRN (clinical resource nurse) at the Grace” because “she’s always kind of present”, she’s “neither surgeon, nor GI”, and she’s likely to speak up “when she starts to see people doing things that are not right” (Gastroenterologist 13). Multiple providers similarly mentioned approaching the “charge nurse” when making past changes to their endoscopy practice, and that nurses were important facilitators of those changes. Two surgeons mentioned that nursing could possibly institute barriers if not properly engaged “because like, they run the endoscopy show” (Surgeon 15), and they are very “protocol driven” (Surgeon 7). Similarly, a gastroenterologist felt that because “nursing staff is very well, I think, schooled and steeped in process” and that with proper engagement “they would be helpful” to enforce the new recommendations as a “standardized process” (Gastroenterologist 11).

Importantly, most of the leadership actions expressed in the interviews were described primarily as aspirational, or as suggestions for future directions by participants, rather than as concrete actions they were likely to take immediately. Therefore, while many of these perceptions were positive, there were few tangible commitments from leaders, for an overall neutral effect of this construct for both gastroenterologists and surgeons.

Gastroenterologists and surgeons were united in that they both described a lack of *available resources* needed to support full implementation of the recommendations. Participants had many examples of recommended practices that they felt were limited by resource constraints. Regarding the ScopeGuide, which is recommended for documentation when localization is difficult, gastroenterologists said: “I don't really have ScopeGuide” (Gastroenterologist 5); and “it's only in one room, I think at HSC, and it's never in the room that I'm in” (Gastroenterologist 8). Similarly, a surgeon said: “Concordia has no ScopePilot (Pentax Medical Company, Toyko, Japan, equivalent to the ScopeGuide). They haven't put it up yet. They have it there, but they haven't actually instituted [it]” (Surgeon 20).

For photographs, which are recommended for documentation of all significant colorectal lesions detected at endoscopy, participants described many resource-related barriers. One surgeon said, “I'm sure you've seen that trying to fax these photographs doesn't work” (Surgeon 3). Accordingly, one gastroenterologist said, “faxing a color photo becomes a black and white smudge, which is not useful to the surgeon, and he may choose to repeat [the endoscopy] rather than to seek to access it through EndoVault” (Gastroenterologist 4).

Inability to access the colonoscopy report due to systemic resource constraints was another common complaint. One gastroenterologist said, “I'm routinely requesting reports from hospitals and it's always like, you're never sent anything. The family doctor doesn't send it. Maybe the family doctor doesn't know. But there's no one centralized place to go and say, ‘OK, we have the report’” (Gastroenterologist 17). Endoscopy reports were described as unavailable to providers in both specialties. A gastroenterologist stated, “I don't have an EMR (electronic medical record) in my office” (Gastroenterologist 4). Another said some clinics “don't have EndoVault” and “somewhere between 2000 and 4000 scopes [per year] between gastroscopes and colons [are] done between Manitoba clinic and Winnipeg clinic” (Gastroenterologist 18). Some surgeons said they “can't log in to EndoVault in clinic” (Surgeon 15), so would have to either use a faxed copy of the report, or go to the hospital to access color images. Other limitations arose from the endoscopy reporting software itself. One gastroenterologist stated, “I always thought, it's a shame that when we take a picture, the ScopeGuide doesn't come up on it. That would be very helpful” (Gastroenterologist 6). Others mentioned the lack of prompts in the software to help document recommended practices like tattoo position.



The final resource-related barrier described by most providers was the lack of time. This concept was also covered in detail under the ‘costs’ and ‘incentives’ constructs above. Related to available resources, lack of time was a limitation as many providers expressed that they may not be able to incorporate all the practices because they didn’t have enough time in their slate, or not enough time to test out practices with which they were unfamiliar due to lack of time. If endoscopists ran late, this had implications for cancelled slates, longer waitlists, or nurses and other providers staying overtime, for which there were no slack resources in the system to accommodate.

Many of the recommended strategies and adjuncts participants suggested as implementation strategies to aid with guideline uptake also required additional resources that didn’t exist. For example, participants commonly requested access to printed educational materials and posters, or the implementation of a formal feedback system. One surgeon suggested a paid scribe who “would be able to document everything at the same time as it's being done” to facilitate documentation (Surgeon 20).

*Access to knowledge and information* about the new recommendations was a barrier for both groups that was foreseeable given the new recommendations were unpublished at the time of data collection and thus access to relevant information was limited. One of the more common barriers identified by both gastroenterologists and surgeons was that “it's easy to forget” (Gastroenterologist 12), and participants “need to be reminded of the technical aspects” (Gastroenterologist 4). Many participants suggested that the guideline infographic be printed off and placed “in every endoscopy suite” (Gastroenterologist 8), and some suggested “some sort of reminder or prompt” be built into the reporting software (Gastroenterologist 2). Educational sessions at academic rounds or “GI journal club” (Surgeon 14), and an assigned champion at endoscopy sites were also suggestions for disseminating information. Not all aspects of this construct were barriers, however. Covered under this construct is the need for training, which overlaps with ‘self-efficacy’ (below). Most gastroenterologists and surgeons said they and their colleagues should need “no additional training” (Gastroenterologist 19) to follow the new recommendations, which was a facilitator. They would only need to be reminded of the new recommendations, as most felt that endoscopists already possessed the skills to follow them. The only recommended practice which was a bit contentious with regards to training was the

recommendation for polyp characterization, which two gastroenterologists and one surgeon said some of their colleagues would likely need more training to be able to do appropriately.

Two gastroenterologists and two surgeons identified the role for nurse training and education to facilitate guideline use, explaining that “these people are professionals that are very engaged in, you know, these kinds of processes” and involving nurses would be “very helpful” (Gastroenterologist 11). Some examples were that nurses could be trained to “set up ScopeGuide for every patient” (Surgeon 7) or could remind the endoscopist to follow the recommendations. One gastroenterologist explained “you [could] have the nurse saying, ‘we’re going to inject, right? I’m drawing up the spot, remember you’re supposed to do the saline blebs, look at the infographic’” (Gastroenterologist 13). One gastroenterologist noted that nurses were “steeped in process”, which is helpful for standardizing practices. A surgeon suggested that if these techniques became part of nursing process, this would encourage the endoscopist to follow the recommendations because “at some degree it becomes more burdensome for someone to object to a routine tool than it is to just accept” (Surgeon 7).

#### *Characteristics of individuals:*

Participants from both specialty groups had mixed perceptions related to their *knowledge and beliefs* about the new recommendations, with a net overall impeding effect. There are two parts of this construct. The first part was participants’ attitudes towards the recommendations document as a whole and values placed on it, which overlaps with other values constructs (e.g., relative priority, relative advantage, tension for change, culture, compatibility). As described previously, both gastroenterologists and surgeons held a positive view towards the new recommendations, and generally valued the decision to implement them locally.

The second part of this construct is participants’ familiarity with facts and principals of the intervention. For gastroenterologists, this construct was a barrier because most said they believed that most recommended practices were “already being done” (Surgeon 10), but it became apparent when questioned in more detail about specific recommended practices, that most providers had at least one, if not multiple, key differences between their practices and those recommended. Examples of recommended practices that multiple gastroenterologists admitted they did not follow were saline bleb placement prior to tattoo, three-quadrant tattoo, different volume of ink injected than that recommended, ScopeGuide use, and omission of rectal cancer

tattoos. One gastroenterologist said, “I don't routinely tattoo if it's a huge honking cancer. Like, I guess I mean, I could do that, but if it's pretty obvious, then I generally just assume that the surgeon will see it, because inevitably the patient always gets rescoped before surgery” (Gastroenterologist 17). Another said, “I'm generally not tattooing polyps” (Gastroenterologist 18). One said they place a tattoo proximal to the lesion for rectal cancers, as opposed to the distal location recommended. This construct overlaps with perceptions of ‘evidence strength and quality’ (above), as most of these differences stemmed from a perception by gastroenterologists that there was no evidence for omitted practices. However, which practices gastroenterologists followed differed between providers.

Similarly, surgeons also expressed that their practices were consistent with the recommendations but had many of the same differences that gastroenterologists described above. Multiple surgeons said they did not place a saline bleb prior to tattoo, used a different volume of ink than that recommended, omitted the ScopeGuide, and tattooed rectal lesions. One surgeon mentioned an alternate number of tattoos (two, as opposed to three quadrants). One surgeon said they place a tattoo in two locations, “one tattoo distal, one tattooed proximal” (Surgeon 9) instead of solely in the distal location recommended. Similar to gastroenterologists, which practices surgeons followed varied by provider, and lack of evidence was the most common reason cited for diverging from the recommendations.

The largest barrier for surgeons regarding beliefs about the recommendations was that over half of surgeons interviewed said they were still likely to repeat the endoscopy for their rectal cancer patients, regardless of whether the new recommendations were followed. For rationale, one surgeon explained that the guideline was not explicit enough, and they required even more information; “if someone said, ‘Oh, this is a two-centimetre lesion located in the posterior midline checked by water installation technique. And it's one centimetre above the top of the anal sphincter muscle.’ Then I'll be like, ‘Oh, I don't need to scope this person because I could just visualise what it looks like’” (Surgeon 1). One surgeon said it was more a matter of trust. To stop doing repeat endoscopy, this surgeon said, “I would still do the scope myself a few times and [I would need to] be quite confident that I wasn't really gaining any new information and was potentially subjecting the patient to a procedure that they don't need” (Surgeon 21). Most rectal cancer surgeons wanted to place a tattoo in the rectum to help with surgery, which also requires a repeat endoscopy. Finally, one surgeon said they would repeat endoscopy for all of

their cancers, regardless of location, and regardless of information provided, because of two “horror stories” (past experiences) where they had trusted another provider and then had been unable to localize the tumor during surgery (Surgeon 20). This surgeon was skeptical anything could be done to prevent repeat endoscopy unless they were present for the initial endoscopy themselves. A video recording of the endoscopy, a practice that is beyond what the new recommendations provide, was one potential solution, “if they recorded it and they say, I'm now bouncing my hand on the abdominal wall and there's the deflexion here in, there's no deflection here. Right? That might make me feel a little bit better” (Surgeon 20). Contrary to surgeons, only two gastroenterologists identified lesion location in the rectum as being a good reason to repeat the endoscopy. Others said there was no reason to repeat the endoscopy unless the patient needed a repeat biopsy or they were previously unable to complete the endoscopy.

Perceptions of *self-efficacy* regarding ability to follow the recommendations and perform all recommended practices were mixed for both gastroenterologists and surgeons. All surgeon-endoscopists said that they possessed the skills to apply all the recommended practices. Example statements by surgeons, when asked if they needed more training included: “No, it's pretty straightforward, it's pretty easy to do” (Surgeon 15); “I don't think so. It's all pretty standard stuff, that I think all endoscopists can do” (Surgeon 16); and “Nope. Just the willingness to do it” (Surgeon 20). Many gastroenterologists answered similarly to surgeons. When asked if they would need more training gastroenterologists answered; “Oh God, I hope not. I hope they're doing something similar already” (Gastroenterologist 12); and “I don't think anybody would need training to do it. Just more reminding” (Gastroenterologist 18). However, unlike surgeons, a few gastroenterologists identified some difficulties. Three gastroenterologists mentioned difficulty with the recommended polyp characterization techniques. For example, one gastroenterologist stated, “being able to articulate how to describe the polyp well is something that we're not trained and taught” (Gastroenterologist 17). Another said, “Kudo, NICE and JNET...and even the Paris classification there's some lack of familiarity, there. So that's certainly probably an additional training or upskilling that could go on in that realm” (Gastroenterologist 2). A third said, “Paris is very cumbersome. I've tried to learn Paris. It's very hard to apply it” (Gastroenterologist 11). Other gastroenterologists identified difficulty with other techniques, although stated they just needed “practice” rather than new training (Gastroenterologist 6). Example statements from two gastroenterologists included: “I have the hardest time injecting at

an oblique angle” (Gastroenterologist 6) and “I really have a hard time getting a good tattoo” (Gastroenterologist 11). Conversely, surgeon-endoscopists expressed no difficulty with any of the recommended practices. Only one surgeon mentioned polyp characterization as a potential challenge for other surgeons, but not for himself; “if you ask surgeons what's the Paris classification, they don't know what the heck you're talking about, right?” (Surgeon 1). This surgeon went on to say, “I'm sure the gastroenterologist will make fun of us for it” (Surgeon 1), implying that gastroenterologists were better at polyp characterization than surgeons, which is at odds with the statements made by the other surgeon interviewees. One non-endoscopist surgeon expressed that they would need training to apply the endoscopy techniques recommended in the guideline as they do not perform endoscopy as part of their practice. Those statements were excluded from the analysis of this construct as a barrier or facilitators, as that surgeon’s practice pattern is such that they would only need to read the endoscopy reports and make surgical decisions, rather than perform the endoscopy themselves. Therefore, inability to perform endoscopy was not considered a barrier to implementation for that individual.

*Individual identification with their organization* is a broad construct. Important components include alignment between individual and organizational goals, a perception of organizational justice, and providers' emotional exhaustion or burnout. This overall construct was only partially assessed, as perceptions of burnout were not sought. Both gastroenterologists and surgeons expressed mixed perceptions regarding their individual identification with their organization, for an overall net impeding effect in both groups. First, both groups of providers uniformly made statements that suggested a high degree of identification with their job role as patient caregivers, but less identification with the organization. For example, one gastroenterologist said, “I don't think people really have a huge feeling about leadership anyways” but “this is about patient care and patient safety and that type of thing. I mean, I feel like nobody should have a problem with it” (Gastroenterologist 13). Other participants repeatedly mentioned the importance of “improving patient care” (Surgeon 1), and how that would be an incentive for providers to adopt the recommendations. One surgeon said, “you appeal to a doctor's desire to be good for his patients and for patients in general, and that's all you really need to do for incentives” (Surgeon 14). Regarding adoption of the recommendations, a gastroenterologist said, “if patient care and money doesn't do that, I don't know what else would” (Gastroenterologist 18).

Towards the organization as a whole, two gastroenterologists stated that their organization unfairly prioritized other aspects of healthcare over their own patients' needs. These ideas overlapped with those expressed in the construct 'patient needs and resources'. One gastroenterologist said, "it's not cancer care Manitoba, and it's not cardiac. So that's where all the dough [is]. Or dialysis in Manitoba. That's where all the dough goes" (Gastroenterologist 8). Regarding endoscopy quality improvement, another gastroenterologist said, "It's just that it has to be a priority, right? And, you know, before COVID, it wasn't a priority" (Gastroenterologist 4).

Conversely, surgeons did not state that the organization was unfair, but rather implied that there were some disconnect between their own goals and organizational goals, which overlaps with the constructs of 'culture' and 'compatibility'. One surgeon explained that the organizational leadership prioritizes "efficiency and optics" (Surgeon 7) whereas surgeons prioritized patient care. This surgeon then went on to explain this disconnect was necessary as it was "not realistic" for organizations to "do the absolute best job for every patient, every time and never, ever let time or economic resources influence our decisions" (Surgeon 7). Another surgeon explained that due to resource and time constraints, providers are prevented from doing "the best for their patients" and must also focus on system resources. "I'm here for the patient, so any patient that comes to contact me, including my colleagues, I'll stop for them and we'll take the time and we'll just have to suck it up as a medical institution. But the WRHA is basically saying, we can't" (Surgeon 20).

One surgeon also spoke unprompted at length about burnout, and fatigue among nurses and surgeons being a potential barrier to implementation; "you have to look at, especially with COVID, you have to look at how mentally fatigued everyone is and how they just don't feel like you could not give people enough money to work harder. You can't" (Surgeon 20). Gastroenterologists didn't comment on burnout, therefore whether this was regarded as a possible factor within their own group for implementation success was not evaluated.

### *Process*

The process domain includes constructs related to planning, engaging, executing and evaluating an intervention. At this stage in the implementation of the new recommendations, we were not yet proposing an implementation plan, or evaluating an implementation strategy that

had already occurred. Therefore, many aspects of this domain were not applicable, and interview questions were not developed in advance to assess participants' perspectives on these constructs. Somewhat unexpectedly, a small number of gastroenterologists and surgeons brought up opinions that are best coded to constructs within this domain. Given the small number of opinions for any particular construct within this domain, for the purposes of the analysis, these constructs were grouped together under the umbrella category 'process', and were not used in the barrier/facilitator rankings, or in the determination of adequate participant sample size.

Participants from both specialty groups remarked that the interview discussion itself was helpful. They found it engaging, and important, and remarked on the value. For example, gastroenterologists described the interview and research project as "transformational" (Gastroenterologist 4), "a really neat idea" (Gastroenterologist 13), and "a really good project" (Gastroenterologist 2). Similarly, surgeons described the project as "pretty exciting" (Surgeon 14), "amazing work" (Surgeon 15), "thoughtful" (Surgeon 14) and "novel" (Surgeon 14). A surgeon remarked that they had been involved with many quality improvement projects but had "never been part of a research trial delivery. Although it allows you to get really intimate with the material very quickly. So it may be a way of doing things and maybe even feasible in a city our size with like 40 surgeons" (Surgeon 14).

Regarding the implementation process, participants from both specialties made statements that indicated that the interview process itself had been educational for them, or had inspired them to consider the recommendations more carefully. For example, one gastroenterologist said, "I'm looking forward to reading your paper and that is one of the ways I learn stuff" (Gastroenterologist 6). A surgeon said, "OK, that's very good. I want to take a picture of [the infographic], if you don't mind," and after the interview noted, "you taught me something with tattoo techniques" (Surgeon 20). Some providers even indicated that the interview may cause them to change their practice to be more in line with the recommendations. One gastroenterologist stated, "I've never heard of doing the saline bleb, but I think I'm actually going to try that because I really have a hard time getting a good tattoo. I'm sure I'm squirting into the peritoneal cavity half the time" (Gastroenterologist 11). Similarly, a surgeon stated, "if this is the way the majority of other people are tattooing, then I think that that's helpful. It could be practice changing for me, knowing that" (Surgeon 16). Providers appeared to recognize that the

discussion on barriers and facilitators relating to use of the new recommendations was an early step in an overall implementation process, and many were excited to see what would come next.

### CFIR-ERIC strategy matching

CFIR constructs identified by gastroenterologists as net barriers to implementation of the new recommendations in Winnipeg were mapped to ERIC implementation strategies and are displayed in **Figure 1**. CFIR constructs mapped to ERIC implementation strategies according to surgeons' perceptions are displayed in **Figure 2**. Major barriers and their ERIC solutions are also indicated. Strategies are presented in descending order by cumulative endorsement across CFIR barrier constructs. Level 1 strategies ( $\geq 50\%$  expert endorsement according to ERIC expert endorsement) are highlighted in green, and level 2 strategies ( $\geq 20-49\%$  expert endorsement) in yellow.

ERIC recommendations with the highest cumulative endorsement (mixture of level 1 and level 2 strategies) across CFIR barriers were identified. According to this process, the top six strategies were identical for both gastroenterologists and surgeons, but appeared in slightly different order. For gastroenterologists, the top strategies were: 1. 'Conduct educational meetings', 2. 'Identify and prepare champions', 3. 'Alter incentive/allowance structures', 4. 'Access new funding', 5. 'Capture and share local knowledge', 6. 'Create a learning collaborative'. For surgeons, top strategies: 1. 'Conduct educational meetings', 2. 'Alter incentive/allowance structures', 3. 'Identify and prepare champions', 4. 'Access new funding', 5. 'Conduct local consensus discussions', 6. 'Capture and share local knowledge'. Three of these strategies: 'Identify and prepare champions', 'Conduct local consensus discussions,' and 'Capture and share local knowledge' were not identified as having level 1 endorsement for any individual CFIR construct, but rather had high cumulative endorsement (including level 2 endorsements) across multiple constructs.



**Figure 1. ERIC strategies matched to gastroenterologists' CFIR barriers.**

Percentages indicate relative endorsement of a strategy to address a CFIR barrier according to CFIR-ERIC strategy matching by Waltz et al (51). Level 1 strategies ( $\geq 50\%$  expert endorsement) displayed in green, and bolded in left column. Level 2 strategies (20% to 49% expert endorsement) displayed in yellow. Cumulative endorsement is the sum of expert endorsements for an ERIC strategy across all identified barriers. Major barrier constructs had universal agreement among participants, minor barriers had mixed perspectives.

ERIC Strategies	Major barriers					Minor barriers																	
	External Policy & Incentives	Organizational Incentives & Rewards	Available Resources	Evidence Strength & Quality	Cost	Goals and Feedback	Access to knowledge & Information	Knowledge & Beliefs about the Intervention	Self-efficacy	Individual Identification With Organization													
<b>Cumulative endorsement</b>	<b>256%</b>	<b>246%</b>	<b>240%</b>	<b>213%</b>	<b>189%</b>	<b>176%</b>	<b>162%</b>	<b>159%</b>	<b>155%</b>	<b>148%</b>	<b>139%</b>	<b>136%</b>	<b>134%</b>	<b>126%</b>	<b>122%</b>	<b>116%</b>	<b>114%</b>	<b>108%</b>	<b>107%</b>	<b>102%</b>	<b>101%</b>	<b>97%</b>	<b>89%</b>
Conduct educational meetings	15%	0%	0%	47%	12%	21%	79%	56%	15%	11%													
Identify and prepare champions	22%	25%	4%	41%	12%	12%	24%	40%	30%	36%													
<b>Alter incentive/allowance structures</b>	<b>41%</b>	<b>71%</b>	17%	3%	44%	15%	0%	16%	4%	29%													
<b>Access new funding</b>	<b>7%</b>	<b>38%</b>	<b>78%</b>	3%	72%	3%	0%	8%	0%	4%													
Capture and share local knowledge	26%	8%	22%	25%	4%	12%	31%	24%	19%	18%													
Create a learning collaborative	15%	13%	9%	16%	8%	12%	45%	16%	30%	14%													
<b>Develop educational materials</b>	<b>4%</b>	0%	4%	28%	0%	9%	<b>59%</b>	36%	19%	4%													
Inform local opinion leaders	22%	17%	0%	38%	12%	18%	7%	28%	4%	14%													
Conduct local consensus discussions	22%	8%	0%	41%	4%	18%	10%	12%	0%	39%													
Build a coalition	33%	17%	17%	6%	4%	15%	3%	16%	0%	36%													
<b>Audit and provide feedback</b>	<b>0%</b>	<b>21%</b>	0%	13%	8%	<b>61%</b>	3%	4%	22%	7%													
Conduct educational outreach visits	0%	4%	0%	34%	4%	12%	28%	28%	22%	4%													
Assess for readiness and identify barriers & facilitators	4%	13%	13%	13%	16%	6%	7%	20%	11%	32%													
Identify early adopters	7%	13%	0%	22%	8%	6%	10%	20%	19%	21%													
Conduct ongoing training	4%	0%	9%	6%	0%	9%	38%	12%	41%	4%													
<b>Distribute educational materials</b>	<b>0%</b>	0%	0%	31%	0%	3%	<b>55%</b>	16%	4%	7%													
Fund and contract for clinical innovation	15%	21%	39%	0%	28%	0%	3%	4%	4%	0%													
Involve executive boards	41%	13%	17%	6%	20%	0%	0%	0%	0%	11%													
Organize clinician implementation team meetings	0%	8%	9%	3%	0%	36%	14%	4%	11%	21%													
Develop a formal implementation blueprint	7%	8%	4%	0%	8%	42%	14%	4%	11%	7%													
Facilitation	4%	4%	4%	0%	8%	18%	10%	20%	22%	11%													
Provide ongoing consultation	0%	4%	0%	9%	0%	15%	17%	4%	41%	11%													
Visit other sites	7%	4%	9%	13%	16%	0%	14%	12%	15%	7%													
Tailor strategies	11%	17%	9%	6%	12%	0%	0%	12%	11%	11%													

Conduct cyclical small tests of change	88%	4%	13%	13%	3%	8%	3%	3%	12%	26%	4%
Facilitate relay of clinical data to providers	87%	4%	4%	0%	6%	0%	36%	10%	12%	7%	7%
Recruit, designate and train for leadership	87%	0%	21%	4%	3%	4%	18%	3%	4%	4%	25%
Develop academic partnerships	85%	11%	4%	4%	25%	4%	3%	10%	12%	7%	4%
Model and simulate change	84%	4%	0%	0%	3%	20%	9%	7%	4%	33%	4%
Use other payment schemes	82%	15%	25%	22%	0%	20%	0%	0%	0%	0%	0%
Promote network weaving	78%	11%	8%	9%	0%	0%	6%	10%	12%	4%	18%
Promote adaptability	78%	0%	4%	4%	3%	16%	9%	7%	16%	11%	7%
Conduct local needs assessment	78%	7%	8%	0%	3%	4%	6%	3%	24%	0%	21%
Provide local technical assistance	77%	7%	0%	0%	3%	4%	12%	24%	0%	22%	4%
Use an implementation adviser	75%	4%	0%	13%	6%	4%	4%	14%	0%	7%	14%
Use advisory boards and workgroups	75%	15%	4%	4%	9%	4%	12%	0%	8%	7%	14%
Place innovation on fee for service lists/formularies	74%	19%	8%	17%	6%	24%	0%	0%	0%	0%	0%
Stage implementation scale up	74%	4%	4%	13%	3%	8%	0%	3%	20%	15%	4%
Develop and implement tools for quality monitoring	73%	11%	21%	0%	6%	0%	27%	0%	0%	4%	4%
Make training dynamic	72%	0%	8%	0%	6%	0%	6%	10%	0%	41%	0%
Make billing easier	69%	7%	8%	22%	0%	0%	0%	0%	0%	0%	0%
Develop resource sharing agreements	69%	0%	4%	26%	0%	32%	0%	3%	0%	4%	0%
Obtain formal commitments	63%	15%	13%	13%	0%	0%	12%	0%	0%	0%	11%
Shadow other experts	61%	0%	0%	0%	3%	0%	0%	21%	4%	33%	0%
Change physical structure and equipment	60%	0%	4%	48%	0%	4%	0%	0%	0%	0%	4%
Provide clinical supervision	59%	0%	8%	0%	3%	0%	15%	17%	0%	11%	4%
Develop and organize quality monitoring systems	58%	15%	4%	0%	3%	4%	24%	0%	0%	7%	0%
Revise professional roles	55%	4%	13%	9%	0%	0%	9%	3%	0%	0%	18%
Alter patient/consumer fees	53%	7%	4%	22%	0%	20%	0%	0%	0%	0%	0%
Use train the trainer strategies	52%	4%	4%	9%	3%	0%	3%	10%	4%	15%	0%
Mandate change	50%	15%	13%	0%	0%	8%	0%	0%	4%	4%	7%
Create or change credentialing and/or licensure standards	47%	19%	17%	4%	3%	4%	0%	0%	0%	0%	0%
Increase demand	45%	0%	8%	4%	0%	12%	0%	0%	20%	0%	0%
Involve patients/consumers and family members	44%	11%	4%	0%	13%	0%	9%	3%	0%	4%	0%
Obtain and use patients/consumers and family feedback	43%	0%	13%	0%	6%	4%	9%	0%	4%	4%	4%
Work with educational institutions	43%	4%	4%	4%	16%	4%	0%	7%	4%	0%	0%
Purposely re-examine the implementation	42%	11%	4%	4%	6%	0%	12%	0%	4%	0%	0%
Develop disincentives	42%	7%	8%	0%	0%	16%	3%	0%	0%	0%	7%
Use mass media	37%	15%	0%	0%	6%	4%	0%	3%	8%	0%	0%
Use data experts	33%	4%	0%	0%	6%	12%	3%	0%	4%	4%	0%
Change accreditation or membership requirements	31%	15%	8%	0%	0%	4%	0%	0%	0%	0%	4%
Change liability laws	30%	19%	8%	0%	0%	0%	0%	0%	0%	0%	4%
Centralize technical assistance	30%	0%	0%	0%	3%	0%	9%	3%	0%	11%	4%
Use capitated payments	29%	0%	4%	9%	0%	16%	0%	0%	0%	0%	0%
Develop an implementation glossary	28%	4%	0%	0%	0%	4%	9%	7%	4%	0%	0%
Change record system	21%	4%	0%	4%	0%	0%	9%	0%	0%	4%	0%
Create new clinical teams	19%	0%	0%	4%	0%	0%	0%	0%	0%	7%	0%
Intervene with patients/consumers	15%	4%	4%	0%	3%	4%	0%	0%	0%	0%	0%
Change service sites	15%	4%	0%	4%	3%	0%	0%	0%	0%	0%	4%

Prepare patients/consumers to be active participants	11%	0%	4%	0%	0%	0%	0%	0%	0%	0%	0%	4%
Start a dissemination organization	7%	0%	0%	0%	0%	3%	3%	0%	0%	0%	0%	0%
Remind clinicians	6%	0%	0%	0%	0%	3%	3%	3%	0%	0%	0%	0%
Use data warehousing techniques	3%	0%	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%

**Figure 2. ERIC strategy matching to surgeons' CFIR barriers.**

Percentages indicate relative endorsement of a strategy to address a CFIR barrier according to CFIR-ERIC strategy matching by Waltz et al (51). Level 1 strategies ( $\geq 50\%$  expert endorsement) displayed in green, and bolded in left column. Level 2 strategies (20% to 49% expert endorsement) displayed in yellow. Cumulative endorsement is the sum of expert endorsements for an ERIC strategy across all identified barriers. Major barrier constructs had universal agreement among participants, minor barriers had mixed perspectives.

ERIC Strategies	Major barriers					Minor barriers					
	Cumulative Percent	External Policy & Incentives*	Organizational Incentives* & Rewards*	Goals and Feedback*	Available Resources*	Evidence Strength & Quality	Cost	Compatibility	Access to knowledge & Information	Knowledge & Beliefs about the Intervention	Individual Identification With Organization
<b>Conduct educational meetings</b>	<b>251%</b>	15%	0%	21%	0%	47%	12%	10%	<b>79%</b>	<b>56%</b>	11%
<b>Alter incentive/allowance structures</b>	<b>246%</b>	41%	71%	15%	17%	3%	44%	10%	0%	16%	29%
Identify and prepare champions	237%	22%	25%	12%	4%	41%	12%	21%	24%	40%	36%
<b>Access new funding</b>	<b>216%</b>	7%	38%	3%	<b>78%</b>	3%	<b>72%</b>	3%	0%	8%	4%
Conduct local consensus discussions	196%	22%	8%	18%	0%	41%	4%	41%	10%	12%	39%
Capture and share local knowledge	184%	26%	8%	12%	22%	25%	4%	14%	31%	24%	18%
Build a coalition	169%	33%	17%	15%	17%	6%	4%	21%	3%	16%	36%
Create a learning collaborative	161%	15%	13%	12%	9%	16%	8%	14%	45%	16%	14%
Inform local opinion leaders	159%	22%	17%	18%	0%	38%	12%	3%	7%	28%	14%
Assess for readiness and identify barriers and facilitators	157%	4%	13%	6%	13%	13%	16%	34%	7%	20%	32%
<b>Develop educational materials</b>	<b>147%</b>	4%	0%	9%	4%	28%	0%	3%	<b>59%</b>	36%	4%
<b>Audit and provide feedback</b>	<b>123%</b>	0%	21%	61%	0%	13%	8%	7%	3%	4%	7%
Fund and contract for clinical innovation	121%	15%	21%	0%	39%	0%	28%	10%	3%	4%	0%
Identify early adopters	118%	7%	13%	6%	0%	22%	8%	10%	10%	20%	21%
Tailor strategies	115%	11%	17%	0%	9%	6%	12%	38%	0%	12%	11%
Conduct educational outreach visits	114%	0%	4%	12%	0%	34%	4%	0%	28%	28%	4%
<b>Distribute educational materials</b>	<b>113%</b>	0%	0%	3%	0%	31%	0%	0%	<b>55%</b>	16%	7%
Promote adaptability	112%	0%	4%	9%	4%	3%	16%	45%	7%	16%	7%
Involve executive boards	111%	41%	13%	0%	17%	6%	20%	3%	0%	0%	11%
Organize clinician implementation team meetings	110%	0%	8%	36%	9%	3%	0%	14%	14%	4%	21%
Facilitation	104%	4%	4%	18%	4%	0%	8%	24%	10%	20%	11%
Conduct cyclical small tests of change	100%	4%	13%	3%	13%	3%	8%	38%	3%	12%	4%
Develop a formal implementation blueprint	99%	7%	8%	42%	4%	0%	8%	3%	14%	4%	7%
Conduct local needs assessment	98%	7%	8%	6%	0%	3%	4%	21%	3%	24%	21%

Visit other sites	7%	4%	0%	9%	13%	16%	10%	14%	12%	7%
Facilitate relay of clinical data to providers	4%	4%	36%	0%	6%	0%	3%	10%	12%	7%
Recruit, designate and train for leadership	0%	21%	18%	4%	3%	4%	0%	3%	4%	25%
Use other payment schemes	15%	25%	0%	22%	0%	20%	0%	0%	0%	0%
Conduct ongoing training	4%	0%	9%	9%	6%	0%	0%	38%	12%	4%
Place innovation on fee for service lists/formularies	19%	8%	0%	17%	6%	24%	3%	0%	0%	0%
Develop academic partnerships	11%	4%	3%	4%	25%	4%	0%	10%	12%	4%
Use an implementation adviser	4%	0%	12%	13%	6%	4%	10%	14%	0%	14%
Promote network weaving	11%	8%	6%	9%	0%	0%	0%	10%	12%	18%
Develop and implement tools for quality monitoring	11%	21%	27%	0%	6%	0%	3%	0%	0%	4%
Use advisory boards and workgroups	15%	4%	12%	4%	9%	0%	3%	0%	8%	14%
Purposefully re-examine the implementation	11%	4%	12%	4%	6%	0%	28%	0%	4%	0%
Make billing easier	7%	8%	0%	22%	0%	32%	0%	0%	0%	0%
Stage implementation scale up	69%	4%	0%	13%	3%	8%	10%	3%	20%	4%
Develop resource sharing agreements	69%	4%	0%	26%	0%	32%	3%	3%	0%	0%
Provide local technical assistance	68%	0%	12%	0%	3%	4%	14%	24%	0%	4%
Change physical structure and equipment	66%	0%	4%	48%	0%	4%	7%	0%	0%	4%
Revise professional roles	66%	4%	13%	9%	0%	0%	10%	3%	0%	18%
Provide ongoing consultation	64%	4%	15%	0%	9%	0%	3%	17%	4%	11%
Obtain formal commitments	63%	15%	13%	13%	0%	0%	0%	0%	0%	11%
Provide clinical supervision	58%	0%	8%	0%	3%	0%	10%	17%	0%	4%
Model and simulate change	54%	4%	0%	0%	3%	20%	3%	7%	4%	4%
Develop and organize quality monitoring systems	54%	15%	4%	24%	3%	4%	3%	0%	0%	0%
Alter patient/consumer fees	53%	7%	4%	0%	0%	20%	0%	0%	0%	0%
Involve patients/consumers and family members	51%	11%	4%	9%	13%	0%	10%	3%	0%	0%
Mandate change	50%	15%	13%	0%	0%	8%	3%	0%	4%	7%
Obtain and use patients/consumers and family feedback	47%	0%	13%	0%	6%	4%	10%	0%	4%	4%
Create or change credentialing and/or licensure standards	46%	19%	17%	0%	3%	4%	0%	0%	0%	0%
Work with educational institutions	46%	4%	4%	4%	16%	4%	3%	7%	4%	0%
Increase demand	45%	0%	8%	4%	0%	12%	0%	0%	20%	0%
Develop disincentives	42%	7%	8%	0%	0%	16%	0%	0%	0%	7%
Use mass media	40%	15%	0%	0%	6%	4%	3%	3%	8%	0%
Change liability laws	37%	19%	8%	0%	0%	0%	7%	0%	0%	4%
Use train the trainer strategies	37%	4%	4%	9%	3%	0%	0%	10%	4%	0%
Make training dynamic	34%	0%	8%	0%	6%	0%	3%	10%	0%	0%
Shadow other experts	31%	0%	0%	0%	3%	0%	3%	21%	4%	0%
Change accreditation or membership reqs	31%	15%	8%	0%	0%	4%	0%	0%	0%	4%
Centralize technical assistance	30%	0%	0%	9%	3%	0%	10%	3%	0%	4%
Use data experts	29%	4%	0%	3%	6%	12%	0%	0%	4%	0%
Use capitated payments	29%	0%	4%	9%	0%	16%	0%	0%	0%	0%
Develop an implementation glossary	28%	4%	0%	0%	0%	4%	0%	7%	4%	0%
Intervene with patients/consumers	18%	4%	4%	0%	3%	4%	3%	0%	0%	0%
Create new clinical teams	18%	0%	0%	4%	0%	0%	7%	0%	0%	7%
Change service sites	18%	4%	0%	4%	3%	0%	3%	0%	0%	4%
Change record system	17%	4%	0%	4%	0%	0%	0%	0%	0%	0%

Prepare patients/consumers to be active participants	14%	0%	4%	3%	0%	3%	0%	0%	0%	0%	0%	4%
Start a dissemination organization	7%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%
Remind clinicians	6%	0%	0%	3%	0%	0%	0%	0%	0%	3%	0%	0%
Use data warehousing techniques	3%	0%	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%

The level 1 strategies identified to address net barriers were the same for both gastroenterologists and surgeons. The level 1 strategies for both groups, (in descending order of cumulative endorsement across all barrier domains) were as follows: 1. ‘Conduct educational meetings’, 2. ‘Alter incentive/allowance structures’, 3. ‘Access new funding’, 4. ‘Develop educational materials’, 5. ‘Audit and provide feedback’, 6. ‘Distribute educational materials’. These strategies also had some of the highest cumulative endorsement across CFIR barriers identified for both groups, and partially addressed the CFIR constructs that had no level 1 strategies.

#### Participant suggestions for implementation

Interview participants had many suggestions for how they would like to see the new recommendations implemented in their setting. Of the 73 total constructs described in the ERIC framework, 24 were addressed by at least one participant during the interviews. The number of participants who endorsed a specific ERIC strategy are listed, and compared to CFIR-ERIC strategies identified according to cumulative expert endorsement across barriers in **Table 5**.

**Table 5. Frequency of ERIC strategies suggested by interview participants compared to recommended strategies according to CFIR-ERIC strategy mapping**

ERIC Strategy	Gastroenterologists			Surgeons		
	Endorsed	Opposed	CFIR-ERIC tool cumulative %	Endorsed	Opposed	CFIR-ERIC Tool cumulative %
Audit and feedback*	11	0	139	9	0	123
Change record systems	9	0	21	8	0	17
Distribute educational materials*	10	0	116	7	0	113
Conduct educational meetings*†	7	0	256	7	1	251
Promote adaptability (modify guideline)	7	0	78	7	0	112
Stage implementation and scale up (pilot)	7	2	74	5	5	69
Inform local opinion leaders	9	0	159	3	0	159
Identify and prepare champions†	3	0	246	6	0	237
Mandate change	4	2	50	3	2	50
Develop disincentives	3	1	42	3	1	42
Involve executive boards	3	1	108	1	2	111
Alter incentive or allowance structures*†	2	1	240	2	0	246
Remind clinicians	4	0	6	0	0	6
Identify early adopters	1	0	126	2	0	118
Conduct ongoing training	2	0	122	1	0	81
Develop educational materials*	2	0	162	1	0	147
Change physical structure and equipment	1	0	60	1	0	66
Access new funding*†	1	0	213	1	0	216
Work with educational institutions	1	0	43	0	0	46
Obtain and use patient feedback	0	0	43	1	0	50
Capture and share local knowledge†	1	0	189	0	0	184
Conduct educational outreach visits	1	0	136	0	0	114
Shadow other experts	1	0	61	0	0	31
Use train-the-trainer strategies	1	0	52	0	0	37

\* Identified as a level 1 strategy to address barriers identified from CFIR-ERIC tool

† Identified as a strategy with one of the top 6 highest cumulative endorsement percentages in the CFIR-ERIC tool



All six ERIC strategies identified by CFIR-ERIC matching that had level 1 endorsement by experts to overcome the barriers identified, were also identified by at least one provider in both specialties during the interviews. The strategies ‘audit and feedback’, ‘distribute educational materials’ and ‘conduct educational meetings’ were among the most frequently recommended by participants across both specialties, and were mentioned by more than half of interviewees. Two of the three other top ERIC strategies selected via cumulative endorsement across CFIR constructs using CFIR-ERIC matching tool, were also mentioned by participants. However, ‘capture and share local knowledge’, and ‘access new funding’ were only mentioned by one participant each. One of the top ‘cumulative’ ERIC recommendations, to ‘conduct local consensus discussions,’ was not mentioned in any interviews.

Some implementation strategies desired by participants are not strongly endorsed by experts according to CFIR-ERIC matching process. The suggestion to ‘change record systems’ was mentioned by nearly all participants, however, this strategy has poor endorsement for any of the CFIR barriers identified, with only 21% and 17% cumulative endorsement across all barrier constructs identified by gastroenterologists and surgeons, respectively. Other strategies with extremely low expert endorsement (<50% pooled endorsement across CFIR barriers) that participants mentioned included: ‘Mandate change’, ‘Develop disincentives’, ‘Remind clinicians’, ‘Work with educational institutions’, and ‘Obtain and use patient feedback’. Within each ERIC framework construct, gastroenterologists and surgeons had some specific suggestions for how they would like to see each ERIC strategy implemented. Opinions of gastroenterologists and surgeons organized according to the ERIC framework are elaborated below.

### ERIC content analysis

‘*Audit and feedback*’ was the most frequently-mentioned ERIC strategy identified in provider interviews. All gastroenterologists and all but one surgeon mentioned this strategy as an important aspect of implementation that they would support. Some participants desired “regular feedback” (Surgeon 3) and “aggregate, non-punitive, written feedback” (Surgeon 10). Others preferred a more personal approach. For example, one gastroenterologist said they would “prefer to receive narrative feedback with comments based on individual experiences” (Surgeon 7) so that they could identify specific instances where they could improve. The source and nature of this feedback also varied by individual. Some wished to receive feedback from researchers,

others described feedback as coming from their section leadership or the endoscopy program. Many gastroenterologists wanted feedback “from the surgeon” (Surgeon 9).

Some providers described existing feedback mechanisms within their workplace that they felt could be somehow linked to feedback on the new recommendations. Examples of these existing feedback frameworks were listed in the CFIR analysis above, and included the ColonCheck program and existing pathology quality improvement feedback processes. Providers were all specifically asked about feedback as part of the assessment of the ‘goals and feedback’ CFIR domain regarding existing endoscopy feedback. None of the participants interviewed expressed that feedback on these new recommendations would be unwanted. However, some participants cautioned that before giving feedback, providers should be notified that they are going to be monitored so it did not come as a surprise. One gastroenterologist theorized that just telling people they are going to be monitored might improve compliance with the recommendations due to the “Hawthorne effect” (Gastroenterologist 4; an observer effect that causes behavioural changes to participants in research(81)). Some others emphasized that feedback should be educational and “non-punitive” (Gastroenterologist 13), especially initially while providers gain familiarity with the new recommendations. Conversely, some others felt that feedback should be used to punish those that are non-compliant with the recommendations (discussed in ‘disincentives’ below).

*Change record systems* was the second most common ERIC strategy identified by both gastroenterologists and surgeons. Providers from both specialties identified limitations of the EndoVault system for documenting recommended practices such as the ScopeGuide position, tattoo placement, and polyp characteristics. Some providers mentioned that it would be helpful if the system would show the ScopeGuide automatically when a photograph was taken. Others asked for synoptic items in the electronic endoscopy report related to the new recommendations. Some gastroenterologist asked for the EndoVault documentation to be automatically uploaded onto eChart so that all providers would have access to the color photographs and digital reports in their clinics.

*Distribute education materials* was also recommended by most interviewees in both specialties. Nearly all participants recommended that the new summary infographic be emailed to providers or placed up in the endoscopy suite “by the computer to reference during your paperwork” (Gastroenterologist 18) so that it could serve as a quick reference tool, and a

memory aid to endoscopists and endoscopy nurses that these practices are now recommended. Some providers highlighted their perceived limitations of information distribution through email or other written correspondence, however, as they felt they may be unlikely to notice or engage with the information due to other competing priorities in their busy work environment. An alternate solution frequently suggested was to *conduct educational meetings* to allow participants to engage actively with the subject matter and “ask questions” (Surgeon 21). Venues for these meetings varied somewhat between provider groups, and included “GI journal club” (Surgeon 16), “GI link rounds” (Gastroenterologist 18), “surgery section rounds” (Surgeon 16), and “grand rounds” (Surgeon 9). Two surgeons were less enthusiastic about the prospect of more meetings, however. One surgeon stated: “I’m fine with email. I hate meetings, mainly because in my current role, I do so many meetings” (Surgeon 15). Surgeon 14 cautioned:

“You have to be careful about how information gets rolled out because it gets cumbersome, and people don’t want to go to more meetings. But, you know, a five-minute ad right before the next surgery or the next journal club or a five-minute plug before the next the GI Journal Club, right? Those are forums where you’re getting enough people coming that you’re going to get critical mass.”

Many gastroenterologists and surgeons suggested ways that we could ‘*promote adaptability*’ and tailor the recommendations document to meet their local needs. Most frequently, these perceptions applied to the infographic, where some participants had suggestions for how this could be optimized. Some participants suggested that we modify the images included with the infographic in order to emphasize good techniques, or highlight tumor characteristics. Others felt more recommendations from the full-length document should be placed on the infographic. Others suggested we remove certain recommendations from the infographic as they were deemed to be less important.

Not all ERIC strategies that were mentioned during interviews were considered favorably, however. Some participants specifically brought up implementation strategies that they would prefer to avoid. The most contentious item was the concept of a pilot trial, evaluated under the ERIC construct ‘*stage implementation and scale up*’. While no participant specifically opposed a pilot trial, two gastroenterologists and five surgeons said the pilot trial would be “unnecessary work” and they would rather see full scale adoption, as the recommendations provided were “so simplistic” and consistent with “standard of care” practices (Surgeon 7). This was particularly contentious among surgeons, nearly half of whom said a pilot would be unnecessary. Gastroenterologists as a group were more supportive of a pilot, with most mentioning this

strategy favorably. One gastroenterologist said they would volunteer to participate in a pilot if one were to occur.

Participants in both groups proposed important pilot outcomes they would want to see. Most commonly, participants wished to see that implementation of the new recommendations in a trial setting was leading to decreased repeat endoscopy rates. They also wanted to see that following the new recommendations was not costing them more time, and that the quality of lesion localization and tattoos at surgery were improving.

Most gastroenterologists and a few surgeons suggested that using *local opinion leaders* was an important strategy that would likely influence them and their colleagues to adopt the new recommendations. Both gastroenterologists and surgeons mentioned specific providers by name whom they felt would be a good fit for these roles, and could positively influence implementation by providing their endorsement, or could be potential obstacles if not properly engaged. The most common opinion leader identified was also the head of Winnipeg endoscopy, and was a gastroenterologist, Dr. Dana Moffatt. Nearly all providers who mentioned this ERIC strategy as important, stressed the importance of having Dr. Moffatt endorse the new recommendations for their implementation to be successful.

Similarly, providers in both groups described *implementation champions* as an important component of success for these new recommendations. They had a variety of suggestions for who these champions could be, and what role they would have. Common to both gastroenterologists and surgeons was the suggestion that there should be champions who are gastroenterologists, surgeons, and nurses, so as to provide support from all three areas. One gastroenterologist and one surgeon suggested the resident physicians would be effective champions because “they're scoping with people throughout the city” and can bring new ideas to many different people. The head endoscopy nurse at each endoscopy site was frequently identified as an important champion for implementation, as these nurses were described as being in “control of standards”, “always kind of present”, and “neither surgeon or GI” (Gastroenterologist 13).

The decision whether to ‘*mandate change*’ as an implementation strategy to increase uptake of the new recommendations in Winnipeg was another controversial topic that some gastroenterologists and surgeons brought up in their interviews. The name of this ERIC construct is somewhat misleading, as the definition is to “have leadership declare the priority of the

innovation and their determination to have it implemented,” rather than the more common definition - to make something compulsory(19). According to the ERIC framework, gastroenterologists and surgeons addressed this construct by suggesting the endoscopy program “implement a policy” (Surgeon 7) to help with implementation. Others went further, declaring “I think you probably should mandate it” and that people should have “no choice” but to follow the recommendations (Surgeon 1). However, others expressed disagreement with the concepts of mandates. One gastroenterologist explained, “mandating it becomes problematic because people don't have the proper teaching and knowledge beforehand to implement it” (Gastroenterologist 2). Others were less opposed to mandates, but preferred incentives. One surgeon said, “if you first implemented it in a less aggressive manner and it wasn't received, then [mandates] would be the next step because this is a fairly important system. So I think the stick is not a bad idea. But, you know, probably the carrot is usually more preferable” (Surgeon 10).

Accordingly, some individuals proposed we *developed disincentives* if the recommendations are not appropriately followed. For example, one surgeon stated, “there should maybe be some sort of punishment if people aren't following the rules” (Surgeon 1). Example disincentives suggested by one gastroenterologist included “a letter sent”, “follow-up audits”, “more advice”, “and then ultimately it comes down to resource utilization and that individual's endoscopy time could be adjusted to kind of recognize that the utility of what he is doing is less clear” (Gastroenterologist 4). A surgeon described a similar stepwise approach; “I don't think you need a stick at all until you get to the latter stages where that last straggler is holding out and refuses to do it. That's when you say, ‘Well, everyone else is, and if you don't, then we're suspending your privileges’” (Surgeon 14). Conversely, one gastroenterologist and one surgeon said very definitively, “I think nothing should be punitive” (Gastroenterologist 2). Most providers did not mention disincentives during their interviews.

Three gastroenterologists and one surgeon suggested that we *involve executive boards* in the implementation effort. One surgeon suggested that we “pitch” the importance of this innovation to regional leadership by emphasizing that “minimizing repeat endoscopy is efficiency. It's investing a little bit more time upfront to minimize the number of repeat scopes and every repeat scope you don't have to do is somebody off the waitlist you get done” (Surgeon 7). A gastroenterologist suggested that we emphasize the importance of this intervention to surgery and gastroenterology leadership so that they could obtain funding for this innovation,

explaining; “surgeons and gastroenterologists wanting the same kinds of things is powerful because if you had both (the head of Surgery) and (the head of Internal Medicine) going after something, it would be more powerful than just one” (Gastroenterologist 8). However, two surgeons and one gastroenterologist said that leadership would not be a good way to implement these recommendations. The gastroenterologist explained, “if it feels like it's coming from on high, like it's kind of coming down to people, maybe they would be a little bit less inclined to do it” (Gastroenterologist 13). One surgeon explained that to follow the recommendations, “there's nothing that I would need of [leadership] to help me” (Surgeon 16). The other stated that “Shared Health likes to be difficult just for the sake of being difficult”, and that getting “a quiet buy in from the group that practices this” would be more effective (Surgeon 14).

Two surgeons and two gastroenterologists suggested that we *alter incentive or allowance structures* to influence compliance with the recommendations. All four providers noted that “we don't get paid for tattooing in Manitoba” (Surgeon 21). One surgeon explained, “if you could include 15 bucks in the fee schedule for anytime anyone tattooed a lesion, people would be tattooing all over the place. It would be no problem” (Surgeon 10). The others repeated that opinion, one saying 10 dollars would be sufficient. One gastroenterologist and one surgeon explained there was a precedent in Manitoba for a similar billing practice as incentive in endoscopy. The surgeon explained that you could trust providers to follow the recommendations and bill appropriately; “you get 10 or 15 bucks if you take a biopsy during a colonoscopy. So you know, this isn't much different than that” (Surgeon 10). A gastroenterologist explained that tattooing only when indicated could be selectively reimbursed, comparing this idea to an existing payment practice; “you get an extra \$10 for going into the terminal ileum, but only in settings of abdominal pain and diarrhea” (Gastroenterologist 18). A surgeon explained that in another province where they had worked previously, tattoo placement was reimbursed; “I think it was in B.C. or in Ontario, I can't remember. I worked too many places, but I think one of the provinces there is a code that you add on to a polypectomy” (Surgeon 21). Conversely, one gastroenterologist predicted their colleagues would suggest extra reimbursement, and felt that was “absolutely ridiculous”, explaining “you're getting paid enough, I would say, to do that procedure. To learn the standard of how you mark something, we're going to have an extra tariff on there, that's absolutely nuts” (Gastroenterologist 11).

Forgetting to follow the recommendations was a common barrier described by both gastroenterologists and surgeons during the interview. In response, four gastroenterologists directly suggested *reminding clinicians* as a solution. One suggested these reminders be built into the reporting software; “[a] system that kind of prompts you to make sure that you are doing it that way” (Gastroenterologist 2). The others had nonspecific suggestions of “sending out reminders” (Gastroenterologist 12).

*Identifying early adopters* was a strategy proposed by two surgeons and one gastroenterologist to provide peer pressure and increase support for the recommendations. A surgeon explained: “You've already got the early adopters and then you've got a critical mass and then you can just force the naysayers to do it because everyone else is doing it” (Surgeon 14). Similarly, a gastroenterologist said; “If you know that three quarters of your peers are doing it already, you don't want to be the one quarter that's not doing it” (Gastroenterologist 18).

In response to a skills deficiency identified in relation to the ability to identify and appropriately mark polyps by gastroenterologists, two suggested we *conduct ongoing training* as a potential solution. A surgeon suggested that the nurses be trained as part of implementation, explaining “if someone were to ask for a spot, if the nurses kind of prompt and say, ‘Okay, do you want saline first?’ Then there's that extra step of having to say, ‘no’ or ‘why’ or ‘why not’” (Surgeon 21).

Two gastroenterologists and one surgeon suggested that we *develop educational materials* to help individuals learn to follow the recommendations and encourage uptake. One gastroenterologist suggested developing an educational video “of ways to try to inject easily and into the submucosal space well” (Gastroenterologist 2). Another suggested online “learning modules or little things you click through that kind of teach you stuff” (Gastroenterologist 12). A surgeon suggested a document listing references supporting the recommended practices, explaining “We don't bother checking it out ourselves. We don't have enough time to do that. But if you know it's there that it's not just sort of something that you're making up on the spot that I think you got, it just makes it more scientific-seeming, more evidence based-seeming” (Surgeon 14).

Lack of physical resources required to follow certain recommendations, were commonly identified as a barrier to implementation. Most of these barriers were addressed in relation to endoscopy documentation, and solutions were proposed under the ERIC strategy ‘change record

systems'. However, two providers, one gastroenterologist and one surgeon suggested that we otherwise *change physical structure and equipment* to overcome these barriers. Lack of access to ScopeGuide was a common barrier identified. One gastroenterologist suggested "if that's going to be the standard, then every room should have ScopeGuide in it all the time" (Gastroenterologist 5). One surgeon had many suggestions for physical structure changes that could facilitate implementation of the recommendations including the provision of a "prefabricated tattoo kit" including saline and ink, "standardizing that all endoscopy towers, including the ones in the O.R., need to have some capacity to save images and or print images" and "routine access to ScopeGuide" (Surgeon 7).

Other ERIC strategies were suggested by only single participants from either specialty. *Working with educational institutions* was mentioned by one gastroenterologist who suggested, "we need to do better in fellowship or in your general surgery training because the basis for all of this assumes that everyone has a very similar level of competence, which I don't know" (Gastroenterologist 17). While many participants identified a lack of resources, or costs, as a barrier to implementation, only one gastroenterologist suggested we try to *access new funding* as a potential solution. This gastroenterologist explained the importance of funding for implementing new techniques and measuring their performance, explaining how they previously obtained funding from the department of internal medicine for past innovations in endoscopy. One surgeon suggested we *obtain and use patient feedback*, inquiring early in the interview, "have you asked the patients?" and wondered aloud if the patients "care" about repeat endoscopy (Surgeon 3). *Capture and share local knowledge* is a construct that refers to using anecdotal evidence for how individuals used the intervention within their setting to facilitate others following suite. One gastroenterologist addressed this construct by suggesting, "to get buy-in and, you know, examples of times where not adhering to these practices just kind of make things more difficult or hard for a patient or complicated the surgery or that sort of stuff. These are good lessons in helping reinforce that. I think most people would be receptive to that" (Gastroenterologist 2) The same gastroenterologist suggested *educational outreach visits* as an important strategy, describing them as "in-services", and having "someone who's a stakeholder in the project being in a unit and talking to people who work in there" (Gastroenterologist 2). *Shadow other experts* was described by one gastroenterologist; "I actually want to do a slate with [another endoscopist], for example, just to have him go in, do some complicated polyps. Me,



watch him” (Gastroenterologist 17). This gastroenterologist went on to explain that they were inspired by another of their colleagues who had recently shadowed another endoscopist to learn new polypectomy techniques. Finally, this same gastroenterologist suggested using an additional similar ERIC construct, *train-the-trainer strategies*, explaining “it's difficult when you're out on your own and there's no one to just point out to you like, ‘Hey, you should do this,’” and suggested, “I wouldn't mind [a more senior gastroenterologist] going through my notes and being like, ‘fix this, fix this, fix this.’ Because that would actually be very helpful” (Gastroenterologist 17).

## Chapter 5. Discussion

Providers use different strategies for colorectal lesion localization, which increases the need for repeat preoperative endoscopies, which in turn leads to increased patient stress and risk, prolonged wait time for surgery, and healthcare system inefficiency(5–7,57,82,83). While various groups have created recommendations to standardize lesion localization techniques(40,84–86), to date these practices remain heterogenous in Winnipeg(7,57,82,83).

The new Canadian Delphi consensus recommendations for marking and documenting colorectal lesions at lower gastrointestinal endoscopy provides a framework to reduce repeat preoperative endoscopy(14). Guided by the CFIR, the present research identifies across endoscopists and surgeons: (1) consensus on the major barriers and facilitators to implementing these new recommendations in Winnipeg, and (2) areas with mixed perceptions both within and across study groups. Importantly, most barriers (9 out of 10) identified for each group were common to both gastroenterologists and surgeons. Barriers in common included external policies and incentives, organizational incentives and rewards, available resources, evidence strength and quality, costs, goals and feedback, access to knowledge and information, knowledge and beliefs about the intervention, and individual identification with organization. The CFIR-ERIC strategy-matching algorithm was used to propose the types of strategies needed to overcome the perceived barriers, and some study participants proposed additional implementation strategies. Due to the similarity in perceived barriers between specialty groups, top ERIC strategies were the same for both specialties. These top strategies include: 1. ‘Conduct educational meetings’, 2. ‘Alter incentive/allowance structures’, 3. ‘Access new funding’, 4. ‘Develop educational materials’, 5. ‘Audit and provide feedback’, and 6. ‘Distribute educational materials’. Using this

matching process allows us to prioritize categories of interventions from a long list of potential desired implementation strategies. Study results are discussed in more detail in the following text.

### Major barriers and solutions

Gastroenterologists and surgeons each perceived major barriers to implementing the new guidelines (i.e., ranked '-2' in our construct rating process, see Table 1), thus emphasizing the importance of intervening strategies. Both study groups consistently identified 'external policy & incentives', 'organizational incentives & rewards', and 'available resources' as implementation barriers, and surgeons also identified 'goals & feedback' as an additional major barrier. Superficially, these barriers may appear to suggest that gastroenterologists and surgeons require more money (or other incentives) for following the new recommendations. While an increase in pay to compensate for time-intensive practices was suggested (rarely), more commonly participants expressed that no financial incentives were necessary. Their desire to do "a good job" or "what is best for the patient" were much more common motivators described. Therefore, these barrier constructs should not be construed as Winnipeg gastroenterologists and surgeons demanding more pay for practices that others might consider routine. Rather, our participants have informed us that specific incentives do not exist, which is a barrier to implementation according to the implementation science framework we have selected(18).

#### *External policies and incentives.*

A lack of 'external policies and incentives' was the first major barrier identified universally by all gastroenterologists and surgeons. Barriers arose primarily because participants could not identify any existing extrinsic incentives for following the recommendations. In part, this barrier was predictable, as the recommendations were introduced just before the interviews, have not been endorsed by the participating institutions, and have not been formally implemented. However, many of the practices and strategies recommended in the new guideline are not controversial, and have been recommended before(14). Therefore, it is somewhat disappointing that no policies or incentives exist to encourage compliance with some of the more well-established components that are repeated from prior guidelines. For example, tattoo placement to facilitate operative localization of a colon cancer has been recommended for nearly

fifteen years(43,87–96), and is supported by observational studies dating back nearly three decades(34). Our research participants were unable to find any incentives in Winnipeg to encourage tattoo placement, nor for any other recommended localization practice. Observational data suggests that tattoos are appropriately placed in only 72% of colon cancer patients in Winnipeg(57).

Examples of external policies and incentives proposed by the CFIR include government (or central organizational entity) policies and/or regulations, external mandates, guidelines (or other official recommendations), pay-for-performance, collaboratives, and public benchmark reporting. The main recommended strategy proposed by experts in CFIR-ERIC strategy matching to address this barrier was to ‘alter incentives and allowance structures’. However, this recommendation comes with only 41% (level 2) agreement (see **Figure 1**). The authors of the ERIC define ‘alter incentives and allowance structures’ as “work to incentivize the adoption and implementation of the clinical innovation”, including financial incentives such as pay increases or loan forgiveness tied to performance metrics(19). Interestingly, despite incentives being a frequent barrier identified, only two gastroenterologists and two surgeons proposed altering the payment scheme as a solution. Another gastroenterologist was adamantly opposed to financial incentives. These mixed perceptions are also reflected in the literature. Altering incentives, (i.e., pay-for-performance) is one of the most frequently studied ERIC strategies and is the subject of two recent systematic reviews. Both reviews identified mixed or inconsistent effects of pay-for-performance, and it is unclear which types of incentives targeted at which individuals are likely to lead to improved care(97,98). For Canadian physicians specifically, two recent observational studies demonstrated no effect of increased payment for guideline compliance on clinical practice(99,100). Although neither of these Canadian studies included gastroenterologists or surgeons. While altering incentives is an expert-recommended strategy(19), others suggest that this strategy is best used in combination with others, as it is unlikely to help overcome systemic barriers in place that prevent guideline adoption(101).

Some participants proposed mandate changes to help facilitate adherence to the new guidelines. This is defined by the ERIC as having “leadership declare the priority of the innovation and their determination to have it implemented.” Interestingly, mandate change was not endorsed as a level 1 strategy for any CFIR barrier, and had only 15% endorsement for overcoming barriers with external policies and incentives. In many cases (and in the present

study) external policy and incentive barriers arise not only from a lack of policies or incentives, but also a lack of external mandates. Political directives, policies and explicit mandates are all strategies under the umbrella term ‘mandate change’ according to the ERIC framework. These ‘mandate change’ strategies have some of the strongest evidence of efficacy according to a 2004 systematic review and meta-analysis that served as the foundation for the development of the CFIR(18,102). It is unclear why the implementation experts polled in the prior CFIR-ERIC matching research did not endorse mandates as a preferred strategy(51). One possibility is the vagueness of this recommendation. Mandates exist on a spectrum ranging from written or verbal declaration provided by an authoritative figure; to formal laws, the penalty for non-compliance could be fines, loss of employment or jail time. The efficacy and consequences of each mandate strategy is likely to differ. Accordingly, mandates must be implemented thoughtfully and cautiously. Without other dedicated implementation efforts to secure buy-in, there is a risk of box-checking or malicious compliance rather than true committed use(18). Furthermore, mandates instituted without the appropriate backing of authorities are unlikely to have the anticipated effect(102). Policies and mandates can also have harmful consequences if they are not culturally sensitive(103). Therefore, the recommendation to “mandate change” without consideration for a given context may have been perceived by prior implementation experts as an unhelpfully vague recommendation, hence the low level of ERIC endorsement previously(51).

#### *Organizational Incentives and Rewards.*

Both study groups consistently identified major barriers that aligned with this CIFR construct. Due to the absence of any extrinsic incentives related to the topics covered in the guidelines (internal to the organization or otherwise) perceptions of this construct were nearly identical to the ‘external policies and incentives’ construct in the outer settings. Expert-recommended strategies to address this construct’s barriers are like those used to address a lack of external incentives discussed above. However, unique to the present construct, ERIC experts highly recommended ‘Alter incentive and allowance structures’ to address the lack of incentives in the inner setting, with 71% endorsement(51). Recall, this strategy was only weakly endorsed to address a lack of incentives in the outer setting. The reason experts more highly endorse altering incentives for lack of incentives in the inner setting is not entirely clear. To our knowledge, no studies have examined for relative differences in origin of incentives (whether

they be external or internal to the organization), which may be an interesting area for future research.

The inner setting ‘incentives’ construct also assesses non-financial incentives for guideline compliance, such as awards, performance evaluations, advancements, and increased esteem(18). Our participants explained that none of these factors are present in Winnipeg related to the new guidelines. However, participants also did not propose any of these strategies as solutions. While not explicitly recommended in the ERIC-strategy matching, non-financial incentives may be another avenue to explore, as these factors are hypothesized to also affect general implementation success(18).

#### *Available Resources.*

Both study groups consistently identified major barriers that aligned with the CIFR ‘available resources’ construct. The level of resources dedicated for implementation have been previously positively associated with implementation success(68,69,102). Important components of this construct include dedicated implementation time and funds, and organizational resource slack (e.g., excess time and money that can be reassigned without adversely affecting other areas)(102). Participants in our study identified a lack of these factors, and several missing resources required for optimal integration of the new recommendations. Therefore, this construct is an important one to address to successfully implement the new recommendations in Winnipeg. The top ERIC strategy recommended to address this construct’s barriers is unsurprisingly to ‘access new funding’. According to ERIC, new funding can be used to finance clinical innovation, purchase materials or provide logistical support(51). This ERIC strategy was previously used to facilitate implementation of the large multicenter BEACON cluster randomized trial in response of resource barriers, and is an active area of research(104). In contrast to the ERIC experts, our interview participants seldom suggested attaining new funding as a strategy in response to these barriers. Instead, participants were more likely to propose attaining or modifying specific (nonfinancial) resources that would help them. One such resource, categorized according to a different ERIC construct, was ‘change record systems’. Participants commonly identified limitations related to the current electronic synoptic endoscopy reports as an impediment to following the new recommendations. Some participants suggested modifying this electronic system to include synoptic sections incorporating the new guideline-

recommended items. ‘Change record systems’ is not highly endorsed by ERIC experts as a strategy to address ‘available resource’ barriers (4% endorsement). Moreover, ‘change record systems’ is not a strategy specifically endorsed (neither level 1 or level 2 consensus) for any CFIR barrier in the entire framework(51). However, the evidence of efficacy for the implementation of synoptic reporting to improve medical documentation of quality indicators has strong support in surgery(105,106), diagnostic radiology(107), and diagnostic pathology literature(108). Perhaps medical record change is too specific for the ERIC experts to endorse as a blanket strategy for any particular CFIR barrier construct. However, one of the main goals of the new recommendations is to enhance documentation at endoscopy. Given the evidence of synoptic reports’ efficacy for this purpose, changing medical records (i.e., implementing a guideline-specific synoptic report) may represent a specific strategy to use in Winnipeg that goes beyond the CFIR-ERIC strategies proposed.

#### *Goals and Feedback.*

Gastroenterologists but not surgeons consistently identified major barriers that aligned with this CFIR construct. Goals and feedback is one of the most well-supported constructs within the CFIR as a modifiable construct with empirical evidence for its effectiveness(18). For example, an important feature of many individual behavior change and coaching models is setting goals and receiving constructive feedback on progress(109). Similarly, on an organizational level, goal setting provides a standard against which people can assess the value of an intervention(18). There is still no consensus on the optimal feedback method, and is an ongoing area of research in multiple disciplines(109). However, meta-analysis of 70 randomized comparative trials provides some clues. Feedback is more effective for improving low initial performance, when the source of feedback is a peer or supervisor, is provided repeatedly, is provided in both verbal and written forms, and when it includes explicit goals and an action plan(110). The top ERIC recommendation to address this barrier, unsurprisingly is to ‘Audit and provide feedback’, which is also a strategy most of our participants endorsed. Audit and feedback is one of the few ERIC strategies with empirical evidence to support its’ effectiveness(19), based upon a large Cochrane systematic review and meta-analysis(110). Although the benefits of audit and feedback observed were generally small, and were highly dependent upon the method of feedback used and the baseline performance(110).

### Major facilitators

The second important finding were gastroenterologists and surgeons perceptions of major facilitating constructs that are likely to enable implementation of the new guidelines within Winnipeg. These construct, ranked '+2' in our construct rating process, included concepts where all individuals within a specialty group were able to endorse the construct as a facilitator, and provided specific examples of how this construct would aid with implementation of the new guidelines. According to gastroenterologists, the major facilitators were 'trialability' and 'cosmopolitanism'. For surgeons, major facilitators were 'trialability', 'relative advantage', 'complexity', and 'structural characteristics'.

### *Trialability*

The 'trialability' construct was unique in this process. No barriers arose within this construct from either group. According to the CFIR, the trialability construct evaluates perceptions of whether an intervention can be piloted within an organization(18). Universally, our participants from both gastroenterology and surgery agreed that small-scale implementation before widespread adoption was possible. Based upon these opinions, a pilot implementation is likely an excellent strategy to employ in our setting to facilitate uptake of the new recommendations in Winnipeg. In general, pilot studies are important as they have been strongly associated with effective implementation in many settings(102). Furthermore, pilot and feasibility studies are recommended to provide methodological evidence about the design, planning and justification of a research trial, which would be required should we wish to evaluate the effectiveness of new recommendations or of the implementation strategies proposed in further research(111). The only potential downside of a pilot or feasibility study is it potentially delays implementation if full scale adoption could have been done instead. Internal pilot studies (a pilot within a full-scale trial) with pre-specified criteria to inform the decision whether to proceed or change course, have been proposed as a method to proceed efficiently from pilot data to implementation or effectiveness research(112). Some of our participants wanted to skip the feasibility study part of the implementation process. However, prior healthcare implementation literature suggests the potential perils of omitting feasibility research during the implementation process. The goal of feasibility research is to ensure that whatever facilitation is put in place to

support practice change is maximally effective (leads to the greatest change possible) and minimally time consuming(113).

However, there are a few important issues that were identified that should be addressed if a small-scale implementation of the recommendations is trialed in Winnipeg before more widespread adoption. Firstly, while there was universal agreement among participants that a pilot implementation process was possible, there were some mixed opinions within this construct on whether a pilot was desired. One potential issue encountered with some of our participants (primarily surgeons) was that they said a pilot study was unnecessary. We chose not to rate these opinions as barriers, as these participants also expressed a high degree of confidence in the quality of the recommendations and would prefer to move ahead to full scale adoption instead. They felt a pilot implementation was possible, but did not think it was needed. However, it is unclear if those perceptions would also translate into barriers should we decide to disregard their opinions and proceed to a pilot study in Winnipeg instead. Ignoring their suggestion to move ahead to full-scale implementation may be perceived as a slight, and therefore lead to less engagement from those individuals. Conversely, many other participants expressed a strong desire for a pilot and espoused the numerous benefits. Omitting a pilot study may offend those latter individuals as well. Managing these conflicting stakeholder expectations is a challenging area of implementation research. Involving stakeholders in ongoing meetings throughout the implementation is recommended, which can also be a time-consuming and resource intensive process(114).

Secondly, 'stage implementation scale up' (the ERIC strategy encompassing the concept of a pilot trial) was not one of the top strategies identified in our CFIR-ERIC strategy matching process. Therefore, while 'trialability' was a strength, performing a pilot trial may not be an efficient strategy to address the barriers identified in this research. Rather, according to the ERIC experts, 'stage implementation scale up' is not particularly endorsed as a top strategy to overcome any CFIR barrier(51). A pilot or feasibility study is a good way to identify barriers, and is an important part of research and for testing interventions(111), but may not be a good sole dedicated strategy to overcome barriers previously identified. Weighing these pros and cons, a pilot is likely still an important next step. As one of our participants said, "I'm a fan of the pilot because you won't really know. You and I can theoretically sit around and speculate on the weaknesses, but you will see them very clearly the first day you show up to the OR [and use



them]” (Gastroenterologist 11). A pilot study may also be a good avenue to test some of the ERIC implementation strategies.

### *Cosmopolitanism*

‘Cosmopolitanism’ was another clear enabler for both gastroenterologists and surgeons. There are many examples in the literature of organizations that support and promote cosmopolitanism being more likely to implement new practices quickly(18,102,115–117). Accordingly, both gastroenterologists and surgeons described support from their institutions to engage in inter-organizational networking, and described participation in international meetings, professional groups, and external training courses. However, some surgeons described a lack of networking or skills development related to endoscopy or colorectal cancer. That is not to say that those individuals did not engage in other networking opportunities. Rather, those individuals described plenty of networking and skills development on unrelated topics, but none related to topics covered by the guideline. While not specifically addressed by the CFIR, this scenario represents an unusual situation. On paper, those surgeons had many of the generic criteria for successful implementation described by the CFIR: they are well-connected, are involved in multi-centre networks, participate in conferences, and engage in external training(18). However, their lack of involvement in those activities pertinent to the new endoscopy guidelines is likely a barrier that is not well-described by the CFIR framework. One rationale for the cosmopolitanism construct’s beneficial effect on implementation relates partially to peer pressure from external institutions. Individuals that are well-networked learn about new innovations from more advanced external peers, and try to keep up(18). For this reason, there is often a negative relationship between cosmopolitanism and implementation speed and success until an intervention is clearly advantageous or well-accepted elsewhere(102). Organizations want to stay on the cutting edge, and adopt new innovations to stay ahead(102). None of those factors would inspire a surgeon to adopt the new guideline if they do not engage in any networking related to endoscopy, despite being otherwise well-connectedness to external institutions. In Winnipeg, healthcare is a government-run monopoly organization. It is also unclear what effect cosmopolitanism and peer pressure has on such an organization that does not have to compete for business or resources.

However, cosmopolitanism is a separate construct from ‘peer pressure’ as there are some reasons, aside from a desire to imitate, that make an organization that is well-networked be more successful at implementation. Other cosmopolitanism benefits described by the CFIR include “increased boundary spanning activities”, enhanced individual self-confidence, and increased commitment to change(18). Some of those factors may still apply to surgeons who do not participate in endoscopy networking specifically. Further research is needed to better understand this construct and if general networking provides an advantage for implementation even if networking specific to the proposed intervention is absent. There are three level 1 strategies recommended to address cosmopolitanism barriers, all designed to enhance interconnectedness: ‘Build a coalition’, ‘Promote network weaving’, and ‘Develop academic partnerships’(51). While ‘cosmopolitanism’ was a net facilitator, should the lack of endoscopy networking for non-endoscopist surgeons prove to be an impediment to implementation, some of those strategies could be employed.

### *Relative advantage*

While all surgeons and nearly all gastroenterologists viewed implementation of the new recommendations as the most desirable solution to repeat endoscopy, there were two outliers (gastroenterologists only) who felt that building trust between specialties and abdominal CT scans were better solutions. Both solutions are compelling. The accuracy of CT scans for preoperative localization of colorectal lesions has been evaluated previously, and was found to be less accurate than surgeon repeat preoperative endoscopy (118). The CFIR authors suggest that “relative advantage must be recognized and acknowledged by *all* key stakeholders for effective implementation”(18). Therefore, while this construct was a net facilitator, it may still be worthwhile to consider ERIC strategies targeted at those rare individuals (a few gastroenterologists) who are not convinced of the recommendation’s relative advantage. Particularly if after initial implementation efforts targeted at more common barriers these perceptions remain an impediment to implementation. Interestingly, there are no level 1 ERIC strategies to address ‘relative advantage’ barriers. The strategy with highest endorsement to address this barrier was to ‘identify and prepare champions’, with only 45% agreement(51). Conversely, our research participants suggested reporting the results of a local pilot study to address relative advantage barriers. For example, they might see the recommendations as

relatively advantageous to maintaining the status quo if they saw that the implementation was leading to enhanced lesion localization, and decreased repeat endoscopy, without increased cost to clinicians. These participant recommendations align most closely to the ERIC construct ‘stage implementation scale up’, which had only 10% endorsement according to the CFIR-ERIC panel to address relative advantage barriers. Roger’s diffusion of innovation theory also provides suggestions for how to manage individuals who do not recognize the relative advantage of an innovation. One aspect according to Roger’s Theory of Innovation is that there is always a small number of people in any context who will not change. One way to manage them is to essentially work around them until they eventually recognize they have become outliers and agree to conform or leave(119).

### *Complexity*

‘Complexity’ was another facilitating construct, as both gastroenterologists and surgeons said the guidelines were simple and easy to follow. This was a major facilitator for surgeons, with more mixed (albeit mostly positive) opinions from gastroenterologists. The only barrier expressed related to this construct were that the recommended polyp classification systems (e.g., NICE and Paris) were too complex for some endoscopists to apply. However, these classification systems are an important part of an endoscopist’s assessment. Paris and NICE classification systems help an endoscopist determine whether a polyp is suspicious for cancer, and whether a patient should be referred for endoscopic excision, or surgical resection(79,120). The appearance of a polyp according to these classification systems may also inform an endoscopist whether they should choose to biopsy a lesion, attempt advanced endoscopic excision, and how many tattoos should be placed(14,121). The recommended classification systems have validity evidence in a variety of settings, and are recommended in endoscopy guidelines endorsed by national and international bodies(87,88). Therefore, it is important to address these barriers to facilitate use of these classification systems in Winnipeg, not only for the goals of the present research, but for enhanced colonoscopy patient care in general.

To address ‘complexity’ construct barriers, ERIC experts had no strategies with level 1 endorsement. Top strategies (each with between 20%-49% endorsement) included to make a ‘formal implementation blueprint’ and ‘promote adaptability’(51). While polyp characterization was identified as a ‘complexity’ construct barrier, this may more accurately reflect other barriers

associated with individuals' 'perceptions of the evidence' or beliefs in their individuals' own capabilities ('Self efficacy,' discussed below). Given the extensive evidence for the validity of the recommended polyp characterization techniques(14,79,120,121), educational ERIC interventions (such as those suggested to overcome perceptions of evidence strength and quality) may be more appropriate than to adapt the recommendations to remove those suggestions. An alternate approach is to remove those "too complex" recommendations during initial implementation, and 'stage implementation scale up' (30% ERIC endorsement for complexity barriers(51)) to add them back in, as familiarity with the new recommendations grows.

### *Structural characteristics*

The final major facilitating construct identified were the 'structural characteristics' of the healthcare organizations within Winnipeg. This construct is only partially assessed in the present research due to the nature of the methodology employed. According to the CFIR, most structural characteristics are objective quantifiable measures(18). Structural characteristics such as functional differentiation, specialization, centralization, size, age, and maturity of an organization are all variably associated with implementation success(18,102,122). These characteristics have not been published in the research literature for the healthcare organizations in Winnipeg, however, the institutions do engage in continuous quality improvement and these characteristics could be previously evaluated internally(123). Conversely, it is unclear to what degree opinions of structural characteristics are important to evaluate, as perceptions of these factors have not been correlated with implementation success separately from objective quantifiable measures(102,122). We included this construct within our analysis as we felt that gastroenterologists and surgeons working within the healthcare institutions in Winnipeg could provide important insights into barriers and facilitators that may arise from structural characteristics, acknowledging that alternate approaches to quantitatively evaluate this construct are prudent areas for further research.

Centralization of the endoscopy program was the major facilitator within this construct that was identified for both groups. Centralization is defined by the CFIR as "the concentration of decision-making autonomy"(18). Participants perceived that endoscopy was organized through a central organizational structure, which could be used to easily disseminate information and standards. While participants were of the unanimous opinion that centralization would be a

strength for implementation of the new colonoscopy recommendations, the effects of centralization in the literature are mixed. For example, a large meta-analysis that informed the development of this construct within the CFIR found that decentralized organizations (those with diffuse decision-making authority) are more likely to initiate innovations, whereas those with more centralized structures carry initiatives through to implementation(18,122). Therefore, our study participants' perceptions are consistent with this evidence in that centralization would aid in the present "implementation" stage of the new recommendations.

Many participants also mentioned the small size of the healthcare organization within Winnipeg as a factor that would facilitate implementation. However, the literature suggests that small organizational size is not necessarily associated with implementation success. According to Greenhalgh's meta-analysis on diffusion of innovations in service organizations, groups are more likely to assimilate innovations if they are large, mature, and divided into specialized, semiautonomous units(102). These factors are contrary to the "small" organization described by our participants. Despite participants' assertion that Winnipeg healthcare delivery is a "small" organization, objectively the hospitals in Winnipeg are some of the largest, oldest organizations in the province of Manitoba. Nearly 6% of all working age adults in Winnipeg work in healthcare delivery, many of them at Winnipeg hospitals(124). Furthermore, the Winnipeg healthcare organizational structure is divided into the many subspecialized units and sections. Organizational division into subspecialized units is described by Greenhalgh as a recipe to implementation success(102).

It is unclear what strategies can be taken to address the minor barriers related to structural characteristics of an organization that can facilitate implementation. The ERIC strategies provide few clues, as no strategies achieved level 1 consensus. The top strategy 'Assess for readiness and identify barriers and facilitators', had only 36% endorsement by experts(51). A tempting solution is to simply modify the structural characteristics of an organization that were perceived as barriers. However, there is no evidence to suggest that this can be done, or is an effective strategy. Prevailing theory in implementation research is that structural characteristic variables are difficult to isolate and their individual effects on implementation cannot be independently quantified(102). In the present study, rapid nurse, and nurse-manager turnover (relating to the stability of the organization) was the only barrier identified under this construct. Nurse retention

and job stability has many other organizational benefits, and is an active area of research, but is difficult to affect(125), and is likely beyond the scope of the present research to address.

### Mixed barriers and solutions

The remaining CFIR constructs evaluated in this research had more mixed of opinions, both within and between specialty groups. While our focus was to identify consistent opinions (i.e., major barriers and facilitators) within specialty groups to design targeted interventions, there were many other constructs where participants described barriers that needed to be addressed. It remains unclear to what degree constructs with more mixed opinions would also preclude effective implementation. The CFIR framework proposes all constructs as equally important, based on theory and empirical evidence for their effects on implementation in many settings(18). However, past research would suggest that the perception of a barrier does not always translate into actual barriers in real world use(68,69,126). Although construct relative priority rankings, as we have performed in our research, have been used to identify “distinguishing” constructs that correlate with implementation success previously(68,69). As we have no way to predict which constructs are ‘distinguishing’ in our present research context, we included the following net barrier constructs in our identification strategy for CFIR-ERIC strategy matching. Fortunately, gastroenterologists and surgeons identified similar mixed barrier constructs, which allows for identification of common strategies for both specialty groups.

### *Evidence strength and quality*

Most participants could identify individual practices that they disagreed with due to a perceived lack of evidence. Recommendations that individuals identified as lacking evidence varied, however. This factor likely reflects participants’ inconsistent interpretation of the evidence and is partly explained by the authors of the CFIR who describe that there are different types of evidence and no universally agreed upon standard for what is “good evidence”(18). For example, the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) system is the most popular method used in guideline development. However, GRADE is itself a subjective assessment of the evidence, and clinicians may not necessarily agree with the expert’s interpretation(127). Furthermore, just because evidence exists, doesn’t mean that people are aware of it. This latter factor is supported by the results of our current research, as the

guideline we evaluated clearly presents the supporting evidence (and percent expert consensus) for every included recommendation(14). Participants nevertheless came to different conclusions on which practices were essential. This factor has important implications when attempting to design implementation solutions. In response to evidence strength and quality barriers, experts recommend primarily educational interventions such as developing and distributing educational materials or conducting educational meetings(51). These recommendations fit with the findings of this current research as participants were unaware of the importance of some recommendations because they had not read the guideline. However, education may not be all that is required. For example, participants' desire to omit some recommended practices may not be entirely unreasonable. It is currently unknown if every recommendation must be followed for enhanced localization and diminished repeat endoscopies, or if instead some recommendations can be ignored, and the desired effect will still occur(14). To address this concept, the CFIR introduces the concept of an intervention's "core components" versus its "adaptable periphery"(18). The core components are the aspects of an intervention that must be followed for implementation success, whereas the adaptable components are the optional aspects that may not necessarily be required. It is unclear with this current guideline which aspects are "adaptable" and which are "core". The authors of the Delphi consensus recommendations suggest that recommendations with lower consensus could be considered "optional", whereas those with higher consensus (i.e., consensus from the first Delphi voting round) are more strongly recommended(14). However, this advice is open to interpretation. Our interview participants most frequently discussed the high-consensus items (which are also displayed on the guideline infographic tool). Their perceptions of the evidence for even these highly recommended "core" items were variable.

Another potential solution to address a perception of a lack of evidence strength and quality according to the ERIC framework is 'establishing local consensus'(51). This was not one of the top 6 ERIC strategies identified via our CFIR-ERIC strategy matching for all barriers, however it is a level 2 strategy (with 41% endorsement by implementation experts) for addressing this individual 'evidence strength and quality' barrier. Establishing local consensus (in addition to the already defined Canadian consensus used to establish the guidelines) might be an important implementation strategy to consider in the future. For example, local consensus could be used to establish a Winnipeg or Manitoba agreement on the new recommendations'

“core” components. Local consensus may be particularly important if an ongoing barrier is that individuals continue to ignore certain recommendations due to perceptions of poor evidence despite educational interventions.

### *Costs*

‘Costs’ were another net barrier for both gastroenterologists and surgeons, arising primarily from opportunity costs (i.e., loss of pay). Cost barriers such as perceptions of how much it will cost the institution to purchase enough tattoo supplies, print posters and place on the wall, institute ScopeGuide in each endoscopy suite, or disseminate information, were only rarely mentioned. Unsurprisingly, the ERIC recommendation with level 1 endorsement for addressing this barrier was to ‘access new funding’(51). However, this recommendation only addressed some of the barriers identified within this construct during this research. For example, new funding could be used to pay for required materials, but does not directly address disincentives related to opportunity costs identified by providers, unless this new funding was used to pay providers differently. This barrier overlaps with the other barrier constructs identified: ‘organizational incentives and rewards’ and ‘external policy and incentives’. The top strategies recommended to overcome those barriers were to ‘alter incentive and allowance structures’(51), which more directly addresses the opportunity costs barrier identified by participants under the ‘costs’ construct.

### *Access to knowledge and information*

‘Access to knowledge and information’ was a barrier for most gastroenterologists and surgeons because no specific information and materials were available related to the new recommendations. This was somewhat of an expected barrier, as the recommendations are new, and no strategies had yet been employed to disseminate the information. However, this construct was also facilitated somewhat by most participants’ assertion that they and their colleagues would require no additional training to employ nearly all recommendations. Ready access to digestible information is strongly associated with implementation success(68,102). The ERIC framework provides three level 1 recommendations for addressing this construct’s barriers: ‘Conduct education meetings’, ‘Distribute education materials’ and ‘Develop educational materials’(51). Educational interventions have been independently associated with increased



clinician adherence to guidelines on a recent systematic review and meta-analysis(128). However, optimal methods of providing clinician education to encourage guideline compliance are unknown(129). A combination of educational interventions with additional implementation strategies appears to be superior to educational interventions alone in some settings(130,131).

### *Knowledge and beliefs about the intervention*

‘Knowledge and beliefs about the intervention’ was another barrier for many individuals interviewed. The CFIR defines this construct as “individual attitudes toward and value placed on the intervention as well as familiarity with facts, truths, and principles related to the intervention”(18). The importance of this construct derives from evidence that skilled and enthusiastic use of an intervention is required for its success(102,119). The degree to which new behaviors are valued by individuals are theorized to affect behaviour change(132). The ERIC framework recommends ‘educational meetings’ to address the ‘knowledge and beliefs’ construct barriers(51). However, examination of the specific barriers within this construct provides further clues for more specific implementation strategies.

Barriers from this construct arose from two sources: 1. Both specialty groups identified recommendations that they did not value or believed were ineffective; 2. Some surgeons valued repeat endoscopy for some of their patients (primarily rectal cancers). For the first barrier, participants viewed those recommendations as less important based upon their understanding of the evidence. This barrier appears to originate from a lack of knowledge about the expected effects of these specific recommendations, and is therefore likely amenable to educational interventions, as suggested by the ERIC framework(51). Educational interventions to close a knowledge gap have sound theoretical rationale(133), and as discussed above, have been used as implementation strategies in many settings(128,130,131). Therefore, this expert recommendation appears to have strong face validity for addressing this barrier, and is in accordance with the available evidence.

The second barrier within this construct is much more difficult to address. Some surgeons appeared to value the repeat endoscopy itself, regardless of the information provided to them in the index endoscopy. This opinion was expressed primarily by surgeons who treat rectal cancers, although one surgeon said they repeat endoscopy for all of their colon cancers as well. Often these repeat scopes were done to validate the information provided to them. One surgeon spoke

in depth about a past cancer they were unable to locate during surgery. This perception was also a theme (e.g., lack of trust) in prior qualitative research exploring the reasons for repeat endoscopy in Winnipeg(82). These opinions would appear to be resistant to educational interventions, as the interviewees often acknowledged the rarity with which the repeat endoscopies changed their own management but based their practice on individual anecdotes.

One surgeon suggested that individual feedback after standardization of practices in Winnipeg would be a way to address repeat endoscopy, explaining, “it probably would have to standardise things and then still do the scope myself a few times and be quite confident that I wasn't really gaining any new information and was potentially subjecting the patient to a procedure that they don't need.” Interestingly, ‘audit and feedback’, the ERIC category within which this surgeon’s recommendation would fall, was only endorsed by 4% of experts to address ‘knowledge and beliefs about and intervention’ barriers(51). This represents an important discrepancy between the ERIC experts’ and our own participants’ perceptions.

An alternate framework to identify strategies to overcome barriers related to characteristics of individuals is the Theoretical Domains Framework (TDF). While the TDF was not used as a primary framework for the present research, it does provide an interesting additional perspective within the characteristics of individuals domain. Under the TDF, fear of missing a cancer leading to repeat endoscopies would be best coded to the TDF domain of “Beliefs about Consequences”(134). Consensus strategies to address TDF barriers have been developed. To address ‘beliefs and consequences’ barriers, experts recommend: ‘self-monitoring’, ‘feedback’ ‘persuasive communication’, and ‘information regarding behaviour/outcome’(133). These latter two strategies could fit under educational interventions such as ‘education meetings’, ‘distribute educational materials’ or ‘disseminate education materials’ according to the ERIC(19). However, the former two strategies are more consistent with ‘audit and feedback’ (not recommended by ERIC here), and align with our participating surgeon’s suggestion. We are unaware of any empirical evidence to suggest the efficacy of one recommended strategy over another for addressing this barrier. There is also no evidence to suggest whether TDF-strategy matching or CFIR-ERIC strategy matching is superior for designing interventions. Based upon the information available, “self-monitoring’ and “feedback” seem to be as effective strategies as any other for addressing the specific barriers identified by participants under this construct. Although one surgeon’s assertion that they would continue to

repeat colonoscopies no matter what information is provided to them is concerning, and it is unclear which strategy, if any, could address this perspective.

### *Individual identification with their organization*

Like many of the CFIR constructs, individual identification with their organization is quite broad. Included are perceptions on how individuals perceive their organization, alignment between individual and organizational goals and values, a perception of organizational justice, individuals' commitment to their organization, and providers' emotional exhaustion and burnout(18). Some of these factors have been evaluated in relation to implementation, and have variable effects. A perception of organizational injustice is tied to implementation failure(135). Provider emotional exhaustion and burnout has many detriments in healthcare outcomes(136), including implementation effectiveness(137). Burnout and provider exhaustion were not specifically evaluated in the present research. Although burnout has been evaluated for some Winnipeg general surgeons previously(138). Burnout was brought up spontaneously by only a single surgeon participant as a barrier, and likely applies to other participants. Burnout rates have been previously evaluated among physicians in Canada at approximately 30%(139), and are hypothesized to have increased during the COVID pandemic(140). Interventions to ameliorate burnout in healthcare have had variable success(136). To what degree burnout factors will impede the implementation of the new recommendations in Winnipeg are unknown.

The top ERIC strategy recommended by experts to overcome barriers associated with this construct was to 'Conduct local consensus discussions', although this strategy only achieved 39% agreement(51). The specific barriers within this construct that were identified for gastroenterologists included a perception of organizational injustice. For surgeons, barriers were a misalignment between individual and organizational goals, and burnout according to one surgeon. To re-align goals and establish fair priorities, consensus discussions between surgeons, gastroenterologists, and organizational leadership would appear to be a good strategy. There are many examples in the literature where both surgeons and gastroenterologists have participated in joint consensus discussion(141–146), including in Winnipeg (14,147). Often clinicians with organizational leadership roles were selected for these consensus panels. Strategic consensus between management and employees has been used as a successful business implementation strategy(148). However, it is unclear to what role local consensus between leadership and

clinicians in Winnipeg can be achieved and be used to facilitate healthcare guideline implementation.

### *Self-efficacy*

‘Self-efficacy’ is defined by the CFIR as “individual belief in their own capabilities to execute courses of action to achieve implementation goals”(18). Uniquely, this is the only construct that was rated as a barrier for gastroenterologists but a strength for surgeons. This difference in perspective arose primarily because surgeons said they could apply all practices recommended, whereas a few gastroenterologists doubted their ability to perform recommended polyp characterization techniques without additional practice or training. Interestingly, despite this difference between groups in individual self-perception, one surgeon implied gastroenterologists were better at polyp characterization than surgeons. Based on my own experience working with these providers, I wonder if these perceptions of self-efficacy reflect a difference in personality type between participating gastroenterologists and surgeons, rather than a true reflection of their actual skills. There is some research in support of a “surgical personality” that is distinct from the general population, although a tendency towards high perceived self-efficacy was not measured(149). Others have criticized the concept of a surgical personality as overly simplistic(150). Regardless, this construct seeks to evaluate individuals’ beliefs in their own capabilities, because individuals with high perceived self-efficacy are more likely to make a decision to embrace an intervention and exhibit committed use even in the face of obstacles(18). This will be an important construct to re-evaluate once providers have had an opportunity to trial the new recommendations, as perceptions of their own capabilities may change with use.

There are no level 1 recommended ERIC strategies to address barriers in self-efficacy. The top ERIC strategies to address this construct, all with 41% consensus each, include: ‘Conduct ongoing training’, ‘Make training dynamic’, and ‘Provide ongoing consultation’(51). The former two strategies are quite intuitive recommendations for addressing a perceived lack of skills. The latter strategy may help more broadly with the implementation process. It is also informative to compare this construct to those covered under the TDF. Our participant’s perspectives of self-efficacy overlap most with TDF domains of ‘Skills’ and ‘Beliefs about capabilities’(18,134). Experts recommended 12 strategies to overcome those two TDF

domains(133), which align most closely to the ERIC constructs of ‘Conduct ongoing training’, ‘Audit and feedback’, and ‘Alter incentives’. These latter two strategies were not particularly endorsed by the ERIC experts for this CFIR construct, with <20% agreement for each, although based on the TDF may be other recommendations to consider for this barrier.

### *Compatibility*

Compatibility was the final barrier construct, although it was only a net barrier for surgeons, as gastroenterologists had more balanced perspectives. According to Greenhalgh, values, meaning, and innovation-system fit (all categorized under the compatibility construct in CFIR) are associated with effective implementation(18,102). Both groups had overall mixed perceptions, with some individuals describing high compatibility for some components, and others describing barriers. The major difference between groups, and the reason this construct was a barrier for surgeons, was that some wished to continue to repeat their lower endoscopies for rectal cancers, regardless of the new recommendations. For these surgeons, the new recommendation suggesting that endoscopists not tattoo low or mid rectal cancers was praised, so that these surgeons could repeat the endoscopy and place the tattoo themselves, which is contrary to the goals of the recommendations document. This significant lack of compatibility of “fit” between the recommendations and goals of these surgeons is likely a significant barrier, not necessarily to implementation, but to the underlying goals of the project which is to reduce repeat endoscopy.

Again, there were no level 1 ERIC strategies recommended to address compatibility barriers. The top strategy, with 45% consensus, was to ‘promote adaptability’; which the ERIC authors define as identifying ways to tailor the intervention strategy. There are multiple ways that an intervention can be tailored, and little consensus or evidence to guide how this could be done(151). Generally, experts agree that assessment of barriers and facilitators, and aligning strategies to those identified is the optimal strategy(152). The CFIR-ERIC strategy matching process is one approach(51). Selecting implementation strategies proposed by stakeholders is another.

### Mixed perspectives and implications

The remaining CFIR constructs had equally mixed opinions, or a small trend towards a facilitating effect. Therefore, these constructs were not used to select ERIC strategies in our research. However, these constructs are discussed below, along with potential strategies to overcome some of the barrier perceptions expressed within each, should they become important as implementation of the new recommendations progresses in the future.

#### *Innovation source*

The first ‘mixed’ construct evaluated was the ‘innovation source’ - who developed and decided to implement the new recommendations, and whether this was an “internal” or “external” decision(18). We didn’t initially plan on assessing this construct, as there was no *a priori* guideline implementation strategy proposed that we intended to evaluate. Furthermore, the new guidelines were developed by clinicians within Winnipeg, and are consequently an “internal” development(14). While the innovation source construct has theoretical merit, there is no empirical evidence to suggest this construct has any effect on implementation effectiveness. Rather, the literature suggests that fewer researchers perceive this construct to be of significance compared to others within the intervention characteristics domain, as evidenced by a recent systematic review which identified no published tools for objective assessment of innovation source(153). A recent multi-centre trial determined that perceptions of innovation source did not help distinguish between high and low- implementation efficacy in a large scale multicentre weight management intervention(69). Therefore, no questions were designed to evaluate innovation source in the interviews. Unexpectedly, a few participants brought up topics related to this construct organically. We analyzed those perspectives and included them in the analysis. Gastroenterologists had mixed opinions, whereas surgeons felt this construct was a weak facilitator. However, these results should be interpreted with caution, as we had a much lower sample size for this construct compared to the others, and did not attain theoretical sufficiency. It is certainly possible that had we asked all participants for their perspectives on the origin of the new recommendations, others may have had entirely different opinions for this construct.

Another consideration for future research in relation to the innovation source construct is to code perceptions of whether the innovation was ‘internally’ or ‘externally’ developed in addition to a barrier or facilitator determination. Internal/external coding may be important because

perceptions of key stakeholders about whether the decision to change practice is coming from within or outside of the organization has been theorized to influence implementation success(18,102). For example, it has been observed that engagement with multicentre cluster randomized trials is higher when the participating sites perceive the trial to be at least partially internally sourced(104,154). However, external initiatives are not automatically barriers. Rather external interventions coupled with low transparency, and/or poor adaptability are thought to lead to implementation failure(18). Key ideas that come from outside the organization and are effectively tailored to the organization can result in successful implementation instead. Peer-pressure deriving from the successful implementation of an externally derived innovation elsewhere can even be a facilitator(102). While the present guideline was internally developed, sometimes even internal decisions to implement an intervention may be perceived as externally driven, thus leading to barriers(18). Therefore, despite the relative lack of empirical evidence for the importance of this construct, based upon its theoretical merits we suggest re-evaluation of the innovation source construct in the future once an implementation strategy is proposed.

### *Adaptability*

Participants also had mixed perceptions relating to the new recommendations' 'adaptability'. Gastroenterologists had more optimistic opinions on whether the guideline could be adapted to their practice compared to surgeons, although neither group viewed adaptability as a net barrier. The positive opinions regarding adaptability for both groups arose from two areas. First, many participants felt the interventions could be used without any changes. Second, individuals said the guidelines were adaptable because they could be easily changed and certain aspects (primarily those they disagreed with) could be omitted. While adaptability was not a net barrier according to the construct rating process employed for either specialty, some barriers were identified, primarily arising from uncertainty whether some of the changes to the recommendations' content could be made without affecting the fidelity of the document. The ERIC experts suggest 'promoting adaptability' (71% agreement) as the main strategy to address 'adaptability' barriers(51). However, again, to facilitate those changes, we would need to clarify which elements of the guideline must be maintained to preserve fidelity (i.e., carefully define the 'core components', according to the CFIR framework).

### *Design quality and packaging*

Participants had mostly positive perceptions of the ‘design quality and packaging’ of the recommendations. Participants liked the infographic, and overall this construct was a net facilitator. However, some participants said the whole recommendations document was too long for them to read. Given the net enabling perceptions related to this construct, it does not necessarily require ERIC solutions. Should this construct prove to be a hindrance to implementation later, ‘promoting adaptability’ of the recommendations is recommended by ERIC experts(51), and therefore defining the core components would also be important, as discussed previously.

### *Patient needs and resources*

The ‘patients needs’ construct also evaluates the resources required to meet those needs and the extent to which those needs are accurately known and prioritized by the organization. This is a broad construct, again with an overall net neutral effect for both specialty groups. While the construct attempts to assess the organization in relation to the outer setting, a major way used to evaluate it was through the perceptions of the individuals within the organization to infer the overall organizational perception of patient needs and resources. Accordingly, participants often expressed that they understood their patients’ needs, and those needs were consistent with the needs addressed by the guideline. One limitation of the present research, however, which relates to all constructs but was particularly poignant here, was that we can only evaluate perceptions. Therefore, while participants said they understood their patients’ needs, that doesn’t necessarily mean those perceptions are accurate. For example, the literature suggests that it is unclear whether patient perceptions related to repeat endoscopy are accurately known in Winnipeg or elsewhere. This factor was highlighted when one participant asked, “Have you asked the patients?” In Winnipeg, there has not been any published research on patient perspectives related to repeat preoperative endoscopy. We are only aware of a single prior study that has purported to examine patient perspectives of repeat preoperative endoscopy(155). This study from 2016 evaluated patient perceptions in Ontario, Canada. The researchers describe their own patients as being reassured by the repeat endoscopy, that this practice enhances patient confidence in their care, and that patients view repeat endoscopy as a net positive experience. They also explain that any concerns patients had regarding repeat preoperative endoscopy was overshadowed by their



concern regarding their own cancer diagnosis. Those prior findings are limited, however, in that there is no described qualitative research methodology to substantiate the validity of their findings(155). Furthermore, it is unclear if those perspectives from patients in Ontario apply to patients in Winnipeg. While not a stated objective of the present research, our own participating physicians provided some anecdotes that conflicted with those perceptions conveyed in the Ontario study. Our participants described significant patient anxiety related to repeat procedures, largely arising from the increased delays to their definitive surgery. This agrees with previously published local data that suggests that patients have significant anticipatory anxiety related to colonoscopy and flexible endoscopy for any indication(156,157), which is also observed on systematic literature review in multiple settings(27). Repeat lower endoscopies in Winnipeg (for all indications) are associated with decreased anticipatory anxiety compared to the first procedure, attributed to increased patient knowledge about the procedure(158). However, it is unclear how delaying cancer treatment for a repeat diagnostic test affects those perceptions. Therefore, research is needed to better understand the patient perspectives regarding repeat preoperative endoscopy for colorectal cancers in Winnipeg. Accordingly, the ERIC experts recommend ‘using patient feedback’ as the primary method of addressing the ‘patient needs and resources’ construct barriers(51)

Other barriers that arose from the patient needs and resources construct came from individuals’ perceptions that the regional health organizations did not adequately prioritize endoscopy quality improvement. Participants provided many anecdotes to support this opinion. There is evidence that organizations that are perceived as patient-centred by individuals within their clinical teams are more likely to implement change effectively(18,159).

One limitation of this research related to this construct is that the opinions of the organizational leadership were not sought. Endoscopy physician with dual clinical/leadership positions were interviewed in this study itself, but non-physicians leaders were not included. The official position of the healthcare organizations in Winnipeg is that they support patient-centred innovation and research(123). Leaderships’ interviews may have supported that statement and provided some evidence to support their dedication to endoscopy quality improvement. Therefore, this construct is biased somewhat by the exclusion of those individuals. Leadership engagement is an area for future work.

### *Peer pressure*

‘Peer pressure’ was another net neutral construct for both gastroenterologists and surgeons. Despite being relatively well-networked with external organizations, participants were all unaware of any other organizations examining or trying to improve their own repeat preoperative endoscopy rate. This is consistent with the literature in that only a single region (Toronto, Ontario) aside from our own has previously published their own repeat preoperative endoscopy rate and examined why this occurs(5,6,74,155). However, there have been many calls for enhanced localization and endoscopic tattooing practices(40,84,160), so it was surprising to hear that no participants were aware of any unpublished quality improvement initiatives on this topic through their extensive networks. Peer pressure can be a very strong motivator for implementation, particularly for late adopting organizations(18,102). Therefore, unsurprisingly the absence of other institutions’ work in this area was a minor impediment for some participants. Fortunately, some gastroenterologists also felt Winnipeg was behind other institutions in endoscopy quality improvement as a broad topic, and that provided many of them with significant motivation to adopt the new recommendations to not fall behind. Under this construct is the concept of a “desire for a competitive edge”, which some surgeons described as a motivator to implementation of the new recommendations. This perception is addressed under the popular ‘Diffusion of Innovation Theory’, which describes five adopter categories: Innovators, early adopters, early majority, late majority, and laggards. Each category reflects individuals’ rate of adopting an innovation in decreasing order of likelihood(119). It has been hypothesized that an organization that values innovation, and contains more early adopters will lead to more rapid diffusion of an innovation(119). However, placing individuals into these general categories (i.e., early adopter) for all innovations has been criticized as a pitfall of this framework, and ignores the adopter as a free agent who interacts purposefully with a complex innovation(102). For example, an “early adopter” for one innovation in one setting using a particular implementation strategy may be a “laggard” in another. Given the recency of the new recommendations’ development, most participants were hearing about them for the first time during the interviews. They would not have had time to form mature opinions about the subject matter. Therefore, we did not ask them questions with the aim to categorize their thoughts within these adopter categories, or make an attempt to address the ‘individual stage of change’ construct according to any framework.

Interestingly, while peer pressure from external institutions can influence adoption, it is unclear to what degree a lack of peer pressure can impede implementation, particularly in publicly funded non-profit single payer healthcare. For example, analysis of a recent hypertension management intervention in HIV-positive patients found no association between peer pressure barriers and uptake of the intervention between high-uptake and low-uptake institutions(68). Similarly, analysis of uptake of a multi-center weight management program in publicly funded non-profit healthcare institutions found peer pressure was also not a factor in implementation success(69). Accordingly, there is poor consensus and no evidence to guide how to overcome peer pressure as a barrier. The strategy with the highest expert consensus identified in the CFIR-ERIC strategy matching process was to ‘alter incentive and allowance structures’, with only 47% agreement(51). This ERIC strategy could be criticized as not really addressing peer pressure as a barrier, but rather provides alternate “external” incentives in the form of increased pay.

#### *Networks and communication*

The “networks and communication” construct had again equally mixed perspectives for both gastroenterologists and surgeon. Effective intra-organizational communication networks, are associated with enhanced diffusion of innovation and implementation(102). However, while providers described some strong networks, many participants in both specialties had multiple examples of past endoscopy initiatives that were poorly communicated. There was also a lack of communication surrounding feedback related to the new recommendations. An important factor relating to networks and communication was that both specialties exist in separate departments within their hospitals and the University of Manitoba. While subspecialisation is associated with higher implementation success according to Greenhalgh(102), we assume that this siloing of providers also prevents information transfer. For example, in their interviews, both gastroenterologists and surgeons mentioned common venues where information could be disseminated, such as “grand rounds”, “email”, or “journal club”. However, those events, while sharing common names, are held separately, so information in those meetings is shared with only one group. When devising information sharing strategies targeted at both groups of providers, more venues for information sharing are required than would be immediately apparently by reading the interview transcripts.

While this construct had a net neutral rating due to an equal balance of facilitating and enabling perspectives, it is still informative to look to prior research to overcome the potential barriers identified. Two ERIC strategies are recommended for addressing CFIR barriers related to networks and communication. The first recommended strategy is to ‘Organize clinician implementation team meetings’. This ERIC construct involves “teams of clinicians who are implementing the innovation and give them protected time to reflect on the implementation effort, share lessons learned, and support one another’s learning”(19). Team meetings are distinct from the ‘conduct educational meetings’ construct. Educational meetings have been evaluated in many settings, and are an important aspect of many multi-pronged implementation strategies(161,162). Conversely, implementation team meetings are less prevalent in the literature. Although these team meetings have been suggested as a helpful strategy to maintain intervention fidelity and keep up momentum(163). They may also keep stakeholders engaged, and serve as a venue for complementary implementation strategies such as sharing local knowledge, and conducting ongoing training(163,164). One quasi-experimental study relying heavily on clinician meetings had excellent uptake of their reduced blood transfusion initiative(165).

The second recommended strategy to address ‘networks and communication’ barriers is to ‘promote network weaving’, defined by the ERIC as to “identify and build on existing high quality working relationships and networks within and outside the organization, organizational units, teams, etc.”(19). As discussed above, well-integrated networks and communication are associated with implementation success(102). Promoting network weaving has multiple purported benefits, enabling connections between multiple sites and to connect professional networks(166). However, it is unclear to what degree these networks can be modified by ‘promoting network weaving’ strategies, and what are the best strategies to employ to do so. Promoting network weaving as an implementation strategy in response to CFIR barriers is an active area of investigation in other settings(104,167).

### *Culture*

Gastroenterologist and surgeon perceptions of the organizational ‘culture’ were also equally mixed. Unique to this construct, often conflicting opinions were expressed by single individuals within the same interview. One explanation for these contradictory opinions is that

culture is a broad construct(18), with many definitions in the literature(168). I attempted to mediate this factor by defining culture beforehand (see interview script in **Appendix**). Nevertheless, when asked about culture, perhaps participants interpreted this construct in different ways. A limitation of this construct is we did not ask providers to define culture themselves, which may have allowed us to analyze their responses in comparison to their own culture definitions.

Participants may have had another reason for their mixed perspectives on their organization's culture. It was rare for participants to declare explicitly that culture was a barrier, but would instead "show" cultural barriers through their examples. Culture is well recognized as an extremely important factor for implementation effectiveness(18). Culture is also generally viewed as a relatively stable, subconscious, and difficult to modify aspect of an organization(168). Participants were all well-educated individuals, so may have been aware of these factors. They may have consciously or subconsciously felt that to admit their workplace culture was a barrier, was to also suggest that their organization could not be changed. This perception may have influenced their responses when asked about culture directly but allowed them to describe significant cultural difficulties when asked for barriers more generally.

One common method for evaluation of an organization's culture is through the competing values framework (CVF). This framework categorizes culture into different archetypes which reflect organizations' functionality(169). This framework is described in the CFIR, although not specifically endorsed as a recommended method to evaluate culture(18). In one study, the CVF was not found to be influential in the number of evidence-based practices used by healthcare organizations(159). Although other evidence suggests aspects associated with different cultural archetypes may be positively or negatively associated with implementation(18,159,170). The goal of the present research was to evaluate gastroenterologists and surgeon perceptions of barriers and facilitators to use of the new recommendations, therefore this framework did not fit within our research objectives. However, classification of the Winnipeg healthcare organizational culture in relation to endoscopy quality improvement according to CVF could be an area for further research, particularly should the organizations' culture be found to be a significant barrier to use of the new recommendations following a trial period.

Culture is unfortunately a very difficult aspect of an organization to change. Many strategies have been attempted, but available evidence does not identify any effective,

generalizable strategies(171). Accordingly, the only level 1 ERIC strategy recommended to address cultural barriers ('Identify and prepare champions') is not designed to change organizational culture(51). Rather champions "dedicate themselves to supporting, marketing, and driving through an implementation, overcoming indifference or resistance that the intervention may provoke in an organization."(19). As with many ERIC strategies, the effectiveness of implementation champions to address culture barriers are based entirely on expert opinion, and there is no prospective evidence yet to inform the validity of this approach.

### *Tension for change*

'Tension for change' was a minor facilitator for surgeons, and had a net neutral effect for gastroenterologists. This construct reflects individuals' perceptions that the current situation is untenable(18). Previously, perceptions of tension for change have been strongly associated with implementation success in a multi-centre trial for a weight management intervention(69). According to the authors of the CFIR, "it is difficult to create a tension for change when none actually exists." Accordingly, the ERIC strategy experts were unable to agree on any level 1 strategies to address this construct as a barrier. The top two ERIC strategies recommended for this construct, both with only 43% endorsement, were to "Conduct local consensus discussions" and "Conduct local needs assessment"(51). While these strategies might identify pre-existing tension, neither strategy will create tension for change if none previously exists, nor do these strategies provide any solutions. However, needs assessments and consensus discussions may identify other more pressing issues that are relevant to stakeholders, which may be beneficial. Interestingly, local consensus discussions were not mentioned as a strategy by any of the interviewees, despite this being a common ERIC strategy. Perhaps Winnipeg participants felt further consensus was unnecessary because the new recommendations were based on Canadian consensus already, and included many local stakeholders(14). It is unclear how much additional information a consensus discussion with Winnipeg-only providers would provide.

### *Relative priority*

'Relative priority' was another net neutral construct due to mixed opinions for both gastroenterologists and surgeons. The CFIR tells us that the higher the relative priority of an innovation is, the more likely it is to be implemented successfully, and the less likely it is to be

viewed as a distraction(18). This is supported by more recent research, where relative priority perceptions were positively correlated with implementation in diverse settings(68,69). An important component of this construct is the number of other recent implementation strategies that have been tried, which can lead to fatigue and a lower likelihood of future implementation success(102). Fortunately, our current participants did not describe this latter factor as a barrier.

As with tension for change, the top ERIC strategy recommended to overcome ‘relative priority’ barriers was to ‘conduct local consensus discussions’ (with 46% agreement)(51). Again, this strategy seems unlikely to be successful in addressing the root cause of this construct’s barriers. For example, consensus discussions may serve to establish majority agreement on what the priorities are, but are unlikely to change an issue from low priority to high priority.

### *Learning climate*

‘Learning climate’ was another net neutral mixed construct for gastroenterologists and had a minor net positive effect for surgeons. The CFIR defines the learning climate as one in which “leaders express their own fallibility and need for team members’ assistance and input; team members feel that they are essential, valued, and knowledgeable partners in the change process; individuals feel psychologically safe to try new methods; and there is sufficient time and space for reflective thinking and evaluation”(18). These components all have theoretical merit for enhancing implementation of new interventions(102), and were present in variable quantities for Winnipeg gastroenterologists and surgeons. Furthermore, learning climate was associated with implementation success in a large multicenter weight management program, providing further support for this constructs validity(69).

Dissimilar to culture, the learning climate reflects the degree to which individuals within an organization perceive that the organization and its leadership demonstrate “learning attributes”(18). Therefore, this construct should be more easily modifiable compared to culture. Although, this construct is not described in other implementation frameworks aside from the CFIR(18), so it is difficult to find examples where learning climate has been otherwise described and assessed.

The only level 1 ERIC strategy proposed to overcome learning climate barriers is ‘Facilitation’ with 54% endorsement(51). Facilitation is defined by the ERIC as “a process of interactive problem solving and support that occurs in a context of a recognized need for

improvement and a supportive interpersonal relationship”(19). Although it is somewhat unclear how this strategy would overcome the barriers such as a lack of time, lack of leadership support, and team members feeling less valued or not empowered to make changes. Given the importance of leadership behaviours in this construct, the ERIC strategy to ‘recruit, designate and train for leadership’ was the second highest endorsed strategy with 35% agreement according to the implementation experts(51). This strategy would imply replacing existing leaders with those who value implementation and would demonstrate the desired behaviours for a positive learning climate.

### *Leadership engagement*

The ‘leadership engagement’ construct evaluates leaders’ commitment to implementation of the innovation. Again, our participants in both specialty groups had an approximately equal number of enabling and impeding perceptions and examples. Evaluation of this construct was significantly limited, as we did not seek to interview leadership as part of this research. Furthermore, as the new recommendations had not yet been introduced, participants could not provide examples of leadership supporting use of the new recommendations. Instead, perceptions were included on how participants felt leadership would engage with the new recommendations’ implementation, including examples from past similar interventions. This process may be useful, as prior behaviours often predict future behaviours(172). Interviewing leadership to determine their support for implementation of the new recommendations is an important area for future research, as leadership engagement has previously been found to be a determinant in implementation success(69,173). Interestingly, some of our participants discouraged the involvement of upper organizational leadership, citing organizational bureaucracy or other barriers they might create. However, many of the other barriers identified in this research, such as a lack of resources, and involvement of allied health professionals, would almost certainly require leadership support to overcome.

The top ERIC strategy to address a lack of leadership engagement is to ‘involve executive boards’. This strategy had only 45% endorsement according to ERIC experts(51). However, if leaders are not involved in the intervention, they cannot be engaged in the implementation process, thus this construct could become a barrier. Therefore, this strategy, or others to help engage leadership, are likely an important component for implementation of the



new recommendations. Perhaps clinicians can use the new recommendations without any involvement of leadership, as some of our participants suggest. However, the literature would suggest that leadership involvement is typically required for implementation success(69,102,173).

### Contributions to the literature

To our knowledge, this is the first study in the literature to use the CFIR to examine barriers and enablers to implementing a new guideline targeted towards gastroenterologists and surgeons to reduce repeat endoscopy. Using this approach, we have applied modern implementation science methodology to identify strategies that may be used to enhance uptake of the recommendations in Winnipeg in the future. Others have attempted to evaluate endoscopy guideline implementation and quality improvement, however, those prior efforts are difficult to compare due to their lack of frameworks, and poor reporting of implementation strategies (7,82,174,175). A strength of the current research is that by selecting robust, frequently used frameworks (CFIR and ERIC), we position the present research in the context of a broader body of literature(18,19). This process has many benefits. For example, by following a structured theory-based framework, our research can serve as a sort of formula for others to follow suite. While our results are not necessarily applicable to implementation of the new recommendations outside of Winnipeg, the processes used are open to critique, and readily applicable elsewhere(46). Our literature review also provides an up-to-date summary of the strengths and limitations of the CFIR and ERIC constructs evaluated. By using a framework, it is also imminently apparent to ourselves, and to other researchers, which aspects of the study setting have been evaluated, and which areas need further research (e.g., the entire ‘process’ domain, and the ‘innovation source’ and the ‘stage of change’ constructs). Had we used an inductive or tacit-knowledge-derived framework, deficient areas may not have been as apparent(46).

Another major benefit of using an implementation science framework is that we have built upon the previous advances of others(18). For example, our CFIR construct ranking criteria has been used previously on a *post-hoc* basis to examine factors associated with prior implementation success for weight management(69) and hypertension strategies(68). We built upon this prior research in multiple ways. First, we expanded up Damschroder and Lowery’s construct ranking system(68,69). We modified their system and adapted to the pre-

implementation phase, which has never been done previously. We propose using this ranking system as a new way to identify barriers significant enough to warrant selection of ERIC strategies. Previously researchers have selected ERIC strategies according to all CFIR barriers identified by participants, without a method of determining their relative significance(51). Others selected ERIC strategies for all CFIR constructs, regardless of whether they were perceived as a barrier or facilitator(104). Furthermore, now that we have a baseline assessment, we could also evaluate how perceptions of CFIR constructs in Winnipeg change in response to implementation strategies for our new recommendations.

Another unique aspect of our research is that we have expanded implementation science frameworks to a new discipline: endoscopy guideline-implementation. Colon cancer screening has been previously evaluated using implementation science frameworks(176–179), including the CFIR(180,181), but to our knowledge, guidelines for implementation of new endoscopy practices have not been evaluated with any implementation science framework.

A final unique aspect of our research is we have identified a disconnect between what strategies our clinician participants desire compared to those that are recommended by experts. To our knowledge, this is the first study to specifically examine the differences between strategies endorsed by the CFIR-ERIC experts, and those strategies desired by research participants. The CFIR-ERIC strategies are purported to address CFIR barriers according to expert opinion, but as discussed above, to date there is little empirical evidence to support selection of one strategy over another(51). Comparison between ERIC strategies, or to those strategies identified by research participants represents an interesting avenue for further research. These comparisons may provide much-needed evidence for how a strategy can be selected in the future. Presumably, participants would be more likely to buy-in to ERIC strategies they specifically endorsed, although there is no evidence to support this yet.

### Study limitations

In addition to the limitations discussed above in relation to specific constructs, this study design has some important limitations. The first limitation is that while the information gained from the interviews is interesting and highly applicable to the providers and settings evaluated in Winnipeg, this information is unlikely to be applicable elsewhere. For example, the barriers and enablers identified are specific to the participants and settings evaluated, and should not be

interpreted as broadly generalizable. This is not so much an inadequacy of the present research, and it is an inherent limitation of qualitative research methodology(65). Our research was in depth, but also highly specific to the individuals and settings evaluated. Accordingly, we recruited gastroenterologists and surgeons from Winnipeg to inform us of the barriers and enablers to new guideline use for our research. However, our sample was not intended to be representative of a more general population. Despite this limitation and the high specificity of our results, the research processes we used can be repeated in other settings, and are thus interesting to other implementation science researchers. Due to the use of a structured framework, some of our findings may also be comparable between settings in future research studies.

A second limitation related to the methodology was the use of a single analyst for data coding. Due to the confines of the study budget and research timeline, we used only a single analyst for evaluation of the transcripts and rating the CFIR constructs. Using at least two independent analysts for coding qualitative research is recommended as an important strategy to ensure validity of the data(70). Similarly, due to the schedules of our participants, member checking was not a primary validation strategy used in this research. We used other validation strategies instead such as triangulation, reporting disconfirming evidence, dialogic engagement, and reflexive engagement throughout the research process. The primary analyst vouches for the accuracy of the information presented here, however, we recognize that those additional popular qualitative research validation methods may have further enhanced the quality of the research.

Another limitation of the research is the recognition that alternate coding systems and alternate frameworks could have been used. There are hundreds of knowledge translation frameworks described, some of which may have worked with the present research(46). We selected the CFIR as it appeared to have a good fit for the research questions, study methods, and setting. However, it is possible that another framework would have worked just as well, and may have led to slightly different results. Even within the CFIR, there are multiple methods of analysis and data coding that are possible. For example, some users of the CFIR have looked for inductive unifying themes that span multiple constructs and domains(117,182). Had we applied this inductive methodology to the present research, we may have identified 'lack of time' as a unifying barrier that encompassed the CFIR constructs costs, organizational incentives, and implementation climate, for example. While this type of analysis is interesting, it does not

necessarily help us answer our research questions and objectives, which were ultimately to identify potential strategies to overcome barriers according to CFIR constructs. The frameworks we chose help researchers select strategies based on CFIR construct barriers(51). Unifying inductive themes would not help us select those strategies. However, there are some other advantages of using inductive analysis. For example, the CFIR has many constructs, which can be overwhelming to analyze(183). Adding inductive themes to the analysis, or using a completely inductive framework may have helped consolidate the information. However, by collapsing the CFIR constructs into themes, there is a risk of losing data. In the present research, even the existing CFIR constructs were overly simplistic for some broad constructs. Take for example the ‘individual identification with organization construct,’ which has no discrete subconstructs. It became apparent in our analysis that some components of this construct are quite dissimilar, so attempting to select ERIC strategies to address this entire construct was difficult. This may also partially explain the low consensus for strategies to address CFIR barriers in the prior CFIR-ERIC selection strategy matching study(51). Weighing these pros and cons, we felt that using the CFIR with a deductive ‘directed content analysis’ approach, was the best fit for the research questions(66).

Other limitations arise from the choice of frameworks selected for this research. Neither the CFIR nor the ERIC framework define what constitutes a significant barrier that is important enough to warrant the application of a dedicated implementation strategy. Rather, this determination is left to the discretion of the researcher or the participants. For example, if one participant identifies a CFIR construct as a problem, does that warrant a solution? What if opinions are truly “mixed” (i.e., 50/50)? In our analysis, we selected “net” barriers (i.e., those constructs with a score of -1 or -2) as those in need of ERIC strategies. In this way, constructs that are consistently identified as the most significant problems could be targeted to possible solutions. Major barrier constructs (i.e., rank of -2) and their solutions were also highlighted should an even more directed approach be desired to target only the most significant problems. However, there is no compelling evidence to suggest that only net barriers require solutions. CFIR-ERIC strategy mapping is a relatively novel approach to implementation strategy development, however previous researchers using this methodology have applied different approaches. One strategy is to target ERIC strategies to all barriers identified, no matter how significant(51). Another strategy is to target ERIC strategies to all relevant CFIR constructs,

including barriers and facilitators(104). Although this latter approach is counter to the goals of the CFIR-ERIC framework, which was developed by asking experts to identify strategies to overcome barriers rather than to amplify facilitators(51). In the present research, even net facilitating constructs had one or two participants who identified barriers. Had we followed either of these alternate approaches, we would have identified nearly every CFIR construct as in need of an ERIC strategy, which we argue is not productive, and defeats the purpose of examining barriers and facilitators to identify targeted strategies.

Another limitation related to the chosen frameworks was that while the CFIR-ERIC process was developed to align expert-recommended strategies with CFIR barriers, there was low consensus for any individual strategy. For example, an item with  $\geq 50\%$  consensus was considered “high” for that study(51). Furthermore, currently, there is no prospective evidence that using CFIR-ERIC strategy matching in this way leads to more effective implementation compared to any other approach. An alternate strategy would have been to use the TDF framework(134), and its corresponding strategy matching framework instead(133). However, as discussed previously, the TDF, and its’ corresponding behaviour-change strategies, are limited primarily to the characteristics of individuals(133,134), whereas the CFIR targets the settings as well(18,51). There were significant barriers identified related to the ‘inner’ and ‘outer settings’ in the present research that may have been overlooked using another framework.

A fifth limitation implicit to the methodology selected is it is still unclear how to best select ERIC strategies once barriers are identified. Many strategies address many barriers. The authors of the ERIC framework suggest using a combination of strategies with high cumulative consensus (i.e., efficient strategies that map to multiple barriers), but also some highly specific ERIC strategies that are the best fit for specific barriers(51). We reported the CFIR-ERIC strategy matching tool results for all of the level 1 strategies (i.e.,  $\geq 50\%$  consensus for one CFIR construct), and compared to the top 6 highest cumulative consensus strategies (highest % consensus across all barrier constructs) to see how they differed. Interestingly, many of these results were the same, indicating that some level 1 strategies are both specific to the barriers identified, while also efficiently address multiple barriers at once. The level 1 strategies partially addressed every barrier identified, and therefore appeared near the top of the cumulative endorsement list. If we select the “top” cumulative strategies instead, we risk missing more selective strategies that are specific to certain constructs. The most obvious example is the ‘audit

and feedback' ERIC strategy, which is highly specific to the 'goals and feedback' CFIR construct barrier. Surgeon and gastroenterologist opinions for their own suggested implementation strategies also aligned better with the level 1 strategies compared to the high cumulative endorsement strategies (**Table 5**).

The final, and perhaps most notable limitation was that our research only included surgeon and gastroenterologist perspectives. Nurses, patients, healthcare administrators, allied health professionals, policy makers, and managers (who are neither gastroenterologists or surgeons) were excluded from the research process. This was done deliberately, as the new recommendations are targeted primarily at physicians, and their perspectives on barriers and enablers were felt to be key for devising next steps in the implementation process. Now that Winnipeg gastroenterologist and surgeon perceptions are known, these additional healthcare providers who form part of the complex system that is endoscopy service delivery in Winnipeg should be engaged to ensure no unanticipated barriers arise when attempting to spur guideline uptake for the physicians. As highlighted above, patients' perspectives are particularly important to evaluate, as it is relatively unknown what their perceptions are of repeat preoperative endoscopy practices.

### Knowledge translation

According to the Canadian Institutes of Health Research (CIHR), the principal consideration for knowledge translation is appropriateness of the knowledge translation strategy to the importance, magnitude, and validity of the research findings(49). This research is only a single step in a multi-component integrated knowledge translation research process involving local gastroenterologists and surgeons to enhance the care of their colorectal cancer patients by reducing unnecessary repeat preoperative endoscopies. It is unclear if the barriers and facilitators identified within this research will be helpful, nor is it certain that the selected expert-recommended strategies to overcome barriers will lead to meaningful improvements in patient care. Accordingly, a suitably modest knowledge translation strategy will be used to share the results of this research with the relevant individuals, until the validity of our results can be tested (see future directions below).

The first knowledge translation strategy employed is integrated within the research process. Knowledge users from both gastroenterology (Harminder Singh) and general surgery

(Ramzi Helewa) were involved in the conception, data collection, and analysis process for this research, and all of the previous relevant research projects that came before (7,57,82,83,184). The initial idea to evaluate repeat preoperative endoscopy for colorectal cancer patients in Winnipeg arose from colorectal surgeon and gastroenterology knowledge users. The progress of this research has been shared with these individuals throughout, and the results will be shared with them through this thesis document and oral presentation. To share knowledge obtained in this project with the clinician interview participants, they were provided with an analyzed summary of their results shortly after data analysis concluded (**Appendix**).

Although the research results and conclusions are specific to Winnipeg endoscopy, some of knowledge gained and the research methodology employed will be of interest to scientists and clinician investigators outside of Winnipeg. Accordingly, to facilitate information sharing among non-participants, I will present the results of this study at both gastroenterology (Digestive Diseases Week, May 2022, San Diego, California) and general surgery (Canadian Surgery Forum, September 2022, Toronto, Ontario) academic research conferences. I will also aim to publish our results in relevant academic journals.

#### Recommendations for implementation and for future research

Returning to the underlying Knowledge to Action Cycle framework that has informed this research (47), the present study assessed *barriers and enablers to knowledge use*, and we have *identified potential interventions* based on theoretical constructs (from CFIR and ERIC). However, the efficacy of these implementation strategies is yet untested. There is a strong theoretical basis for these frameworks (18,19), and in some instances, there is even empirical evidence to support the application of some implementation strategies in general medical settings. However, there is no empirical evidence to suggest that the strategies we have identified herein will lead to enhanced uptake of our new recommendations in Winnipeg, nor that use of these guidelines will lead to reduced repeat preoperative endoscopy. Hence, an area for further investigation. We (or other researchers) could use the list of strategies identified here as guidance to design a cluster randomized controlled trial in Winnipeg to determine the relative merits of some of the implementation strategies proposed. There are multiple possible combinations of ERIC strategies that are identified in this research that could be compared.

First is the list of prioritized ERIC implementation strategies based on CFIR-ERIC strategy matching (**Figures 1 and 2.**) According to this process, strategies can be selected by selecting from multiple categories from the top of the cumulative consensus column in the top left of these figure. These strategies had partial expert consensus endorsement for all of the barrier constructs identified in this research. As discussed, the top strategies identified using this method were slightly different for gastroenterologists than for surgeons. The top six items were identical for both specialty groups, which could be used for simplicity if a single list of strategies is desired for both specialties: 1. ‘Conduct educational meetings’, 2. ‘Identify and prepare champions’, 3. ‘Alter incentive/allowance structures’, 4. ‘Access new funding’, 5. ‘Capture and share local knowledge’, 6. ‘Create a learning collaborative’. If desired, more strategies could be added depending on number of resources available for implementation by descending the “cumulative consensus” column of these figures. The second possible combination of strategies that could be employed in Winnipeg based upon the barriers identified in our research is to select only the “level 1” consensus strategies. These are the strategies that implementation experts most highly recommended with  $\geq 50\%$  consensus in prior research to address each of the identified net barriers identified in our own research. Six strategies were identified, and are all common to both gastroenterologist and surgeon groups in Winnipeg: 1. ‘Conduct educational meetings’, 2. ‘Alter incentive/allowance structures’, 3. ‘Access new funding’, 4. ‘Develop educational materials’, 5. ‘Audit and provide feedback’, and 6. ‘Distribute educational materials’. The third distinct list of strategies we identified were the 24 implementation strategies recommended by our own research participants (**Table 5**). Again, multiple strategies could be selected by descending the first row of this table according to the number of implementation resources available. Many of these strategies are not highly endorsed by implementation experts to address our study barriers, however. A fourth possibility is to use a combination of strategies from each method. There is no evidence to say selecting strategies one way over another is better. However, based upon the results of the current analysis, picking a combination of strategies according to each method may allow us to address the limitations inherent in each approach. For example, if only ‘level 1’ strategies for barrier constructs are selected, then the ‘individual identification with the organization’ construct is poorly addressed (has no level 1 consensus strategies). However, ‘Alter incentive/allowance structures,’ (a top strategy selected through the cumulative endorsement approach across all barriers) does partially address that construct. Similarly,



‘changing medical record systems’ (i.e., guideline-based synoptic endoscopy report) was suggested by many of our participants, and is one of the few strategies supported by empirical evidence for enhancing clinician documentation according to guideline recommendations(105), despite lacking CFIR-ERIC expert endorsement(51).

There are eight sites in Winnipeg where endoscopy is performed. It is conceivable that some of these site could be stratified to test the relative effectiveness of different combinations of implementation strategies for feasibility and effectiveness in a future randomized quasi-experimental trial. It would also be useful to research the perceptions of patients, healthcare administrators, policy makers, managers, nurses and other allied health professionals to understand how those individuals may facilitate or impede the new guideline implementation. Finally, regardless of the implementation strategies and future research approaches selected, as the new guidelines are disseminated in Winnipeg, it would be an important area of future research to continue to measure the relative rates of repeat preoperative endoscopy in Winnipeg to ensure the new guideline use is associated with the desired effects.

While there are multiple different possible combinations of strategies that can be applied to facilitate use of these new guidelines in Winnipeg, there are some commonalities between them that our research has identified that should be considered at minimum for use of the new guidelines to possibly succeed. First, is an educational intervention to disseminate knowledge about the new recommendations. Without some form of education, providers are unlikely to find out about the recommendations or understand their importance. The ERIC provides suggestions for general strategies that can be used to disseminate information (conduct meetings, develop/distribute educational materials). Our participants provide more specific examples of how these can be administered in Winnipeg such as informational emails (ideally from endoscopy and section leadership), placing the guideline infographic on the walls of the endoscopy suites; and giving grand rounds on the topic for both sections. A second essential strategy, is to measure compliance with the guideline recommendations and provide feedback. For example, our participants said they do not want to raise a saline bleb, they weren’t convinced that 3-quadrant tattoo was necessary, and they weren’t in agreement that the volume of ink was important. But the surgeons said they regularly get patients where tattoo ink was all over the abdomen, or sometimes they can’t see the ink spot at all. Audit and feedback of these practices (and other recommended by the guidelines) is a method to address these concerns and provide

real-world local data back to providers to encourage them to change their practice to fall in line with the recommendations. Altering incentive/allowance structures was also repeatedly mentioned as a desirable strategy, and is heavily endorsed by the ERIC. One strategy would be to do what our participants suggest, and just give a small amount of extra money for a properly placed tattoo if it is administered and documented exactly as recommended. Another example that's potentially more divisive is to withhold payment for a procedure that has to be repeated, or to not pay for a repeat endoscopy that was not indicated. However, there are plenty of potential unintended consequences of this, such as providers having to fight over who's scope was really indicated. The surgeon would have to justify why they needed to repeat it. The index endoscopist would have to say why their first scope was adequate and a repeat was unnecessary. People who routinely repeat scopes for no reason wouldn't get any referrals because the gastroenterologist wouldn't want to risk losing their income. People who always have to have their scopes repeated might think twice about their technique if its not in accordance with the new recommendations. Finally, 'accessing new funding', recommended by ERIC, comes across as a non-specific recommendation, but is likely essential to the implementation of any new intervention or adjunct that does not already exist. Nearly any intervention to enhance endoscopy will cost some money (at least in the short term) before the financial benefits of decrease repeat endoscopy are realized. New funding could be used to apply for much-needed resources such as an endoscopy medical record system that is accessible to all relevant providers, or increase access to guideline-recommended materials such as the ScopeGuide device in every endoscopy suite. Depending on the budget for implementation of the new recommendations, more strategies can be selected from the ERIC recommended strategies in Table 5 or Figures 1 and 2 placed within the context of the interviews.

### Conclusions

This research was one part of an ongoing knowledge translation research process designed to enhance the use of expert-recommended practices to reduce redundant unnecessary repeat preoperative endoscopies for patients with colorectal tumors in Winnipeg. We identified barriers and enablers according to gastroenterologists and surgeons, which we were able to effectively map to CFIR constructs. Gastroenterologists and surgeons had some differences in perspective, but also many similarities, which allowed us to identify a unified list of prioritized

expert recommendations to overcome perceived barriers within both specialty groups. Surgeons and gastroenterologists also had many thoughtful recommendations for implementation strategies that they themselves felt could be used to overcome the barriers identified. We compared participants own recommended strategies to those previously endorsed by implementation experts to identify a list of strategies that can be potentially used in Winnipeg to enhance the new guidelines' use. Future research is needed to test the relative advantages of these recommended strategies, and to measure their effect on repeat preoperative endoscopy.

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## Appendices

### Appendix A. Timeline

	2020						2021						2022												
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
CIP (Jul '20 – Jun '22)																									
CHS courses																									
MSc Proposal writeup+defense													Jul 16												
Ethics													Jul 26												
Write proposal for publication																									
Data collection																									
Data analysis																									
Writing thesis																									
Write for publication																									
Defense																									

Appendix B. Budget

<b>Budget</b>	
Participant honorarium (\$100 x 20)	\$2,000
NVivo software (2 student accounts x 85 USD)	\$210
Resident Travel to Present	\$1500
Publication Costs	\$1000
<b>Subtotal</b>	
	\$4710
<b>Funding available (GFT grant)</b>	\$15,000

Appendix C. Consent form and questionnaire

**RESEARCH PARTICIPANT INFORMATION AND CONSENT FORM**

**Title of Study:** Perceptions among gastroenterologists and surgeons in Winnipeg, Manitoba on new national recommendations for preoperative endoscopic localization of colorectal neoplasms

**Principal Investigator:** Dr. Garrett Johnson, PGY-3 General Surgery, MSc Candidate, Department of Community Health Sciences, University of Manitoba,

**Co-Investigators:** Dr. Malcolm Doupe, Dr. Harminder Singh, Dr. Ramzi Helewa, Dr. Kathryn Sibley, Dr. Kristen Reynolds.

You are being asked to participate in a research study. Please take your time to review this consent form and discuss any questions you may have with the study staff

**Purpose of Study**

This research study is being conducted to study the role of a new national guideline designed to enhance communication between endoscopists and surgeons for colorectal tumor localization in Winnipeg, Manitoba.

This project has two objectives:

1. To elicit the opinions of gastroenterologists and surgeons in Winnipeg regarding enablers and barriers towards the application of the new colonoscopy lesion localization recommendations.
2. To develop a strategy for implementation of the new colorectal lesion localization guidelines in Winnipeg.

**Study procedures**

You will be asked to participate in a 60-minute interview. You will be provided with a copy of the new guidelines prior to the interview. The interview will be audio-recorded and transcribed in order to maintain confidentiality. During this session, topics surrounding your approach and treatment of colorectal lesions will be discussed, in addition to information related to repeat endoscopy. Our intention is to explore ideas, thoughts and factors related to integration of these new guideline recommendations into your usual practice.

You can stop your participation in the study at any time. However, we encourage you to talk to the study staff first.

**Risks and Discomforts**

There are no known risks to participating in this study.

You might find the interviews uncomfortable. You might not like all of the questions that you are asked. You do not have to answer any questions that make you uncomfortable.

### **Benefits**

You will not receive any direct benefit from your participation in this study. Your participation may allow the researchers to identify and address barriers in practice patterns and repeat endoscopy for colorectal cancer patients. This may benefit future patients.

### **Payment for participation**

For your time, information and expertise provided, each participant will be offered a gift card (\$100) upon completion of the interview. This shows appreciation and value for the feedback provided and time taken to complete the interview.

### **Confidentiality**

Information gathered in this research study may be published or presented in public forums, however your name and other identifying information will not be used or revealed.

All study related documents will bear only a unique anonymized study number. Despite efforts to keep your personal information confidential, absolute confidentiality cannot be guaranteed. Your personal information may be disclosed if required by law.

The audio-recordings will be transcribed and anonymized to ensure confidentiality. All data collected, including the original copies of the audio-recordings, will be kept for 10 years, after this time they will be destroyed. The University of Manitoba Health Research Ethics Board may review records related to the study for quality assurance purposes. All records will be kept in a locked secure area and only those persons identified will have access to these records. No information revealing any personal information such as your name, address or telephone number will leave the University of Manitoba facilities. Personal information will be treated as confidential in accordance with provincial and federal privacy legislation.

### **Voluntary Participation/Withdrawal from the Study**

Your decision to take part in this study is voluntary. You may refuse to participate or you may withdraw from the study at any time. If the study staff feel that it is in your best interest to withdraw you from the study, they will remove you without your consent.

### **Questions**

You are free to ask any questions that you may have about your rights as a research participant. If any questions come up during or after the study please contact: Dr. Garrett Johnson [REDACTED]

For questions about your rights as a research participant, you may contact The University of Manitoba, Bannatyne Campus Research Ethics Board Office at (204) 789-3389

Do not sign this consent form unless you have had a chance to ask questions and have received satisfactory answers to all of your questions.

### **Statement of Consent**

I have read this consent form. I have had the opportunity to discuss this research study with Dr. Garrett Johnson and/or his/her study staff. I have had my questions answered by them in language I understand. The risks and benefits have been explained to me. I believe that I have not been unduly influenced by any study team member to participate in the research study by any statements or implied statements. Any relationship (such as employer, supervisor or family member) I may have with the study team has not affected my decision to participate. I understand that I may be given a copy of this consent form after signing it. I understand that my participation in this study is voluntary and that I may choose to withdraw at any time. I freely agree to participate in this research study.

I understand that information regarding my personal identity will be kept confidential, but that confidentiality is not guaranteed. I authorize the inspection of any of my records that relate to this study by The University of Manitoba Research Ethics Board, for quality assurance purposes.

By signing this consent form, I have not waived any of the legal rights that I have as a participant in a research study.

I agree to be contacted for future follow-up in relation to this study, Yes \_ No \_

**Participant** printed name : \_\_\_\_\_ Date \_\_\_\_\_ (day/month/year)

**Participant** signature: \_\_\_\_\_

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I, the undersigned, have fully explained the relevant details of this research study to the participant named above and believe that the participant has understood and has knowingly given their consent

**Study personnel** printed name: \_\_\_\_\_ Date \_\_\_\_\_ (day/month/year)

Role in study: \_\_\_\_\_

**Study personnel** signature: \_\_\_\_\_

**Pre-Study Questionnaire**

Name: \_\_\_\_\_

Age: \_\_\_\_\_

Gender: \_\_\_\_\_

Specialty: \_\_\_\_\_

Sub-specialization(s) (if applicable): \_\_\_\_\_

Number of years in practice as an attending physician:  
(excluding fellowship and residency) \_\_\_\_\_

Where was your last training:  
(US, Canada, elsewhere, please specify) \_\_\_\_\_

Do you work primarily in community or academic practice?  
(academic practice is working primarily in association with the University of Manitoba, and in regular contact with residents and medical students) \_\_\_\_\_

Do you perform colonoscopies as part of your typical practice? (circle):

Yes	No
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(If yes) Where do you scope?:  
(which hospitals/clinics) \_\_\_\_\_

Approximately how many colonoscopies do you perform in an average month? (circle)

<20	20-40	41-60	61-80	>80
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Please write in actual number, if known: \_\_\_\_\_

**THE FOLLOWING QUESTIONS APPLY TO SURGEONS ONLY**

Where do you operate?  
(which hospital/clinics): \_\_\_\_\_

How many colorectal tumors (polyps and cancers) do you operate on per month?

	0-1	2	3-4	≥5
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Actual number if known: \_\_\_\_\_

How often do you operate on people where you have not done the scope yourself?

	Never	Less than Half	Approximately Half	More than half	Always
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How often do you request (or perform) repeat pre-operative endoscopies?

	Never	Less than Half	Approximately Half	More than half	Always
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Comments (optional) \_\_\_\_\_



## Appendix D. Qualitative semi structured interview template

### **[Introduce self]**

#### **Introduce project:**

Thank you for participating. The purpose of this project is to try and enhance communication between providers to streamline care of patients with colorectal tumors. This new guideline was produced to standardize tumor marking and enhance documentation at endoscopy. This may help reduce unnecessary repeat preoperative endoscopies while preserving excellent lesion localization rates. This can also help enhance lesion localization at repeat colonoscopies.

As you may be aware, many patients with colorectal tumors in Winnipeg get a repeat endoscopy prior to elective colorectal surgery. This is done for many reasons, but one of the key contributors identified was that practices are non-standardized between providers, so sometimes important information is felt to be missing. New guidelines have recently been developed to establish recommendations to enhance communication, and secondarily to decrease unneeded repeat endoscopies. Included in these guidelines are recommendations for tattoo indications, tattoo technique, and charting.

#### **Purpose of the interview:**

This interview will help us to better understand the challenges and facilitators to using these new recommendations in Winnipeg. Using the findings from these interviews, we aim to develop specific strategies to help endoscopists and surgeons use these new guidelines and hopefully improve care for patients with colorectal tumors.

This interview will be audio recorded so that we have an accurate record of your thoughts. Your recording will be kept private and confidential. Our study has University of Manitoba HREB approval. Once your interview has been transcribed, only a study ID number will be linked to the transcripts. You may also skip any questions you wish during the interview. I also wanted to remind you that we will be giving you a \$100 gift card as a small token of our appreciation for your participation.

Here is an infographic from the guideline with a summary of the recommendations.

[Share infographic on screen or give a handout]

[Go through each of the recommendations listed on the infographic]

Before we begin, do you have any questions for me about the interview process, or about the guidelines?

[Answer any questions]

**Focusing statement:**

Now we will move onto the meat of the interview. I will ask questions to get your perspectives on this new guideline. I want to emphasize that these questions are not a test for comprehension of the guideline, but are all designed to gather your perspectives so that both gastroenterologists and surgeons can use these recommendations most effectively in the future.

**Intervention characteristics** [additional probes: why/why not, can you give an example)

1. What are your first impressions of this guideline?
  - Do you think it is needed?
  - Do you agree with the recommendations?
  - Which ones don't you agree with?
2. If you were referred a patient with a colon or rectal tumor who had a colonoscopy performed following all of the recommendations in this guideline, can you envision a scenario where you would need to repeat the scope?
  - Why? What more would you need?
3. How difficult do you think it would be to implement these recommendations in Winnipeg?
  - Why?
4. What do you perceive as the major barriers?
5. What resources would you need to overcome some of these barriers?
6. What are the major strengths, or advantages, we have in Winnipeg that might facilitate implementation of this guideline?
7. Do you think this guideline addresses a patient need?
  - How could the guideline be altered to better meet their needs?

**Relative Advantage**

1. Are you aware of any other interventions in Winnipeg that people have tried before to enhance colorectal lesion localization?
  - What advantages does the guideline have compared to those others?
  - What disadvantages?
2. Is there another solution to repeat endoscopy that you'd rather see implemented?

**Adaptability/Complexity**

1. What kinds of changes or alterations do you think need to be made to the guideline so it will work effectively in your setting?
  - Do you think these changes can be made? Why or why not?
2. Are there components that should not be altered?
  - Which ones?
3. How different are the guidelines' recommendations from your current practice?
  - What about from your colleagues' practices?

**Access to Knowledge & Information**

1. What kind of training would you need to be able to implement this guideline in your practice?
2. What kinds of information or materials about the guideline would you need?

**Trialability**

1. What are your thoughts on piloting a guideline implementation strategy in one of your endoscopy programs?
  - Do you think it would be realistic to pilot this guideline in your endoscopy suite?
  - Would a pilot study be important to you?

## Design Quality & Packaging

1. Would you need a tool to help you use this guideline?
  - What types of tools or supports would you use?
  - (e.g., online resources, marketing materials, a toolkit, guideline summary, integration into EMR, posters on the wall, flow sheets, patient-oriented information, checklist)

## Cost

1. Are you aware of any financial incentives or disincentives for following these guidelines?
2. Do you think it will cost you, in time or lost opportunity, to follow these guideline recommendations?
  - Do you view this as a net benefit or loss?
  - Why?

## Questions about the settings:

Changing gears a bit, the next set of questions pertain to the healthcare system that you work in, including the hospitals, clinics and health authority, and the individuals you work with.

## Networks, communication, implementation climate

1. To what extent do you feel like you can try new things to improve your work processes?
  - Examples?
  - If you want to make a change, how do you get stuff done?
  - Who are your go-to people?
2. What role do site leaders play? What actions do they take?
  - Do you feel like quality improvement initiatives are valued or respected by leadership?
3. How do you typically find out about new information, such as new initiatives, or issues?
  - Is this effective? Is there another avenue that you would prefer?
4. Do you feel new endoscopy quality improvement initiatives should be initiated in Winnipeg?

## Goals and Feedback

1. What do you think the general level of receptivity in your organization will be to implementing this guideline?
  - a. Why/Where might barriers arise?
  - b. How might this new guideline align with existing organizational goals?
2. Would you find it helpful to receive feedback on your work related to aspects of this guideline?
  - a. [For example, feedback related to compliance with the guideline recommendations, your own repeat endoscopy rate, tattoo rate]
  - b. What might be an acceptable method to receive feedback?

## External Policies & Incentives

1. What (other) kinds of incentives would you support that could help ensure that the implementation of the guideline is successful?
  - (e.g., Hospital policies, mandates, pay for performance)
  - Are any of these incentives already in place?

## Culture (general beliefs, values, assumptions that people embrace)

1. What role do you think your organization's culture will play in the implementation of this guideline?
  - Can you describe an example that highlights this?
  - Are new ideas/QI valued?

## Compatibility

1. How could this guideline be integrated into existing work processes and practices?
  - How will it interact or conflict with current programs or processes?
  - What are likely issues that may arise?
2. Do you think this guideline's implementation could replace or compliment a current program or process?
  - Which ones? In what ways?

### **Leadership Engagement**

1. What would you want site leadership to do to help you use these guidelines?
  - a. What types of barriers might they create?
2. Are there other influential individuals to get on board with implementation of this guideline?
  - a. Who? Why?

### **Peer Pressure/cosmopolitanism**

Past literature suggests that interaction between organizations, in particular "peer pressure", can influence intervention success.

1. Do you know of any other organizations elsewhere that have looked at reducing repeat endoscopies?
  - [if yes] What have they done?
  - How does this affect support for implementing new strategies in Winnipeg?
2. Would implementing this guideline provide an advantage for our hospitals or health organizations compared to elsewhere?
  - Do you see any benefit to being ahead of other institutions?
3. To what extent do you network with other gastroenterologists and surgeons outside your own practice setting (i.e., people who you don't work with clinically)?
  - What are the venues?
  - Do you attend local/national conferences?
  - Does your organization encourage you to network?

### **Conclusion:**

1. Thinking back to how you answered these questions, were you thinking from the point of view of the endoscopist performing the initial scope, or from the perspective of the surgeon (or advanced endoscopist) receiving the endoscopy report, (or both)?
  - a. Would your answers to the questions change thinking from the other perspective?
2. Are there any other aspects about this guideline that you wanted to mention, or that you feel I should have asked about?

Appendix E. CFIR construct original short definitions and qualitative codebook inclusion criteria

(Adapted from Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implementation Science*. 2009 Aug 7;4(1):886–15)

<b>Construct</b>	<b>CFIR original short definition</b>	<b>Codebook definitions and inclusion criteria</b>
<b>I. INTERVENTION CHARACTERISTICS</b>		
A Intervention Source	Perception of key stakeholders about whether the intervention is externally or internally developed.	Perceptions related to the entity that developed of the guideline/recommendations and/or where it was developed. Whether the guideline and/or the decision to implement is an “internal” organizational decision versus an “external” organizational decision is included in this construct.
B Evidence Strength & Quality	Stakeholders’ perceptions of the quality and validity of evidence supporting the belief that the intervention will have desired outcomes.	Perceptions of the quality and validity of evidence supporting the belief that the recommendations will have desired outcomes (e.g., decreased repeat endoscopies, enhanced quality of Winnipeg endoscopy, enhanced care). There are two complementary components to this construct: 1. Perceptions related to recommendations as a whole; 2. Perceptions related to specific individual recommendations made. Both components will be examined in the analysis for an overall estimation of providers perceptions of the evidence strength & quality.
C Relative Advantage	Stakeholders’ perception of the advantage of implementing the intervention versus an alternative solution.	Perceptions of the relative advantages and disadvantages of implementing the new guideline recommendations versus alternative solutions to repeat preoperative endoscopy and lesion localization errors in Winnipeg. Alternate solutions will be coded under this construct, but are not rated in barrier/facilitator analysis unless the participant feels the other solution is preferable.
D Adaptability	The degree to which an intervention can be adapted, tailored, refined, or reinvented to meet local needs.	Perceptions of the degree to which the guideline recommendations, and their implementation can be adapted, tailored, refined, or reinvented to meet local needs. Suggestions for improvement are captured under this construct, but do not affect barrier/facilitator rating unless it is clear that the participant feels the change is needed but that the program cannot be adapted.
E Triability	The ability to test the intervention on a small scale in the organization, and to be able to reverse course (undo implementation) if warranted.	Perceptions on the ability to test the guideline recommendations on a small scale in their setting, and to be able to reverse course if warranted. Include statements about whether a pilot study is possible. Double code statement about whether a pilot study is needed, and possible desirable pilot study outcomes to evidence strength & quality.
F Complexity	Perceived difficulty of implementation, reflected by duration, scope, radicalness, disruptiveness, centrality, and intricacy and number of steps required to implement.	Perceived complexity of the guideline and recommendations, reflected by duration, scope, radicalness, disruptiveness, centrality, and intricacy and number of steps required to implement. Exclude statements related only to how the guideline is presented/packaged and code to design quality & packaging below.
G Design Quality & Packaging	Perceived excellence in how the intervention is bundled, presented, and assembled.	Perceived excellence in how the recommendations are bundled, presented, and assembled. There are two parts to this: 1. the full-length document; 2. the recommendations infographic. Participants were asked, although not required, to review both. Both components were equally weighted
H Cost	Costs of the intervention and costs associated with implementing the intervention including investment, supply, and opportunity costs.	Perceptions related to costs from implementing and following the recommendations, including investment, supplies, and opportunity costs. Differentiate between costs associated with following/implementing the recommendations, versus statements relating to availability of existing resources (coded separately under available resources construct below).
<b>II. OUTER SETTING</b>		

A	Patient Needs & Resources	The extent to which patient needs, as well as barriers and facilitators to meet those needs, are accurately known and prioritized by the organization.	The extent to which patient needs, as well as barriers and facilitators to meeting those needs (relating to gastrointestinal endoscopy, colorectal cancer, and colorectal cancer surgery), are accurately known and prioritized by the organization. There are two main parts included within this construct: 1. Statements demonstrating awareness of the needs and resources of those served by the organization (e.g., “the organization does or doesn’t understand the needs of patients because...”). 2. Statements that can be used to infer the level of awareness within the organization based on individual awareness (e.g., “I don’t know if this is an issue.”)
B	Cosmopolitanism	The degree to which an organization is networked with other external organizations.	The degree to which an organization is networked with other external organizations (e.g., conferences, formal and informal communication with individuals from outside organizations.) Exclude general networking and communication within the organization, and code those statements to the Networks & Communications construct in the Inner Setting domain (below).
C	Peer Pressure	Mimetic or competitive pressure to implement an intervention; typically because most or other key peer or competing organizations have already implemented or are in a bid for a competitive edge.	Perceived competitive pressure to implement a solution to repeat preoperative endoscopy. Include statements about perceived pressure or motivation from outside entities/organizations to implement the innovation, either because others have already addressed this (or similar) issue, or because of desire to be ahead of other organizations.
D	External Policy & Incentives	A broad construct that includes external strategies to spread interventions, including policy and regulations (governmental or other central entity), external mandates, recommendations and guidelines, pay-for-performance, collaboratives, and public or benchmark reporting.	Perceptions towards external strategies (i.e., government, licensing body, regulatory organizations) relating to the new recommendations and intended purpose of their implementation (reduced repeat endoscopy). Include statements regarding policies and regulations, external mandates, pay-for-performance, collaboratives, benchmark reporting, or even other recommendations and guidelines. Exclude statements related to policies/incentives from individual hospitals, clinics, Shared health, the WRHA, and code those instead to the Inner Setting construct “Organizational incentives”.
<b>III. INNER SETTING*</b>			
A	Structural Characteristics	The social architecture, age, maturity, and size of an organization.	Perceptions on how the social architecture, age, maturity, and size of the organizations within Winnipeg will affect implementation and use of the new endoscopy recommendations. Exclude perceptions related to outside hospitals (rural or other provinces) and code to cosmopolitanism or peer pressure, as appropriate.
B	Networks & Communications	The nature and quality of webs of social networks and the nature and quality of formal and informal communications within an organization.	Perceptions towards the nature and quality of webs of social networks and the nature and quality of formal and informal communications within the organizations in Winnipeg. Aspects related to communication specific to the new recommendations and the topic covered within are included within this construct, but also overlap with those in the “Goals & Feedback” construct (and are double coded). Exclude perceptions related to outside hospitals (rural or other provinces) and code to cosmopolitanism or peer pressure, as appropriate. Exclude perceptions towards resources required for communication for the purposes of patient care and code to “Available Resources” instead.
C	Culture	Norms, values, and basic assumptions of a given organization.	Perceptions of norms, values, and basic assumptions of the given organization, as they relate to endoscopy quality improvement, and implementation of past and future interventions within Winnipeg. There are two main ways used to evaluate this construct: 1. Statements directly addressing the culture within the organization (e.g., “I think the culture will be a barrier/facilitator because of X”) 2. Statements that can be used to infer the culture within the organization based on individual values (e.g., “This is not important to me and my peers.”). This second part overlaps with characteristics of individuals construct.

D	Implementation Climate	The absorptive capacity for change, shared receptivity of involved individuals to an intervention, and the extent to which use of that intervention will be rewarded, supported, and expected within their organization.	The absorptive capacity for change, shared receptivity of involved individuals to an intervention, and the extent to which use of that intervention will be rewarded, supported, and expected within their organization. This construct is an umbrella and automatically includes the following sub-constructs 1-6 below.
1	Tension for Change	The degree to which stakeholders perceive the current situation as intolerable or needing change.	Perceptions that the current situation (relating to topics covered in the recommendations) is intolerable or needing change. Unlike the other constructs, this is weighted as a barrier if participants are ambivalent to the current situation.
2	Compatibility	The degree of tangible fit between meaning and values attached to the intervention by involved individuals, how those align with individuals' own norms, values, and perceived risks and needs, and how the intervention fits with existing workflows and systems.	Perceptions demonstrating the fit between meaning and values attached to the intervention (the new recommendations) by involved individuals and: 1. How those align with individuals' own norms, values, and perceived risks and needs; 2. How those align with perceived organizational values (some overlap with culture); and 3. How the intervention fits with existing workflows and systems (overlap with "available needs and resources" construct).
3	Relative Priority	Individuals' shared perception of the importance of the implementation within the organization.	Individuals' shared perception of the importance of the implementation (of the new recommendation) within the organization. This construct has two components. 1. The relative priority of the intervention as individuals perceive it to be viewed from the organizations' standpoint (e.g., "I do/don't think Shared health will prioritize this") 2. The relative priority of the intervention for individuals, which can be used to infer the overall organization's priorities (e.g., "This is my number one priority"). Note, these criteria have substantial overlap with the constructs "Relative advantage" and "Tension for change". The difference between this construct and the others is best illustrated by examples. E.g., someone may say the situation needs to change (tension for change facilitator), but they or the organization have other more important priorities (relative priority barrier). Individuals may say this is the best solution available (relative advantage facilitator), but this problem isn't important to them or the organization (tension for change barrier).
4	Organizational Incentives & Rewards	Extrinsic incentives such as goal-sharing awards, performance reviews, promotions, and raises in salary, and less tangible incentives such as increased stature or respect.	Perceptions towards extrinsic incentives (that are internal to the organization) such as goal-sharing awards, performance reviews, promotions, and raises in salary (separate from provincial fee-for-service reimbursement, which is classified in the outer setting), and less tangible incentives such as increased stature or respect from their peers within the organization (if related to external organizations coded to peer pressure construct instead). Note: According to the CFIR-ERIC framework, this concept is rated as a barrier if there are no incentives, regardless of participants' perceptions whether incentives are important to them for implementation.
5	Goals and Feedback	The degree to which goals are clearly communicated, acted upon, and fed back to staff, and alignment of that feedback with goals.	Perceptions that existing organizational goals (related to topics covered in the new recommendations regarding repeat endoscopy, adequacy of endoscopic lesion localization practices) are clearly communicated, acted upon, and fed back to staff, and alignment of that feedback with goals. Suggestions for improvement (i.e., type of feedback participants' would like to receive) are coded under this construct.
6	Learning Climate	A climate in which: a) leaders express their own fallibility and need for team members' assistance and input; b) team members feel that they are essential, valued, and	This construct includes perceptions related to four components of the learning environment: 1. leaders express their own fallibility and need for team members' assistance and input (some overlap with leadership engagement); 2. Team members feel that they are essential, valued, and knowledgeable partners in the change process 3. Individuals feel psychologically safe to try new methods; and 4. there

		knowledgeable partners in the change process; c) individuals feel psychologically safe to try new methods; and d) there is sufficient time and space for reflective thinking and evaluation.	is sufficient time and space for reflective thinking and evaluation (some overlap with available resources).
E	Readiness for Implementation	Tangible and immediate indicators of organizational commitment to its decision to implement an intervention.	Tangible and immediate indicators of organizational commitment to its decision to implement the new endoscopy recommendations. This construct is an umbrella that automatically includes the following sub-constructs 1-3 below.
1	Leadership Engagement	Commitment, involvement, and accountability of leaders and managers with the implementation.	General perceptions regarding the commitment, involvement, and accountability of leaders towards the implementation of the new recommendations in Winnipeg. As the recommendations are novel, with no proposed implementation strategy <i>per se</i> , included within this construct are general perceptions towards leadership and examples from past similar quality improvement initiatives in endoscopy/surgery. Leadership is assessed at multiple levels, (e.g., endoscopy site leads, endoscopy regional lead, nursing leadership, surgery leadership, organizational leadership) due to the complex nature of the system. For rating this construct, assessed are perceptions towards leadership within the Winnipeg organizational settings (i.e., exclude comments related to provincial political leadership, national licencing body leadership). Some participants had leadership roles within the organization. Their perceptions were weighted the same as general participants.
2	Available Resources	The level of resources dedicated for implementation and on-going operations, including money, training, education, physical space, and time.	Perceptions towards the level of resources available for implementation and on-going operation of the new recommendations, including money, training, education, physical space, and time. Coded under this construct are additional resources that are requested or required for use of the new recommendations.
3	Access to Knowledge & Information	Ease of access to digestible information and knowledge about the intervention and how to incorporate it into work tasks.	Awareness and perceptions of access to the new recommendations. Perceptions towards ease of access to digestible information and knowledge about the practices recommended by the new guidelines.
<b>IV. CHARACTERISTICS OF INDIVIDUALS</b>			
A	Knowledge & Beliefs about the Intervention	Individuals' attitudes toward and value placed on the intervention as well as familiarity with facts, truths, and principles related to the intervention.	There are two parts to this construct, which are equally weighted and evaluated separately: 1. Individuals' attitudes toward and value placed on the implementation of the new recommendations; 2. Familiarity with facts, truths, and principles related to the intervention (i.e., components of the guideline). This latter aspect has some overlap with the Evidence Strength & Quality construct.
B	Self-efficacy	Individual belief in their own capabilities to execute courses of action to achieve implementation goals.	Individual belief in their own capabilities to: 1. Follow all of the recommendations themselves; 2. Their perceptions of their colleagues' ability to follow the recommendations; 3. Their ability to implement the recommendations; 4. Their perceptions of their colleagues' ability to implement the recommendations.
D	Individual Identification with Organization	Characterization of the phase an individual is in, as he or she progresses toward skilled, enthusiastic, and sustained use of the intervention.	A broad construct related to how individuals perceive the organization, and their relationship and degree of commitment with that organization. There are multiple components: 1. Alignment between individual and organizational goals/values; 2. A perception of organizational justice; and 3. Providers' emotional exhaustion/burnout.

\*Organizations assessed within the Inner Setting domain include local practice groups, individual hospitals, clinics, endoscopy suites, Shared health, and the Winnipeg regional health authority (WRHA); plus perceptions of the overall endoscopy organizational structure, and the surgery organizational structure (as they relate to colorectal tumors and their treatment) within Winnipeg.



Appendix F. CFIR constructs and rationale for selection

(Adapted from Damschroder L.J, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implementation Science*. 2009 Aug 7;4(1):886–15)

Construct	Examples from interview guide	If not included, rationale for exclusion
<b>I. INTERVENTION CHARACTERISTICS</b>		
A	Intervention Source	We chose not to ask specifically their assessment of the evidence or perceptions of it being developed locally, as it is completely new, and we felt that participants will not have had the opportunity to assess these aspect in detail prior to the interview. However, should participants bring up these topics, they will be coded.
B	Evidence Strength & Quality	
C	Relative Advantage	
D	Adaptability	
E	Trialability	
F	Complexity	
G	Design Quality & Packaging	
H	Cost	
<b>II. OUTER SETTING</b>		
A	Patient Needs & Resources	
B	Cosmopolitanism	
C	Peer Pressure	
D	External Policy & Incentives	
<b>III. INNER SETTING</b>		
A	Structural Characteristics	The social architecture, age, maturity, and size of the organization is already generally known to us, and is often assessed objectively(18). Perceived effect of this construct was assessed in general terms. During piloting participant answers to the questions under this construct suggested on the cfrguide.org website overlapped with questions assessing implementation climate and design quality and packaging. These questions were thus removed for efficiency, but responses can be double coded to this construct if necessary, during analysis.

B	Networks & Communications	Included. E.g., how do you find out about new information?	
C	Culture	Included e.g., what role do you think your organization's culture will play?	
D	Implementation Climate		
1	Tension for Change	Included e.g., Is this guideline needed in Winnipeg?	
2	Compatibility	Included. E.g., How could this guideline be integrated into existing workflows?	
3	Relative Priority	Included. E.g., Are there other interventions you'd rather see implemented?	
4	Organizational Incentives & Rewards	Included. E.g., Questions about financial incentives and other incentives. Preferred incentives	
5	Goals and Feedback	Included. Would you find it helpful to receive feedback on your work related to aspects of this guideline?	
6	Learning Climate	Included. E.g., To what extent can you try new things?	Partially assessed. Questions about leadership double code to this construct. Gi and surgeon perceptions of value, and role in change process are not assessed, as these constructs were felt not to apply without a proposed implementation strategy in advance.
E	Readiness for Implementation		
1	Leadership Engagement	Included. E.g., How can site leadership help you use these guideline?	
2	Available Resources	Included. E.g., What resources are available/do you still need to use these guidelines?	
3	Access to Knowledge & Information	Included, but no specific questions.	The guideline is new, and has not yet been implemented in the organization, therefore questions about how this information is accessed are not yet applicable.
<b>IV. CHARACTERISTICS OF INDIVIDUALS</b>			
A	Knowledge & Beliefs about the Intervention	Included. E.g., Is this intervention needed? Would you use this?	Questions about how individuals identify with the guideline and whether they can use it are included. As the guideline has not been implemented yet, questions pertaining to stage of change associated with guideline uptake were not developed. The cfrguide.org website does not provide suggested questions assessing Individual identification with their organization. Instead, this construct was generally assessed during the analysis when participants make applicable statements when responding to other questions. (Perceptions of provider burnout (included under individual identification with organization) are historically negatively associated with implementation success, but are beyond the scope of this current project and questions related to that issue were not included.
B	Self-efficacy	Included. E.g., Can you use this guideline? What barriers exist	
C	Individual Stage of Change	Not assessed	
D	Individual Identification with Organization	Included, but assessed only in part. Participants addressed this construct when asked about culture, leadership, and compatibility.	
E	Other Personal Attributes	Excluded.	This construct is not part of the ERIC framework, and its role in identifying implementation strategies is unclear according to the chosen frameworks. Relevant characteristics of individuals that did not fit within the other constructs were coded here.

# Endoscopic Localization of Colorectal neoplasms



## Tattoo Indications

✓ All lesions to be referred for endoscopy, surgery or surveillance.

✓ Any suspicion of cancer

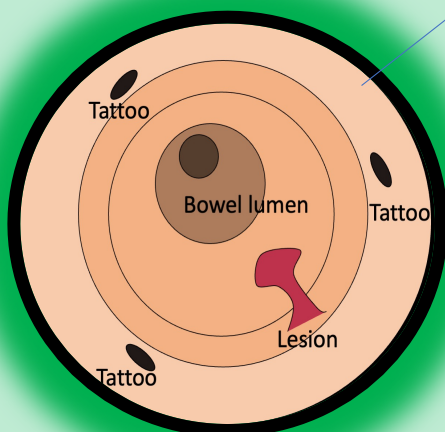
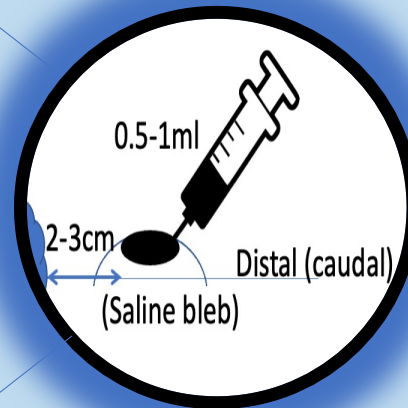
### Exceptions:

✗ Low or mid rectum.

✗ Cecum (if confident of lesion location and is documented to anatomic landmarks)

## Tattoo Technique

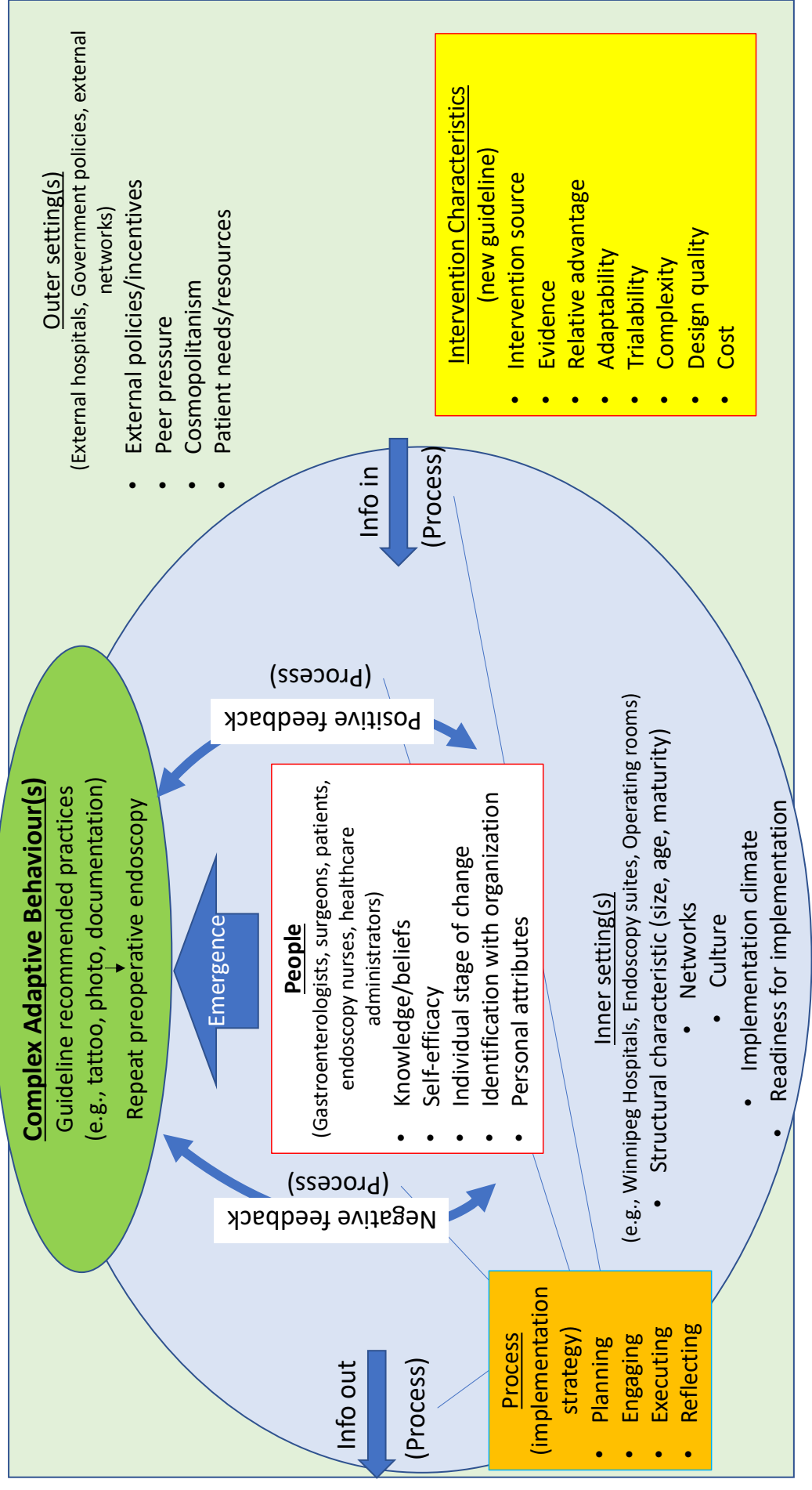
- Raise saline bleb first.
- Tattoo 2-3cm distal to lesion (1-2cm in upper rectum).
- Tattoo should not touch the lesion.
- Inject at an oblique angle.
- 0.5-1ml per spot.
- Mark three concentric quadrants for a surgical referral, or one spot for endoscopic excision/surveillance



## Documentation

- **Photographs:** For all but tiny (<1cm) benign appearing polyps. Show relation to landmarks and tattoo. Show completeness of excision (if applicable).
- Scopeguide®/Scopepilot™ position should be documented if localization is difficult.
- Document lesion location, tattoo placement, lesion characteristics, biopsy and polypectomy details.

Appendix H. Simplified schematic of the endoscopy system in Winnipeg mapped to CFIR constructs (adapted from [https://en.wikipedia.org/wiki/File:Complex\\_adaptive\\_system.svg](https://en.wikipedia.org/wiki/File:Complex_adaptive_system.svg))



## Appendix I: Synthesized analyzed data handout provided to research participants after study completion

### **PERCEPTIONS AMONG GASTROENTEROLOGISTS AND SURGEONS OF NEW NATIONAL RECOMMENDATIONS FOR PREOPERATIVE ENDOSCOPIC LOCALIZATION OF COLORECTAL NEOPLASMS**

**Investigators:** Garrett Johnson, Malcolm Doupe, Ramzi Helewa, Kathryn Sibley, Kristen Reynolds, Harminder Singh

**Rationale:** Many patients in Winnipeg (~29%) undergo a repeat endoscopy before surgery for colorectal neoplasms. This occurs primarily if lesion location was poorly documented, or the tumor was inadequately marked during the index scope. New consensus-derived recommendations for localizing and documenting colorectal lesions were recently developed.

**Aim:** The purpose of this study was to identify barriers and facilitators to using these new recommendations in Winnipeg.

#### **Participants:**

- 11 Gastroenterologists and 10 Surgeons (9 “Community” and 12 “Academic”) from every hospital and every endoscopy suite in Winnipeg

#### **Facilitators:**

1. Most surgeons and gastroenterologists could not identify a reason to repeat a preoperative endoscopy if the recommendations were followed and all information was provided
2. Implementation of the recommendations was seen as important, and advantageous or complementary to alternate solutions to localization issues
3. The simplicity of the recommendations as well as the excellent design quality and packaging of the infographic were strengths
4. The local central intake organizational structure for endoscopy, interdisciplinary communication networks (GI rounds, informal networks) and the learning environment were all perceived as facilitators that would spur implementation
5. Participants viewed the decision to apply the guideline as a homegrown initiative, which was well-regarded
6. Endoscopy leadership was viewed as valuing quality improvement (QI), approachable for innovation, and would facilitate application of the new recommendations

#### **Barriers:**

1. Participants felt they would likely forget to follow some recommendations if not reminded
2. There was a perception by some participants that certain recommendations were unnecessary (e.g., saline bleb before tattoo, Scopeguide, three-quadrant tattoo, tattoo ‘obvious’ cancers)
3. No relevant formal feedback processes exist
4. Fee-for-service payment disincentivizes following the recommendations and incentivizes repeat scopes
5. Some important resources were missing (e.g., Scopeguide, time, Endovault access in clinics)
6. A small number of surgeons were likely to repeat endoscopy even if all recommendations were followed (needed more information in rectum, or wanted to see/feel for themselves)
7. Organizational leadership (WRHA/Shared Health) were perceived as not valuing QI, unfairly prioritizing other areas of healthcare, and placing unnecessary barriers to past QI initiatives.

#### **Common participant recommendations:**

1. Capture local data and provide feedback (Facilitate peer-review; non-punitive, non-judgemental feedback)
2. Provide new resources (e.g., Endovault report on e-chart, Scopeguide in every room, Synoptic sections in Endovault)
3. Create/disseminate educational materials (Printouts/posters in endoscopy suite, reminders in Endovault, grand rounds, journal clubs, nurse education)
4. Conduct educational meetings (rounds, journal club presentations)
5. Edit infographic (e.g., More rectal lesion info, example photographs of real lesions, simplify documentation)
6. Stage implementation scale-up\* (pilot studies, step-wise progression of implementation roll-out)
7. Identify and prepare site ‘champions’ and opinion leaders (e.g., influential endoscopists or CRNs to help promote/model good practices)

8. Implement formal policies or mandate change\* (centralized colorectal surgery referral form, leadership endorsement of recommendations)
9. Alter incentives/allowance structures\* (Fee for proper tattoo placement)

\*These recommendations were controversial with some participants opposed.