Alberta Health Evidence Review Report

Building Capacity for High Quality Gastrointestinal Endoscopy in Alberta

July 2022

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Competing interest is considered to be financial interest or non-financial interest, either direct or indirect, that would affect the research contained in this report or create a situation in which a person's judgment could be unduly influenced by a secondary interest, such as personal advancement.

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Executive Summary

Background and Alberta Context

Endoscopy has become an indispensable tool for gastroenterology. Continued improvement in diagnostic accuracy, treatment efficiency, safety, and patient comfort has contributed to the proliferation of its use and associated increase in cost. Specifically in Alberta, approximately 250,000 endoscopic procedures are performed annually, at a cost of almost $120 million. The volume of endoscopies has increased 2–9% per year, and a total volume increase of 19% from 2012–2013 to 2016–2017. This increase in demand has led to prolonged wait times: non-urgent condition wait times range from 9–24 months, and more urgent conditions are exceeding the 8-week wait time Canadian benchmark.

Health systems have begun to evaluate the appropriateness of care, as a way to ensure sustainable, quality service use with constrained resources. A procedure is deemed inappropriate (also termed unnecessary or low-value), when the risks of the procedure exceed the benefits, and this judgment may also incorporate considerations of cost-effectiveness, clinical judgment, patient-centredness, and equity. In Alberta, evidence is required to identify the indications for which may not warrant an endoscopic procedure, evaluate current guidelines and identify gaps or inconsistencies in current recommendations, and identify how to best intervene to reduce overuse, in order to build capacity for appropriate utilization of these high-cost procedures.

This Health Evidence Review was completed by the Institute of Health Economics (IHE) to guide the Digestive Health Strategic Clinical Network (DHSCN) in identifying the scope of endoscopy overuse in Alberta and the potential solutions to intervening on the issue. The overarching policy question for the Health Evidence Review is: how can we reduce the number of endoscopies performed in Alberta that have been recommended by clinical guidelines or other practice advice to be discontinued or reduced in frequency,and encourage efficient and appropriate use of endoscopy services within the province?

Scoping Review of Indications Where Endoscopy Use Should be Reduced or Avoided

Methods

A scoping review was undertaken to review literature identifying indications where gastrointestinal (GI) endoscopy use should be reduced or avoided (due to the risks outweighing benefits, a lack of evidence to support use, and/or as suggested through consensus). An information specialist conducted database and grey literature searches to identify English-language articles published from 2010 onward (last 10 years), and one reviewer selected literature for inclusion. Data were extracted and synthesized to generate a list of indications where GI endoscopy indications have been recommended by clinical guidelines or other practice advice to be discontinued or reduced in frequency, which was then prioritized. For selected indications, a comparison of the related clinical practice guideline recommendations was undertaken and the quality of the guidelines were assessed.

Results

There were 53 articles included overall. Thirty-one clinical practice guidelines, two systematic reviews, and six low-value care lists reported 134 indications where endoscopy should be reduced or avoided, which were amalgamated into 19 unique indications. One low-value care prioritization

report and 14 primary studies reported on the prevalence of and/or cost attributed to recommendation nonadherence for one or more indications, from Australia, Canada, United Kingdom, and the United States. Two indications were selected: colorectal adenoma surveillance and investigation of undiagnosed dyspepsia and/or gastroesophageal reflux disease (GERD).

Four national guidelines reported recommendations regarding colorectal adenoma surveillance after an index screening colonoscopy. There was a slight variation in the breadth of recommendations, as well as the surveillance interval for similar index findings across all guidelines, with the greatest variation occurring for the recommendation for low-risk adenomas. There was some overlap across guidelines in the evidence that was used to support the recommendation, but there was also non-negligible variation, which likely contributed to the differences in recommendations between guidelines. Differences among recommendations may also have occurred due to the explicit prioritization of colorectal cancer (CRC) incidence and mortality evidence and only offering colonoscopy surveillance when there was demonstrated benefit in some guidelines, while others recommended the modality and surveillance interval based on those modalities and interval used in the evidence. All guidelines were of good quality.

Six national guidelines, published between 2015 and 2020, reported recommendations regarding endoscopy for investigations of dyspepsia and/or GERD symptoms. The guidelines differed in the age cut-off at which esophagogastroduodenoscopy (EGD) may be warranted, as well as whether or not alarm symptoms warranted EGD regardless of age. Recommendations likely differed due to the varying definitions of their dyspepsia and/or GERD population, and minimal overlap in the evidence used to support the recommendations. Guidelines were of average to good quality.

Systematic Review of New Evidence to Clarify Guideline Discordance

Methods

We undertook a systematic review of any new primary studies that may resolve discordance among guidelines for the selected indication colorectal adenoma surveillance. An information specialist conducted searches in those databases usually searched by the guidelines for English-language articles published from November 1, 2019 (the time at which the last searches were conducted for relevant guidelines) until 20 November 2020. One reviewer screened titles and abstracts, and two reviewers selected articles for inclusion. Data were extracted into summary of findings tables and quality was assessed.

Results

Five new cohort studies reported on the incidence of advanced adenomas and/or CRC based on the index colonoscopy pathology findings, since the most current guideline search for evidence. None of the five studies assessed surveillance time intervals. Generally, the findings on advanced adenoma and/or CRC risk in these studies were consistent with the evidence base of the current guidelines, with no studies able to clarify the guideline discordance of who should be classified as low risk for further advanced adenomas and/or CRC, and what the optimal surveillance strategy is for those who may be considered low risk. Studies were of very low to moderate quality.

Systematic Review of Interventions to Reduce Endoscopy Overuse

Methods

We completed a systematic review on the evidence on the effectiveness of interventions intended to reduce referrals and procedures for the selected indications where endoscopy is recommended to be avoided or reduced in frequency (that is, colorectal adenoma surveillance and dyspepsia/GERD). An information specialist conducted database and grey literature searches to identify English-language articles published from 2010 onward (last 10 years), with one reviewer screening titles and abstracts, and two reviewers selecting articles for inclusion. Data were extracted into predeveloped tables, categorized using a published classification system, and quality of each study was assessed.

Results

For colorectal adenoma surveillance, the following five behaviour change interventions were identified:

- One training intervention, which did not improve surveillance recommendation accuracy. The study had low risk of bias.
- Two enablement interventions: a registry increased the number of patients scoped within a year of their surveillance recommendation, with no change to the rates of early colonoscopies, and a clinical decision support system increased the likeliness for guideline adherent recommendations. These studies had high risk of bias.
- One environmental restructuring intervention using yearly fecal immunochemical tests (FIT) testing for patients considered at intermediate risk for CRC, estimated up to 71% of colonoscopies could be avoided, but with 30 to 40% of CRCs going undetected. The study had moderate risk of bias.
- One persuasion intervention using quarterly report cards, showed a significant trend toward recommendation guideline adherence. The study had very high risk of bias.

A single study on behaviour change intervention for managing patients with dyspepsia or GERD symptoms was identified. This environment restructuring intervention used a nurse-led shared medical appointment pathway and found that endoscopy utilization was lower and endoscopy wait times were shorter for patients who went through the nurse-led pathway. The study had a moderate risk of bias.

Epidemiology of Endoscopy Use in Alberta

Using administrative health databases, we examined the use of endoscopy (EGD and colonoscopy) for the diagnosis and/or treatment of GI disorders between April 1, 2010 and March 31, 2019 in Alberta. We found a substantial increase in endoscopy use during the eight years of the study. There were increases in both the annual number of procedures (37% increase), the number of patients receiving endoscopy each year (32% increase), and the rate of utilization over time (6,261 to 7,444 procedures per 100,000 population between the first and the last year of the study). We also found a substantial number of procedures that could be provided against the guideline's recommendations. About 18,000 surveillance colonoscopy procedures were provided with an interval less than three years which was shorter than the range of three to 10 years recommended by clinical guidelines. Approximately 100,000 EGD procedures were potentially unnecessarily provided to patients with

dyspepsia or GERD. These procedures could represent endoscopy overuse in Alberta and could be delayed or averted to save resource use and costs.

Looking at geographical variation between facilities, for the year 2018, large centers like Foothills, Rockyview, Red Deer, Royal Alex, and University of Alberta hospitals provided high number of endoscopies. However, smaller centers like Rocky Mountain and Drayton Valley led the province in weighted population rate. Red Deer hospital stood out with both high number of procedures provided and a high weighted population rate. Coverage was quite focused in the North, Central, and South zones, while the coverage was widely spread out in Calgary and Edmonton zones.

Economic Analyses

We conducted the analysis to understand the potential cost-savings available in Alberta from a reduction of the use of colonoscopy and EGD for indications where it is not recommended. The analysis included two studies that reported effectiveness in reducing overuse of GI endoscopy. If the reported management strategies and associated effectiveness are applied to Alberta, we estimated that the potential annul cost avoidance to the health system would be $7.25 million for patients undergoing surveillance for colorectal adenomas, and $2.52 million for patients with symptoms of dyspepsia and/or GERD.

It is important to note that the scope of the economic analysis is to assess the direct cost due to endoscopy overuse. We therefore only considered the benefit of the management strategies in the reduction of the utilization of endoscopy. Other potential costs and benefits, such as the cost of implementing the management strategies as well as medical costs and patient outcomes affected by the strategies, were not included in our cost estimations.

Abbreviations

All abbreviations that have been used in this report are listed here, unless the abbreviation is well known, has been used only once, or has been used only in figures or tables, in which case the abbreviation is defined in the figure legend or in the notes at the end of the table.

AA	advanced adenoma
ACG	American College of Gastroenterology
ACS	American Cancer Society
ADR	Adenoma detection rate
AGREE	Appraisal of Guidelines for Research and Evaluation
AH	Alberta Health
AHCIP	Alberta Health Care Insurance Plan
aHR	adjusted hazard ratio
AHS	Alberta Health Services
aOR	adjusted odds ratio
aRR	adjusted relative risk
ASCO	American Society of Clinical Oncology
ASGE	American Society for Gastrointestinal Endoscopy
BSG	British Society of Gastroenterology
CAG	Canadian Association of Gastroenterology
CCI	Canadian Classification of Health Interventions
C-GRS	Canada-Global Rating Scale
CI	confidence interval
CoRS	colonoscopy pathology reporting and clinical decision support system
CPG	clinical practice guidelines
CRC	colorectal cancer
CTFPHC	Canadian Task Force on Preventive Health Care
DHSCN	Digestive Health Strategic Clinical Network
DAD	Discharge Abstract Database
EAG	Expert Advisory Group
ED	emergency department
EGD	esophagogastroduodenoscopy
EMR	electronic medical record

FSA	forward sortation area
FIT	fecal immunochemical tests
GERD	gastroesophageal reflux disease
GI	gastrointestinal
GRADE	Grading of Recommendations, Assessment, Development and Evaluations
HR	hazard ratio
HSCCPC	Health Service Canadian Classification of Procedures Extended Code
ICD	International Statistical Classification of Diseases and Related Health Problems
IHE	Institute of Health Economics
IQR	interquartile range
MeSH	Medical Subject Heading
NACRS	National Ambulatory Care Reporting System
NHMRC	National Health and Medical Research Council
NICE	National Institute for Health and Care Excellence
OR	odds ratio
QALY	quality-adjusted life-years
ROBINS-I	Risk Of Bias In Non-randomized Studies - of Interventions
RR	relative risk
SD	standard deviation
UCLA	University of California, Los Angeles
USMSTF	United States Multi-Society Task Force

Glossary

Advanced adenoma – A colorectal adenoma of at least 10 mm in size or containing high-grade dysplasia; may also include tubulovillous or villous histology.[1]

Advanced neoplasia – A combination of advanced adenomas and colorectal cancers.[1]

Appropriate care – The use of a procedure where the expected health benefits sufficiently exceed the expected negative consequences.[2]

Colonoscopy – The examination of the inside of the colon, including the rectum, sigmoid colon, descending colon, transverse colon, ascending colon, and cecum.[3]

Colorectal adenoma – abnormal growth in the colon lining; may also be referred to as a polyp.[3]

Dyspepsia – symptom of predominant epigastric pain, which can be associated with other any other upper gastrointestinal symptom (such as epigastric fullness, nausea, vomiting, or heartburn) provided that epigastric pain is the predominate symptom.[4]

Endoscope – An instrument consisting of a thin, hollow tube with a light and camera attached at the end.[3]

Endoscopy – A non-surgical procedure that uses an endoscope to diagnose or treat a condition.[3]

Esophagogastroduodenoscopy – The examination of the lining of the upper part of the gastrointestinal tract, which includes the esophagus, stomach and duodenum (first portion of the small intestine) using an endoscope. It can also be referred to as upper endoscopy or gastroscopy.[3]

Gastroesophageal reflux disease – a condition that develops when the reflux of stomach contents causes troublesome symptoms (for example, heartburn, regurgitation) and/or complications (for example, erosive esophagitis).[5]

High-risk adenomas – At least one advanced adenoma or three or more adenomas less than 10 mm in size.[6]

Inappropriate care – The use of a procedure where the risks exceed the benefits. Inappropriate care can be synonymous with overuse, low-value, and unnecessary care.[2]

Low-risk adenomas – One to two tubular colorectal adenomas with low-grade dysplasia, each less than 10 mm in size.[6]

Misuse – The delivery of the wrong care, including medical errors. Misuse of care occurs when a patient doesn't fully benefit from a procedure/treatment because of a preventable problem, or when a patient is harmed by a treatment.[7]

Overuse – The delivery of health care for which the risks outweigh the benefits. Overuse can be synonymous with inappropriate, unnecessary, or low-value care.[7]

Serrated polyp – The umbrella term used to describe hyperplastic polyps, sessile serrated lesions, sessile serrated lesions with dysplasia, traditional serrated adenomas, and mixed polyps.[1]

Sigmoidoscopy – The examination of the lining of the rectum and a portion of the colon. It is also called flexible sigmoidoscopy.[2]

Underuse – The failure to deliver health care for which the benefits outweigh the risks.[7]

Glossary Sources

The glossary terms listed above were obtained and adapted from the following sources:

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SECTION ONE: Introduction

1.1. Background

1.1.1. Endoscopic Procedures and Their Use

Gastrointestinal (GI) endoscopy is a procedure where an endoscope (a thin, hollow tube with a light and camera attached at the end) is used to visualize certain parts of the GI tract.[1] Endoscopy may be used to diagnose GI disorders/conditions through visual assessment of the mucosa, confirm a diagnosis through tissue collection via biopsy, for surveillance of conditions likely to progress or as a part of a preventive program, and/or to administer minimally invasive interventions to treat a variety of complex digestive diseases.[1]

Different types of GI endoscopy are used to examine different parts of the GI tract. The most common types are esophagogastroduodenoscopy (EGD), also known as upper endoscopy or gastroscopy, which visualizes the upper part of the GI tract including esophagus, stomach, and duodenum, and colonoscopy, which visualize the large intestine and colon.[1] Healthcare professionals including gastroenterologists, surgeons, trained family physicians, or nurse practitioners perform these procedures with the support of anesthesiologists and nurses, in dedicated endoscopy units within larger centres, in operating rooms, or in stand-alone facilities. After being referred by their primary care provider or specialist, patients usually undergo an endoscopic procedure after a clinic consultation with an endoscopist, though in some instances referring providers may utilize open access models or direct procedures referrals, whereby they refer patients directly for an endoscopy procedure without a previous endoscopist consultation.[2] Preparation may be necessary before an endoscopic procedure, particularly for colonoscopy, which may include an altered diet, fasting, taking laxatives and/or having an enema, and often sedation is used to aid in minimizing discomfort.

Since the development of the fiberoptic endoscope in the late 1950s, endoscopy has become an indispensable tool for gastroenterology. Continued improvement in diagnostic accuracy, treatment efficiency, safety, and patient comfort has contributed to the proliferation of its use and associated increase in cost. In Canada, almost two million EGDs and colonoscopies were performed in 2017-2018, costing $365 million in physician renumeration and a 13% total increase in utilization over five years.[3] As this suggests, the availability of endoscopy is being outstripped by demand, resulting in prolonged wait times, patient anxiety and reduced satisfaction, and potential adverse health effects like prolonged symptom affliction, later stage diagnosis, and the need for more complex treatments.[4, 5]

1.1.2. Appropriate Care

To address the increased service utilization, cost, and wait times, health systems have begun to evaluate the appropriateness of care, as a way to ensure sustainable, quality service use with constrained resources. There is no widely accepted definition of appropriate care, and the understanding of the perspective and scope varies.[6-8] Most commonly, a procedure is considered *appropriate* when it provides clinical benefit based on an acceptable risk ratio. A procedure is deemed *inappropriate* (also termed *unnecessary or low-value),* when the risks of the procedure exceed the benefits.[9] In addition to the clinical risk-benefit profile, judgments about the appropriateness of care may also include, depending on the perspective taken, cost-effectiveness, clinical judgment, patient-centredness, and equity.[6, 9]

There are many strategies to identify clinical- and cost-effective care (for example, clinical practice guideline), but methods focusing on identifying care that should be discontinued or not routinely

performed are still in their infancy.[10] Approaches such as systematic reviews, health technology assessments/reassessments, practice variation studies, and program budgeting and marginal analysis are methods that are not specific to assessing care that should be avoided or reduced, but have been implemented for such purposes.[11, 12]

The most rigorous and widely adopted method has been developed by RAND and the University of California, Los Angeles (UCLA), which combines available scientific evidence with the collective judgment of experts to evaluate the risks, benefits, and magnitude of the treatment effect to yield a statement regarding the appropriateness or inappropriateness of performing a procedure.[7, 9] The RAND-UCLA method was employed by the European Panel on the Appropriateness of Gastrointestinal Endoscopy first in 1999, and again when the recommendations were updated in 2009.[13, 14] In the 2009 update, 29% of the 463 assessed clinical scenarios were deemed inappropriate.[14]

The Choosing Wisely campaign is another well-known appropriateness initiative to identify and disseminate information regarding overused health services, promote physician responsibilities beyond caring for the patient, including quality improvement and the management of finite resources, and engage physicians and patients in conversations about tests and procedures that may not be warranted for the situation.[15, 16] The campaign has gathered significant momentum, which now spans 20 countries across five continents. The Choosing Wisely Canada list includes gastroenterology recommendations from the Canadian Association of Gastroenterology.[17]

Despite the existence of several appropriateness initiatives, and increased attention to priority setting and eliminating care with limited benefits, there have been continued difficulties in implementing and adhering to the recommendations, not just for endoscopy. This is in large part due to numerous contextual factors and biases in assessing and/or managing procedures that contribute to the continued overuse of health services.[10, 18]

1.1.3. Health Evidence Review Rationale

DHSCN has prioritized endoscopy quality as part of its 2017-2021 Transformational Roadmap.[19] The DHSCN and the Alberta Colorectal Cancer Screening Program have launched an Endoscopy Quality Working Group to implement, monitor, and evaluate an endoscopy quality management framework for Alberta; appropriateness is a key element of the framework. The Working Group identified a need to consistently evaluate the quality of endoscopy in Alberta and to provide a mechanism to support quality and service improvement in local endoscopy units.

The first initiative of this group was the provincial implementation of the Canada-Global Rating Scale (C-GRS)[20] at all adult endoscopy sites in Alberta. The C-GRS is an evidence-based, patient-centred approach to assessing the quality of endoscopic services and to guiding endoscopy teams to identify quality improvement opportunities.[20] The need to address appropriateness was highlighted by the most recent provincial C-GRS results which showed 80% of sites failed to achieve above the lowest rating for appropriateness, which was defined as ensuring endoscopies are scheduled based on published screening and surveillance guidelines, and auditing adherence to these guidelines to ensure acceptable levels of efficiency. Currently, procedure indication is not routinely recorded in the majority of Alberta's endoscopy units and can only be ascertained by chart review. Less than 30% of endoscopy teams perform audits of adherence to screening and surveillance guidelines, largely due to a lack of infrastructure to support audit and feedback.

Access to timely endoscopy and rates of endoscopy utilization are concerns in Alberta that have not been quantified. Reducing suboptimal utilization of GI endoscopy and ensuring procedures are

completed within recommended time frames will create capacity for more urgent indications and more appropriate use. Evidence is required to identify indications which do not warrant an endoscopic procedure, evaluate current guidelines and supplement gaps/inconsistencies in current recommendations, and identify how to best intervene to reduce overuse, in order to build capacity for the appropriate utilization of these high-cost procedures.

The following Health Evidence Review by the IHE will guide the DHSCN in identifying the scope of endoscopy overuse in Alberta and the potential solutions to intervening on the issue.

1.2. Objectives and Research Questions

The primary objectives of the proposed Health Evidence Review were the following:

1. identify GI endoscopy indications which have been recommended by clinical guidelines or other practice advice to be discontinued or reduced in frequency, yet continue to be used in high volumes in current practice
2. compare recommended criteria for endoscopies between clinical practice guidelines, to identify guideline concordance/discordance and any gaps in the recommendations for the selected indication(s)
3. identify new evidence published since the clinical practice guidelines, that may clarify guideline discordance and recommendation gaps for selected indication(s)
4. evaluate the evidence on the effectiveness of interventions intended to reduce referrals and procedures for the selected indication(s)
5. estimate the volume and geographical distribution of endoscopies in Alberta for the selected indication(s)
6. conduct cost-effectiveness analyses of the recommended interventions. The recommendations will be based on evidence review (i.e., published studies) as well as expert opinion, and will include interventions that have been shown to be effective and are applicable to the Alberta context
7. develop policies/implementation strategies that could optimize the Albertan endoscopy process while maintaining quality and safety using the recommendations and budget impact analysis.

The overarching policy question for this Health Evidence Review was: how can we reduce the number of endoscopies still performed in Alberta, which have been recommended by clinical guidelines or other practice advice to be discontinued or reduced in frequency, and encourage efficient and appropriate use of endoscopy services within the province?

To achieve the primary objectives and address the overarching policy question, the following research questions were addressed in this report. These research questions have been provided to guide the analysis and provide decision-makers with the information required to address the overarching policy question.

- **Alberta context:**
    1. What is the current utilization pattern (procedure volume and wait time) for endoscopies in Alberta?
    2. What is the economic burden of endoscopy use in terms of healthcare resource utilization and impact?

3. What is the current clinical pathway(s) in Alberta for deciding on a referral for an endoscopy?

- **Scoping literature review of endoscopy indications and relevant guidelines**:

4. What indications have recommendations for endoscopy not to be routinely performed or performed at reduced frequency, and what is the extent of their overuse, as indicated in the literature?
5. For select indication(s), are there any current clinical practice guidelines?
    - Are there major differences between guideline recommendations, and if so, what are they?
    - Are there any gaps in the recommendations presented in these guidelines and, if so, what are they?

- **Systematic review to supplement guideline recommendation gaps (systematic review 1):**

6. For select indication(s), what new evidence is available since the published guidelines, that may clarify recommendations where discordance/gaps exist?

- **Systematic review of interventions for reducing endoscopy overuse (systematic review 2):**

7. Are there effective strategies to reduce the use of endoscopies which have been recommended to be avoided or reduced in frequency, for selected indication(s)?
8. What are the facilitators and barriers to implementing these effective strategies?
9. If available, what are the proposed funding mechanisms for the interventions?

- **Epidemiology:**

10. How frequently are the selected indicated overused procedures performed in Alberta?
11. How is utilization distributed geographically in Alberta (across the entire province and between Zones and sites)?
12. What are the types and distribution of endoscopists and how do staff and facility resources vary?
13. How does endoscopy utilization vary by patient characteristics?

- **Economic Analyses:**

14. What are the unit and total costs per year of providing endoscopies to the population for which it is indicated its use should be avoided or reduced in frequency?
15. What is the cost-effectiveness of the identified intervention(s) for reducing use of endoscopy for which has been recommend its use should be avoided or reduced in frequency?
16. What are the potential cost savings available to the system if the identified intervention(s) for reducing use of endoscopy, for the selected indication(s), were adopted?

- **Policy Option Analysis:**

17. Based on the findings from above, what are the recommendations/policy options for reducing use of endoscopy when indicated its use should be avoided or reduced in

frequency in the Alberta context, to inform the development of novel strategies to optimizing endoscopy utilization?

1.3. Methodological Approach

We used Soril et al.'s[21] health technology reassessment framework to identify and organize endoscopy overuse. The model consists of three phases and six stages:

- Phase one: Technology selection
  - Identification
  - Prioritization
- Phase two: decisions
  - Evidence synthesis
  - Policy/practice recommendations
- Phase three: Execution
  - Policy/practice implementation
  - Monitoring/evaluation

Stakeholder engagement and ongoing knowledge exchange and utilization are incorporated across all stages. This report will encompass the first two phases.

The Health Evidence Review consists of seven components: Alberta context (Section Two), scoping review of indications and guidelines (Section Three), systematic review of new evidence to clarify guideline discordance (Section Four), systematic review of interventions to reduce endoscopy overuse (Section Five), epidemiology of endoscopy use in Alberta (Section Six), economic analyses (Section Seven), and policy option analysis. It was based on a workplan that was approved by the DHSCN, Alberta Health (AH). Section Two to Seven will be presented in this report, and policy option analysis will be presented in a companion document.

For the purpose of this report, we focused on care that was overused; that is, endoscopy indications for which there is evidence of a lack of clinical and (if available) cost justification, yet services for such indications continue to be delivered within the Albertan or similar health care systems, consuming substantial healthcare resources. Identifying underuse, a lack of resource use for clinically and economically justified (appropriate) indications, was outside the scope of this Health Evidence Review project.

Various methods were used to gather relevant data and conduct this report (Table 1.1). The detailed methodology for each section is described in sections two to seven.

Table 1.1: Overview of methodological approaches

Section	Component	Data source(s)	Objective(s)	Research question(s)
Context	Targeted literature review of endoscopy utilization and impact	Published and grey literature	Not applicable	1–3
	Internal and routine administrative data	Alberta data		
	Consultations with targeted clinical and operational experts			

Section	Component	Data source(s)	Objective(s)	Research question(s)
Scoping review	Scoping literature review of indications where endoscopy should be avoided or reduced	Clinical practice guidelines Published literature Grey literature	1–2	4–5
	Consultations with targeted clinical and operational experts			
Systematic review 1	Systematic review of primary studies that supplement discordant clinical practice guideline recommendations	Published literature Grey literature	3	6
Systematic review 2	Systematic review of primary studies on effective interventions to reduce endoscopy overuse	Published primary studies Grey literature	4	7–9
Epidemiology	Utilization rates and costs associated with overused endoscopies from Alberta's administrative health data	Administrative health data Data from published sources and/or expert opinion may also be obtained if necessary	5	10–13
Economic analyses	Decision analytic model for assessing the cost-effectiveness of interventions targeted at reducing endoscopy overuse in Alberta	Administrative health data Data from published sources and/or expert opinion may also be obtained if necessary	6	14–16
Policy option analysis[a]	Recommendations for implementation options	Key findings from above sections	7	17

[a] Policy option analysis will be presented in a separate document.

1.3.1. Expert Advisory Group

As part of the Health Evidence Review, an Expert Advisory Group (EAG) was convened. The role of the EAG was to advise on the scope and direction of the review and the contextualization of findings. Individuals serving on the EAG were appointed by AH based on nominations from the DHSCN and IHE. Membership of the EAG included clinicians and other professionals responsible for endoscopy care such as program and service managers, as well as budget holders, administrators, policy-makers from impacted areas, and patient representatives.

The specific involvement of the EAG is described where appropriate in sections two to seven.

SECTION TWO: Alberta Context

Lindsey Warkentin, MSc, Dat Tran, PhD, Lisa Tjosvold, MLIS, Bing Guo, MD, MSc

This section is an environmental scan of the Albertan endoscopy landscape, to describe the province's overall endoscopy utilization, cost and available health system supports.

The following research questions were addressed:

- What is the current utilization pattern (procedure volume and wait time) for endoscopies in Alberta?
- What is the economic burden of endoscopy use in terms of healthcare resource utilization and impact?
- What is the current clinical pathway(s) in Alberta for deciding on a referral for an endoscopy?

The most common GI endoscopy procedures, identified by the DHSCN, that are of most interest to this project are EGD and colonoscopy, and will therefore be the focus of this section.

2.1. Resource Utilization and Economic Impact

An information specialist (LT) conducted targeted searches for publicly available, Alberta specific, utilization and economic data published from January 2015 to June 2020. In addition, we queried available Alberta data (including Discharge Abstract Database, National Ambulatory Care Reporting System, Practitioner Claims, and Alberta Health Care Insurance Plan Registry) when publicly available data were not available.

For each procedure, we searched for the following data on the procedures performed and those waiting for a procedure: number of procedures performed or the number of patients currently waiting for a procedure, location of procedure or waiting (AHS geographical zone [Calgary, Edmonton, North, South, and Central], urban/rural, large centre/stand alone facility), endoscopist type (gastroenterologist, surgeon, trained family physician, or nurse practitioner), referring provider type (family physician, gastroenterologist, or other specialist), patient demographics (sex, age), indication, cost, and average wait time. Two researchers (LW, DT) summarized the utilization data in the text and tables below.

2.1.1. Gastrointestinal Endoscopy

There are 50 adult endoscopy sites across the health zones in Alberta; the sites perform approximately 250,000 endoscopic procedures annually, at a cost of almost $120 million.[22] The volume of endoscopies has increased 2 to 9% per year, with a volume increase of 19% from 2012–2013 to 2016–2017 (see Table. 2.1).[22, 23] This increase in demand has led to prolonged wait times: non-urgent condition wait times range from 9 to 24 months, and more urgent conditions are exceeding the eight-week wait time Canadian benchmark.[22, 24] Gastroenterologists perform the majority of procedures.

Table 2.1: Endoscopy procedures performed in Alberta

Subgroup	Year(s)	Number of procedures preformed	Cost (CND)
All procedures[23]	2017–2018	248,995[a]	156 million[b]

Subgroup	Year(s)	Number of procedures preformed	Cost (CND)
Zone[25]			
North	2016–2017	32,198[a]	
	2015–2016	32,936[a]	
Edmonton	2016–2017	72,212[a]	
	2015–2016	85,290[a]	
Central	2016–2017	38,926[a]	
	2015–2016	38,355[a]	
Calgary	2016-2017	89,263[a]	
	2015–2016	99,242[a]	
South	2016–2017	25,057[a]	
	2015–2016	24,311[a]	
Endoscopist[26]			
Gastroenterology	2010–2018	987,658	
General surgery	2010–2018	547,146	
General practice	2010–2018	145,753	
Internal medicine	2010–2018	215,568	
Others	2010–2018	76,563	

[a] Outpatient endoscopies.

[b] Estimated using the Canadian Institute for Health Information Research Intensity Weight methodology, including nursing, laboratory, medical imaging, and indirect hospital infrastructure costs, as well as physician procedure claims.

2.1.2. Esophagogastroduodenoscopy

The number of patients waiting for an EGD procedure from a gastroenterologist has more than doubled in the last five years, with the median time waiting for an EGD after consultation increasing to 23.5 weeks in 2019 (reasonable median wait time was 5.5 weeks), from 18.0 weeks in 2015 (median reasonable wait time is four weeks) (Table 2.2).[4, 27]

Table 2.2: Esophagogastroduodenoscopy wait times in Alberta

Subgroup	Year	Number waiting	Time waiting (median weeks)[a]
Endoscopist[4, 27-30]			
Internal medicine	2019	766	23.5
	2018	579	18.0
	2017	292	12.0
	2016	251	12.0
	2015	299	18.0

[a] From specialist consultation to endoscopy procedure.

The number of EGDs performed has also risen sharply, with a 15% increase from 2014-2015 to 2017-2018, costing the health system almost a million additional dollars annually in physician remuneration (see Table 2.3).[3] Gastroenterologists perform the majority of EGDs (66.4%), with surgeons preforming just under a third (27.5%) and family physicians performing a small proportion (6.1%).[3]

Table 2.3: Esophagogastroduodenoscopies performed in Alberta

Subgroup	Year(s)	Number of procedures preformed	Cost (CND)[a]
All procedures[3]	2017–2018	49,613	$5,755,869
	2016–2017	47,684	$5,558,506
	2015–2016	44,978	$5,219,049
	2014–2015	42,009	$4,851,721
Endoscopist[3]			
Medical specialists	2017–2018	32,946	$3,856,592
	2016–2017	30,813	$3,610,177
	2015–2016	29,081	$3,403,347
	2014–2015	26,460	$3,082,278
Surgical specialists	2017–2018	13,643	$1,563,664
	2016–2017	13,780	$1,600,433
	2015–2016	13,080	$1,500,787
	2014–2015	12,658	$1,444,461
Family medicine	2017–2018	3,024	$335,613
	2016–2017	3,091	$347,896
	2015–2016	2,817	$314,916
	2014–2015	2,891	$324,973

[a] Physician payment only.

2.1.3. Colonoscopy

The number waiting for colonoscopies has varied greatly in the last five years, with more than 17,000 patients waiting for a colonoscopy in 2019, and the median wait time after specialist consultation being up to 23.5 weeks (Table 2.4).[4] Note that these numbers are based on physician survey and are estimates rather than true counted totals.

Table 2.4: Colonoscopy wait times in Alberta

Subgroup	Year	Number waiting	Time waiting (median weeks)
Endoscopist [4, 27-30]			
Internal medicine	2019	17,233	23.5[a]
	2018	9,483	13.0[a]
	2017	13,195	23.0[a]
	2016	6,551	12.1[a]
	2015	8,925	18.0[a]
General surgery	2019	2,850	10.0[a]
	2018	4,254	12.0[a]
	2017	2,270	8.0[a]
	2016	1,872	7.0[a]
	2015	2,699	10.0[a]
Indication			
Abnormal fecal test[27]	2015		9.0[b,c]

[a] From specialist consultation to endoscopy procedure.

[b] Wait time start not specified.

[c] Colonoscopies completed longer than 26 weeks after abnormal fecal test were excluded.

There were 91,037 colonoscopies performed in 2017-2018, a 7% increase over four years, which cost the health system more than $22 million.[3] Currently, colonoscopies for CRC and screening or surveillance accounts for 30% of all endoscopies performed in Alberta, with the majority performed in the Calgary and Edmonton Zones.[23] Gastroenterologists perform 61.2% of colonoscopies, surgeons perform 32.2% and family physicians perform 5.7% (Table 2.5).[3]

Table 2.5: Colonoscopy procedures performed in Alberta

Subgroup	Year(s)	Number of procedures preformed	Cost (CND)[a]
All Procedures [3]	2017–2018	91,037	$22,469,224
	2016–2017	90,302	$24,261,552
	2015–2016	86,322	$22,812,801
	2014–2015	84,772	$21,612,676
Zone[26]			
South	2010–2018	89,537	
Calgary	2010–2018	429,140	
Central	2010–2018	140,138	
Edmonton	2010–2018	386,238	
North	2010–2018	123,734	
Endoscopist [3]			
Medical specialists	2017–2018	56,565	$14,039,343
	2016–2017	54,224	$14,942,534
	2015–2016	52,465	$14,140,641
	2014–2015	51,121	$13,264,759
Surgical specialists	2017–2018	29,310	$6,985,690
	2016–2017	31,031	$7,721,364
	2015–2016	29,049	$7,165,756
	2014–2015	28,906	$6,914,273
Family medicine	2017–2018	5,162	$1,444,191
	2016–2017	5,047	$1,597,655
	2015–2016	4,808	$1,506,405
	2014–2015	4,745	$1,433,643

[a] Physician payment only.

2.2. Clinical Pathways for Endoscopy Referral

To understand the clinical pathway, from symptom identification to receiving an endoscopic procedure, and the support for endoscopy referral, one researcher (LW) and the IHE information specialist (LT) conducted an environmental scan to identify and summarize the current clinical pathway to gastroenterology and/or endoscopy referral in Alberta. This involved conducting an informal search of the health system and government websites using relevant keywords.

2.2.1. Referral to Gastroenterology/Endoscopy

In Alberta, access to endoscopy is controlled either by gastroenterology service – where by primary care physicians must refer patients first to a gastroenterologist, who then decides to schedule endoscopy with or without prior consultation – or through direct referral to a surgeon. Within the Calgary zone, the majority of non-emergent referrals to a gastroenterologist are made through the Central Access and Triage Service.[31] Within the Edmonton zone, non-urgent referral to a gastroenterologist is most often made through an electronic consult request in Alberta's Netcare Electronic Health Record eReferral system or faxed to the Single Point of Referral Triage.[32, 33] For the North, Central, and South zone, as well as some exceptions in the Calgary and Edmonton zone, the following referral processes occur: for some specific endoscopists, referrals are sent directly to their office and managed internally, and eligible patients may be referred for colon cancer screening directly to the Alberta Colorectal Cancer Screening Program in Calgary or the SCOPE program in Edmonton.[34] The Alberta Referral Directory, and a Calgary zone Gastroenterology referral quick reference provides referral guidelines including eligibility requirement, required tests/investigations, and necessary information to record on the referral as to help guide physicians in the decision to refer patients.[31, 35]

2.2.2. Primary Care Supports

Within the Calgary zone, seven Primary Care Networks and gastroenterologists had partnered in 2015 to develop a Health System Support specialist Integration Task group, in order to build capacity within a patient's medical home.[36, 37] A *Specialist LINK* service was created, which includes a real-time, physician-only tele-advice line (response within one hour), that supports family physicians to care for their patients by receiving guidance and confirming treatment plans with an appropriate specialist. In the Edmonton Zone, a *Connect MD* service functions similarly to the Specialist LINK tele-advice line.[36] Specialist LINK had also created evidence-based primary care pathways, to guide family doctors on the treatment of low-risk conditions. Appropriate indications for referral for gastroenterology consultation/endoscopy are built into the primary care pathways. The DHSCN made the decision in 2017 to lead an initiative to validate the applicability of these pathways and to spread availability and foster adoption of the pathways across Alberta. To date, gastroenterology care pathways have been developed for chronic abdominal pain, chronic constipation, chronic diarrhea, dyspepsia, gastroesophageal reflux disease, *H. pylori*, irritable bowel syndrome, iron deficiency anemia and high-risk rectal bleeding.[36, 38] The pathways incorporate clinical practice guidelines, and are reviewed and revised by a multi-disciplinary team led by family physicians and gastroenterologists every five years. From inception to 2018-2019, the gastroenterology care pathways have been downloaded 2,458 times, and there were 982 tele-advice requests through Specialist LINK.[37]

AHS has also recently developed an *eReferral Advice Request* for adult gastroenterology and general surgery, which allows physicians and clinical support staff to submit non-urgent questions to a specialist through Alberta's Netcare Electronic Health Record and receive a response within five calendar days.[32, 36] This may also allow patients to avoid unnecessary referral to specialists, while receiving evidence-based treatment plans within their medical home.

Specific to colorectal screening and surveillance, the Alberta Colorectal Cancer Screening Program provides guidance through *www.screeningforlife.ca/coloractal*. This website, along with guiding documents[39, 40] provide patients and health care providers resources to understand CRC risk factors, eligibility for cancer screening and surveillance, and the processes of referral, screening, and follow up.

SECTION THREE: Scoping Review of Indications Where Endoscopy Use Should be Reduced or Avoided and their Relevant Guidelines

Lindsey Warkentin, MSc, Lisa Tjosvold, MLIS, Mohammad Karkhaneh, MD, PhD, Bing Guo, MD, MSc

3.1. Objective and Research Questions

This is a scoping review to identify indications where GI endoscopy use should be reduced or avoided (due to the risks outweighing benefits, a lack of evidence to support use, and/or as suggested through consensus), clinical practice guideline (CPG) variation, and CPG recommendation gaps.

The primary objectives of this section are to:

- Identify GI endoscopy indications which have been recommend by clinical guidelines or other practice advice to be discontinued or reduced in frequently, yet continue to be used in high volumes in current practice.
- Compare such recommendations between CPGs, to identify guideline concordance/discordance, and any gaps in the recommendations, for the selected indications.

The following research questions will be addressed by this review:

- What indications have recommendations for endoscopy not to be routinely performed or performed at reduced frequency, and what is the extent of their overuse, as indicated in the literature?
- For selected indications, are there any current CPGs?
    - Are there major differences between guideline recommendations, and if so, what are they?
    - Are there any gaps in the recommendations presented in these guidelines and, if so, what are they?

3.2. Methods

This scoping review consists of two elements: review of literature that reported on recommendations for use of GI endoscopy, to generate a list of indications where endoscopy use should be avoided or performed less frequently, and a comparison of CPG recommendations for those indications which were selected by the stakeholders to be of high priority.

Our methods for identification and prioritization of indications, where endoscopies should not be routinely performed, are similar to those proposed by Soril et al.(2018),[41] and included compiling recommendations from available literature, identifying prevalence of overuse and associated costs of recommendations in the literature, prioritizing indications based on stakeholder selected criteria, and stakeholder review and selection of indications.

3.2.1. Literature Search

To identify published academic literature, an IHE information specialist (LT) conducted a database search in MEDLINE and Embase. A combination of relevant keywords and medical subject heading (MeSH) terms were used, including: *colonoscopy* or *gastroscopy* or *sigmoidoscopy* or *esophagogastroduodenoscopy* and *duodenum** or *gastro** or *stomach* or *esophag** or *intestin** or *digestive* and *health*

services misuse or *unnecessary* or *overuse* or *inappropriate* or *unneeded* or *ineffective* and *guideline* and *adherence* or *compliance* or *comply* or *follow* or *concordance*. To identify grey literature, the IHE information specialist (LT) searched the Internet and websites of HTA and government agencies relevant societies and associations, and appropriate care initiatives. In addition, we checked reference lists and conducted key word searches in Endnote. We included evidence from Canada, Australia, New Zealand, the United Kingdom, and the United States. We included English-language articles published from 2010 to 2020. A detailed search strategy for the literature is available in Appendix A, Table A.1.

3.2.2. Study Selection

One reviewer (LW) screened the titles and abstracts of all retrieved citations, and assessed the full text of any potentially relevant articles (Table 3.1). For identifying indications, CPGs were excluded if they are were not published within the last ten years or had a subsequent published revision. For any study reporting on the prevalence or cost of overuse, relevant guidelines used by those studies needed to be published within the last 10 years, and for reviews with multiple studies, the majority (greater than 50%) of included studies had to use guidelines published within the last 10 years. Articles pertaining to bowel preparation, comparison of imaging/biopsy/tissue collection techniques or other quality indicators were excluded, as they do not pertain to the decision to use endoscopy. Articles surveying physicians on guidelines adherence were not included, as these do not provide details on actual endoscopy recommendations or use. A second reviewer (MK) screened a random sample of 10% of the citations from database searches and all grey literature, and checked all included studies against study selection criterion, with uncertainties resolved by discussion. The grey literature search was updated after indication selection, to ensure all relevant, current guidelines were identified for the indications of interest.

Table 3.1: Selection criteria for literature on indications where endoscopy should not be performed or use should be limited

	Description	
Research question	**What indications have recommendations for endoscopy not to be routinely performed or performed at reduced frequency?**	**What is the extent of endoscopy overuse?**
Study design	• Clinical practice guidelines • Systematic reviews, health technology assessments, other reviews • Grey literature with recommendations on endoscopy use (e.g., Choose Wisely, "do not do" lists)	• Systematic reviews • Primary studies (e.g., cohort, cross-sectional, before-and-after studies)
Population	*Included* • Adults aged ≥18 years who have gastrointestinal tract indications for non-urgent (routine), semi-urgent (to be assesses within 8 weeks), or urgent (to be assessed within 2 weeks) endoscopic investigation (e.g., dyspepsia, dysphagia, persistent gastroesophageal reflux, lower abdominal pain, chronic diarrhea, chronic constipation, hemodynamically stable gastrointestinal bleeding, positive celiac antibody test results, abnormal fecal immunochemical test, weight loss, iron-deficiency anemia) or those who may be eligible for endoscopic surveillance (e.g., Barrett esophagus, ulcerative colitis, Crohn's disease, irritable bowel syndrome, post-gastro intestinal malignancy, post-colonic polypectomy) *Excluded* • Indications for emergency investigations (e.g., perforations, complete obstructions, mesenteric ischemia, infection/abscess, hemodynamically unstable gastrointestinal bleeding)	

	Description	
Research question	**What indications have recommendations for endoscopy not to be routinely performed or performed at reduced frequency?**	**What is the extent of endoscopy overuse?**
Intervention	*Included* • Use of any of the following endoscopy procedures for the purpose of diagnosis or surveillance: esophagogastroduodenoscopy (gastroscopy), colonoscopy, sigmoidoscopy *Excluded* • Endoscopic retrograde cholangiopancreatography, endoscopic ultrasound, enteroscopy, capsule endoscopy • Bowel preparation • Pre-, intra- or post-endoscopy processes (examples: patient instructions, endoscopist training, sedation, management of adverse events) • Imaging, biopsy, and tissue collection techniques	
Setting/provider	*Included* • Procedures performed in an outpatient setting • All health professionals providing endoscopy procedures (e.g., gastroenterologists, surgeons, trained general practitioners, and/or other trained practitioners) *Excluded* • Inpatient endoscopies	
Outcomes of interest	*Included* • Indications with recommendations for endoscopy use discontinuation, reduction or avoidance *Excluded* • Diagnostic accuracy of endoscopic procedures • Recommendation for other quality indicators (such as adenoma detection rate, cecal intubation rate, withdrawal time)	*Included* • Rates of nonadherence to indication recommendations • Sensitivity, specificity or diagnostic yield of adhering to guideline recommendations • Wait times • Cost *Excluded* • Physicians' recommendation adherence ascertained from survey

3.2.3. Quality Assessment

For articles (CPGs, review or grey literature) reporting recommendations, quality was not assessed, and instead any information about quality assessment conducted by the authors of the recommendations was extracted. For example, the strength of the recommendation and quality of supporting evidence reported were extracted for the specific CPG guideline recommendation. No quality assessment was conducted for primary studies on the extent of overuse.

For the national CPGs which were included as part of the narrative comparison of recommendations for selected indications, quality was assessed and reported using the Appraisal of Guidelines for Research and Evaluation tool II (AGREE II),[42] supplemented by the IHE developed Boolean-based User Guide.[43] The AGREE II tool has 23 items organized into six domains: scope and purpose, stakeholder involvement, rigour of development, clarity of presentation, applicability, and editorial independence. Two reviewers (LW, MK) independently conducted the guideline quality assessments. The guidelines were rated as good, average, or poor according to the seven essential quality items specified in the Boolean-User guide: systematic search conducted; methods used to formulate recommendations described; link between recommendations and evidence; external

review by experts; specific, unambiguous recommendations; editorially independent from funder, and conflicts of interest reported.[43]

3.2.4. Data Extraction and Synthesis

One reviewer (LW or MK) extracted relevant information on the recommendations into a standardized data extraction table (Appendix A). Recommendations were considered relevant if they contained any of the terms: *do not do/perform*, *not recommended*, *not indicated*, *no more frequently than*, *avoid performing*, *not warranted*, and/or *advise against*. Data from primary studies reporting endoscopy overuse was also extracted (Appendix A).

To generate the final list of indications/recommendations, identical or similar recommendations were amalgamated and summarized in tables. Recommendations from Canadian national guidelines were used in the event of variation between similar recommendations; when recommendations from Canadian national guidelines were unavailable, the most recent recommendation were used. The indication list and evidence summary tables for overuse studies were checked by a second reviewer (MK).

The compiled list of indications/recommendations was discussed by IHE, AH, and DHSCN, to agree on prioritization criterion and to ensure the indication/procedures have identifiable Albertan administrative data. The indications were prioritized by

- the quality/strength of the supporting evidence for recommendations – indications with reported supporting evidence of moderate to strong quality were prioritized over indications with reported very low to low-quality supporting evidence, as well as those indications for which the quality of supporting evidence for recommendations was not reported. In the event that the reported quality of the supporting evidence varied between CPGs, recommendations with the strongest supporting evidence were used for prioritization
- the amount of evidence of overuse identified from primary studies
- the stakeholder's expert opinion on procedure volume for the indication and perceived potential overuse within Alberta.

Selected indications were approved by the EAG, and became the focus of the review for new evidence to clarify guideline discordance, systematic review of the effectiveness of strategies to reduce endoscopy overuse, frequency of endoscopy overuse in Alberta, and economic analyses.

For the comparison of guidelines for selected indications, one reviewer (LW) abstracted guideline information into standardized evidence inventory tables (details in Appendix A).

3.3. Results

3.3.1. Literature Search

From a total of 2,035 citations (titles and abstracts) identified, 53 articles were included after full-text assessment. There were 31 CPGs,[40, 44-73] two systematic reviews,[74, 75] six articles reporting low-value care lists,[17, 76-80] and 14 primary studies.[81-94] The study selection process is illustrated in Figure 3.1. The excluded studies and the reasons for their exclusion are listed in Appendix B.

3.3.2. Indications Where Endoscopy Use Should be Reduced or Avoided

Thirty-one CPGs,[40, 44-73] two systematic reviews,[74, 75] and six low-value care lists[17, 76-80] reported 134 indications where endoscopy should be reduced or avoided, which were amalgamated into 19 unique indications. Two indications were selected by the stakeholders for further examination: colorectal

adenoma surveillance and investigation of undiagnosed dyspepsia and/or gastroesophageal reflux disease (GERD; Table 3.2). The excluded indications were: investigation of abdominal pain, Barrett esophagus screening, Barrett esophagus surveillance (non-dysplastic, or dysplastic), CRC population screening (age of initiation and termination, modality), CRC screening for inflammatory bowel, colorectal adenoma surveillance for inflammatory bowel, investigation of constipation, investigation of diverticulitis, investigation of duodenal ulcer, gastric cancer surveillance, investigation of hiatal hernia, investigation of iron deficiency, investigation of irritable bowel, endoscopy in those with metastatic cancer, and endoscopy before a trial of proton-pump inhibitors (Appendix C, Table C.1).

3.3.3. Prevalence of Endoscopy Overuse

One low-value care prioritization report[80] and 14 primary studies[81-94] reported on the prevalence of and/or cost attributed to recommendation nonadherence for one or more indications, from Australia, Canada, United Kingdom, and the United States. The indications included Barrett esophagus surveillance (two studies), CRC screening and surveillance (12 studies), and dyspepsia/GERD (two studies)

Colonoscopy overuse varied from 0.3% (CRC screening in those older than 85 years) to 33.7% (premature colorectal adenoma surveillance); and EDG overuse varied from 27.9% to 37.9% (multiple indications combined). The descriptions of studies and their findings are provided in Appendix C, Table C.2.

Figure 3.1: Study identification and selection

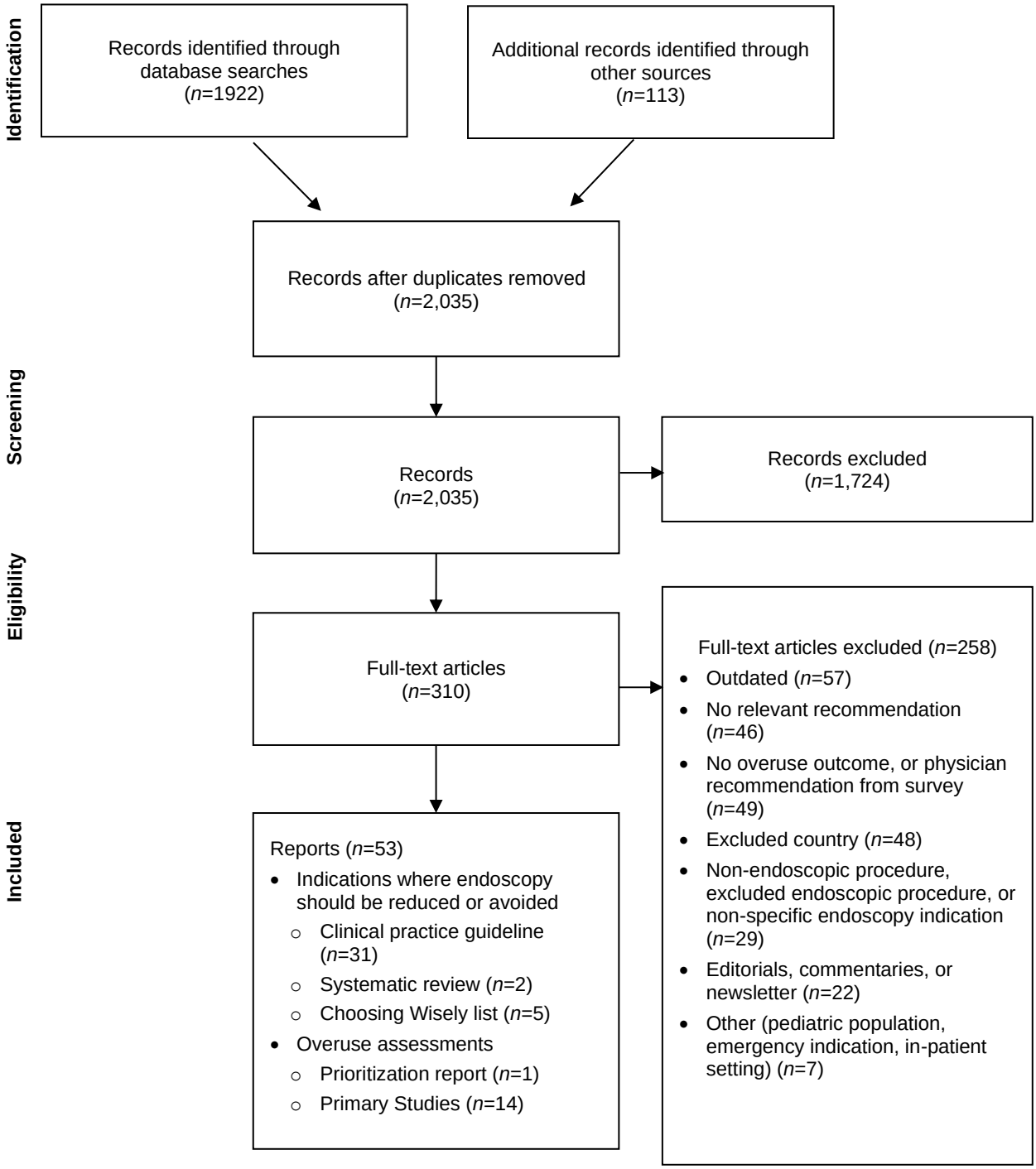

Table 3.2: Selected indications where endoscopy use should be reduced or avoided

Indication	Recommendation	Source(s)[a]	Rationale	Strength/quality of recommendation
Colorectal adenoma surveillance	• In patients with 1–4 tubular adenomas, <10mm with low grade dysplasia, participate in a national bowel cancer screening program 10 years after the index colonoscopy. If no program is available, repeat the colonoscopy after 10 years. • In patients with adenomas with villous histology or high-grade dysplasia or ≥10mm in size, or ≥5 adenomas, surveillance colonoscopy should occur no sooner than 3 years after the index colonoscopy.	• *ESGE 2020 CRC surveillance guidelines*[51] • USMSTF 2020 guidelines[53] • BSG 2020 guidelines[71] • NHMRC 2019 guidelines[54] • Cancer Care Ontario 2019 guidelines[60] • British Columbia 2013 guidelines[59] • Alberta 2013 guidelines[40] • Choosing Wisely CND[17] US,[78] and AUS[76]	• Progression from polyp to cancer occurs over many years; there is an increases risk for neoplasia with each additional adenoma. • The 5-year risk of advanced adenomas: ○ No polyps: 1.3–2.4% ○ 1–2 tubular adenomas: 2.4–6.1% ○ Large or multiple adenomas: 11.9–24.1% • The likelihood missing adenoma is higher in patients with multiple adenomas. • Serrated lesions are more difficult to detect; serrated lesion may be associated with up to one-third of CRCs.	ESGE: strong recommendation, moderate quality evidence USMSTF: strong recommendation, high-moderate quality evidence BSG: strong recommendation, low-quality evidence NHMRC: grade D recommendation
Dyspepsia and GERD	• Avoid performing an endoscopy for dyspepsia for patients younger than 60 years. • We recommend not screening adults (≥18 years) with chronic GERD for esophageal adenocarcinoma or precursor conditions (BE or dysplasia).	• *ACG-CAG 2017 guidelines (Recommendation 1)*[45] • *CTFPHC 2020 guidelines (Recommendation 2)*[72] • NICE 2019 guidelines[46] • NICE 2017 suspected cancer guidelines[47] • ASGE 2015 dyspepsia guidelines[48] • ASGE 2015 GERD guidelines[73] • Choosing Wisely CND[17]	• Risk of cancer in young patients: 0.2–0.4% • Alarm features had limited value in identifying any organic pathology: ○ Sensitivity: 67%, 95% CI [54%, 83%], ○ Specificity: 66%, 95% CI [55%, 79%], ○ Positive likelihood ratio: 2.74, 95% CI [1.47,5.24] • Endoscopy can identify precursor conditions earlier, but no difference in long-term survival. • Endoscopy is not cost-effective; there is little gain in symptom relief and considerable additional cost.	ACG-CAP: conditional recommendation, moderate quality evidence CTF: strong recommendation; very low certainty evidence NICE: moderate-high quality evidence ASGE: moderate quality evidence

[a] Recommendation details are reported from the italicized source.

ACG: American College of Gastroenterology; ACS: American Cancer Society; ASGE: American Society of Gastrointestinal Endoscopy; BE: Barrett esophagus; BSG: British Society of Gastroenterology; CAG: Canadian Association of Gastroenterology; CI: confidence interval; CND: Canada; CRC: colorectal cancer; CTFPHC: Canadian Task Force on Preventive Health Care; ESGE: European Society of Gastrointestinal Endoscopy; LR: likeliness ratio; NHMRC: National Health and Research Council; NICE: National Institute for Health and Care Excellence; USMSTF: United States Multi-Society Task Force.

3.3.4. Clinical Practice Guidelines of Selected Indications Where Endoscopy Use Should be Reduced or Avoided

Colorectal adenoma surveillance after initial index colonoscopy

Four national guidelines reported recommendations regarding colorectal adenoma surveillance after an index screening colonoscopy (Table 3.3).[51, 53, 54, 71] All recommendations focused on those with an average risk for CRC (that is, absence of inflammatory bowel diseases, family or personal history of CRC, and hereditary syndrome associated with increased risk) and presumed the bowel preparation and quality of the index colonoscopy was sufficient. All relevant guidelines have been updated within the last two years (2019). There was a slight variation in the breadth of recommendations, as well as the surveillance interval for similar index findings across all guidelines, with the greatest variation occurring for the recommendation for low-risk adenomas, which is generally defined as one to two adenomas that are less than 10 mm in diameter.

The United States Multi-Society Task Force (USMSTF) updated their recommendations for post-polypectomy follow up in February 2020.[53] Recommended surveillance intervals were seven to 10 years for low-risk adenomas, three to five years for moderate risk adenomas (three to nine adenomas that are less than 10 mm in size), and one to three years for high-risk adenomas (10 or more adenomas, or an adenoma greater than or equal to 10 mm, or with tubulovillousity, or with high grade dysplasia). Intervals for low-risk adenomas increased from five to 10 years between previous guidelines, as additional studies confirmed long-term outcomes from prior evidence, to suggest that this population was at low risk for advance neoplasia. The guideline reported one meta-analysis of seven studies (11,387 patients), with a pooled rate of metachronous advanced neoplasia of 3.6% after two to five years of follow up for low-risk index adenomas compared with a pooled rate of 1.6% in those with normal index colonoscopies.[95] Another meta-analysis of eight studies (10,139 patients) found the five-year cumulative incidence of metachronous advanced neoplasia was 4.9% for low-risk adenomas compared with 17.1% in those who had advanced index adenomas, and 3.3% in those with no adenomas.[96] The guidelines also reported on three cohort studies, which found that the risk of CRC was similar to or lower than the general population.[97-99] The guidelines reported the strength of the recommendation as strong (benefits clearly outweigh risks and burden or vice versa) and the quality of the evidence as "moderate" (further research will probably have an important effect on our confidence in the estimate of effect, and may change the estimate).

Table 3.3: Colorectal adenoma surveillance clinical practice guidelines recommendation summaries

	United States USMSTF 2020[53]	Europe ESGE 2020[51]	United Kingdom BSG 2020[71]	Australia NHMRC 2019[54]
Methodology	*Evidence:* PubMed, Embase, and CINAHL up to Sep 2018 *Consensus:* 2 authors developed recommendations, then refined through consensus with all authors *Quality Assessment:* GRADE	*Evidence:* MEDLINE and Cochrane Central Register of Controlled Trials up to Oct. 2019 *Consensus:* leaders of each task force drafted recommendations, then distributed to all task force members for revision and discussion *Quality Assessment:* GRADE	*Evidence:* MEDLINE, Embase, and Cochrane Library database from 2007 to Jan. 2018 *Consensus:* guideline development group defined the research questions, reviewed the evidence summaries and voted on recommendations *Quality Assessment:* GRADE	*Evidence:* PubMed, Embase, Cochrane Database, DARE, CINAHL and PsycINFO up to June 2017 *Consensus:* NHMRC working party members developed recommendations, with feedback from public consultation before finalization *Quality Assessment:* NHMRC evidence statements
1–2 tubular adenomas <10 mm				
Surveillance interval ***Recommendation strength/evidence quality***	7–10 years *Strong recommendation; moderate quality evidence*	Return to screening program (or colonoscopy in 10 years if no screening program exists) *Strong recommendation; moderate quality evidence*	No colonoscopy surveillance (if eligible, participate in national bowel screening program) *Strong recommendation; low-quality evidence*	>5 years *D recommendation; level II and III-2 evidence*
3–4 tubular adenomas <10 mm				
Surveillance interval ***Recommendation strength/evidence quality***	3–5 years *Weak recommendation; very low-quality evidence*	Return to screening program (or colonoscopy in 10 years if no screening program exists) *Strong recommendation; moderate quality evidence*	≥2 premalignant polyps with at least one being an advanced colorectal polyp:[a] 3 years *Strong recommendation; low-quality evidence*	<5 years *D recommendation; level II and III-2 evidence*
5–9 tubular adenomas <10 mm				
Surveillance interval ***Recommendation strength/evidence quality***	5–10 adenomas: 3 years *Strong recommendation; moderate quality evidence*	3 years *Strong recommendation; moderate quality evidence*	3 years *Strong recommendation; low-quality evidence*	<3 years *D recommendation; level III-2 evidence*
≥10 adenomas				

	United States **USMSTF 2020[53]**	**Europe** **ESGE 2020[51]**	**United Kingdom** **BSG 2020[71]**	**Australia** **NHMRC 2019[54]**
Surveillance interval ***Recommendation strength/evidence quality***	>10 adenomas: 1 year *Weak recommendation; very low-quality evidence*	3 years *Strong recommendation; moderate quality evidence*	3 years *Strong recommendation; low-quality evidence*	<3 years *D recommendation; level III-2 evidence*
Adenoma(s) ≥10 mm				
Surveillance interval ***Recommendation strength evidence quality***	3 years *Strong recommendation; high quality evidence*	3 years *Strong recommendation; moderate quality evidence*	≥2 premalignant polyps with at least one being an advanced colorectal polyp:[a] 3 years *Strong recommendation; low-quality evidence*	<5 years *D recommendation; level II and III-2 evidence*
Adenoma(s) with HGD or villosity				
Surveillance interval ***Recommendation strength/evidence quality***	3 years *Strong recommendation; moderate quality evidence*	HGD: 3 years Villosity: return to screening program (or colonoscopy in 10 years if no screening program exists) *All strong recommendations; moderate quality evidence*	≥2 premalignant polyps with at least one being an advanced colorectal polyp:[a] 3 years *Strong recommendation; low-quality evidence*	<5 years *D recommendation; level II and III-2 evidence*
Serrated lesion(s)				
Surveillance interval **Recommendation strength/evidence quality**	1–2 SPs <10mm: 3-10 years 3–5 SPs <10mm: 3–5 years 5–10 SPs <10mm, ≥10mm, or with HGD: 3 years Traditional serrated adenoma: 3 years *All weak recommendations; very low-quality evidence*	<10mm, no dysplasia: Return to screening program (or colonoscopy in 10 years if no screening program exists) ≥10mm, or with dysplasia: 3 years *All strong recommendations; moderate quality evidence*	≥2 premalignant polyps with at least one being an advanced colorectal polyp:[a] 3 years *Strong recommendation; low-quality evidence*	<5 years *D recommendation; level II and III-2 evidence*
Hyperplastic polyp(s) <10 mm				

	United States USMSTF 2020[53]	Europe ESGE 2020[51]	United Kingdom BSG 2020[71]	Australia NHMRC 2019[54]
Surveillance interval ***Recommendation strength/evidence quality***	≤20 in rectum or sigmoid colon: 10 years (colonoscopy or other screening modality) *Strong recommendation; moderate quality evidence* ≤20 proximal to sigmoid colon: 10 years *Weak recommendation; very low-quality evidence* ≥10mm: 3–5 years *Weak recommendation; very low-quality evidence*		≥2 premalignant polyps with at least one being an advanced colorectal polyp:[a] 3 years *Strong recommendation; low-quality evidence*	>5 years *D recommendation; level II and III-2 evidence* ≥10mm: <5 years *D recommendation; level II and III-2 evidence*

[a] premalignant polyps: serrated polyps (excluding diminutive [1–5mm] rectal hyperplastic polyps) and adenomatous polyps; advanced colorectal polyps: serrated polyp with dysplasia, adenoma ≥10mm, adenoma with high-grade dysplasia.

BSG: British Society of Gastroenterology; ESGE: European Society of Gastrointestinal Endoscopy; GRADE: Grades of Recommendation, Assessment, Development, and Evaluation; NHMRC: National Health and Medical Research Council; SR: systematic review; SP: serrate polyp; USMSTF: United States Multi-Society Task Force.

Several studies were cited that suggested patients with nonadvanced adenomas has a long-term risk of CRC incidence and mortality similar to, or lower than that of patients without adenomas on the index colonoscopy.[96-108] The guidelines also included up to four adenomas in the no surveillance recommendation, based on evidence from three retrospective studies. First, a series of 15,953 post-polypectomy patients showed that those with up to three adenomas were at no increased risk for CRC compared to those with no adenomas after 13 years' follow up (adjusted rate ratio for incidence 1.3, 95% confidence interval (CI) [0.9, 1.9]; adjusted rate ratio for mortality 1.2, 95% CI [0.5, 2.7]).[99] Second, A multicenter study of 11,944 patients showed that the number of nonadvanced adenomas was not independently associated with a higher risk of CRC incidence or morality at a median of 7.9 years' follow up, and a lower risk than the general population (standardized incidence ratio 0.5, 95% CI [0.3, 0.8]).[109] Third, a screening-based series of 236,089 patients found that the number of adenomas, or those less than 20 mm in size are at a lower risk for CRC than the general population (standardized incidence ratio 0.35, 95% CI [0.28, 0.44]).[101] In addition, up to four adenomas did not increase the risk of metachronous advanced neoplasia.[110] Villosity and small serrated polyps without dysplasia were also recommended for no surveillance, as neither characteristic conferred a long-term increased risk of CRC.[101, 102, 109] Using GRADE, the strength of the recommendation was strong, with the supporting evidence being of moderate quality.

The British Society of Gastroenterology (BSG) updated their post-polypectomy surveillance guidelines in January 2020.[71] These guidelines incorporated the newer national bowel cancer screening program,[111] and took the stance of only encouraging surveillance when benefits had been well demonstrated in the evidence. The guidelines stated that the greatest benefit in terms of CRC prevention is derived from the index polypectomy rather than subsequent surveillance (though the evidence summary did not identify any studies that assessed this), and that there is considerable burden on patients and endoscopy services because of these surveillance colonoscopies. The guideline evidence identified those with two or more premalignant polyps with at least one advanced colorectal polyp, or five or more premalignant polyps as being at high risk for CRC and suggested they undergo colonoscopy surveillance. Alternatively, those without high-risk findings were recommended against receiving colonoscopy surveillance, and instead to participate in the national bowel cancer screening program, if eligible. The recommendation strength for those without high-risk findings was assessed as strong, with the supporting evidence rated as low (further research is very likely to have an important effect on our confidence in the estimate of effect and will probably change the estimate).

In Australia, the National Health and Medical Research Council (NHMRC) developed an iterative wiki-based guideline for surveillance colonoscopy, with the most recent update in November 2019.[54] Surveillance intervals in their evidence-based recommendations were between three and five years. For patients with one or two small adenomas, the guidelines suggested a surveillance interval of no sooner than five years, based on the evidence that had surveillance intervals ranging between three and five years, the reported incidence of CRC being less than or equal to 1% in all studies, and the incidence of metachronous advanced adenomas ranging from 1.34% to 8.04%.[112-122] Several long-term follow-up studies, that did not meet the guideline inclusion criterion of analyzing only colonoscopies performed after 2002, were also discussed. Cottet et al. (2012) [98] conducted a retrospective cohort study with 5,779 patients who received polypectomy and found that the standardized incidence ratio for CRC was 0.68, 95% CI [0.44, 0.99] overall, with a 10-year cumulative probability of CRC being 0.76%, 95% CI [0.39, 1.48] for those who had colonoscopy surveillance, and 1.37%, 95% CI [0.70, 2.56] for those without surveillance. A large case-control study by Brenner et al. (2012)[107] found that patients who had undergone a colonoscopy with polyp

removal, but without high-risk features, had a reduced adjusted odds ratio (OR) of CRC proportional to time since polypectomy: 0.2, 95% CI [0.1, 0.2] for less than three years, 0.4, 95% CI [0.2, 0.6] for three to five years, and 0.8, 95% CI [0.4, 1.5] for 6 to 10 years, compared with no colonoscopy (OR 1.0). In a cross-sectional study of low- and high-risk patients,[123] the risk of CRC mortality of those with adenomas removed was the same as those with non-adenomatous polyps at 10 years. Cumulative CRC-specific mortality at 20 years was 0.8% for the low- and high-risk polyp patients, compared with 1.5% in the general population. A cross-sectional study[97] including patients with low-risk adenomas who did not undergo any surveillance colonoscopy (as per guidelines) showed a lower risk of mortality (standardized mortality ratio of 0.75, 95% CI [0.63, 0.88]) compared to the general population. The recommendation was assessed as a level D (weak evidence, extrapolated from well-conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal).

Dyspepsia and gastroesophageal reflux

Six national guidelines, published between 2015 and 2020, reported recommendations regarding endoscopy for investigations of dyspepsia and/or GERD (Table 3.4).[45-48, 72, 73] The guidelines differed in the age cut-off at which EGD may be warranted, as well as whether or not alarm symptoms warranted EGD regardless of age.

The American College of Gastroenterology (ACG) and Canadian Association of Gastroenterology (CAG) published joint guidelines for dyspepsia management in 2017.[45] The guideline recommendation states: *We do not suggest endoscopy to investigate alarm features for dyspepsia patients under the age of 60*. The age threshold was based on previous ACG guidelines, which was supported by evidence that endoscopy was borderline cost-effective at the 55-year-old threshold. Given that age-specific incidence of gastric cancer had since fallen in the United States and Canada, and the cost of endoscopy per case of upper GI cancer detected is substantial, the age threshold was increased up to 60 years in the guideline recommendation. Previous guidelines had also suggested EGD at any age, in the presence of alarm symptoms such as weight loss, anemia, dysphagia, and/or persistent vomiting; however, reviews of patients undergoing GI endoscopy found that alarm features had limited value in predicting malignancy, or other organic pathology such as peptic ulcer disease or esophagitis,[124] which has been confirmed by more recent studies of administrative databases.[125-127] Given the low positive predictive values of alarm features, generally low risk of having malignancy in patients under 60 years, and expectation that endoscopy for younger patients would not be cost-effective, using alarm features to stratify patients for endoscopy was not recommended by the guideline. The guidelines noted the recommendation is limited by the definition of dyspepsia, and reinforced that those with symptoms such as dysphagia or weight loss without epigastric pain, which are out of scope of these guidelines, may prompt endoscopic or imaging investigation. The quality of the evidence was rated as moderate, based on the cross-sectional studies and unexplained heterogeneity. Given that severe symptoms or combinations of symptoms haven't been rigorously studied, the recommendation was labelled conditional (many patients will have this recommended course of action but different choices may be appropriate) and stated that there may be a minority of patients younger than 60 years with alarm features that could warrant endoscopy and would need to be evaluated on an individual basis.

Table 3.4: Dyspepsia and gastroesophageal reflux clinical practice guideline recommendation summaries

	Canada ACG-CAG 2017[45]	Canada CTFPHC 2020[72]	United States ASGE 2015[48]	United States ASGE 2015[73]	United Kingdom NICE 2017[47,a]
Population	Dyspepsia	Chronic GERD without alarm symptoms	Dyspepsia	GERD	Dyspepsia and GERD
Population definition	Predominant epigastric pain ≥1 month, which can be associated with any other upper gastrointestinal symptom (epigastric fullness, nausea, vomiting, or heartburn) provided epigastric pain is the patient's primary concern.	Montreal global definition;[128] acid regurgitation ≥12 months, causing troublesome symptoms such as heartburn and water brash.	ROME III criteria; one or more of the following three symptoms for three months within the initial six months of symptom onset: postprandial fullness, early satiety, and epigastric pain or burning.	Reflux of stomach contents causing troublesome symptoms (heartburn, regurgitation, epigastric pain), or adverse events (erosive esophagitis).	Upper GI symptoms (upper abdominal pain or discomfort, heartburn, acid reflux, nausea, or vomiting), present for four weeks or more for ≥1 month.
Methodology	*Evidence:* MEDLINE, Embase, and the Cochrane Database for evidence up to Dec. 2015 *Consensus:* modified Delphi approach with voting on all final statements *Quality Appraisal:* GRADE	*Evidence:* MEDLINE and Embase, the Cochrane Database for evidence up to Nov. 2018 *Consensus:* evidence-to-decision framework for developing the recommendations, which the entire task force reviewed and approved *Quality Appraisal:* GRADE	*Evidence:* PubMed *Consensus:* expert consensus *Quality Appraisal:* GRADE	*Evidence:* Medical literature (not specified) from Jan. 1990 to Aug. 2014 *Consensus:* expert consensus *Quality Appraisal:* GRADE	*Evidence:* NHS Evidence, Cochrane Databases, HTA Database, NHSEED, HEED, MEDLINE, and Embase for evidence up to Aug. 2014 and minor updates in July 2017 *Consensus:* Guideline development group reviewed, assessed and formulated recommendations *Quality Appraisal:* QUADAS-2

	Canada ACG-CAG 2017[45]	Canada CTFPHC 2020[72]	United States ASGE 2015[48]	United States ASGE 2015[73]	United Kingdom NICE 2017[47,a]
Recommendation	We do not suggest endoscopy to investigate alarm features for dyspepsia patients younger than 60 years.	We recommend not screening adults (≥18 years) with chronic GERD for esophageal adenocarcinoma or precursor conditions.	We recommend that dyspeptic patients younger than 50 years of age and without alarm features undergo either an initial "test and treat" approach for H. pylori or empiric therapy with a PPI.	• Uncomplicated GERD should be diagnosed on the basis of typical symptoms without the use of EGD. • EGD should not be routinely performed solely for the assessment of extraesophageal GERD symptoms.	Consider endoscopy for: • Treatment resistant dyspepsia, 55 and over • Dyspepsia or reflux with weight loss, 55 and over • Dyspepsia or reflux with raised platelet count or nausea or vomiting, 55 and over.
Recommendation strength	Conditional	Strong	Not reported	Not reported	Not reported
Evidence quality	Moderate	Very low	Moderate	Moderate-high	Moderate-high

[a] NICE Gastroesophageal Reflux and Dyspepsia guidelines[46] reference this set of guidelines for recommendations regarding dyspepsia specific subgroups warranting endoscopy.

ACG: American College of Gastroenterology; ASGE: American Society for Gastrointestinal Endoscopy; CAG: Canadian Association of Gastroenterology; CTFPHC: Canadian Task Force on Preventive Health Care; EGD: esophagogastroduodenoscopy; GERD: gastroesophageal reflux disease; GI: gastrointestinal; GRADE: Grades of Recommendation, Assessment, Development, and Evaluation; NICE: National Institute for Health and Care Excellence; QUADAS: Quality Assessment of Diagnostic Accuracy Studies; PPI: proton pump inhibitor.

The Canadian Task Force on Preventive Health Care (CTFPHC) published guidelines in 2020 for screening for esophageal adenocarcinoma in patients with chronic GERD.[72] Patients with alarm symptoms (for example, dysphagia, recurrent vomiting, and unexplained weight loss) were excluded from these guidelines, as were those with a diagnosis of Barrett esophagus. The CTFPHC recommendation states: "we recommend not screening adults (greater than or equal to 18 years) with chronic GERD for esophageal adenocarcinoma or precursor conditions (Barrett esophagus or dysplasia)." The systematic review found two retrospective cohort studies, which compared screening to no screening. One study of 155 patients diagnosed with esophageal adenocarcinoma, with (*n*=25) or without (*n*=130) EGD in the last five years, found no statistically significant improvement in long-term survival (adjusted hazard ratio 0.93, 95% CI [0.58, 1.50]),[129] while the other study had insufficient data to determine if screening reduced the stage at diagnosis or mortality.[130] No included studies reported or provided data on other identified outcomes of interest (cause-specific mortality, quality of life, additional medical procedures, or overdiagnosis). Evidence on the harms of screening reported relatively minor discomfort, which was well tolerated.[131-135] The recommendation strength was strong, based on very low certainty evidence (any estimate of effect is very uncertain).

The American Society for Gastrointestinal Endoscopy (ASGE) published guidelines in 2015 for the role of endoscopy in dyspepsia.[48] The guideline notes that dyspepsia symptoms do not reliably identify patients with GI pathology, so patient age and alarm features are used to categorize patients. Patients older than 50 years and those with alarm features (for example, family history of upper GI malignancy, unintended weight loss, GI or iron deficiency anemia, dysphagia, odynophagia, persistent vomiting, or abnormal imaging suggesting organic disease) were considered appropriate for EGD. The age cut-off of 50 years old comes from older dyspepsia guidelines from the AGA, which report that GI malignancy becomes more common after age 45 to 55.[136] In patients younger than 50 years and without alarm features, they could be evaluated by one of the following: non-invasive testing for *H. pylori* with subsequent treatment if positive (the test-and-treat approach), an empiric trial of acid suppression, or initial endoscopy. Patients unresponsive to *H. pylori* or proton pump inhibitor treatment, may warrant undergoing endoscopy to assess for structural disease, but prevalence of such diseases are low. Test-and-treat has been shown to have no difference in symptom control compared to initial endoscopy, with most studies also showing increased cost with the initial endoscopy.[137] However, negative endoscopy findings have been found to reduce anxiety and increase satisfaction in dyspeptic patients.[138, 139] The quality of the evidence was rated as moderate.

The ASGE also published guidelines for the role of endoscopy in the management of GERD in 2015.[73] The guideline recommendations were: that uncomplicated GERD be diagnosed on the basis of typical symptoms without the use of diagnostic testing, including EGD, and that EGD not be routinely performed solely for the assessment of extraesophageal GERD symptoms (for example, choking, coughing, hoarseness, asthma, laryngitis, chronic sore throat, or dental erosions). It was reported in the guidelines that those with extraesophageal symptoms are unlikely to have endoscopic evidence of esophagitis, especially when taking empiric medial therapy.[140] The guidelines also noted a paucity of evidence supporting the use of EGD to improve the management, course, or health-related quality of life of patients with typical symptoms of GERD without alarm features.[141] The certainty of the evidence as rated as high for uncomplicated GERD (further research is very unlikely to change our confidence in the estimate of effect) and moderate for extraesophageal symptoms.

In the United Kingdom, the 2017 NICE guidelines for suspected cancer (referred to as suspected cancer guidelines)[47] give recommendations for those presenting with dyspepsia or reflux, and have also published gastroesophageal reflux and dyspepsia guidelines (referred to as reflux guidelines) in 2019.[46] For the suspected cancer guidelines, a 3% positive predictive value threshold was used to underpin recommendations, and when possible, cost-effectiveness data were considered in conjunction with clinical effectiveness data. The reflux guidelines included two retrospective cross-sectional studies with very low quality, which suggested that those

with dyspeptic or reflux symptoms were associated with endoscopic findings such as gastric ulcers or cancer, but concluded there is still high uncertainty and further research is required.[142, 143] The guideline development group decided they could not justify the trade-off between appropriate diagnosis with potential endoscopic adverse events (such as perforation and bleeding, discomfort, as well as the resource implications of offering endoscopy to all people with uninvestigated dyspepsia/reflux) and therefore did not make any changes to previous 2004 guidelines, which suggested managing dyspepsia in primary care. Subgroups of patients with concurrent symptoms (who may benefit from endoscopy for assessment), were directed to the suspected cancer guidelines. The suspected cancer guidelines recommended considering endoscopy for those patients 55 years or older, with treatment resistant dyspepsia, dyspepsia/reflux with weight loss, or dyspepsia/reflux with raised platelet count, nausea, or vomiting. Age cut-off was determined by the age cut-offs presented in the evidence. The overall pooled estimate for the positive predictive value for having symptoms of dyspepsia was 0.25%, 95% CI [0.13%, 0.5%] for esophageal cancer and 0.65%, 95% CI [0.33%, 1.3%] for stomach cancer. However, two or more symptoms presenting in combination was associated with overall positive predictive values for stomach cancer ranging from 0% to 20% (symptoms including dyspepsia with jaundice or anemia, nausea/vomiting and upper abdominal pain, upper abdominal pain and weight loss/anorexia). Weight loss presenting with abdominal pain was also associated with an appreciable risk of pancreatic cancer in people aged 60 and above, and a raised platelet count also increased the likelihood of lung or pleural cancers. Included studies provided observational data of moderate-high quality, using the Quality Assessment of Diagnostic Accuracy Studies-2 tool.[144] No relevant, published economic evaluations were identified and no additional economic analysis was undertaken.

3.3.5. Quality Assessment of Guidelines

Nine national guidelines were assessed for quality (Appendix D).[45, 47, 48, 51, 53, 54, 71-73] Using the AGREE II tool, [42] supplemented by the IHE developed Boolean-based User Guide,[43] guideline quality rating was average to good across all guidelines (lowest score of 15, highest of 27.5). Colorectal adenoma surveillance guidelines all had a good quality rating, and dyspepsia/GERD guidelines were average to good.

3.4. Discussion

3.4.1. Summary of Key Findings

We used an evidence-driven, systematic approach to identify 19 unique indications for which GI endoscopy should be not routinely performed or performed less frequently, with varying levels of certainty for the supporting evidence for recommendations. Four indications were shortlisted based on having moderate/strong quality supporting evidence and examples of endoscopy overuse in Canada or similar jurisdictions. After stakeholder discussion, two indications were selected as the focus for the systematic review for new evidence to clarify guideline discordance, systematic review of the effectiveness of strategies to reduce endoscopy overuse, frequency of overuse in Alberta, and economic analyses: colorectal adenoma surveillance and dyspepsia and GERD.

For colorectal adenoma surveillance, relevant national guidelines were generally of good quality and all have recently been updated. Overall, the guidelines defined those at low risk for CRC to include those with one to two index adenomas less than 10 millimetres in size in American and Australian guidelines or up to four small adenomas in the United Kingdom and European guidelines. There was also similar jurisdictional variation for the surveillance interval, with American and Australian guidelines recommending surveillance via colonoscopy between five and 10 years after the index colonoscopy, and United Kingdom and European guidelines suggesting surveillance was not warranted, and instead patients return to CRC screening programs if eligible (with testing with fecal modalities). Supporting evidence suggested that this population had a risk for CRC and advance neoplasia similar to, or lower than, that of the general population. Moderate- and high-risk adenomas were generally defined more consistently among the guidelines, to include at least five adenomas,

adenoma greater than or equal to 10 millimetres or with high-grade dysplasia, with surveillance interval recommendations ranging from one to five years. There was some overlap across guidelines in the evidence, which was used to support the recommendation, but there was also non-negligible variation and this likely contributed to the differences in recommendations between guidelines. Recommendation difference may also have occurred due the United Kingdom and European guidelines explicitly prioritizing CRC incidence and mortality evidence, and only offering colonoscopy surveillance when there was demonstrated benefit, while the American and Australian guidelines recommended the modality and surveillance interval which was utilized in the available evidence. The recommendations in the Australian guidelines were particularly conservative, likely due to a limited number of included studies with long-term follow up, as the authors excluded those studies, which had the index colonoscopies performed before 2002.

For investigating dyspepsia and GERD, relevant national guidelines were of average to good quality, and were published within the last five years. The guidelines differed in the age cut-off at which EGD may be warranted, as well as, whether or not alarm symptoms warranted EGD regardless of age. AGA-CAG joint guidelines on dyspepsia suggested, even with alarm symptoms, dyspepsia did not warrant endoscopic investigation younger than 60 years, as they found the incidence of gastric cancer to be very low in the young general population, and the alarm symptom positive predicative values to be suboptimal. In contrast, ASGE dyspepsia recommendations had a threshold for investigation at 50 years, with alarm symptoms (family history of upper GI malignancy, unintended weight loss, GI or iron deficiency anemia, dysphagia, odynophagia, persistent vomiting, or abnormal imaging suggesting organic disease) warranting EGD regardless of age. For GERD, guidelines from both then CTFPHC and ASGE recommended that endoscopy was not warranted for adults with uncomplicated chronic GERD. NICE guidelines developed the same recommendations for dyspepsia and GERD, given the overlap in the clinical presentation. NICE determined that the supporting evidence was highly uncertain and suggested that the majority of dyspeptic/reflux patients could be managed in primary care, without the use of EGD. EGD should be considered for those over the age of 55 years, having dyspepsia or reflux and weight loss, or with raised platelet count, nausea, or vomiting, as patients with these concurrent symptoms have an appreciable increased risk of esophageal, gastric or pancreatic cancer. Guidelines likely differed due to the varying definitions of their dyspepsia and/or GERD population, and minimal overlap in the evidence used to support the recommendations.

3.4.2. Limitations

We relied on the author's statements to identify relevant indications and there is a possibility that certain indications might not have been included had we conducted our own evidence- and consensus-based assessment. When selecting indications, we prioritized those recommendations based on higher quality supporting evidence, to ensure further assessment and behaviour modification strategies were focused on recommendations that were generally well supported.

Due to the impact of the COVID-19 pandemic response for health system administrators, it was not possible to access administrative health data at the time of indication prioritization and selection. Because of this, we were unable to quantify the extent to which endoscopy continues to be utilized for the identified indications where it is not recommended within the Alberta health system before prioritizing and selecting indications for further investigation. To overcome the lack of system-specific information, literature published in relevant jurisdictions was collected to support the prioritization and selection process. Though the scoping review search was broad in its attempt to capture as many indications where endoscopy use should be avoided or reduced as possible, and other studies quantifying overuse could have been missed, we believe we've captured a sufficient amount of overuse examples to adequately support the selection of Alberta health system relevant indications. As discussed in Soril et al. (2017),[21] stakeholders working in the health care system are best positioned to identify overused technologies and practice areas. We are confident that the EAG's expert

opinions, supported by the findings of this scoping review mean that the selected indications will be relevant to the Alberta context and amendable to improvement.

3.4.3. Conclusion

Identification and prioritization of indications where endoscopy use can be discontinued or reduced is the first step in the reassessment process. Two indications, colorectal adenoma surveillance and investigation of dyspepsia/GERD, were selected from 19 candidate indications based on evidence gathered through a scoping review of guidelines and primary studies, as well as expert consultation. It is believed that reducing the frequency or absolute performance of procedures in these two areas may drive better patient outcomes and generate savings within the health system. The information collected here provides a basis for administrative data analysis to better understand the magnitude and scope of endoscopy overuse within Alberta and upon which to identify potentially cost-effective behaviour change strategies to support policy decision-making.

SECTION FOUR: Systematic Review of New Evidence to Resolve Guideline Discordance

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4.1. Objective and Research Question

We undertook a systematic review of any new primary studies that may clarify guidelines discordance for the selected indication colorectal adenoma surveillance.

The primary objective of this review was to identify new evidence published since the publication of the most recent guidelines that may help resolve guideline discordance and recommendation gaps. The overarching research question was: what new evidence is available since the published guidelines that may clarify recommendations where discordance/gaps exist? Our specific research question for the colorectal adenoma surveillance indication was: for patients who have positive findings on their index colonoscopy, what is the incidence of CRC or advanced adenomas at subsequent follow up?

4.2. Methods

Our methodology was guided by the methodology of the relevant guidelines for the selected indication, in consultation with members of the EAG.

4.2.1. Literature Search

An IHE information specialist (LT) conducted searches in those databases usually searched by relevant guidelines (MEDLINE, Embase, Cochrane Database, CINAHL) using a combination of relevant keywords and MeSH terms. We included English-language articles published from 1 November 2019 (the time at which the last searches were conducted for relevant guidelines) until 20 November 2020. The search strategies are available in Appendix E.

4.2.2. Study Selection

One reviewer (LW) screened the titles and abstracts of all citations identified by the searches, and two reviewers (LW and CM) assessed the full text of each potentially relevant paper using predefined inclusion criteria (Table 4.1). Discrepancies were resolved by consensus. Any articles included in current guidelines[51, 53, 54, 71] were excluded.

Table 4.1: Selection criteria for new primary studies on colorectal adenoma surveillance

	Description
Study design	Observational cohort studies (prospective or retrospective)
Population	*Included* Adults (≥18 years) who had a high-quality colonoscopy procedure *Excluded* Adult with a hereditary syndrome associated with increased colorectal cancer risk, personal history of colorectal cancer, and/or inflammatory bowel disease(s)
Exposure	Diagnosis of at least one colorectal adenoma, with the following risk factors: • Low-risk adenomas: 1-4 adenomas <10 mm in size • High-risk adenomas: adenoma ≥10mm or with high grade dysplasia or ≥5 adenomas • Serrated polyp: hyperplastic polyps, sessile serrated lesions, traditional serrated polyps/adenomas, or unspecified serrated polyps. Category definitions may vary by study.
Comparator	Absence of risk factor(s) (e.g., absence of adenoma, small adenoma(s), low grade dysplasia, non-serrated polyps)
Outcomes of interest	• Incidence of cancer at or before the next surveillance (3–10 years, or as defined by the study) • Incidence of advanced adenomas (adenoma(s) ≥ 10mm or with high grade dysplasia, or as defined in the study) at or before the next surveillance (3–10 years, or as defined by the study)

4.2.3. Quality Assessment

To be consistent with the methodology used by the recent guidelines, the quality of the included studies was assessed by two reviewers (LW and CM) using the GRADE approach,[145] which specifies four levels of the certainty for each outcome: high, moderate, low, and very low. Observational studies are considered low quality before assessment, and are subsequently downgraded based on study limitations/risk of bias, inconsistency of results, indirectness of evidence, imprecision, and publication bias; and are upgraded based on the magnitude of the effect, the dose-response gradient, and the effect of plausible residual confounding.

4.2.4. Data Extraction and Synthesis

One reviewer (LW) extracted the data into summary of findings tables. A second reviewer (CM) verified the data, and discrepancies were resolved by discussion. Findings from the included studies are narratively described, and are compared to the evidence already identified in recently published guidelines.[51, 53, 54, 71]

4.3. Results

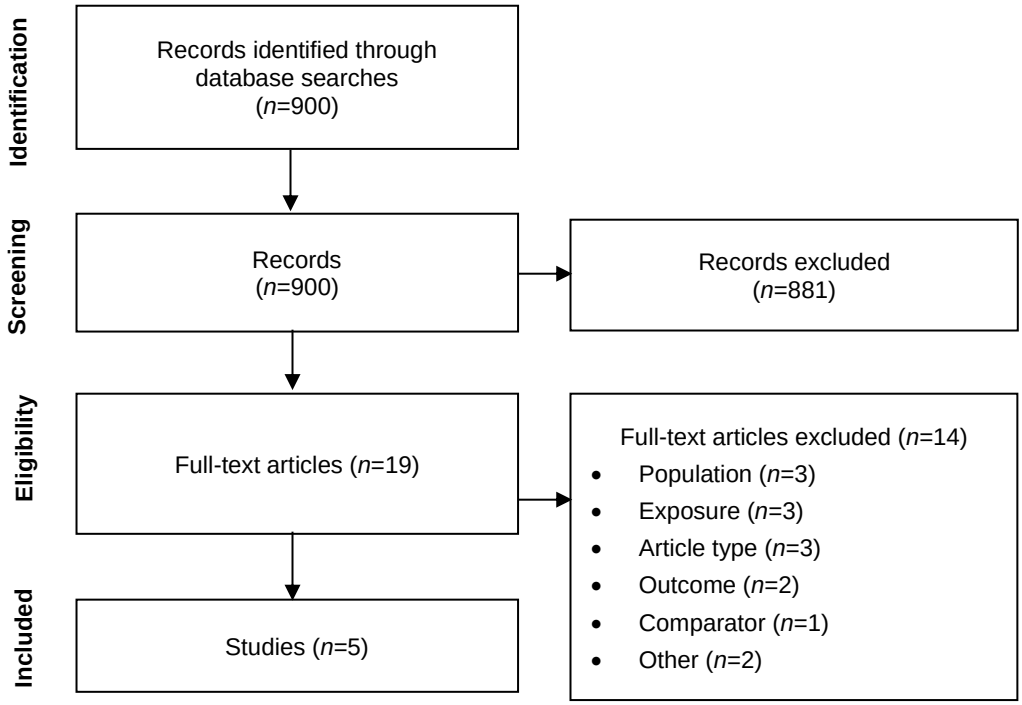
4.3.1. Literature Search

A total of 900 citations were identified, 19 full-text articles were assessed for eligibility, and five included. The included studies used prospective cohort[146] and retrospective cohort designs.[147-150] The study selection process is illustrated in Figure 4.1. The excluded studies and the reasons for exclusion are listed in Appendix F.

Three studies were conducted in the United States,[146, 149, 150] one in Austria,[147] and one in South Korea,[148] with sample sizes ranging from 891 to 352,685 patients. Patients included in these studies were those at average risk for CRC and asymptomatic (that is, bowel cancer screening colonoscopies) or symptomatic (that is, diagnostic colonoscopies). Follow up began at least six months post-index colonoscopy and continued for up to 15 years, with an average follow up of approximately four years. Two studies reported on the risk of CRC at surveillance,[147, 149] one study reported on the risk of advanced adenomas (at least three small adenomas or at least one adenoma at least 10 mm in size, with villous histology, or high grade dysplasia),[146] and two studies

reported on the risk of advanced adenomas and CRC combined (advanced neoplasia).[148, 150] There was no analysis or discussion on optimal surveillance intervals. Most studies reported that the surveillance interval for those with high-risk adenomas were significantly shorter than those with low-risk adenomas (in keeping with guideline recommendations at that time), and most adjusted for the time between index and surveillance colonoscopy in their analyses of advanced adenomas and/or CRC risk. A summary of findings is available in Appendix G.

Figure 4.1: Study identification and selection



4.3.2. Low-Risk Adenomas

The effect of low-risk adenomas at the index colonoscopy on surveillance outcomes were discussed in four studies.[146-148, 150] Low-risk adenomas were defined as the presence of up to two adenomas, which are less than or equal to 10 mm in size, and without villous histology or high-grade dysplasia. One study[147] also included serrated lesions as part of the low-risk adenoma definition, as long as the serrated lesion was less than 10 mm and without dysplasia. The advanced adenoma and/or CRC event rate was reported between 0.14% to 10.0% with non-statistically significant relative effects, compared to no adenomas or non-significant hyperplastic polyps (adjusted OR 1.07, 95% CI [0.82, 1.40] for metachronous advanced neoplasia (1 study); OR 0.96, 95% CI [0.57, 1.64] for advanced adenomas (1 study); adjusted hazard ratio 0.92, 95% CI [0.57, 1.49] for CRC (1 study)).

4.3.3. High-Risk Adenomas

The effect of high-risk adenomas at the index colonoscopy on surveillance outcomes were discussed in four studies.[146-148, 150] High-risk findings were defined as the presence of any adenoma 10 mm or larger in size, adenomas with villous histology or high-grade dysplasia, or three or more small adenomas. One study[147] also included large serrated lesions or serrated lesion with dysplasia as part of the high-risk adenoma definition. The advanced adenoma and/or CRC event rate was reported between 0.63% to 18.3% with statistically significant relative effects, compared to no adenomas or non-significant hyperplastic polyps (adjusted OR

2.05, 95% CI [1.55, 2.70] for metachronous advanced neoplasia (1 study); OR 1.95, 95% CI [1.20, 3.22] for advanced adenomas (1 study); adjusted hazard ratio 3.27, 95% CI [2.36, 4.53] for CRC (1 study)).

4.3.4. Serrated Polyps

The effect of serrated polyp findings at the index colonoscopy were discussed in three studies.[148-150] Generally, sessile polyps included hyperplastic polyps, sessile serrated polyps or traditional serrated polyps. Anderson et al. (2020)[150] divided hyperplastic polyps into two cohorts, small (five to nine mm) hyperplastic polyps and sessile polyps which included hyperplastic polyps greater than or equal to 10 mm, along with sessile serrated polyps and/or traditional serrated polyps. The metachronous advanced neoplasia event rate was 8.0% for small hyperplastic polyps and 4.8% for sessile polyps, with a statistically significant adjusted OR of 1.83, 95% CI [1.19, 2.81] for small hyperplastic polyps and a non-statistically significant adjusted OR 0.95, 95% CI [0.66, 1.38] for sessile polyps, compared to non-significant hyperplastic polyps. Li et al. (2020)[149] differentiated serrated polyps by size (small, <10 mm; large, ≥10 mm) and location, reporting a cumulative CRC incidence rate per 100 person at five years post-coloscopy to be 2.5, 95% CI [1.4, 4.3] for proximal small sessile polyps, 6.2, 95% CI [2.3, 17.0] for proximal large sessile polyps, 1.7, 95% CI [1.1, 2.6] for distal sessile polyps, 4.2, 95% CI [2.9, 6.3] for proximal sessile polyps with synchronous adenoma, and 3.0, 95% CI [2.0, 4.5] for distal sessile polyps with synchronous adenoma. The adjusted hazard ratio was 1.7, 95% CI [1.3, 2.2] for sessile polyps alone, and 3.1, 95% CI [2.4, 4.0] for sessile polyps with synchronous adenoma, compared to no polyp. Park et al. (2019)[148] also reported on sessile polyps with or without adenomas. The advanced neoplasia incidence per 100-person years was reported as 2.1, 95% CI [1.4, 3.0] for sessile polyps with synchronous low-risk adenomas, and 7.7, 95% CI [5.7, 10.4] for sessile polyps with synchronous high-risk adenomas. The study reported no difference in the sessile polyp with synchronous low-risk adenomas cohort (p=0.06) compared to low-risk adenomas alone. Sessile polyps with synchronous high-risk adenomas had an adjusted hazard ratio of 2.24, 95% CI [1.38, 3.64], compared to high-risk adenomas alone.

4.3.5. Quality Assessment

Three studies[147, 149, 150] were of moderate quality, one study[148] was of low quality, and one study[146] was of very low quality (details in Appendix G). Overall, there was very little potential bias that reduced the outcome quality and downgraded the evidence, with a large magnitude of effect or dose-response often upgrading the quality.

4.4. Discussion and Conclusion

Five new cohort studies have reported on the incidence of advanced adenomas and/or CRC based on the index colonoscopy pathology findings, since the most current guideline search for evidence.[146-150] None of the five studies assessed surveillance time intervals. Generally, the findings on advanced adenoma and/or CRC risk in these studies were consistent with the evidence base of the current guidelines:

- low-risk adenomas (one to two adenomas, less than 10 mm in size) were at similar risk for advanced adenomas and/or CRC as those with negative (no polyp) colonoscopies;
- high-risk adenomas (any adenoma 10 mm or larger in size, adenomas with villous histology or high-grade dysplasia, or three or more small adenomas) approximately doubled the risk of advanced adenomas and/or CRC compared to those with normal colonoscopies; and
- sessile polyps were inconsistently associated with the risk for advanced adenomas and/or CRC, dependent on size, location, and synchronous findings.

No study defined low-risk adenomas as per the current European/United Kingdom guidelines and instead included only up to two small adenomas as low risk. Given that there has only been a year since the current guideline searches, and just over six months since the most recent guidelines were published, the limited available research at this time likely reflects older guideline definitions for low risk, which only included up to

two small adenomas. Therefore, no new evidence is available to improve our understanding of advanced adenoma and/or CRC risk specifically for three to four small adenomas, or resolve the discordance between the current United Kingdom/European guidelines (where three to four adenomas are low risk do not require colonoscopy surveillance) and the American/Australian guidelines (where three to four adenomas are high risk and colonoscopy surveillance of three to five years is recommended). The sessile polyp categorization varies across studies, and does not match the categorization used in the current guidelines, making it difficult to compare different categorizations and understand their contribution to guideline discordance.

As the newer guidelines are adopted into practice, research will likely redefine exposure groups to match the most current guidelines, and provide evidence on the newer risk classification definitions in the future. The up-to-date evidence in this review, as well as the content comparison and quality appraisal of guidelines in the scoping review (Section Three), will provide Alberta local guideline developers with the necessary information to assist their decisions on whether to adopt or adapt new national guidelines for the Albertan health care system.

SECTION FIVE: Systematic Review of Interventions for Reducing Endoscopy Overuse

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5.1. Objective and Research Questions

This is a systematic review of the literature on strategies to reduce endoscopy overuse.

The primary objective of this review was to evaluate the evidence on the effectiveness of interventions intended to reduce referrals and procedures for the selected indications where endoscopy is recommended to be avoided or reduced in frequency (that is, colorectal adenoma surveillance and dyspepsia/GERD).

The research questions for this section include:

- Are there effective strategies to reduce endoscopy overuse for colorectal adenoma surveillance and investigating dyspepsia/GERD?
- What are the facilitators and barriers to implementing these effective strategies?
- What are the proposed funding mechanisms for the interventions?

5.2. Methods

5.2.1. Literature Search

An information specialist (LT) conducted database searches (MEDLINE, Embase, Cochrane Database of Systematic Reviews, CENTRAL, CINAHL) using a combination of relevant keywords and MeSH terms, as well as relevant websites of HTA and health services research agencies, government agencies, health authorities, and related societies and associations. Reference lists of relevant reviews were also searched. We included English-language articles from Canada, Australia and New Zealand, Europe, and the United States, published from 2010 to 2020. A detailed search strategy for the literature on endoscopy overuse interventions is available in Appendix H.

5.2.2. Study Selection

One reviewer (LW) screened the titles and abstracts of all retrieved citations, and two reviewers (LW and CM) assessed the full text of each potentially relevant paper using predefined inclusion criteria (Table 5.1). Discrepancies were resolved by consensus. Studies on interventions targeting multiple or nonspecific indications were included if the majority of the patient population was relevant to one of the selected indications, or the analysis reported outcomes specific to the selected indication.

Table 5.1: Selection criteria for the systematic review of interventions reducing overuse

	Description	
Inclusion		
Study design	• Primary studies (randomized or non-randomized controlled trials, cohort studies, quality improvement studies, implementation trials)	
Population	• Care providers (primary care providers, specialists, or other providers) who refer patients to endoscopy • Endoscopists (gastroenterologists, surgeons, general practitioners, nurse practitioners, or other practitioners) or multidisciplinary endoscopy teams (e.g., screening and surveillance programs)	
	Colorectal Adenoma Surveillance • General adult population, who underwent a high-quality index colonoscopy	*Dyspepsia and GERD* • General adult population, with uninvestigated symptoms of dyspepsia or reflux (as defined in the study)
Intervention	• Any single or multi-component behaviour change intervention that explicitly aims to reduce endoscopy overuse, such as: ○ Education (e.g., print materials, training) ○ Clinical support (e.g., clinical champions, clinical pathways/protocol, decision support tools, patient navigators, audit and feedback, prompts/reminders) ○ Alternative diagnostic and treatment options (e.g., trial of proton pump inhibitors, using fecal immunochemical test instead of colonoscopy) ○ Funding/resource mechanisms (e.g., restricting use/rationing, by-laws or other regulations, financial incentives)	
Comparators	• Standard care or usual care (as defined in the study) • Historical control • Alternate behaviour change intervention	
Outcomes	Provider: • Change in the number of endoscopies performed or number of referrals • Change in adherence to clinical practice guidelines • Change in knowledge/attitude Facility/health system: • Change in endoscopy wait times • Frequency of endoscopies used when not recommended • Cost savings/cost-effectiveness Patient: • Satisfaction • Change in knowledge/attitude	
Exclusion		
Study design	• Reviews • Abstracts • Editorials, letters, commentary	
Population	*Colorectal Adenoma Surveillance* • Adult patients with a hereditary syndrome associated with increased CRC risk, familial or personal history of CRC, and/or inflammatory bowel disease(s)	*Dyspepsia and GERD* • Adult patients with diagnosed helicobacter pylori infection, esophagitis, esophageal stricture, achalasia, or Barrett esophagus
Comparators	• Any reference standard (e.g., histology)	

	Description
Outcomes	• Diagnostic accuracy (sensitivity, specificity, positive or negative predicted value) • Other quality indicators

CRC: colorectal cancer; GERD: gastroesophageal reflux disease.

5.2.3. Quality Assessment

The quality of the included studies was assessed independently by two reviewers (LW and CM) with respect to various aspects of methodology and reporting using the Risk Of Bias In Non-randomized Studies of Interventions tool (ROBINS-I).[151] The ROBINS-I tool has assessors specify a hypothetical 'target' randomized controlled trial for which to compare the non-randomized study, then has them evaluate bias across seven domains for the estimates of effectiveness (harm or benefit). The tool is designed for cohort-type studies, particularly those that are controlled, but may be applied to uncontrolled before-and-after studies as well. Risk of bias is determined for each domain and overall, and is rated as low, moderate, serious, or critical risk of bias. Discrepancies between reviewers were resolved by discussion and consensus.

5.2.4. Data Extraction and Synthesis

One reviewer (LW) extracted the data into predeveloped forms. A second reviewer (CM) verified the data, and any discrepancies were resolved by discussion and consensus. The following data were extracted: study characteristics, target population, intervention and comparator, outcomes, and barriers and facilitators.

The interventions were categorized using a "behaviour change wheel"[152] framework and narratively described following the Template for Intervention Description and Replication reporting guide,[153] along with text and evidence summary tables for the assessment of their effectiveness. The behaviour change wheel framework allows users to assess underlying influences for behaviour, and includes nine intervention categories: education, persuasion, incentivization, coercion, training, restriction, environmental restructuring, modelling and enablement.[152]

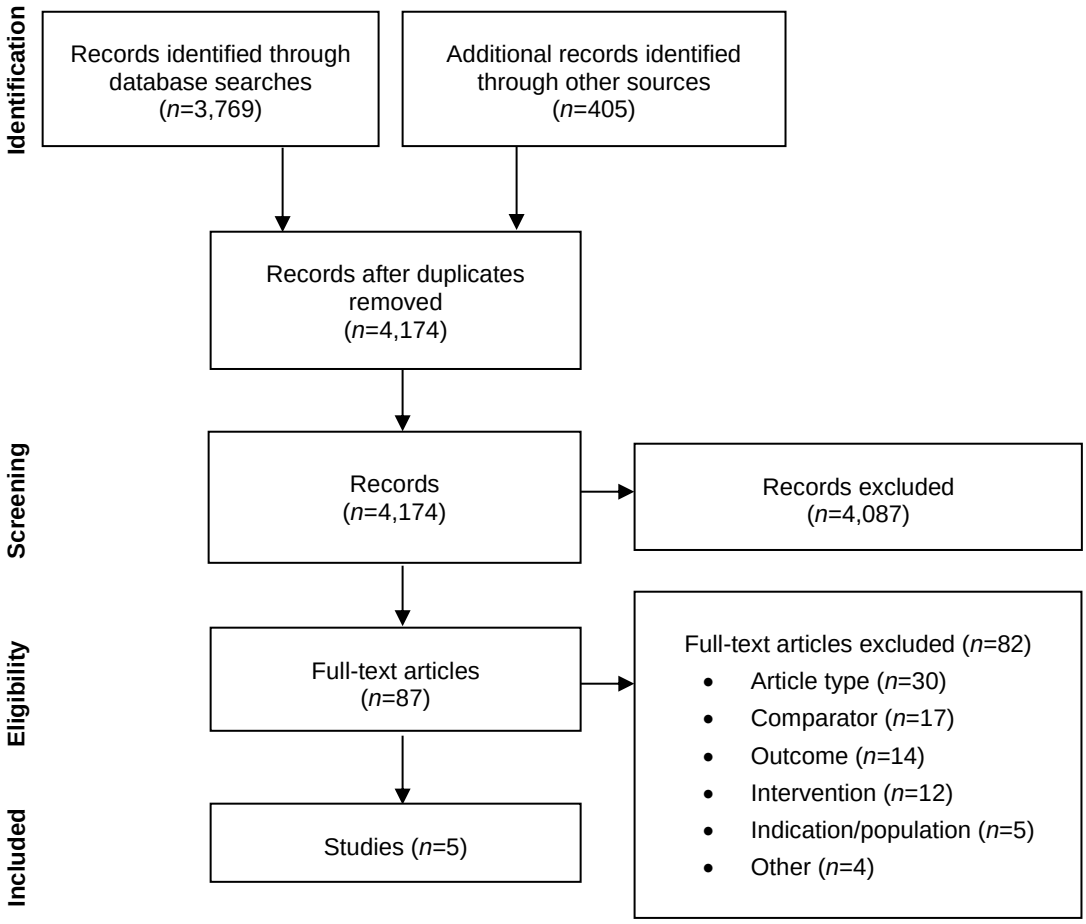
5.3. Results for Colorectal Adenoma Surveillance

5.3.1. Literature Search

A total of 4,174 citations (titles and abstracts) were identified, 87 full-text articles were assessed for eligibility, and five articles were included.[89, 154-157] The study selection process is illustrated in Figure 5.1. The excluded studies and the reasons for their exclusion are listed in Appendix I.

Four studies were conducted in the United States, and one study was conducted in the United Kingdom. The majority of interventions targeted endoscopists and focused on ensuring that the surveillance interval recommended at the time of the index colonoscopy was guideline-adherent. Funding for development was described in two studies, but no description of funding for implementation and maintenance was provided in any study. Discussion of the implementation process, as well as facilitators and barriers were sparse. An evidence overview is in Table 5.2 and full summary tables are provided in Appendix J, Table J.1.

Figure 5.1: Study identification and selection for colorectal adenoma surveillance



5.3.2. Behaviour Change Interventions

Table 5.2: Summary of behaviour change interventions for colorectal adenoma surveillance

Study	Intervention	Study Design	Outcomes	ROBINS-I Risk of Bias
Coe et al. (2012)[155] United States Aug. 2010–Apr. 2011	*Training:* Quality improvement training for endoscopists	Prospective randomized controlled trial *N*=15 endoscopists	*Provider:* Recommendation accuracy	Low
Alvarado et al. (2016)[154] United States Apr. 2004–June 2007	*Enablement:* Polyp-tracking registry and notification system for endoscopy units	Retrospective cohort study *N*=853 patients	*Health System:* Guideline adherent endoscopies preformed	Serious
Magrath et al. (2018)[89] United States	*Enablement:* Colonoscopy pathology reporting and clinical decision	Retrospective cohort study	*Provider:* Guideline adherent recommendations	Serious

Study	Intervention	Study Design	Outcomes	ROBINS-I Risk of Bias
June 2011– Sept. 2015	support system for endoscopists	*N*=3,142 colonoscopies		
Cross et al. (2019)[156] United Kingdom Jan. 2012–Dec. 2013	*Environmental restructuring:* Yearly fecal immunochemical tests for patients at intermediate risk for colorectal cancer	Prospective cohort study *N*=8,009 patients	*Health System:* Number of endoscopies preformed; cost-effectiveness *Patient:* Satisfaction	Moderate
Uche-Anya et al. (2020)[157] United States Jan. 2013–Dec. 2014	*Persuasion:* Quarterly quality metrics report cards for endoscopists	Prospective Cohort Study *N*=194 endoscopists	*Provider:* Guideline adherent recommendations	Critical

Training

Coe et al. (2012)[155] assessed the impact of an Endoscopic Quality Improvement Training Program that target endoscopists. The training was led by a gastroenterologist and consisted of two one-hour small group in-person sessions. The content included methods and techniques for "diagnose and leave" and "diagnose and discard" strategies to increase adenoma detection, recognition of subtle neoplasia features and differentiating between non-neoplasia lesions. The training was concluded with a test to confirm competency, and all endoscopists who completed the training were provided monthly feedback on their adenoma detection rate. The training was designed for individual instruction, but was modified for group session, likely due to resource and time constraints. Funding mechanisms were not described.

The assessment of this training on the impact of surveillance accuracy was a substudy of a prospective randomized controlled trial looking at the impact of the training on adenoma detection rate.[155] After a four-month baseline period without intervention, endoscopists at the Mayo Clinic Florida ambulatory endoscopy centre were randomized to the Endoscopic Quality Improvement Training Program (*n*=8) or no training (*n*=7). The authors found that surveillance interval accuracy based on in vivo optical pathology did not improve with training (75% pre-intervention versus 72% post-intervention) and was similar to the non-trained group (71% pre-intervention versus 66% post-intervention). The authors suggested that because the study design and sample size were selected for the original study, the substudy was likely underpowered to detect changes in surveillance accuracy. It should be noted that pathology-driven recommendations are necessary for guiding appropriate endoscopy use, but are insufficient on their own to ensure appropriate use occurs, so this study assesses endoscopy overuse indirectly.

Enablement

Two retrospective cohort studies[89, 154] assessed the impact of clinical supports. Magrath et al. (2018)[89] reported on the impact of an electronic medical record based colonoscopy pathology reporting and clinical decision support system (CoRS) on guideline-adherent surveillance recommendations, with its development described in Skinner et al. (2016).[158] To use CoRS, endoscopists review the electronic pathology report then answer a series of cascading questions with pull-down menus on the indication, intubation of cecum, bowel preparation quality, family history, number of polyps, and worst finding from pathology. A tailored algorithm uses the collected data to generate a report of the findings and provided a surveillance interval recommendation based on USMSTF guidelines. CoRS then generates a progress note in the electronic medical record (available to specialty and primary care providers) and generates a tailored letter (in English or Spanish) regarding the findings and surveillance recommendation (sent to the referring provider via email and

patient via routine mail). Development funding was provided through the National Institute of Cancer; funding mechanisms for implementation and maintenance were not described.

Skinner et al. (2016)[158] reported the uptake of CoRS in the first year of use and provider opinion about this system. In the first six months of implementation, 83.7% of eligible colonoscopies used CoRS to generate their recommendation, increasing to 98.6% in the last 6 months. Of the 18 endoscopists who used CoRS within the first 6 months of implementation, 15 (83.3%) found it easy to use, 12 (66.7%) said it did not disrupt their workflow, and 16 (88.9%) believed it produced guideline-based recommendations. CoRS implementation was likely facilitated by stakeholder engagement (GI faculty, fellows, laboratory staff, institution leaders, primary care providers, and information technology staff) during development and testing. Magrath et al. (2018)[89] noted that a clinical decision support system like CoRS could address overuse factors such as a lack of knowledge regarding guideline-concordant recommendations, but were unlikely to impact potential financial incentives or physician fear of interval cancers.

In Magrath et al.'s (2018) [89] single site, retrospective, uncontrolled before-after assessment of guideline-adherence, 1,822 colonoscopies conducted in the year and a half prior to the implementation of CoRS were compared to 1,320 colonoscopes conducted in the 10 to 21 months post-implementation (beta-testing was completed in the first nine months of implementation, so colonoscopies from this time were excluded).[89] CoRS was used for 1,186 (89.9%) of eligible colonoscopies in the post-CoRS cohort and CoRS use was associated with an increased likelihood of guideline-adherent recommendations (87.0% for CoRS users versus 63.4% non-users, adjusted relative risk (aRR) 1.34%, 95% CI [1.24, 1.42], $p<0.001$). Guideline-adherent recommendations were more common in the post-CoRS cohort (84.6%) versus pre-CoRS cohort (77.4%, $p<0.001$). Overuse (that is, a shorter-interval recommendation) was reported in 263 cases (14.4% of total, 63.8% of non-adherent) in the pre-CoRS cohort, and in 143 cases (10.8% of total, 70.4% of non-adherent) in the post-CoRS cohort, with overuse being less likely with CoRS use (relative risk 0.55, 95% CI [0.33, 0.88]). Here, too, using the outcome of recommendation guidelines adherence is an indirect assessment of guideline-adherent endoscopy use and the ability to interpret the effectiveness of the intervention in the context of reducing overuse is limited.

Alvarado et al. (2016)[154] reported on the impact of a polyp-tracking registry and notification system on guideline-adherence surveillance examination. All eligible beneficiaries with adenomatous polyps on their index colonoscopy were recorded in the registry, with a corresponding surveillance interval of three to five years. Monthly, the clinic would produce a list of all beneficiaries eligible for surveillance, who were then subsequently contacted and referred. During the follow up period, with establishment of the patient centred medical home, population health nurses also began reviewing the registry on an annual basis during the birth month of each beneficiary, to ensure each is offered surveillance or screening colonoscopies. The registry process was facilitated by quarterly reviews with stakeholders. There was no discussion of funding mechanisms, though the authors speculated that the transition to merit-based payments through the Physician Quality Reporting System (a reporting program that provides financial incentives for certain health care services when quality measures data is submitted) would be well supported by a registry.

In this single site, retrospective, uncontrolled before-after assessment of guideline-adherence, the authors compared surveillance colonoscopy examinations pre-registry (N=340) to post-registry (N=513).[154] They found that more eligible beneficiaries were offered a surveillance colonoscopy, or scoped within a year of their recommendation post-registry compared to pre-registry (85.1% versus 43.7%, $p<0.001$). Those who were receiving surveillance, 107 (31.5%) were scoped pre-registry and 272 (53.0%) were scoped post-registry. There were 12 early colonoscopies (3.5%) pre-registry, with 16 early colonoscopies post-registry (3.1%), in order to evaluate symptoms such as rectal bleeding, anemia, abdominal pain, weight loss or abnormal imaging tests. Details regarding the pathology of the index polyps removed were not captured in the registry, so the appropriateness of the interval recommendation was assumed. The operation of a military health system, with

limited access to records outside the facility, and loss to follow up due to deployment and separation from the military, increased the amount of missing data and limited generalizability of the results.

Environmental restructuring

One prospective cohort study[156] assessed the impact of using yearly FIT for surveillance of intermediate risk for CRC (that is, patients with three to four small adenomas or at least one adenomas that is 10 mm or more in size on their index colonoscopy) to replace colonoscopy. Cross et al. (2019)[156] (with a duplicate publication by Atkins et al. (2019)[159]) mailed FIT kits, instructions, and a pre-paid return envelope to those at intermediate risk for CRC at years one, two and three post-polypectomy. Those who were FIT positive were offered an early colonoscopy by an accredited endoscopist who may have been aware of their FIT results (organized and performed at an affiliated English Bowel Cancer Screening centre) and did not complete subsequent FIT tests. Colonoscopy examination and pathology reports were received by the screening centre and subsequently made available in the patient's electronic medical records.

The assessment of this surveillance strategy was done using a quasi-controlled, prospective cohort design. [156, 159] All participants were offered a routine three-year colonoscopy, and the findings of these and the early colonoscopy results were used as the reference standard for the FIT diagnostic accuracy findings. A simulated control arm was established for the economic analysis; it was created based on the assumption that those who did not complete their FIT positive colonoscopies or were lost to follow up would not have completed the routine three-year colonoscopy. After these patients were excluded from the study cohort, there were 5,938 participants in the FIT cohort and 5,225 participants in the pseudo control arm. There was high uptake of FIT with 74.1% uptake (5,938 of 8,009) in year one, then 97.3% in year two (those who did not return kits were not offered another in subsequent years; 5,329 of 5,479), and 97.0% in year three (5,022 of 5,179). In a subset of patients who completed a substudy evaluating perceptions and preferences for FIT surveillance (*N*=5,020 year one; *N*=4,491 year two, *N*=3,381 year three), 26.8% reported that FIT made them anxious, 29.2% were worried about the accuracy of FIT testing, and 7.3% were worried while waiting for the FIT results. For preferences, 8.9% preferred a routine colonoscopy at year three without any FIT testing, 57.9% preferred annual FIT testing and a routine year three colonoscopy, 31.5% wanted annual FIT testing with only colonoscopy if the FIT results were positive, and 1.8% preferred no surveillance.

The authors estimated that by using annual FIT instead of a three-year surveillance colonoscopy, up to 71% of colonoscopies could be reduced. However, by using annual FIT instead of a three-year surveillance colonoscopy, up to 30% to 40% of CRC and 40% to 70% of advanced adenomas would be missed. In their economic analysis, the mean incremental cost per participant was £365 and total cost difference was £2,169,341, with an estimated cost savings over one screening cycle of £4,700,000. The incremental cost per additional CRC detected by colonoscopy was £7,354, while the incremental cost per additional advanced adenoma detected by colonoscopy was £180,778. Several biases may have influenced the results, such as endoscopists being aware of those who were FIT positive, thereby inflating FIT-positive colonoscopy sensitivity, and missing information and the population being from an established bowel cancer screening program causing selection bias.

Persuasion

Uche-Anya et al. (2020)[157] reported on the impact of a quarterly feedback report initiative on colonoscopy quality metric performance. A colonoscopy quality registry was established in 2011 to identify gaps in colonoscopy quality, and was approved as a qualified clinical data registry in 2014. The registry tracked adenomas detection rate, cecal intubation rate, withdrawal time, bowel preparation, and the interval recommendation following a colonoscopy with no neoplasia identified. Beginning in January 2013, the New York City health department administered quarterly benchmark reports via email to endoscopists, and provided quality metric details for personal and site performance, as well as New York City-wide trends.

Participating endoscopists (*N*=194) came from both hospital and ambulatory sites, with the majority being gastroenterologists (83.2%). Facilitators and barriers for implementation and the funding mechanisms for the intervention were not described.

In this multicenter, prospective, uncontrolled, longitudinal assessment, Uche-Anya et al. (2020)[157] investigated the impact of the quarterly feedback on quality metric performance over time. For negative index colonoscopies (that is, no biopsy or polypectomy), only 28% adhered to the 10-year guideline recommended surveillance interval. After seven subsequent quarterly reports, guideline adherence had improved to 55% ($p<0.001$). In a subset of surveyed endoscopists (*n*=33), 50% reported that they may still recommend a shorter than 10-year surveillance interval due to fear of interval cancers, or due to patient preference. There was no analysis or discussion on the patient, provider, or procedure-related characteristics that correlated with improvement in surveillance interval adherence. There was a lack of details on uptake of the quarterly report, making it difficult to understand who reviewed the report and how this report may have influenced behaviour change.

5.3.3. Quality Assessment

The quality assessment indicated a wide range in the overall risk of bias in individual studies, which reflected the bias due to the confounding domain (Table 5.3). The study by Uche-Anya et al. (2020)[157] was assessed as having critical risk of bias due to the confounding caused by the lack of control group, very short pre-intervention time period, no comparison between potential pre- and post- intervention confounding variables, and no adjustment for baseline confounders in their analysis. Alvarado et al. (2016)[154] and Magrath et al. (2018)[89] were assessed as having serious risk of bias, as both had no control group, though the study did report comparisons between their pre- and post-intervention cohorts and did regressions with adjustment for potential confounders as part of their analysis. Cross et al. (2019)[156] was assessed as moderate risk of bias, as the study used a simulated control group, and reported extensive cumulative, program, and subgroup analyses to test the robustness of their results. Finally, the study by Coe et al. (2012)[155] was assessed as having low risk of bias, given the randomized study design and control cohorts; however, there was a substantial amount of missing information that hampered the ability to make an accurate assessment of bias for each domain.

Table 5.3: ROBINS-I quality assessment for behaviour change interventions

	Confounding	Selection of participants	Classification of interventions	Deviations from intended interventions	Missing data	Measurement outcomes	Selection of the reported result	Overall
Alvarado et al. (2016)[154]	Serious	Low	Low	Serious	Serious	Moderate	No information	Serious
Coe at al. (2012)[155]	Low	Low	Low	No information	No information	Low	Low	Low
Cross et al. (2019)[156]	Moderate	Low	Low	Moderate	Moderate	Moderate	Low	Moderate
Magrath et al. (2018)[89]	Serious	Low	Low	Low	No information	Moderate	Low	Serious
Uche-Anya et al. (2020)[157]	Critical	Low	Low	No information	No information	Low	Moderate	Critical

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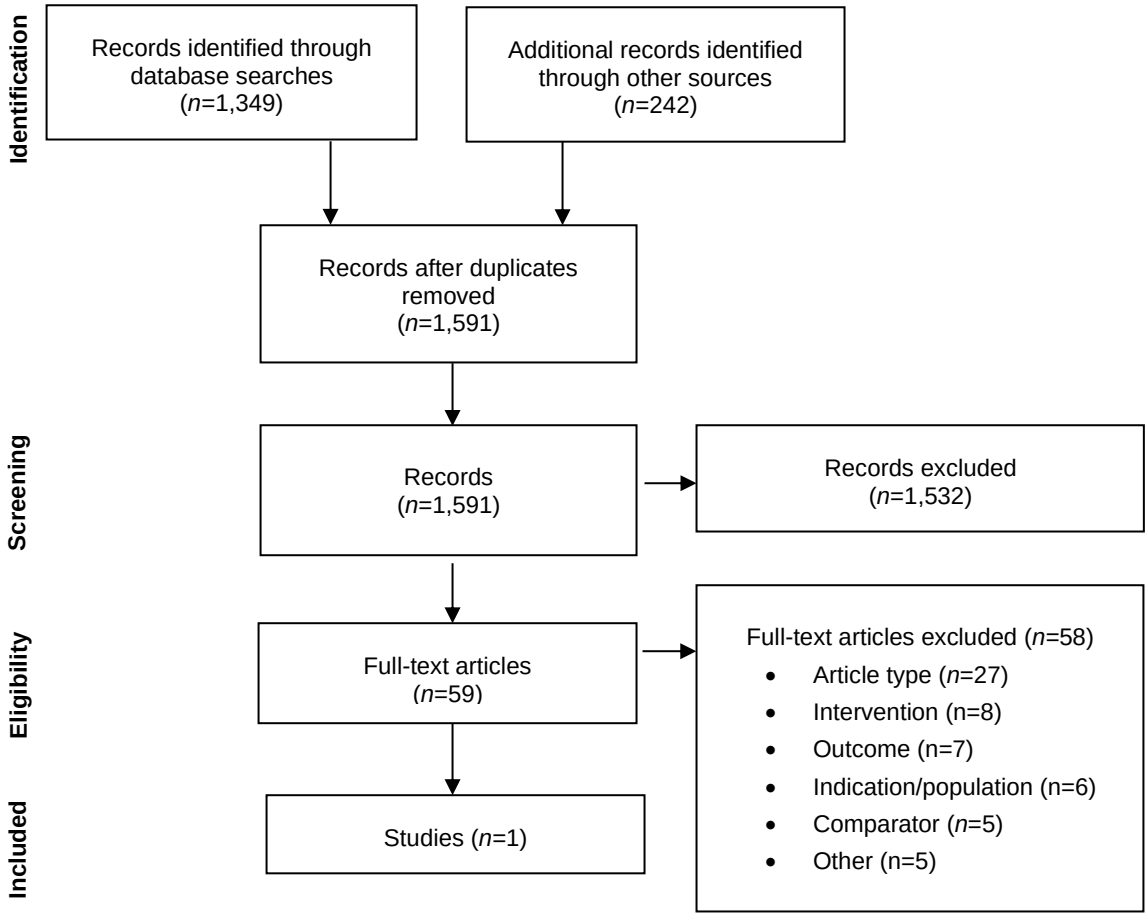
5.4. Results for Dyspepsia and Gastroesophageal Reflux

5.4.1. Literature Search

A total of 1,591 citations (titles and abstracts) identified from literature searches were screened, 59 full-text articles were assessed for eligibility and one article[160] include (Figure 5.2). The excluded studies and the reasons for their exclusion are described in Appendix I.

Figure 5.2: Study identification and selection for dyspepsia and gastroesophageal reflux



5.4.2. Behaviour Change Interventions

Table 5.4: Summary of behaviour change interventions for dyspepsia and gastroesophageal reflux

Study	Intervention	Study design	Outcomes	ROBINS-I risk of bias
Novak et al. (2020)[160] Canada Nov. 2011–Dec. 2014	Environmental restructuring: Nurse-led shared medical appointment pathway for patients	Prospective cohort study *N*=770 patients	Health System: Number of endoscopies preformed; wait times	Moderate

Environmental restructuring

Novak et al. (2020)[160] reported on the impact of a nurse-led shared medical appointment pathway on endoscopy use and wait-times (Table 5.4 and Appendix J, Table J.2.). For patients who were centrally referred for non-urgent gastroenterological consult, a GI-experienced registered nurse contacted patients, offering them a multi-disciplinary education session and shared medical appointment (instead of the usual care pathway of consulting with a gastroenterologist) and took a detailed phone history. The group education session, held at the patient's medical home offices (primary care network), was led by the registered nurse and involved a pharmacist, behaviour change consultant, and a dietician. This session provided information with the goal of improving patient knowledge on symptoms, and self-management options. After completing the group session, individual patients were assessed by a primary care physician with interest in gastroenterology or a gastroenterologist. The interdisciplinary collaboration, a focus on patient empowerment, and peer to peer support during group sessions were all seen as intervention facilitators. The program was developed with quality improvement grants, and funding of the sessions and shared appointments was implied to be provided by the established general physician and primary care network models.

In this prospective observational assessment, the shared medical appointment pathway was compared to usual care (that is, patients with a different medical home not participating in the intervention, who would be centrally referred to a gastroenterologist for consultation).[160] In two years of follow up, the median wait time to endoscopy was 65 weeks (interquartile range 46.14–131.64) in the usual care cohort and 37 weeks (interquartile range 23.29–64.14, $p<0.001$) in the intervention cohort, though authors reported that the nurse-led shared medical appointments were prioritized and may have significantly skewed consult and endoscopy wait times. Endoscopy was also more common in the usual care cohort (76.3%) than the intervention group (50.9%, $p<0.001$), with similar indications as reason for the procedure in both cohorts. The prevalence of significant outcomes (such as cancer or high-grade dysplasia, inflammatory bowel disease or colitis, esophageal diseases, celiac, or achalasia) were not different between cohorts (3.6% intervention versus 5.8% usual care, $p=0.15$). There were significantly more re-referrals to central triage for GI consult in the usual care cohort (15.6%) compared to the intervention (4.6%, $p<0.001$).

5.4.3. Quality Assessment

The overall risk of bias of the study by Novak et al.'s (2020)[160] was moderate (Table 5.5). The risk of bias due to confounding was rated as moderate, as the study had a control cohort, but their analysis did not include adjustments for baseline confounding and there was little comparison between intervention and control cohorts for potential confounding variables.

Table 5.5: ROBINS-I quality assessment for environmental restructuring

	Confounding	Selection of participants	Classification of interventions	Deviations from intended interventions	Missing data	Measurement outcomes	Selection of the reported result	Overall
Novak et al. (2020)[160]	Moderate	Low	Low	Low	Low	Low	Moderate	Moderate

5.5. Discussion

5.5.1. Main Findings

There are a limited number of behaviour change interventions aimed at reducing overuse in endoscopy in the two selected indications, and even fewer that have reported effectiveness. We found five interventions for colorectal adenoma surveillance,[89, 154-157] and one intervention for dyspepsia.[160] The studies varied widely in quality from low to critical risk of bias.

For colorectal adenoma surveillance, the interventions included:

- One training intervention,[155] which did not improve surveillance recommendation accuracy.
- Two enablement interventions: a registry increased the number of patients scoped within a year of their surveillance recommendation, with no change to the rates of early colonoscopies,[154] and a clinical decision support system increased the likeliness for guideline adherent recommendations.[89]
- One environmental restructuring intervention using yearly FIT testing for patients considered at intermediate risk for CRC,[156] estimated up to 71% of colonoscopies could be avoided, but with 30 to 40% of CRCs going undetected.
- One persuasion intervention using quarterly report cards,[157] showed a significant trend toward recommendation guideline adherence.

A single study on behaviour change intervention for managing patients with dyspepsia or GERD symptoms was identified.[160] This environment restructuring intervention used a nurse-led shared medical appointment pathway and found that endoscopy utilization was lower and endoscopy wait times were shorter for patients who went through the nurse-led pathway.

Facilitators, barriers, and funding mechanisms for the interventions were not well described. For some, interventions were facilitated by stakeholder engagement during development and implementation, and greater patient involvement in the diagnosis/surveillance process. Barriers included a distrust in the accuracy in newly implemented diagnosis/surveillance strategies and disruption in current workflow. Funding to develop the intervention was usually through a quality improvement grant, with no explicit discussion on the funding mechanism for sustaining the intervention once it had been established.

5.5.2. Limitations

The use of observational or quasi-experimental study designs for the majority of included studies means that these assessments are prone to temporal trends and confounders that are unrelated to the intervention. There was limited discussion of co-interventions occurring simultaneously, and it is reasonable to expect that there were quality improvement projects and health care system restructuring occurring concurrently and that may have had an impact on the implementation of these interventions and significantly contributed to confounding. Difficulties in attributing the positive effects to the interventions are further exacerbated by the frequent use of routine administrative sources, which may cause issues, due to missing important data on confounders and inability to quantify the amount of missing data, as well as an inability to confirm the quality of the data. Overall, research on overuse suffers from a lack of consistent and accurate variables relevant to appropriateness, inherent difficulties in classifying overuse (especially when the risk-benefit trade off is uncertain or there are variations in this trade off depending on the perspective) and a lack of validated or endorsed overuse metrics and analysis plans;[161] this likely contributed to the small number of studies we were able to include. The available outcomes to assess the effectiveness of interventions in these studies were often indirect assessments of overuse, imprecise, or not reflective of the level of implementation. For example, the study applied the intervention to endoscopists or providers, but only assessed effectiveness at the level of

patient or procedure. There was limited discussion on outcomes relevant to implementation, such as adherence to the behaviour change intervention. All of these concerns combine to produce a weak evidence base to both conduct and analyze overuse reduction strategies.

Most interventions were implemented in a single site or region, and the numbers of included participants were small. Particular to colorectal adenoma surveillance, many studies only focused on a subset of the overall surveillance population, for example, only those with normal colonoscopies, limiting their applicability and potential impact.

5.5.3. Implications

Despite the growing evidence identifying overuse in the health care system, there are few published studies of interventions aimed at reducing endoscopy procedures that have been recommended to be discontinued or reduced in frequency. This may stem from the complex and poorly understood patient-, provider, and system-level factors that influence overuse. A recent qualitative review identified over 300 facilitators and barriers to de-implementation from 81 studies,[162] which highlights how complex and broad the elements related to reducing overuse can be. The majority of factors related to the individual healthcare provider (attitudes and knowledge), but individual patient (attitudes and knowledge), social context (professional teams and development), organizational context (resources, structure, and routines), and economic and political context (financial incentives) were also factors.[162]

Though there are a small number of interventions specifically aimed at endoscopy use, evidence from the broader literature on overuse may provide guidance on alternative options not yet tested in this specific environment. In an overview of behaviour change interventions in primary care,[163] interactive and multi-faceted continuous medical education, training with audit and feedback, and clinical decision support systems were beneficial to improving knowledge and optimizing screening. There was limited evidence on the effectiveness of environmental restructuring or modelling, for improving collaboration and adherence to treatment guidelines. Overall, collaborative team-based policies were most effective.[163]

The evidence in this overview did not support the use of financial incentives,[163] but Patel et al. (2016)[164] postulated that fee-for-service payments for gastroenterologists would encourage high-volume rather then high-quality services in the United States health system, and suggested that alternate payment structures would be needed as a foundation to improve care and avoid unnecessary procedures. Three types of alternate payment models were discussed: bundled models in which gastroenterologists get paid a lump sum for a specific set of services provided during an episode of care (for example, CRC screening/surveillance colonoscopy); per-member per month-models in which a supplementary case management fee is provided for chronic disease patients (for example, inflammatory bowel disease); and shared savings models, in which population-level costs are compared with a benchmark and any savings are shared with providers.

In a review of quality improvement in gastroenterology,[165] audit and feedback was the most frequently used intervention, with it having varying success. Those interventions that combined feedback with retraining, financial incentives or penalties, or other interventions were more successful than feedback alone. For gastroenterology services overall, there was heterogeneity in the success of any type of quality improvement intervention, potentially due in part to a lack of rigorous study design use for assessing effectiveness. Education was frequently used but often insufficient on its own, and electronic medical records were underutilized for decision-making. The authors did not find any studies that improved patient outcomes or the patient experience — critical factors for achieving high-quality care that will need to be addressed in further investigations.

Beyond having an environment which has addressed various enabling and prohibitive factors and implementing an effective intervention, using an established framework and process model for implementation can also help guide the translation of research into practice. None of our included studies

identified an overarching theory of change guiding their implementation, or the framework(s) for which they have tailored their implementation strategy and planned for sustainability. The research regarding implementation science has grown substantially in recent years and has established a strong theoretical base for implementation, as well as strategies to facilitate the systematic uptake of interventions.[166]

5.5.4. Conclusion

There is a small number of interventions that have been examined for their effectiveness in reducing endoscopy overuse. These interventions have focused on training, enablement or persuasion, and restructuring the environment, and they showed varying success in reducing procedures recommended to be avoided, though the assessment of their effectiveness was hampered by potential confounders due to both the design and the conduct of the studies. Successfully implementing behaviour change interventions in Alberta will need to be supported by an implementation framework, as well as by an understanding of the facilitators and barriers present in the Alberta endoscopy referral and provision system, to confidently select and contextualize behaviour change interventions. It is highly likely that multiple interventions will need to be implemented (concurrently or consecutively) to address various underlying factors influencing overuse and to improve appropriateness.

Section SIX: Epidemiology of Endoscopy Use in Alberta

Dat Tran, PhD, Negar Razavilar, PhD, Jeff Round, PhD.

6.1 Objectives and Research Questions

This is a population-based retrospective cohort study to assess the epidemiology of endoscopy use in Alberta.

The objective of this analysis was to estimate the volume and geographical distribution of endoscopies in Alberta for the selected indications (that is, colorectal adenoma surveillance and dyspepsia/GERD).

The research questions for this section were:

- How frequently are the selected indicated overused procedures performed in Alberta?
- How is utilization distributed geographically in Alberta (across the entire province and between zones and sites)?
- What are the types and distribution of endoscopists and how do staff and facility resources vary?
- How does endoscopy utilization vary by patient characteristics?

6.2 Methods

6.2.1. Data Source and Study Population

This study was conducted using linked administrative health databases in Alberta, which include the National Ambulatory Care Reporting System (NACRS), Discharge Abstract Database (DAD), Practitioner Claims, Provider Registry, and Alberta Health Care Insurance Plan (AHCIP) Registry.[26] NACRS records all ambulatory care utilization (same-day surgery, day procedures, emergency department visits, and community rehabilitation services at publicly funded facilities). It provides information on patient demographics, diagnoses, and intervention procedures.[167] DAD contains complete hospitalization data in the province and includes patient demographics, diagnoses, discharge deposition, case mix group classification (to identify homogenous patient clusters), and interventions underwent during a hospitalization. Practitioner Claims provides fee-for-service claims data for physicians and includes the procedures that have been provided during a physician visit.[168, 169] The Provider Registry contains data on sex, birth year, and place of specialty certification for a medical services provider in Alberta.[26] The available data elements in Alberta's administrative health databases have also been described elsewhere.[170, 171]

Patients aged 18 years or older who underwent any of GI procedures endoscopy (including EGD or colonoscopy in this study) during a hospitalization, outpatient visit, or physician visit in Alberta between April, 1 2010 and March 31, 2019 (years 2010–2018) were included. The list of EGD and colonoscopy procedures was generated using Canadian Classification of Health Interventions (CCI), version 2015, and Health Service Canadian Classification of Procedures Extended Code (HSCCPC) and is presented in Appendix K, Table K.1 and K.2.[172] Patients who were not a registrant of the AHCIP during the study period were excluded.

6.2.2. Numbers of Endoscopies Performed in Alberta

We calculated the number of endoscopy procedures for each year during the study and reported endoscopy use by:

- sex, age group, and health zone of the patient's residence
- clinical specialty of the endoscopist
- procedure type (EGD or colonoscopy).

An endoscopy procedure was defined as a unique occurrence of an endoscopy code (CCI and HSCCPC, see Appendix K, Table K.1 and K.2) in one day during a hospitalization or during an outpatient or a physician visit. Therefore, a patient may have multiple endoscopy procedures during a hospital stay and may have more than one endoscopy procedure during an outpatient or a physician visit.

The annual rate per 100,000 population was also reported, based on Alberta population estimates.[173] In addition, we examined distribution of the number of procedures performed by reporting facility and by endoscopist. For this purpose, we only used the data in 2018 to reflect the most recent trends.

Some data points were excluded from analysis to avoid double counting of procedures. For each patient, endoscopy procedures recorded in the Practitioner Claims database that were performed during a hospitalization where endoscopy was also recorded as being performed were considered duplication and were excluded from analysis. It was assumed that these were the same procedure. Similarly, endoscopy procedures recorded in the Practitioner Claims database that were performed on the same day as an outpatient visit where endoscopy was also performed were considered duplication and were excluded from analysis.

6.2.3. Geographic Analysis of Endoscopy in Alberta

We used data on endoscopy performed in Alberta in 2018 to examine how many procedures were conducted at each facility, and the place of residence of patients attending each facility. In this analysis we focus on gastrointestinal endoscopy procedures that were performed at ambulatory care settings and potentially associated with low value utilization (Appendix K, Tables K.3 and K.4). The list of endoscopy facilities in Alberta was provided by the DHSCN. Based on the list of facilities and the list of included procedures, endoscopy procedures were searched primarily in the Practitioner Claims database. Additional endoscopy procedures in the NACRS database (excluding those performed in emergency departments) were also included if they were not reported in the Practitioner Claims database. Endoscopy procedures recorded in NACRS that were performed during a hospitalization where endoscopy interventions were also reported were excluded in the analysis.

Identifiable information of all endoscopy facilities, including name, health system identifier, postal code, and exact location (by longitude and latitude), were provided by Alberta Health. We calculated the number of endoscopy procedures for each facility by location of patient residence, and reported by forward sortation area (FSA). FSA is a geographical area defined by the first 3 digits of the patient residence postal code. Currently, there are 154 FSAs in Alberta. Population count in each FSA was calculated based on Alberta population in 2018 and Population and Dwelling Count Highlight Tables in 2016 Census.[174, 175]

Both total number of endoscopy procedures provided at a facility and the facility's population use rate were reported. Each facility can provide care to patients from a range of FSAs. Patients receiving endoscopy at a facility could be from multiple FSAs, and patients in the same FSA may attend different facilities for their care. To address this, we applied a weight to the population count in each FSA to calculate the population use rate for each facility. The weight of the population count for a facility in an FSA was equal to the proportion of procedures provided by the facility at the FSA over the total procedures for patients at the FSA. The weighted population count for a facility was then derived by summing up all weighted population counts for the facility at all FSAs where it provided endoscopy services.

We assessed performance of each endoscopy facility by ranking and categorizing them into pentiles for both the number of endoscopies provided and the weighted population use rate where the 1st pentile represented highest performance and the 5th pentile represented lowest performance. We also calculated the median values of number of endoscopies and weighted population rates at facility level in the province and compared the median values against corresponding values at each facility.

An exploration of double endoscopy procedures was also performed. Double procedures were defined as endoscopy procedures where a patient had both colonoscopy and gastroscopy on the same day. In addition, we examined differences in endoscopy practice for two different age groups (less than 50 years and ≥ 50 years old) between facilities. We calculated and compared both number of endoscopy procedures and weighted population rates for patients who were less than 50 years of age versus those for patients 50 years of age or older. Because the population count by age group for each FSA was not available, we assumed that each FSA had the same proportion of population aged ≥ 50 years as the proportion of this age group out of all Albertans aged ≥ 18 years which was 40.7% in 2018.[175]

To assist understanding of patient flow at each facility and in each zone, we calculated the number of endoscopy procedures provided according to the FSA of the patients treated. We included FSAs that contributed up to around 80% of the total endoscopies at a facility/zone. That is, to determine the catchment area for a facility/zone we included those FSA that individually contributed the greatest number of patients to a facility, up to 80% of procedures performed. This was to account for the high number of FSAs in urban areas relative to the number of facilities, compared with the small number of FSAs in rural areas relative to the number of facilities. Throughout the results we use Sankey charts to illustrate the flow of patient FSA to facility. The flow of patients at each FSA to a facility and the number of endoscopies at each FSA was also plotted on a map of Alberta, along with the locations of endoscopy facilities. The digital boundary map of FSAs in Alberta was from Statistics Canada.[176]

6.2.4. Use of Colonoscopy for Adenoma Surveillance

Depending on risk factors (for example, number and/or sizes of adenoma detected), clinical guidelines recommend a surveillance colonoscopy interval between three and 10 years.[51, 53, 71] Currently, codes in the administrative data label all colonoscopies undertaken for adenoma and/or CRC detection as "screening;" that is, they do not differentiate between "screening" colonoscopies (usually an initial colonoscopy, for patients with no history of adenoma and/or CRC) and "surveillance" colonoscopies (a subsequent colonoscopy for patients with previously identified adenomas and/or CRC), as is done in CPGs. Given this, using a subset of patients who underwent a colon screening colonoscopy during the study period, we defined the first colon screening colonoscopy encounter as the index screening event. Patient assessment for a subsequent surveillance colonoscopy was from the index event until March 31, 2019, unless they died or moved out of province. We examined the time interval (in years) between the index event and the following colonoscopy events for patients who had more than one colonoscopy during the follow-up period. Colonoscopy events that were within seven days of each other were considered just one colonoscopy event. We reported the proportion of patients who underwent a colonoscopy and had a diagnosis of adenoma, by whether an adenoma diagnosis was recorded before or after the date of the index colonoscopy. The

International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10) and 9th Revision (ICD-9), codes and HSCCPC codes for colon screening colonoscopy and adenoma are presented in Appendix K, Table K.5 and K.6, respectively.

6.2.5. Use of Esophagogastroduodenoscopy for Dyspepsia and Gastroesophageal Reflux

Clinical guidelines do not recommend EGD for investigating dyspepsia symptoms, or for screening of esophageal adenocarcinoma in patients with chronic GERD.[45, 72, 73] We examined the use of EGD in patients with dyspepsia and GERD during the study period and calculated the number of EGD procedures that could have been provided despite the guideline recommendations, for patients with dyspepsia and GERD. Because the administrative data sets do not provide information on indications for endoscopy or patient acuity at time of intervention, the precise number of low-yield EGD procedures is not known, though it is reasonable to assume that some proportion of the total EGD procedures provided despite the recommendations are low yield.

An EGD procedure was considered for dyspepsia or GERD if dyspepsia or GERD diagnoses were recorded in the hospitalization, outpatient visit, or practitioner visit where the EGD was provided. Because the Canadian guidelines for screening of esophageal adenocarcinoma in patients with GERD do not apply for patients who also have alarming symptoms caused by existing esophageal adenocarcinoma or Barrett esophagus (such as recurrent vomiting, unexplained weight loss, or anemia); thus, we excluded patients with a diagnosis of esophageal adenocarcinoma or Barrett esophagus during the EGD event.[72] The ICD codes for dyspepsia, GERD, esophageal adenocarcinoma, and Barrett esophagus are presented in Appendix K, Table K.7 and K.8.

6.2.6. Characteristics of Endoscopists in Alberta

We used the Alberta medical specialty recorded in each practitioner claim to determine the specialty of the physicians who performed endoscopy outside of hospital settings. For endoscopy performed in hospital or outpatient clinics, we used the specialty of the physician who made an endoscopy claim on the same day as the day the endoscopy was provided for the patient.

We defined an endoscopist as a physician who provided at least 100 colonoscopy procedures or at least 100 EGD procedures in a one-year period between April 1 and the subsequent March 31 during the study period. The 100-procedure threshold was used because it has been reported that an adequate annual volume should be required to maintain competency.[177, 178] This threshold has been used previously in research in Canada.[179] The age and health zone of the endoscopists were reported based on the last endoscopy encounter provided by that endoscopist during the study period.

6.2.7. Statistical Analysis

Patients were counted and reported on each year during the study if they had at least one endoscopy procedure during that year. Results were summarized using means (standard deviation), medians (interquartile ranges), counts, and percentages, as appropriate, and were compared across patient groups or health zones using Student's T-test or Kruskal-Wallis (for continuous variables) and χ^2 tests (for categorical variables). Poisson regressions were used to examine trend in endoscopy use rates over time, and negative binomial regressions were used to examine count data over time.

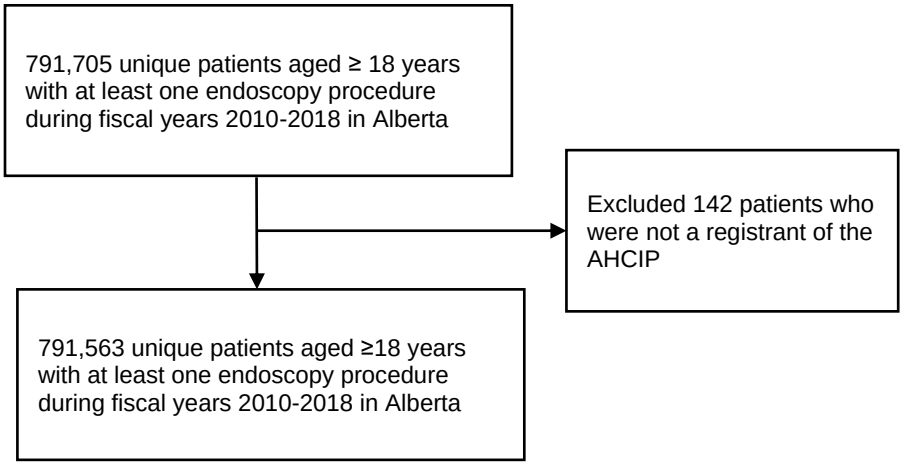
Previously validated ICD-10 codes were used to identify patient comorbidities and calculate Charlson comorbidity scores.[180] Comorbidities were considered present if they were recorded in any diagnostic field of a hospitalization or ambulatory care visit during a reported year.

All analyses were performed using Stata version 14 (Stata Corporation, College Station, Texas); two-sided P values <0.05 were considered statistically significant.

6.3. Results

There were 791,705 unique patients 18 years or older who underwent at least one endoscopy procedure during the study period. After excluding 142 patients who were not registered with the AHCIP, the final study cohort included 791,563 patients. Patient selection is depicted in Figure 6.1.

Figure 6.1: Patient selection flowchart



AHCIP: Alberta Health Care Insurance Plan.

6.3.1. Characteristics of Study Population

Overall use of GI endoscopy (including EGD and colonoscopy) increased over time, from 111,552 patients in 2010 to 147,198 patients in 2018 (32% increase, $p<0.001$). This translated to an increase in use rate of 3,843 to 4,406 patients per 100,000 population between 2010 and 2018, respectively. There were more female (51.5%) than male (48.5%) patients, but the proportion of females decreased over time (2010: 53.2%; 2018: 50.7%; $p<0.001$). The mean age of patients across the entire study period was 56.3 years, and this increased over time (2010: 55.6 years; 2018: 56.9 years; $p<0.001$) (Table 6.1).

Table 6.1: Characteristics of study population

Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018
Patient, n	111,552	117,097	123,851	128,684	134,653	136,367	143,841	143,168	147,198
Female, n (%)	59,303 (53.2)	62,123 (53.1)	65,238 (52.7)	67,617 (52.5)	68,278 (50.7)	68,551 (50.3)	72,618 (50.5)	72,576 (50.7)	74,582 (50.7)
Age, median (IQR)	56 (47–66)	56 (47–66)	56 (48–66)	56 (48–66)	57 (49–67)	58 (48–67)	58 (48–67)	58 (48–67)	58 (48–67)
Age, mean (SD)	55.6 (15.1)	55.8 (14.9)	56.0 (14.8)	56.0 (14.7)	56.5 (14.8)	56.6 (14.8)	56.6 (14.8)	56.7 (14.8)	56.9 (14.8)
Patient by health zone, n (%)									
South	10,258 (9.2)	10,833 (9.3)	10,724 (8.7)	11,105 (8.6)	11,154 (8.3)	11,394 (8.4)	11,897 (8.3)	11,056 (7.7)	11,690 (7.9)
Calgary	41,602 (37.3)	44,047 (37.6)	48,438 (39.1)	50,872 (39.5)	52,758 (39.2)	52,106 (38.2)	52,493 (36.5)	51,817 (36.2)	52,689 (35.8)
Central	14,650 (13.1)	15,556 (13.3)	16,048 (13.0)	16,636 (12.9)	17,799 (13.2)	17,934 (13.2)	18,678 (13.0)	18,626 (13.0)	19,640 (13.3)
Edmonton	31,825 (28.5)	33,124 (28.3)	34,789 (28.1)	35,766 (27.8)	37,922 (28.2)	39,314 (28.8)	44,512 (30.9)	45,170 (31.6)	46,415 (31.5)
North	13,217 (11.8)	13,537 (11.6)	13,852 (11.2)	14,305 (11.1)	15,020 (11.2)	15,619 (11.5)	16,261 (11.3)	16,499 (11.5)	16,764 (11.4)
Comorbidity, n (%)									
Myocardial infarction	1,932 (1.7)	1,937 (1.7)	1,913 (1.5)	1,827 (1.4)	1,874 (1.4)	1,809 (1.3)	1,756 (1.2)	1,663 (1.2)	1,560 (1.1)
Heart failure	2,459 (2.2)	2,429 (2.1)	2,502 (2.0)	2,700 (2.1)	2,825 (2.1)	2,889 (2.1)	2,954 (2.1)	2,695 (1.9)	2,826 (1.9)
PVD	1,551 (1.4)	1,532 (1.3)	1,558 (1.3)	1,528 (1.2)	1,650 (1.2)	1,689 (1.2)	1,858 (1.3)	1,869 (1.3)	1,747 (1.2)

Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018
CEVD	1,663 (1.5)	1,783 (1.5)	1,760 (1.4)	1,819 (1.4)	1,886 (1.4)	1,910 (1.4)	1,963 (1.4)	1,923 (1.3)	1,949 (1.3)
Dementia	930 (0.8)	987 (0.8)	1,077 (0.9)	1,033 (0.8)	1,031 (0.8)	1,042 (0.8)	945 (0.7)	984 (0.7)	964 (0.7)
COPD	5,916 (5.3)	5,915 (5.1)	6,090 (4.9)	5,939 (4.6)	6,118 (4.5)	5,953 (4.4)	5,661 (3.9)	5,628 (3.9)	5,043 (3.4)
Rheumatoid disease	1,041 (0.9)	1,125 (1.0)	1,553 (1.3)	1,521 (1.2)	1,769 (1.3)	1,772 (1.3)	1,970 (1.4)	2,210 (1.5)	2,032 (1.4)
Peptic ulcer	4,539 (4.1)	4,500 (3.8)	4,633 (3.7)	4,975 (3.9)	4,820 (3.6)	4,939 (3.6)	5,427 (3.8)	5,136 (3.6)	5,134 (3.5)
Liver disease	3,093 (2.8)	3,182 (2.7)	3,502 (2.8)	4,131 (3.2)	4,440 (3.3)	4,867 (3.6)	4,863 (3.4)	4,722 (3.3)	4,916 (3.3)
Diabetes	10,044 (9.0)	10,376 (8.9)	11,033 (8.9)	11,817 (9.2)	12,840 (9.5)	13,555 (9.9)	14,489 (10.1)	15,051 (10.5)	15,916 (10.8)
Hemiplegia or paraplegia	424 (0.4)	419 (0.4)	417 (0.3)	446 (0.3)	475 (0.4)	479 (0.4)	456 (0.3)	452 (0.3)	400 (0.3)
Renal disease	2,272 (2.0)	2,214 (1.9)	2,315 (1.9)	2,367 (1.8)	2,464 (1.8)	2,531 (1.9)	2,770 (1.9)	2,663 (1.9)	2,661 (1.8)
Cancer	5,502 (4.9)	5,746 (4.9)	6,026 (4.9)	6,377 (5.0)	6,612 (4.9)	6,881 (5.0)	6,907 (4.8)	6,992 (4.9)	6,983 (4.7)
Metastatic cancer	2,379 (2.1)	2,387 (2.0)	2,436 (2.0)	2,653 (2.1)	2,522 (1.9)	2,694 (2.0)	2,685 (1.9)	2,606 (1.8)	2,657 (1.8)

CEVD: cerebrovascular disease; COPD: chronic obstructive pulmonary disease; PVD: peripheral vascular disease; SD: standard deviation.

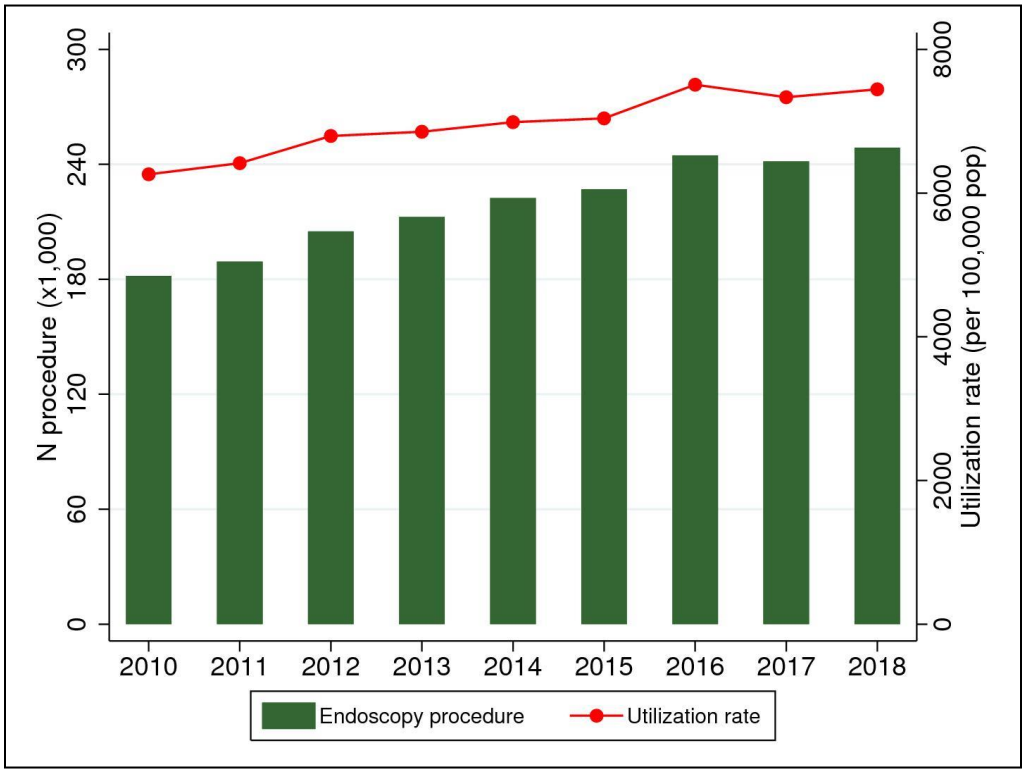
Patients in Calgary (37.7%) and Edmonton (29.4%) zones accounted for most patients undergoing endoscopy. While the proportion of patients having procedures in Calgary decreased slightly (2010: 37.3%; 2018: 35.8%; p<0.001), the proportion of patients in Edmonton increased over time (2010: 28.5%; 2018: 31.5%; p<0.001).

Diabetes mellitus (9.7%) was the most common comorbidity and it increased over time (2010: 9%; 2018: 10.8%; p<0.001). However, the mean Charlson comorbidity score remained unchanged during the overall study period (2010: mean=0.67; 2018: mean=0.65; p=0.299).

6.3.2. Use of Endoscopy in Alberta

A total of 1,972,688 GI endoscopy procedures were performed during the study period. Of them, colonoscopy accounted for 59.2% (1,168,787 procedures). The annual number of procedures increased 37% between 2010 (181,751 procedures) and 2018 (248,676 procedures; p<0.001) (Table 6.2). Accordingly, the GI endoscopy utilization rate increased from 6,261 to 7,444 procedures per 100,000 population between 2010 and 2018 (p<0.001) (Figure 6.2).

Figure 6.2: Utilization of endoscopy in Alberta, 2010-2018



More than half of the number of GI endoscopy procedures were provided to females (51.7%) and patients younger than 60 years (56.7%). However, GI endoscopy was provided increasingly to the more senior patients (≥60 years) during the study period (2010: 73,837 procedures [40.6%]; 2018: 114,583 procedures [46.1%]; p<0.001).

The GI endoscopy utilization rate was highest in patients aged 60 or older (14,306 procedures per 100,000 population in 2018) and was lowest among patients younger than 50 years old (3,665 procedures per 100,000 population; p<0.001) (Figure 6.3). The pattern of utilization by age group

was similar between EGD and colonoscopy, but the gap between the oldest and the youngest groups was wider in colonoscopy (Figure 6.4).

Figure 6.3: Utilization of endoscopy by age group in Alberta, 2010-2018

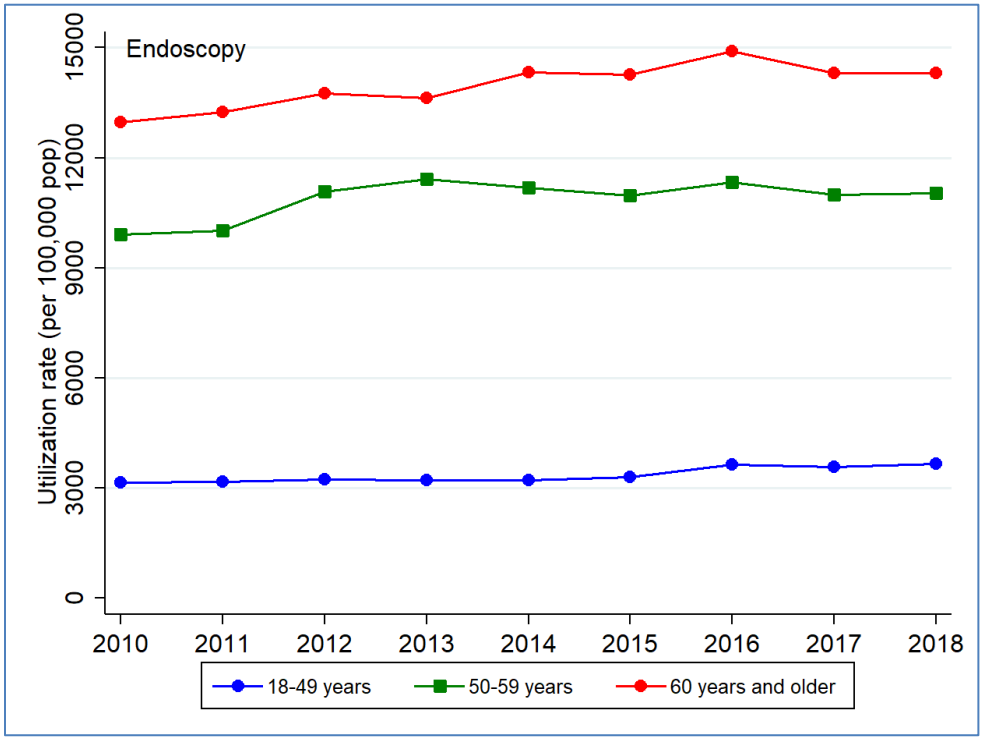
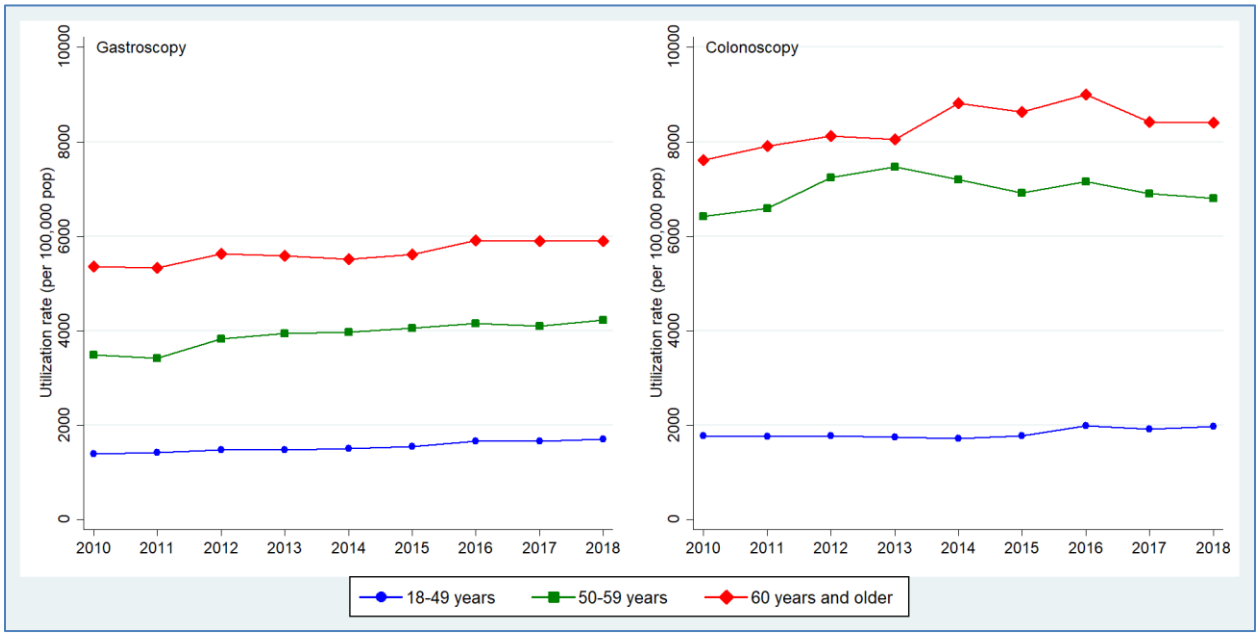


FIGURE 6.4: Utilization of endoscopy by type and age group in Alberta, 2010-2018



Most GI endoscopy procedures were provided either in Calgary (35%) or Edmonton (32.2%) zones and the proportion of procedures remained unchanged over time in both zones (p for trend = 0.198 and 0.979, respectively) (Table 6.2). However, the utilization rate increased in all health zones during the study period. It was highest in the Central zone (9,283 procedures per 100,000 population in 2018) and lowest in the Calgary zone (6,711 procedures per 100,000 population in 2018, p<0.001) (Figure 6.5). The pattern of utilization rate was similar for EGDs with the Central zone being the highest (4,500 procedures per 100,000 population in 2018) and the Calgary zone being the lowest (2,689 procedures per 100,000 population in 2018; p<0.001). The pattern of colonoscopy fluctuated during the study period, but by the end of the study period it followed suit with the Central zone being the highest (4,783 procedures per 100,000 population in 2018) and the Calgary zone being the lowest (4,022 procedures per 100,000 population in 2018; p<0.001). Edmonton zone peaked colonoscopy utilization in 2016 (4,849 procedures per 100,000 population), but decreased to the second highest in 2018 (4,582 procedures per 100,000 population; p<0.001) (Figure 6.6).

Gastroenterologists (50.1%) and general surgeons (27.7%) were the two specialties that performed most endoscopies in Alberta (Table 6.2). Gastroenterologists performed the most of endoscopies in Calgary (64.3% in 2018) and Edmonton (53.6% in 2018) zones while general surgeons did so in South (64.3% in 2018) and North (47.5% in 2018) zones. In Central zone, there was a more balanced contribution in providing endoscopy between gastroenterologists (36.3% in 2018) and general surgeons (28.2% in 2018). Details on the population rates and the proportions of procedures provided by gastroenterologists and general surgeons in each health zone in 2018 are presented in Tables K.9-K.11 in Appendix K. Detailed results on number of procedures by age group in each health zone are presented in Table K.12-K.14 in Appendix K.

Figure 6.5: Utilization of endoscopy by health zone in Alberta, 2010-2018

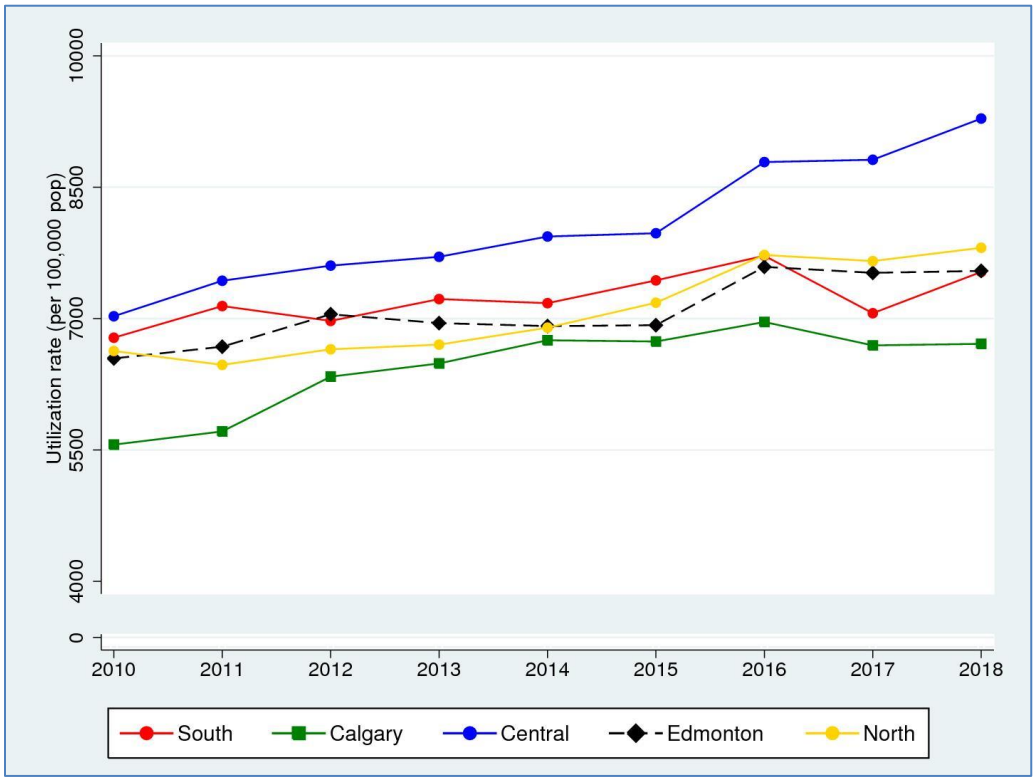
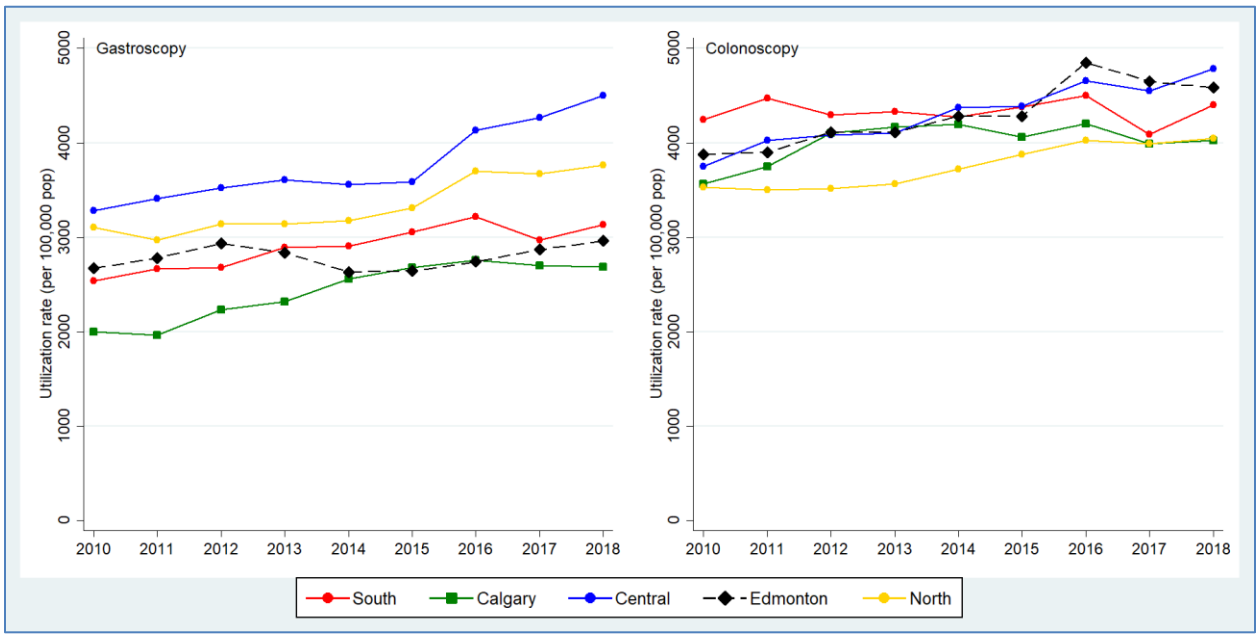


Figure 6.6: Utilization of endoscopy by health zone and type in Alberta, 2010-2018



Detailed usage data for EGD and colonoscopy are presented in Tables 6.3 and 6.4, respectively. While the proportion of EGD procedures remained unchanged and was consistently higher in females (2010: 53.8%; 2018: 53.4%; p=0.160) during the study period, the proportion of colonoscopy procedures for females decreased (2010: 52.9%; 2018: 49.5%; p=0.002) and became less than that in males in the year beginning April 1, 2014. However, both EGD (2010: 41.5%; 2018: 45.2%; p=0.001) and colonoscopy (2010: 40%; 2018: 46.7%; p<0.001) were provided increasingly to more senior group (≥60 years) during the study period.

Table 6.2: Endoscopy utilization in Alberta, 2010-2018

Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018
Endoscopy procedure, n	181,751	189,172	204,959	212,576	222,427	227,009	244,606	241,512	248,676
EGD, n (%)	73,501 (40.4)	75,550 (39.9)	82,858 (40.4)	85,947 (40.4)	88,924 (40.0)	92,567 (40.8)	99,259 (40.6)	100,815 (41.7)	104,480 (42.0)
Colonoscopy, n (%)	108,250 (59.6)	113,622 (60.1)	122,101 (59.6)	126,629 (59.6)	133,503 (60.0)	134,442 (59.2)	145,347 (59.4)	140,697 (58.3)	144,196 (58.0)
Procedure by sex, n (%)									
Female	96,828 (53.3)	100,362 (53.1)	108,165 (52.8)	111,797 (52.6)	113,496 (51.0)	114,635 (50.5)	124,048 (50.7)	123,586 (51.2)	127,204 (51.2)
Male	84,923 (46.7)	88,810 (46.9)	96,794 (47.2)	100,779 (47.4)	108,931 (49.0)	112,374 (49.5)	120,558 (49.3)	117,926 (48.8)	121,472 (48.8)
Procedure by age group, n (%)									
18–29 years	12,048 (6.6)	12,451 (6.6)	13,184 (6.4)	13,228 (6.2)	13,623 (6.1)	13,634 (6)	14,783 (6)	14,169 (5.9)	14,270 (5.7)
30-39 years	15,632 (8.6)	16,594 (8.8)	17,338 (8.5)	18,401 (8.7)	19,756 (8.9)	20,584 (9.1)	23,283 (9.5)	23,205 (9.6)	24,010 (9.7)
40-49 years	29,884 (16.4)	29,117 (15.4)	29,803 (14.5)	29,661 (14)	29,265 (13.2)	30,439 (13.4)	33,462 (13.7)	32,800 (13.6)	34,386 (13.8)
50-59 years	50,350 (27.7)	52,723 (27.9)	60,047 (29.3)	63,574 (29.9)	63,444 (28.5)	62,509 (27.5)	64,107 (26.2)	61,801 (25.6)	61,427 (24.7)
60–69 years	38,616 (21.2)	41,854 (22.1)	46,235 (22.6)	48,210 (22.7)	52,957 (23.8)	56,024 (24.7)	62,062 (25.4)	61,547 (25.5)	63,610 (25.6)
70–79 years	24,352 (13.4)	25,128 (13.3)	26,775 (13.1)	27,250 (12.8)	31,030 (14.0)	31,470 (13.9)	34,510 (14.1)	35,425 (14.7)	38,397 (15.4)
≥80 years	10,869 (6.0)	11,305 (6.0)	11,577 (5.6)	12,252 (5.8)	12,352 (5.6)	12,349 (5.4)	12,399 (5.1)	12,565 (5.2)	12,576 (5.1)

Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018
Procedure by health zone, n (%)									
South	14,857 (8.2)	15,895 (8.4)	15,876 (7.7)	16,524 (7.8)	16,662 (7.5)	17,330 (7.6)	17,950 (7.3)	16,572 (6.9)	17,764 (7.1)
Calgary	60,329 (33.2)	62,942 (33.3)	71,448 (34.9)	75,775 (35.6)	81,219 (36.5)	82,443 (36.3)	86,502 (35.4)	84,089 (34.8)	86,179 (34.7)
Central	24,181 (13.3)	25,979 (13.7)	27,196 (13.3)	27,800 (13.1)	29,082 (13.1)	29,364 (12.9)	32,176 (13.2)	32,807 (13.6)	34,239 (13.8)
Edmonton	59,439 (32.7)	61,609 (32.6)	66,526 (32.5)	67,985 (32.0)	69,740 (31.4)	70,785 (31.2)	79,280 (32.4)	79,035 (32.7)	81,505 (32.8)
North	22,945 (12.6)	22,747 (12.0)	23,913 (11.7)	24,492 (11.5)	25,724 (11.6)	27,087 (11.9)	28,698 (11.7)	29,009 (12.0)	28,989 (11.7)
Procedure by endoscopist specialty, n (%)									
Gastroenterology	87,809 (48.3)	92,457 (48.9)	105,058 (51.3)	109,867 (51.7)	114,110 (51.3)	119,555 (52.7)	121,458 (49.7)	117,616 (48.7)	119,728 (48.1)
General surgery	55,227 (30.4)	58,427 (30.9)	56,251 (27.4)	56,943 (26.8)	59,527 (26.8)	60,857 (26.8)	68,442 (28.0)	65,075 (26.9)	66,397 (26.7)
General practice	13,407 (7.4)	13,320 (7.0)	15,036 (7.3)	15,025 (7.1)	15,257 (6.9)	15,467 (6.8)	18,463 (7.5)	19,718 (8.2)	20,060 (8.1)
Internal medicine	18,359 (10.1)	17,680 (9.3)	20,182 (9.8)	22,288 (10.5)	24,192 (10.9)	22,156 (9.8)	26,230 (10.7)	30,458 (12.6)	34,023 (13.7)
Others	2,825 (1.6)	3,281 (1.7)	4,068 (2.0)	4,187 (2.0)	3,922 (1.8)	4,089 (1.8)	4,156 (1.7)	4,195 (1.7)	4,415 (1.8)
Unknown	4,124 (2.3)	4,007 (2.1)	4,364 (2.1)	4,266 (2.0)	5,419 (2.4)	4,885 (2.2)	5,857 (2.4)	4,450 (1.8)	4,053 (1.6)

EGD: esophagogastroduodenoscopy

TABLE 6.3: Esophagogastroduodenoscopy utilization in Alberta, 2010-2018

Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018
EGD procedure, n	73,501	75,550	82,858	85,947	88,924	92,567	99,259	100,815	104,480
Procedure by sex, n (%)									
Female	39,550 (53.8)	40,754 (53.9)	44,583 (53.8)	46,081 (53.6)	47,523 (53.4)	48,591 (52.5)	52,790 (53.2)	54,077 (53.6)	55,792 (53.4)
Male	33,951 (46.2)	34,796 (46.1)	38,275 (46.2)	39,866 (46.4)	41,401 (46.6)	43,976 (47.5)	46,469 (46.8)	46,738 (46.4)	48,688 (46.6)
Procedure by age group, n (%)									
18–29 years	5,694 (7.7)	5,986 (7.9)	6,390 (7.7)	6,431 (7.5)	6,695 (7.5)	6,559 (7.1)	7,123 (7.2)	6,789 (6.7)	6,894 (6.6)
30-39 years	7,139 (9.7)	7,653 (10.1)	8,086 (9.8)	8,583 (10)	9,363 (10.5)	9,626 (10.4)	10,686 (10.8)	10,999 (10.9)	11,135 (10.7)
40-49 years	12,465 (17)	12,342 (16.3)	12,981 (15.7)	13,058 (15.2)	13,201 (14.8)	13,939 (15.1)	14,735 (14.8)	14,839 (14.7)	15,691 (15)
50-59 years	17,708 (24.1)	18,016 (23.8)	20,763 (25.1)	21,970 (25.6)	22,561 (25.4)	23,095 (24.9)	23,547 (23.7)	23,050 (22.9)	23,514 (22.5)
60–69 years	14,555 (19.8)	15,074 (20.0)	16,839 (20.3)	17,776 (20.7)	18,831 (21.2)	20,584 (22.2)	22,572 (22.7)	23,130 (22.9)	24,199 (23.2)
70–79 years	10,282 (14.0)	10,536 (13.9)	11,591 (14.0)	11,533 (13.4)	12,016 (13.5)	12,312 (13.3)	13,911 (14.0)	14,916 (14.8)	16,075 (15.4)
≥80 years	5,658 (7.7)	5,943 (7.9)	6,208 (7.5)	6,596 (7.7)	6,257 (7.0)	6,452 (7.0)	6,685 (6.7)	7,092 (7.0)	6,972 (6.7)
Procedure by health zone, n (%)									
South	5,555 (7.6)	5,937 (7.9)	6,095 (7.4)	6,612 (7.7)	6,742 (7.6)	7,124 (7.7)	7,478 (7.5)	6,967 (6.9)	7,383 (7.1)
Calgary	21,682 (29.5)	21,605 (28.6)	25,172 (30.4)	27,108 (31.5)	30,738 (34.6)	32,752 (35.4)	34,278 (34.5)	33,921 (33.6)	34,530 (33.0)

Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018
Central	11,287 (15.4)	11,920 (15.8)	12,605 (15.2)	13,006 (15.1)	13,047 (14.7)	13,213 (14.3)	15,131 (15.2)	15,880 (15.8)	16,597 (15.9)
Edmonton	24,236 (33.0)	25,648 (33.9)	27,705 (33.4)	27,746 (32.3)	26,548 (29.9)	27,006 (29.2)	28,626 (28.8)	30,150 (29.9)	32,001 (30.6)
North	10,741 (14.6)	10,440 (13.8)	11,281 (13.6)	11,475 (13.4)	11,849 (13.3)	12,472 (13.5)	13,746 (13.8)	13,897 (13.8)	13,969 (13.4)
Procedure by endoscopist specialty, n (%)									
Gastroenterology	38,209 (52.0)	39,710 (52.6)	45,227 (54.6)	47,192 (54.9)	48,583 (54.6)	51,894 (56.1)	52,889 (53.3)	52,270 (51.8)	54,134 (51.8)
General surgery	17,617 (24.0)	18,600 (24.6)	17,986 (21.7)	18,005 (20.9)	19,052 (21.4)	19,524 (21.1)	21,233 (21.4)	21,150 (21.0)	20,859 (20.0)
General practice	5,614 (7.6)	5,475 (7.2)	6,376 (7.7)	6,445 (7.5)	6,347 (7.1)	6,465 (7.0)	8,166 (8.2)	9,165 (9.1)	9,613 (9.2)
Internal medicine	7,928 (10.8)	7,684 (10.2)	8,727 (10.5)	9,507 (11.1)	10,160 (11.4)	9,704 (10.5)	11,627 (11.7)	13,478 (13.4)	15,078 (14.4)
Others	2,166 (2.9)	2,409 (3.2)	2,719 (3.3)	3,006 (3.5)	2,786 (3.1)	2,987 (3.2)	2,999 (3.0)	3,098 (3.1)	3,254 (3.1)
Unknown	1,967 (2.7)	1,672 (2.2)	1,823 (2.2)	1,792 (2.1)	1,996 (2.2)	1,993 (2.2)	2,345 (2.4)	1,654 (1.6)	1,542 (1.5)

EGD: esophagogastroduodenoscopy.

Table 6.4: Colonoscopy utilization in Alberta, 2010-2018

Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018
Colonoscopy procedure, n	108,250	113,622	122,101	126,629	133,503	134,442	145,347	140,697	144,196
Procedure by sex, n (%)									
Female	57,278 (52.9)	59,608 (52.5)	63,582 (52.1)	65,716 (51.9)	65,973 (49.4)	66,044 (49.1)	71,258 (49.0)	69,509 (49.4)	71,412 (49.5)
Male	50,972 (47.1)	54,014 (47.5)	58,519 (47.9)	60,913 (48.1)	67,530 (50.6)	68,398 (50.9)	74,089 (51.0)	71,188 (50.6)	72,784 (50.5)
Procedure by age group, n (%)									
18–29 years	6,354 (5.9)	6,465 (5.7)	6,794 (5.6)	6,797 (5.4)	6,928 (5.2)	7,075 (5.3)	7,660 (5.3)	7,380 (5.2)	7,376 (5.1)
30-39 years	8,493 (7.8)	8,941 (7.9)	9,252 (7.6)	9,818 (7.8)	10,393 (7.8)	10,958 (8.2)	12,597 (8.7)	12,206 (8.7)	12,875 (8.9)
40-49 years	17,419 (16.1)	16,775 (14.8)	16,822 (13.8)	16,603 (13.1)	16,064 (12)	16,500 (12.3)	18,727 (12.9)	17,961 (12.8)	18,695 (13)
50-59 years	32,642 (30.2)	34,707 (30.5)	39,284 (32.2)	41,604 (32.9)	40,883 (30.6)	39,414 (29.3)	40,560 (27.9)	38,751 (27.5)	37,913 (26.3)
60–69 years	24,061 (22.2)	26,780 (23.6)	29,396 (24.1)	30,434 (24)	34,126 (25.6)	35,440 (26.4)	39,490 (27.2)	38,417 (27.3)	39,411 (27.3)
70–79 years	14,070 (13)	14,592 (12.8)	15,184 (12.4)	15,717 (12.4)	19,014 (14.2)	19,158 (14.3)	20,599 (14.2)	20,509 (14.6)	22,322 (15.5)
≥80 years	5,211 (4.8)	5,362 (4.7)	5,369 (4.4)	5,656 (4.5)	6,095 (4.6)	5,897 (4.4)	5,714 (3.9)	5,473 (3.9)	5,604 (3.9)
Procedure by health zone, n (%)									
South	9,302 (8.6)	9,958 (8.8)	9,781 (8.0)	9,912 (7.8)	9,920 (7.4)	10,206 (7.6)	10,472 (7.2)	9,605 (6.8)	10,381 (7.2)
Calgary	38,647 (35.7)	41,337 (36.4)	46,276 (37.9)	48,667 (38.4)	50,481 (37.8)	49,691 (37.0)	52,224 (35.9)	50,168 (35.7)	51,649 (35.8)

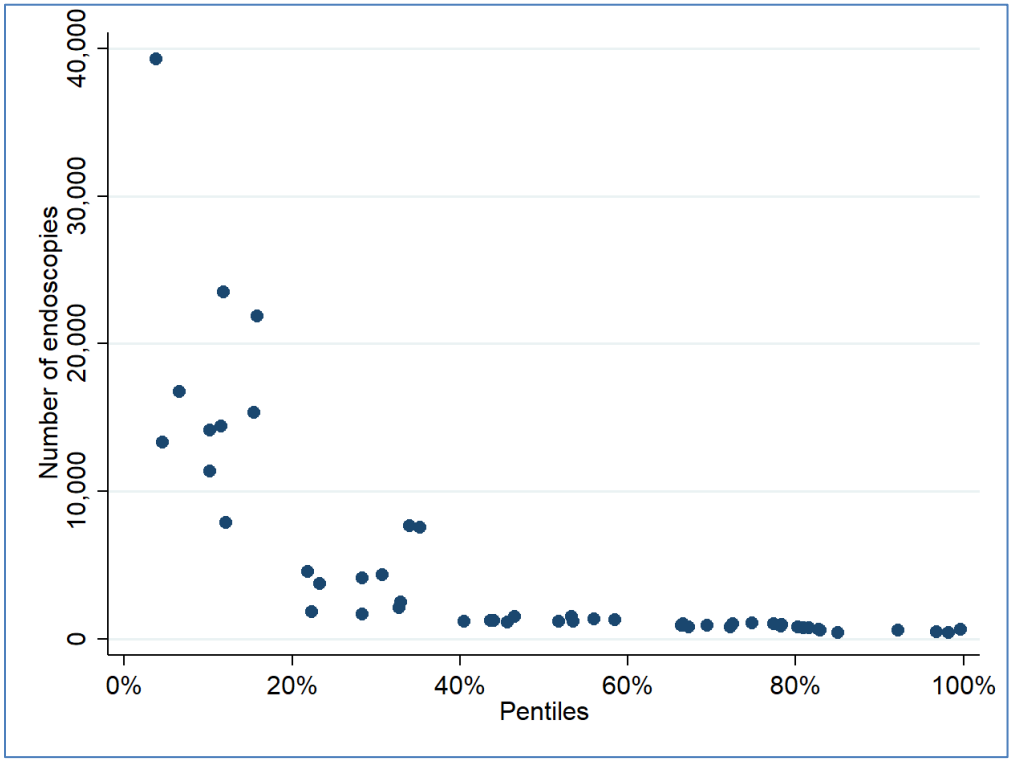
Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018
Central	12,894 (11.9)	14,059 (12.4)	14,591 (11.9)	14,794 (11.7)	16,035 (12.0)	16,151 (12.0)	17,045 (11.7)	16,927 (12.0)	17,642 (12.2)
Edmonton	35,203 (32.5)	35,961 (31.6)	38,821 (31.8)	40,239 (31.8)	43,192 (32.4)	43,779 (32.6)	50,654 (34.9)	48,885 (34.7)	49,504 (34.3)
North	12,204 (11.3)	12,307 (10.8)	12,632 (10.3)	13,017 (10.3)	13,875 (10.4)	14,615 (10.9)	14,952 (10.3)	15,112 (10.7)	15,020 (10.4)
Procedure by endoscopist specialty, n (%)									
Gastroenterology	49,600 (45.8)	52,747 (46.4)	59,831 (49.0)	62,675 (49.5)	65,527 (49.1)	67,661 (50.3)	68,569 (47.2)	65,346 (46.4)	65,594 (45.5)
General surgery	37,610 (34.7)	39,827 (35.1)	38,265 (31.3)	38,938 (30.7)	40,475 (30.3)	41,333 (30.7)	47,209 (32.5)	43,925 (31.2)	45,538 (31.6)
General practice	7,793 (7.2)	7,845 (6.9)	8,660 (7.1)	8,580 (6.8)	8,910 (6.7)	9,002 (6.7)	10,297 (7.1)	10,553 (7.5)	10,447 (7.2)
Internal medicine	10,431 (9.6)	9,996 (8.8)	11,455 (9.4)	12,781 (10.1)	14,032 (10.5)	12,452 (9.3)	14,603 (10.0)	16,980 (12.1)	18,945 (13.1)
Others	659 (0.6)	872 (0.8)	1,349 (1.1)	1,181 (0.9)	1,136 (0.9)	1,102 (0.8)	1,157 (0.8)	1,097 (0.8)	1,161 (0.8)
Unknown	2,157 (2.0)	2,335 (2.1)	2,541 (2.1)	2,474 (2.0)	3,423 (2.6)	2,892 (2.2)	3,512 (2.4)	2,796 (2.0)	2,511 (1.7)

There were 153 unique facilities where 248,676 endoscopy procedures were performed in 2018. However, there are only 50 endoscopy facilities in the province. We ranked facilities by the number of procedures performed and assumed that 103 of least functioning facilities where very few procedures were performed (ranged between 1 and 307 procedures in 2018) were reported with an incorrect facility ID and were excluded from the analysis. The remaining 50 most active facilities accounted for 246,078 (99%) of the total endoscopy procedures in 2018. The average number of endoscopy procedures per site were 4,922. However, there were great variations in site activity with the number of endoscopy procedure per site varying from 39,326 in the highest activity site to just 417 in the lowest activity site in 2018. Distribution of the number of endoscopies, EGD, and colonoscopy procedures per facility in 2018 by pentiles is presented in Table 6.5 and Figure 6.7 and 6.8.

Table 6.5: Performance of endoscopy facilities in Alberta in 2018

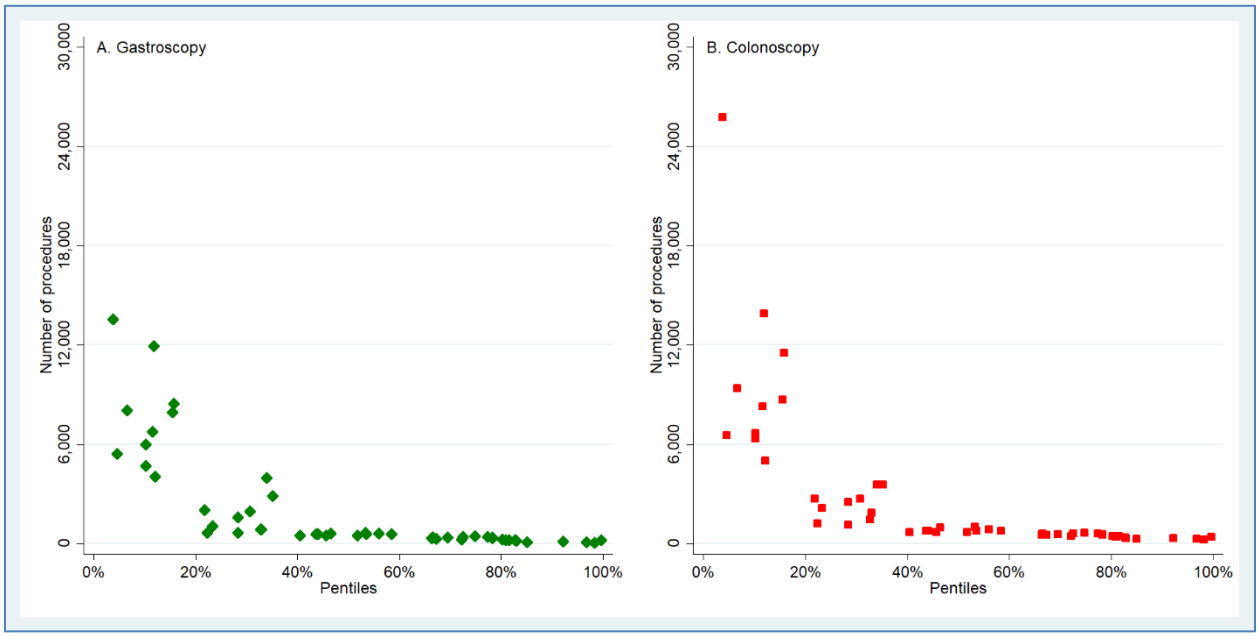
Variable	Endoscopy	Colonoscopy	EGD
Max procedure, n	39,326	25,779	13,547
Min procedure, n	417	235	45
Procedure range by pentiles, n			
1st pentile - max	39,326	25,779	13,547
1st pentile - min	7,903	5,024	4,068
2nd pentile - max	7,637	3,569	3,969
2nd pentile - min	1,679	1,121	650
3rd pentile - max	1,520	1,029	640
3rd pentile - min	1,132	690	493
4th pentile - max	1,078	634	435
4th pentile - min	774	463	259
5th pentile - max	773	456	231
5th pentile - min	417	235	45

Figure 6.7: Performance of endoscopy facilities in 2018 by pentiles.



Each dot represents a facility

Figure 6.8: Performance of endoscopy facilities in 2018 by pentiles for gastroscopy and colonoscopy.



Each dot represents a facility

6.3.3. Endoscopy Geographical Analysis

Endoscopy by facility

There were 143,835 endoscopy procedures of 109,749 patients included in the analysis (Claims database: 123,245 procedures; NACRS database: 20,590 procedures). The list of 49 facilities with endoscopy procedures performed in 2018 is presented in Table 6.6. Among the 49 facilities, median number of endoscopies was 604 procedures (Cold Lake Regional Hospital, North zone) with a range from a high of 27,397 procedures (Foothills, Calgary zone) to a low of 8 procedures (Lamont Health Center, Central zone) while the median use rate per 100,000 population was 3,968 procedures (Royal Alexandra Hospital, Edmonton zone) with a range of 8,052 procedures (Rocky Mountain Hospital, Central zone) to 2,574 procedures (Taber Hospital, South zone).

Table 6.6: List of endoscopy facilities with endoscopy performed in 2018 in Alberta

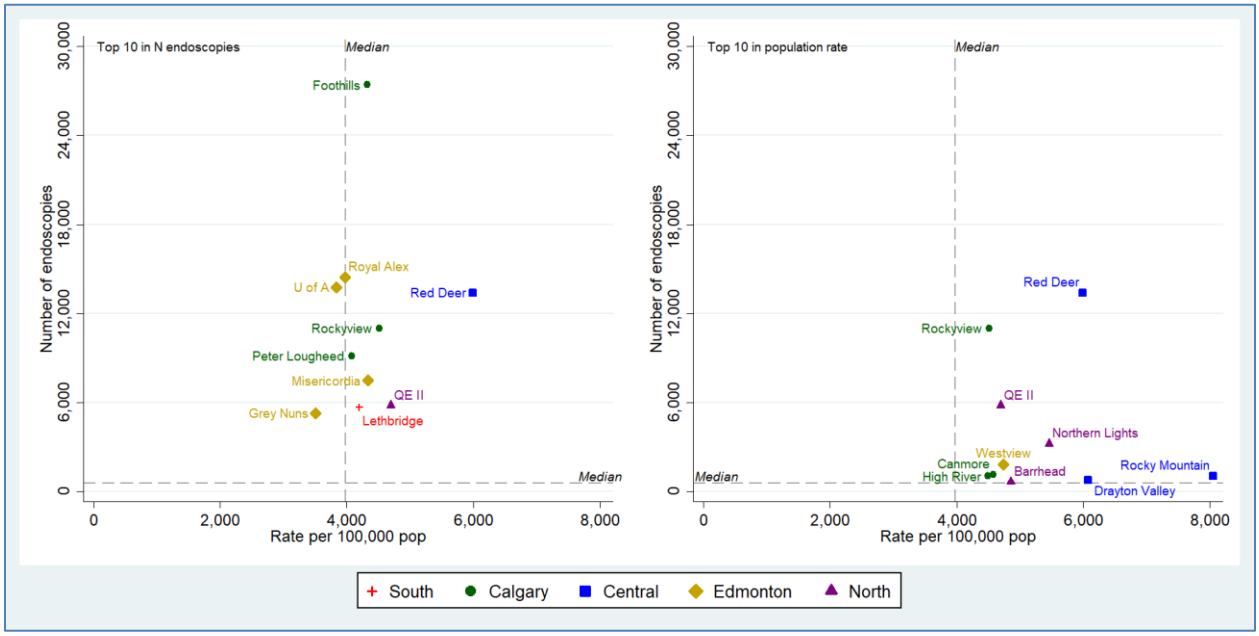
	Facility name	Endoscopy procedures, n	Pentile for number of procedures	Weighted rate, n per 100,000 population	Pentile for population rate
South zone (8 sites)					
1	Lethbridge Regional Hospital	5,657	1	4,198	2
2	Medicine Hat Regional Hospital	2,519	2	3,831	3
3	Coaldale Hospital	1,401	2	4,397	2
4	Brooks Health Centre	393	3	2,805	5
5	Crowsnest Pass Hospital	131	4	3,219	4
6	Cardston Municipal Hospital	109	4	3,142	5
7	Pincher Creek Municipal Hospital	35	5	3,870	3
8	Taber Hospital	15	5	2,574	5
Calgary zone (6 sites)					
1	Foothills Prov Gen Hospital	27,397	1	4,319	2
2	Rockyview General Hospital	10,994	1	4,508	1
3	Peter Lougheed Hospital	9,110	1	4,072	3
4	South Health Campus	4,789	2	4,274	2
5	Canmore Municipal Hospital	1,136	2	4,576	1
6	High River General Hospital	1,041	2	4,494	1
Central zone (13 sites)					
1	Red Deer Regional Hospital	13,401	1	5,992	1
2	Rocky Mountain Hospital & Care Centre	1,053	2	8,052	1
3	Drayton Valley Hospital & Care Centre	801	3	6,072	1
4	St. Mary's Hospital	737	3	3,724	4
5	Drumheller Regional Health Complex	373	3	4,047	3
6	Vermilion Health Care Complex	273	4	2,724	5
7	Stettler Hospital and Care Centre	235	4	4,466	2
8	Wainwright Health Centre	167	4	3,721	3

	Facility name	Endoscopy procedures, n	Pentile for number of procedures	Weighted rate, n per 100,000 population	Pentile for population rate
9	Wetaskiwin Hospital & Care Centre	135	4	4,176	3
10	Daysland Health Centre	130	4	3,337	4
11	Ponoka Hospital and Care Centre	84	5	4,179	2
12	Viking Health Centre	82	5	3,299	4
13	Lamont Health Center	8	5	3,562	4
Edmonton zone (9 sites)					
1	Royal Alexandra Hospital	14,425	1	3,968	3
2	University Of Alberta Hospital	13,755	1	3,833	3
3	Misericordia Hospital	7,482	1	4,330	2
4	Grey Nuns Community Hospital	5,267	1	3,508	4
5	Sturgeon General Hospital	4,372	2	4,458	2
6	Westview Health Centre-Stony Plain	1,835	2	4,731	1
7	Leduc General Hospital	1,121	2	3,701	4
8	Ft Saskatchewan Community Hospital	793	3	3,488	4
9	Cross Cancer Institute	47	5	3,696	4
North zone (13 sites)					
1	Queen Elizabeth II Hospital	5,795	1	4,694	1
2	Northern Lights Regional Health Centre	3,221	2	5,461	1
3	Barrhead Healthcare Centre	658	3	4,854	1
4	Cold Lake Regional Hospital	604	3	3,634	4
5	Sacred Heart Hospital	581	3	4,434	2
6	Whitecourt Healthcare Centre	439	3	3,968	3
7	Hinton Healthcare Centre	406	3	2,646	5
8	Northwest Health Centre	329	4	4,141	3
9	St Therese-St Paul Healthcare Centre	178	4	2,734	5
10	Fairview Health Complex	125	4	4,207	2
11	Peace River Municipal Hospital	101	5	3,085	5
12	Bonnyville Healthcare Centre	48	5	3,080	5
13	William J Cadzow Lac La Biche	47	5	2,670	5

[a] The Foothills Hospital provides colon cancer screening services across the whole of the Calgary Zone, and this is reflected in the high number of procedures performed relative to other large urban facilities.

Facilities in Edmonton and Calgary provided more endoscopies, but facilities in Central and North zones dominated in weighted population use rates. Of the 49 facilities, only Rockyview (Calgary zone), Red Deer (Central zone), and QE II hospitals (North zone) were among the top 10 performers in both the number of endoscopies and the weighted population use rate. No facility in the South zone was among the top 10 performers in weighted population rate (see Table 6.6 and Figure 6.9).

Figure 6.9: Top performers in Endoscopy in 2018 in Alberta



Left side figure illustrates 10 sites with highest number of procedures and right side illustrates 10 sites with highest weighted population use rate in 2018. Horizontal median line is the median number of endoscopies at a facility and vertical median line is the median population use rate at a facility in the province.

Endoscopy by geographic location

The 143,835 endoscopy procedures included in the analysis were from patients living across 152/154 FSAs in the province (two FSAs did not have any patients that received an endoscopy that was part of the analysis). Four FSAs with both low population (fewer than 520 population) and few endoscopies (all less than 24 procedures) were then excluded from the analysis because the low numbers could bias our estimates. The remaining 148 FSAs had 143,780 endoscopy procedures performed in 2018. The number of patients in each FSA that had endoscopies ranged from 74 (T6P, Edmonton zone) to 3,354 (T0M, Central zone) procedures while the rate per 100,000 population ranged from 1,177 (T9V, Central zone) to 13,905 (T4E, Central zone) procedures (see Table 6.7).

Table 6.7: Summary of endoscopy use by geographic location in 2018 in Alberta

Variable	Number of procedures	Rate per 100,000 population
Endoscopy		
Min	74	1,177
Max	3,354	13,905
Mean (SD)	971 (690)	4,477 (1,605)
Median (IQR)	808 (444-1,432)	4,283 (3,675-4,998)
Colonoscopy		
Min	40	517
Max	1,885	8,462
Mean (SD)	566 (404)	2,597 (973)
Median (IQR)	476 (251-809)	2,577 (2,101-3,047)

Variable	Number of procedures	Rate per 100,000 population
Gastroscopy		
Min	31	660
Max	1,514	6,199
Mean (SD)	405 (298)	1,879 (781)
Median (IQR)	323 (172-578)	1,739 (1,428-2,068)

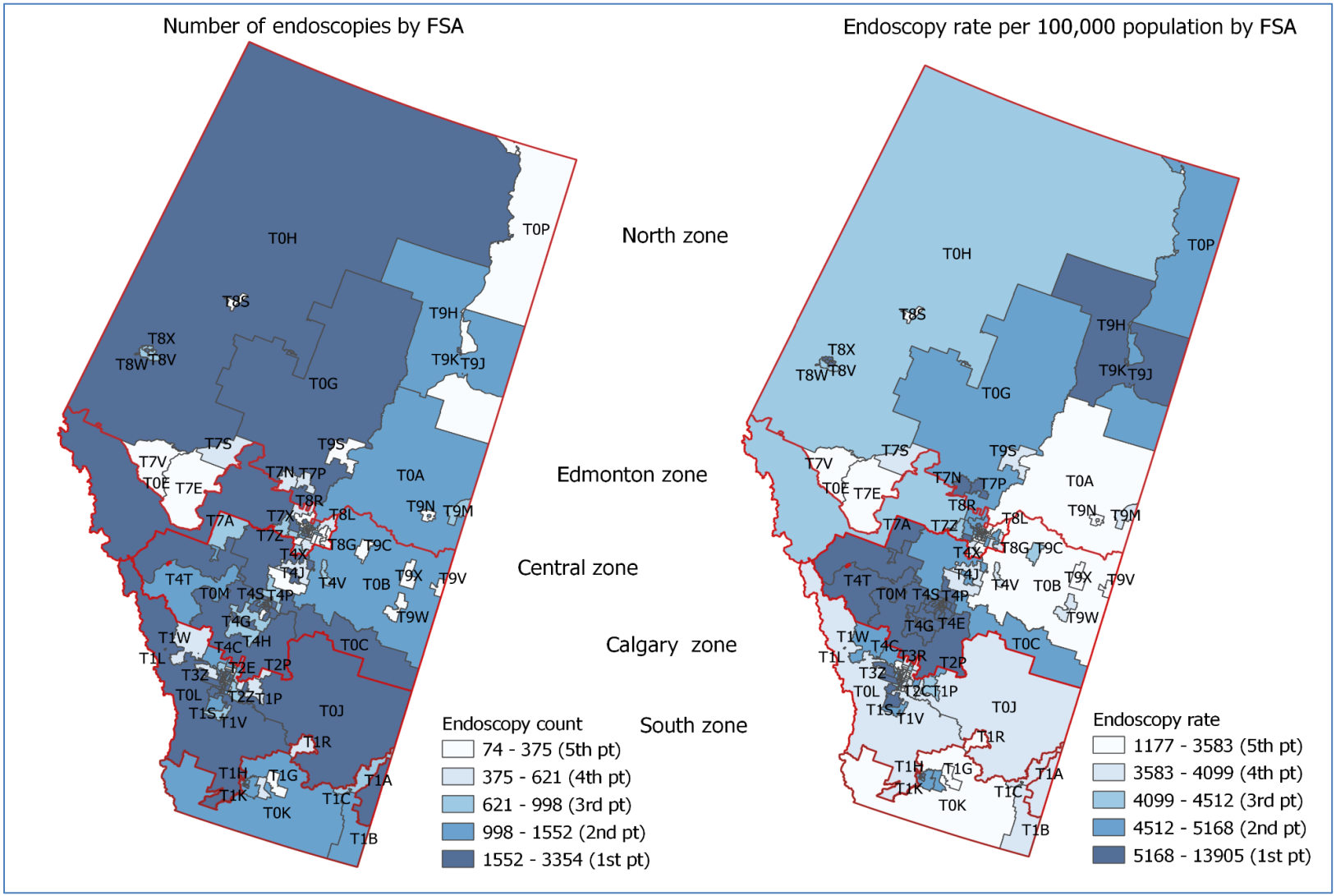
IQR: interquartile range; SD: standard deviation.

The distribution of endoscopy use by FSA is presented in Figure 14. Both the number and the population rate of endoscopies in each FSA were categorized into pentiles where the 1st pentile represented the highest and the 5th represented the lowest performance. The borders of health zones are presented in red lines in Figure 6.10.

There were 35,302 (24.5% of total endoscopies in 2018) endoscopy procedures from the 30 FSAs in the first pentile (highest) of population rate that were performed in 46 facilities in Alberta. Of them, the top 11 facilities accounted for 90% of the 35,302 procedures in the 30 first pentile FSAs.

A majority of endoscopy procedures performed by Northern Lights Health Centre (93.6%) and Red Deer Hospital (80.2%) was for patients from the 30 FSAs in the 1st pentile (highest) of population rate (see Table 6.8).

Figure 6.10: Distribution of endoscopy by geographic location in Alberta



In this figure, the left side illustrates number of endoscopies by FSA and the right side illustrates weighted population rate by FSA. Red border represents health zone boundary. The order from north to south is North, Edmonton, Central, Calgary, and South zones.

Table 6.8: Endoscopy performed in 11 most providing facilities in the 1st pentile of FSAs in population rate in 2018

Facility	Procedures performed in 1st pentile FSAs in population rate, n (A)	Total procedure performed in 2018, n (B)	Contribution from 1st pentile FSAs in population rate, % (A/B)
Northern Lights Health Centre	3,016	3,221	93.6
Red Deer Regional Hospital	10,752	13,401	80.2
Queen Elizabeth II Hospital	2,443	5,795	42.1
Sturgeon General Hospital	1,751	4,372	40.1
Rockyview General Hospital	2,517	10,994	22.9
Misericordia Hospital	1,539	7,482	20.6
Lethbridge Regional Hospital	1,099	5,657	19.4
Foothills Prov Gen Hospital	4,057	27,397	14.8
Peter Lougheed Hospital	1,061	9,110	11.6
University Of Alberta Hospital	1,543	13,755	11.2
Royal Alexandra Hospital	1,498	14,425	10.4

Double colonoscopy and gastroscopy procedures

There were 15,643 (14.3%) patients who had double procedures (both colonoscopy and gastroscopy on the same day) in Alberta. The number of endoscopies of double procedures was 25,143, equal to 17.5% of all procedures performed in 2018. The proportion of double procedure endoscopies was lowest in Central zone (15.1%) and was highest in North zone (19.8%). Calgary and Edmonton zones had similar proportions of double procedure endoscopies (see Table 6.9).

The proportion of double procedures varied by endoscopy facilities. It was highest at Bonnyville Healthcare Centre (North zone, 60.4%) and was lowest at Coaldale Hospital (South zone, 1.2%). However, it should be noted that these centres provided few endoscopies in 2018. Several large providers like Foothills and Rockyview hospitals in Calgary zone had about 19% of procedures that were double procedures, while Royal Alex and University of Alberta hospitals in Edmonton zone had approximately 15% double procedures. Red Deer hospital in Central zone had 14.4% that were double procedures (see Table 6.10).

Table 6.9: Double procedure endoscopies in 2018 by health zone in Alberta

Health zone	Double procedure endoscopies, n (A)	Total endoscopy procedures, N (B)	Proportion of double procedures, % (A/B)
South	1,880	10,427	18.0
Calgary	9,588	54,477	17.6
Central	2,874	19,091	15.1
Edmonton	7,527	43,265	17.4
North	3,274	16,575	19.8

Table 6.10: Double procedure endoscopies in 2018 by facility in Alberta

Facility	Double procedure endoscopies, n (A)	Total endoscopy procedures, N (B)	Proportion of double procedures, % (A/B)
South zone			
Taber Hospital	5	15	33.3
Medicine Hat Regional Hospital	558	2,519	22.2
Brooks Health Centre	87	393	22.1
Cardston Municipal Hospital	22	109	20.2
Pincher Creek Municipal Hosp	7	35	20.0
Lethbridge Regional Hospital	1,110	5,657	19.6
Crowsnest Pass Hospital	19	131	14.5
Coaldale Hospital	17	1,401	1.2
Calgary zone			
Foothills Prov Gen Hospital	5,335	27,397	19.5
Rockyview General Hospital	2,107	10,994	19.2
South Health Campus	750	4,789	15.7
Peter Lougheed Hospital	1,358	9,110	14.9
Canmore Municipal Hospital	123	1,136	10.8
High River General Hospital	19	1,041	1.8
Central zone			
Viking Health Centre	21	82	25.6
Lamont Health Center	2	8	25.0
Rocky Mountain Hospital	190	1,053	18.0
Drayton Valley Hospital	124	801	15.5
Red Deer Regional Hospital Ctr	1,926	13,401	14.4
Vermilion Health Care Complex	39	273	14.3
Drumheller Regional Health	53	373	14.2
Ponoka Hospital and Care Centre	11	84	13.1
Daysland Health Centre	16	130	12.3
St. Mary's Hospital	83	737	11.3
Wainwright Health Centre	18	167	10.8
Stettler Hospital and Care Centre	16	235	6.8
Wetaskiwin Hospital	4	135	3.0
Edmonton zone			
Grey Nuns Community Hospital	1,255	5,267	23.8
Misericordia Hospital	1,676	7,482	22.4
Sturgeon General Hospital	921	4,372	21.1
Ft Saskatchewan Comm Hospital	147	793	18.5

Facility	Double procedure endoscopies, n (A)	Total endoscopy procedures, N (B)	Proportion of double procedures, % (A/B)
Royal Alexandra Hospital	2,235	14,425	15.5
University Of Alberta Hospital	2,092	13,755	15.2
Westview Health-Stony Plain	190	1,835	10.4
Leduc General Hospital	78	1,121	7.0
Cross Cancer Institute	2	47	4.3
North zone			
Bonnyville Healthcare Centre	29	48	60.4
Peace River Municipal Hospital	31	101	30.7
Sacred Heart Hospital	139	581	23.9
Queen Elizabeth II Hospital	1,326	5,795	22.9
Barrhead Healthcare Centre	148	658	22.5
Northwest Health Centre	70	329	21.3
William J Cadzow Lac La Biche	10	47	21.3
Hinton Healthcare Centre	82	406	20.2
Northern Lights Regional Health	556	3,221	17.3
Fairview Health Complex	19	125	15.2
Cold Lake Regional Hospital	75	604	12.4
Whitecourt Healthcare Centre	37	439	8.4
St Therese-St Paul Health Centre	5	178	2.8

Endoscopy use by age groups

Of the 143,835 endoscopy procedures performed in 2018, 106,950 (74.4%) procedures were for patients aged ≥ 50 years. The number of endoscopy procedures and weighted use rate per 100,000 population by age group for each facility are presented in Table 6.11. Overall, the weighted population rates were higher for patients aged ≥ 50 years than those for their younger counterparts and this trend was consistent across facilities. The weighted population rates for the older group were highest in three facilities in Central zone (Red Deer, Rocky Mountain, and Drayton Valley; all greater than 10,000 procedures per 100,000 population).

Table 5.11: List of endoscopy facilities with endoscopy performed by age group in 2018 in Alberta

	Facility name	All		Age < 50 years		Age ≥ 50 years	
		Endoscopy, n	Weighted use rate, n	Endoscopy, n	Weighted use rate, n	Endoscopy, n	Weighted use rate, n
South zone (8 sites)							
1	Lethbridge Regional Hospital	5,657	4,198	1,653	1,726	4,004	7,809
2	Medicine Hat Regional Hospital	2,519	3,831	561	1,688	1,958	6,943
3	Coaldale Hospital	1,401	4,397	116	1,778	1,285	8,210
4	Brooks Health Centre	393	2,805	138	1,551	255	4,595
5	Crowsnest Pass Hospital	131	3,219	20	1,441	111	5,783
6	Cardston Municipal Hospital	109	3,142	29	1,354	80	5,733
7	Pincher Creek Municipal Hospital	35	3,870	8	1,685	27	7,253
8	Taber Hospital	15	2,574	2	984	13	4,767
Calgary zone (6 sites)							
1	Foothills Prov Gen Hospital	27,397	4,319	4,939	1,819	22,458	7,901
2	Rockyview General Hospital	10,994	4,508	3,488	1,871	7,506	8,434
3	Peter Lougheed Hospital	9,110	4,072	2,779	1,762	6,331	7,484
4	South Health Campus	4,789	4,274	1,927	1,857	2,862	7,875
5	Canmore Municipal Hospital	1,136	4,576	196	1,738	940	8,711
6	High River General Hospital	1,041	4,494	359	1,830	682	8,593
Central zone (13 sites)							
1	Red Deer Regional Hospital	13,401	5,992	3,585	2,524	9,816	11,029
2	Rocky Mountain Hospital & Care Centre	1,053	8,052	235	2,923	818	15,660
3	Drayton Valley Hospital & Care Centre	801	6,072	156	2,401	645	11,382
4	St. Mary's Hospital	737	3,724	118	1,204	619	7,368
5	Drumheller Regional Health Complex	373	4,047	88	1,834	285	7,255

	Facility name	All		Age < 50 years		Age ≥ 50 years	
		Endoscopy, n	Weighted use rate, n	Endoscopy, n	Weighted use rate, n	Endoscopy, n	Weighted use rate, n
6	Vermilion Health Care Complex	273	2,724	45	1,046	228	5,003
7	Stettler Hospital and Care Centre	235	4,466	43	1,582	192	8,636
8	Wainwright Health Centre	167	3,721	18	1,036	149	7,702
9	Wetaskiwin Hospital & Care Centre	135	4,176	28	1,593	107	7,889
10	Daysland Health Centre	130	3,337	26	1,060	104	6,640
11	Ponoka Hospital and Care Centre	84	4,179	34	1,992	50	7,232
12	Viking Health Centre	82	3,299	13	1,079	69	6,481
13	Lamont Health Center	8	3,562	3	1,362	5	6,605
Edmonton zone (9 sites)							
1	Royal Alexandra Hospital	14,425	3,968	3,567	1,632	10,858	7,395
2	University Of Alberta Hospital	13,755	3,833	3,497	1,579	10,258	7,116
3	Misericordia Hospital	7,482	4,330	1,724	1,726	5,758	8,130
4	Grey Nuns Community Hospital	5,267	3,508	1,189	1,519	4,078	6,392
5	Sturgeon General Hospital	4,372	4,458	1,203	1,769	3,169	8,407
6	Westview Health Centre-Stony Plain	1,835	4,731	357	1,814	1,478	8,973
7	Leduc General Hospital	1,121	3,701	232	1,660	889	6,619
8	Ft Saskatchewan Community Hospital	793	3,488	186	1,536	607	6,342
9	Cross Cancer Institute	47	3,696	9	1,396	38	7,012
North zone (13 sites)							
1	Queen Elizabeth II Hospital	5,795	4,694	1,999	2,608	3,796	7,664
2	Northern Lights Regional Health Centre	3,221	5,461	1,430	4,017	1,791	7,473
3	Barrhead Healthcare Centre	658	4,854	132	1,999	526	9,075
4	Cold Lake Regional Hospital	604	3,634	188	1,864	416	6,192
5	Sacred Heart Hospital	581	4,434	131	1,963	450	8,004

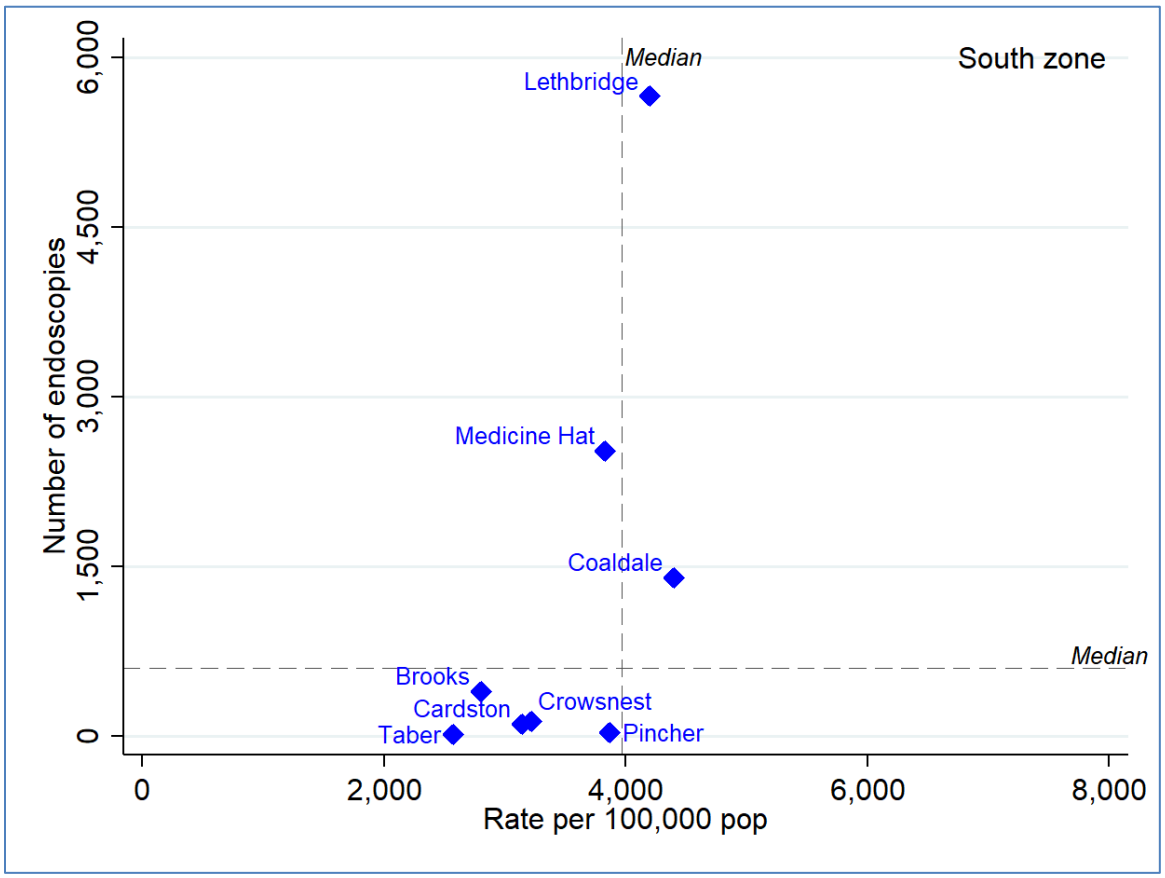
	Facility name	All		Age < 50 years		Age ≥ 50 years	
		Endoscopy, n	Weighted use rate, n	Endoscopy, n	Weighted use rate, n	Endoscopy, n	Weighted use rate, n
6	Whitecourt Healthcare Centre	439	3,968	109	1,946	330	6,976
7	Hinton Healthcare Centre	406	2,646	112	1,346	294	4,491
8	Northwest Health Centre	329	4,141	129	1,990	200	7,269
9	St Therese-St Paul Healthcare Centre	178	2,734	30	1,225	148	5,026
10	Fairview Health Complex	125	4,207	14	1,983	111	7,408
11	Peace River Municipal Hospital	101	3,085	21	1,388	80	5,530
12	Bonnyville Healthcare Centre	48	3,080	9	1,479	39	5,340
13	William J Cadzow Lac La Biche	47	2,670	10	1,070	37	4,989

Zone-based analysis

South zone

There were 8 endoscopies facilities in the South zone. Three facilities (Lethbridge, Medicine Hat, and Coaldale) provided number of endoscopies that were higher than the provincial average. However, only two of them (Lethbridge and Coaldale) had the weighted population rate above the provincial average (see Table 6.6 and Figure 6.11). Other facilities provided few endoscopies and had low weighted population rates.

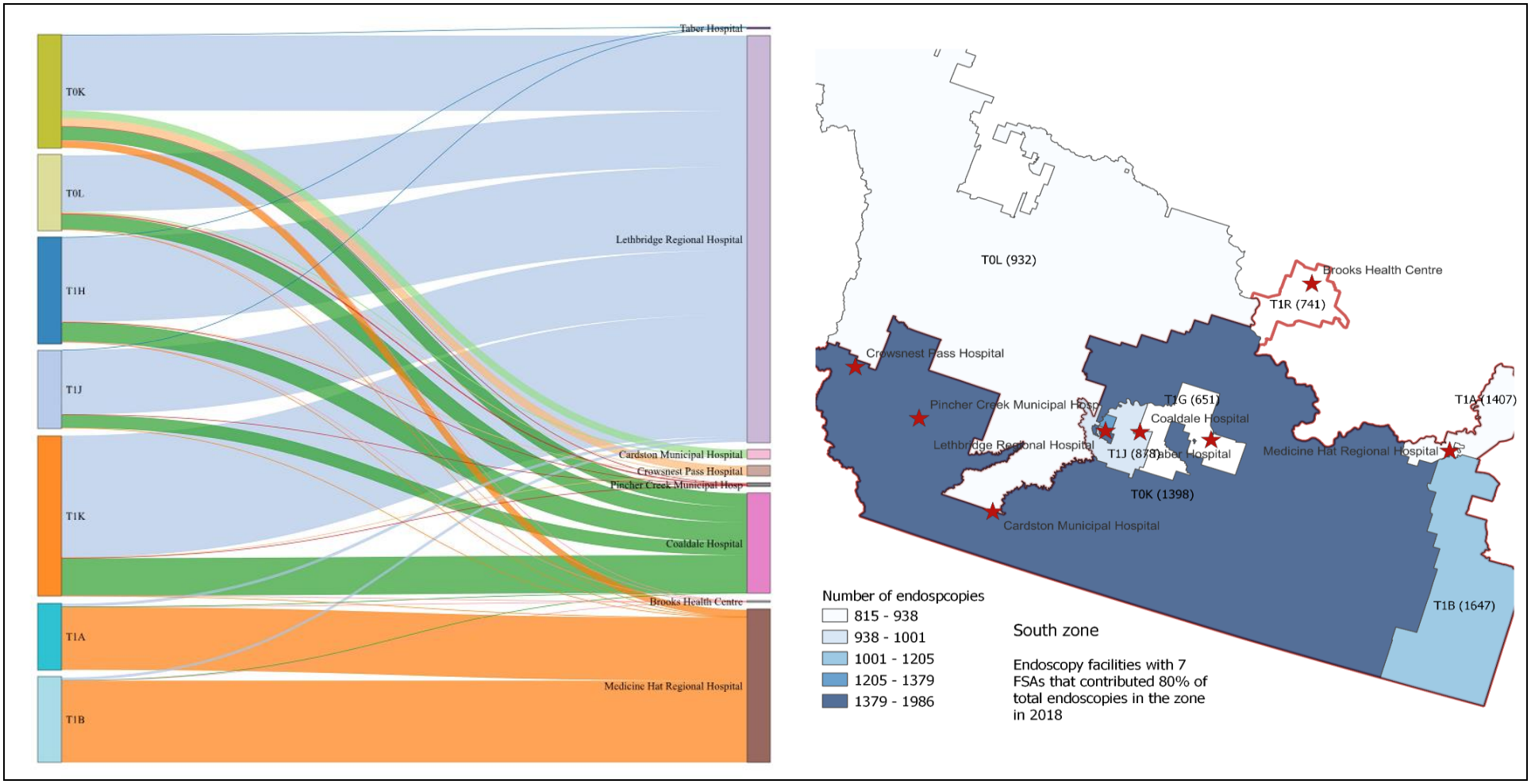
Figure 6.11: Endoscopy provision in 2018 in South zone, Alberta



Population rate was calculated using a weighted method. The population count for a facility in an FSA was set proportional to the number of endoscopies provided by the facility in the FSA out of total endoscopies performed for patients at that FSA. Horizontal median line is the median number of endoscopies at a facility and vertical median line is the median population use rate at a facility in the province.

There were 10,260 endoscopy procedures provided by 8 facilities in South zone in 2018. The overall endoscopy use rate in South zone was 4,421 procedures per 100,000 population. The flow of patients from each FSA to each facility is depicted in Figure 15. The source of patients was quite concentrated in the South zone with 7 FSAs contributing 80% of endoscopies provided by the 8 facilities. South zone facilities also provided a significant number of endoscopies to patients in rural Calgary zone (T0L, see Figure 6.12).

Figure 6.12: Source of patients with endoscopy in 2018 in South zone, Alberta

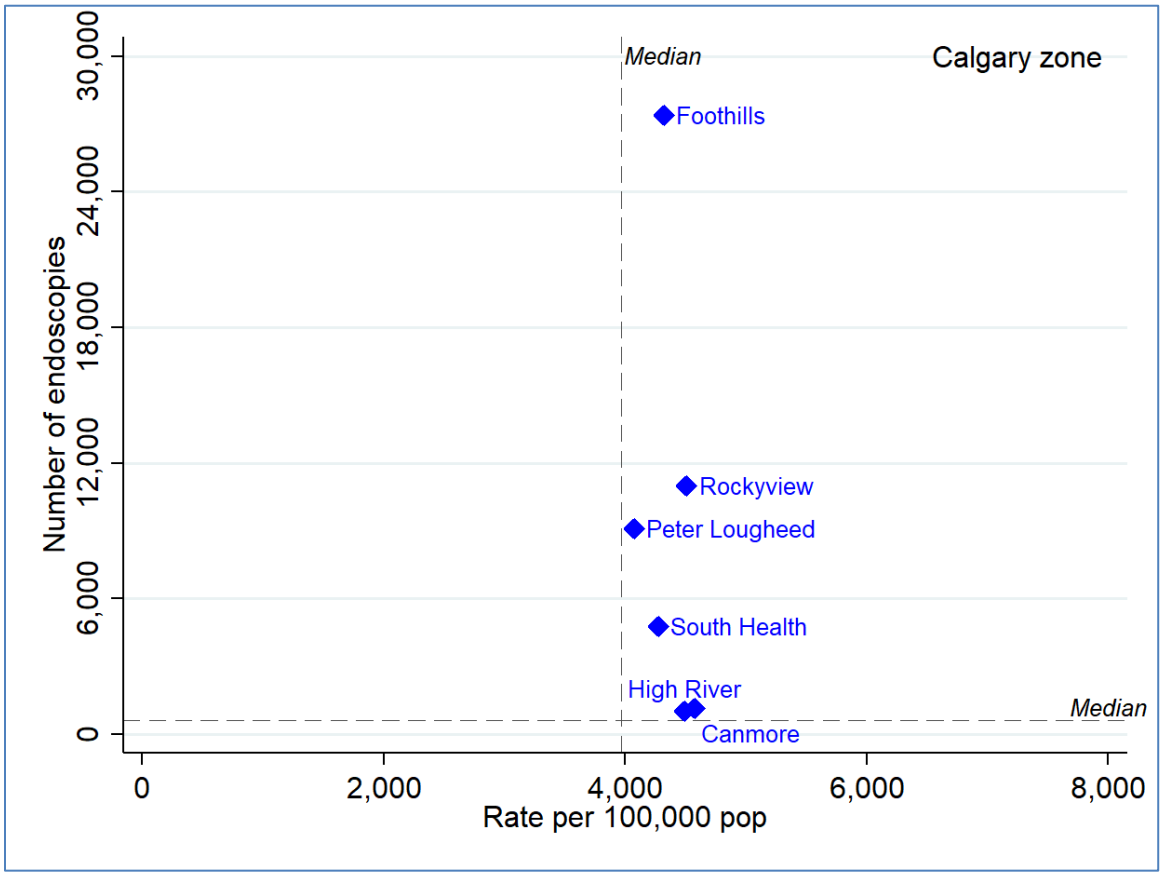


In this left figure, the left side is the geographic areas (FSA). The right side is the endoscopy facilities. The high of the bars (left and right) corresponds to the number of endoscopies provided (from an FSA and at a facility, respectively). Similarly, the thickness of the river connecting the geographic area to the facility indicates the number of endoscopies of patients from a geographic area at a facility. The right figure is the location of FSAs with corresponding number of endoscopies (to all facilities in the zone) from the FSA. A red star represents an endoscopy facility. Red border represents South zone boundary.

Calgary zone

There were 6 endoscopy facilities in Calgary zone in 2018. All of them provided the number of endoscopies and population rates that were higher than the provincial average (see Figure 6.13). In fact, all of them represented in either the top 10 performers in the number of endoscopies or the top 10 performers in population rate (see Table 6.6 and Figure 6.13).

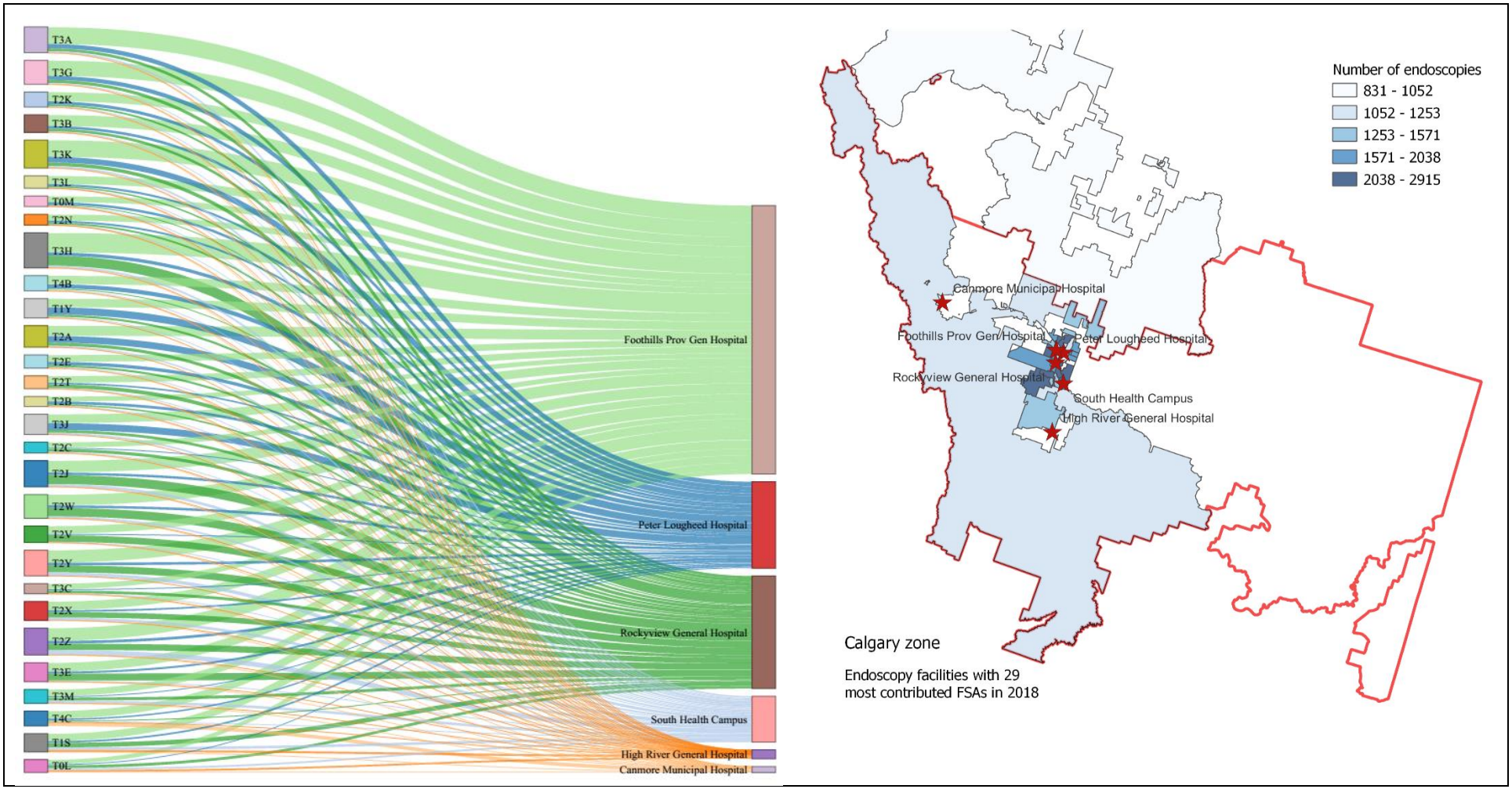
Figure 6.13: Endoscopy provision in 2018 in Calgary zone, Alberta



Population rate was calculated using a weighted method. The population count for a facility in an FSA was set proportional to the number of endoscopies provided by the facility in the FSA out of total endoscopies performed for patients at that FSA. Horizontal median line is the median number of endoscopies at a facility and vertical median line is the median population use rate at a facility in the province.

The six Calgary endoscopy facilities provided 54,467 procedures in 2018. The overall rate of endoscopy use in Calgary zone was 4,242 procedures per 100,000 population. There was a wide span in coverage in Calgary zone facilities where 29 FSAs contributed 80% of total endoscopies provided in the zone. Although the contribution was higher in some FSAs in urban areas, the contribution from the first 29 FSAs appeared relatively similar. The source of endoscopies appeared to concentrate around Calgary city where there were 4 big facilities providing services (Foothills, Rockyview, Peter Lougheed, and South Health Campus) (see Figure 6.14). The provision of colon cancer screening in a single facility may in part explain this pattern

Figure 6.14: Source of patients with endoscopy from 29 FSAs in 2018 in Calgary zone, Alberta

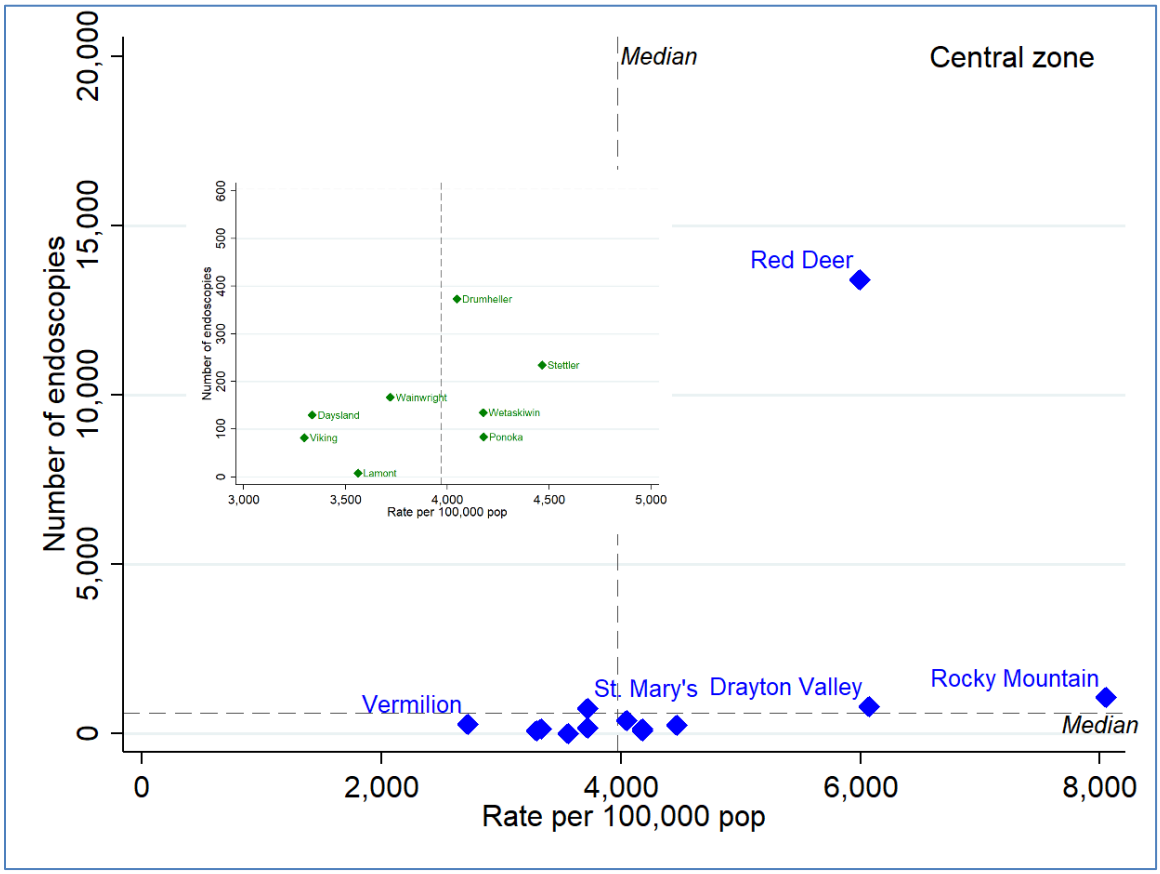


In this left figure, the left side is the geographic areas (FSA). The right side is the endoscopy facilities. The high of the bars (left and right) corresponds to the number of endoscopies provided (from an FSA and at a facility, respectively). Similarly, the thickness of the river connecting the geographic area to the facility indicates the number of endoscopies of patients from a geographic area at a facility. The right figure is the location of FSAs with corresponding number of endoscopies (to all facilities in the zone) from the FSA. A red star represents an endoscopy facility. Red border represents Calgary zone boundary.

Central zone

There were 13 endoscopy facilities in Central zone in 2018. Red Deer hospital stood out from others with high number of endoscopies (13,401 procedures; 1st pentile) and high weighted population use rate (5,992 procedures per 100,000 population; 1st pentile). Drayton Valley and Rocky Mountain provided low number of endoscopies but had high weighted population rates (6,072 and 8,052 procedures per 100,000 population, respectively) (see Table 6.6 and Figure 6.15).

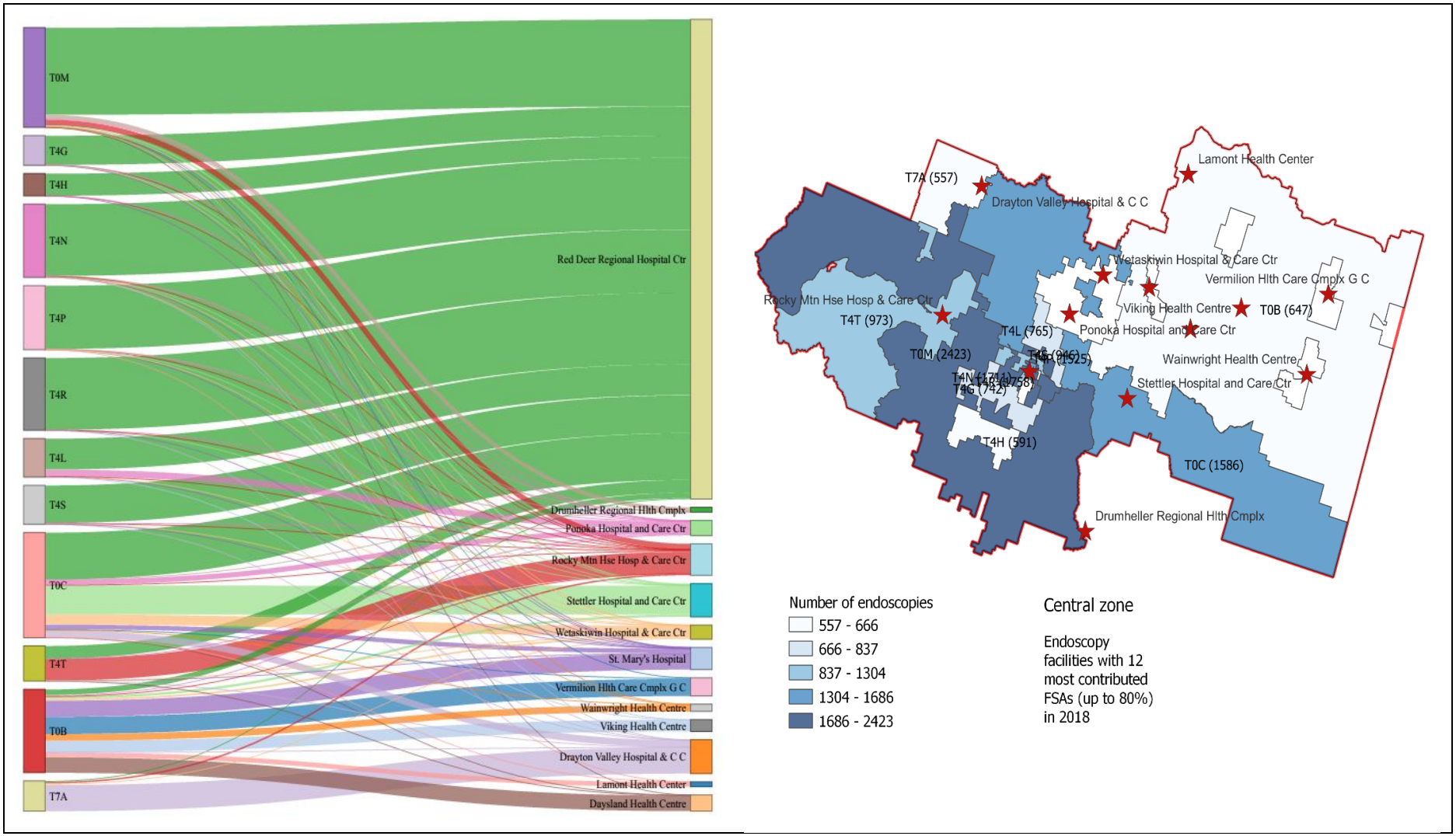
Figure 6.15: Endoscopy provision in 2018 in Central zone, Alberta



Population rate was calculated using a weighted method. The population count for a facility in an FSA was set proportional to the number of endoscopies provided by the facility in the FSA out of total endoscopies performed for patients at that FSA. Horizontal median line is the median number of endoscopies at a facility and vertical median line is the median population use rate at a facility in the province. Inset figure (in green) is a zoom-out of the facilities around the median lines crossing.

Endoscopy facilities in Central zone provided 17,479 procedures in 2018. The overall endoscopy use rate in Central zone was 5,176 procedures per 100,000 population The first 12 FSAs contributed 81.5% of total endoscopy procedures provided in the zone. Coverage for Central zone spread evenly. Source of the patients for Red Deer hospital appeared to be concentrated in several FSAs (T0M, T4N, T4P, and T4R) while St. Mary's, Vermilion, and Daysland centers mainly served patients from T0B (see Figure 6.16).

Figure 6.16: Source of patients with endoscopy from the first 12 FSAs in 2018 in Central zone, Alberta

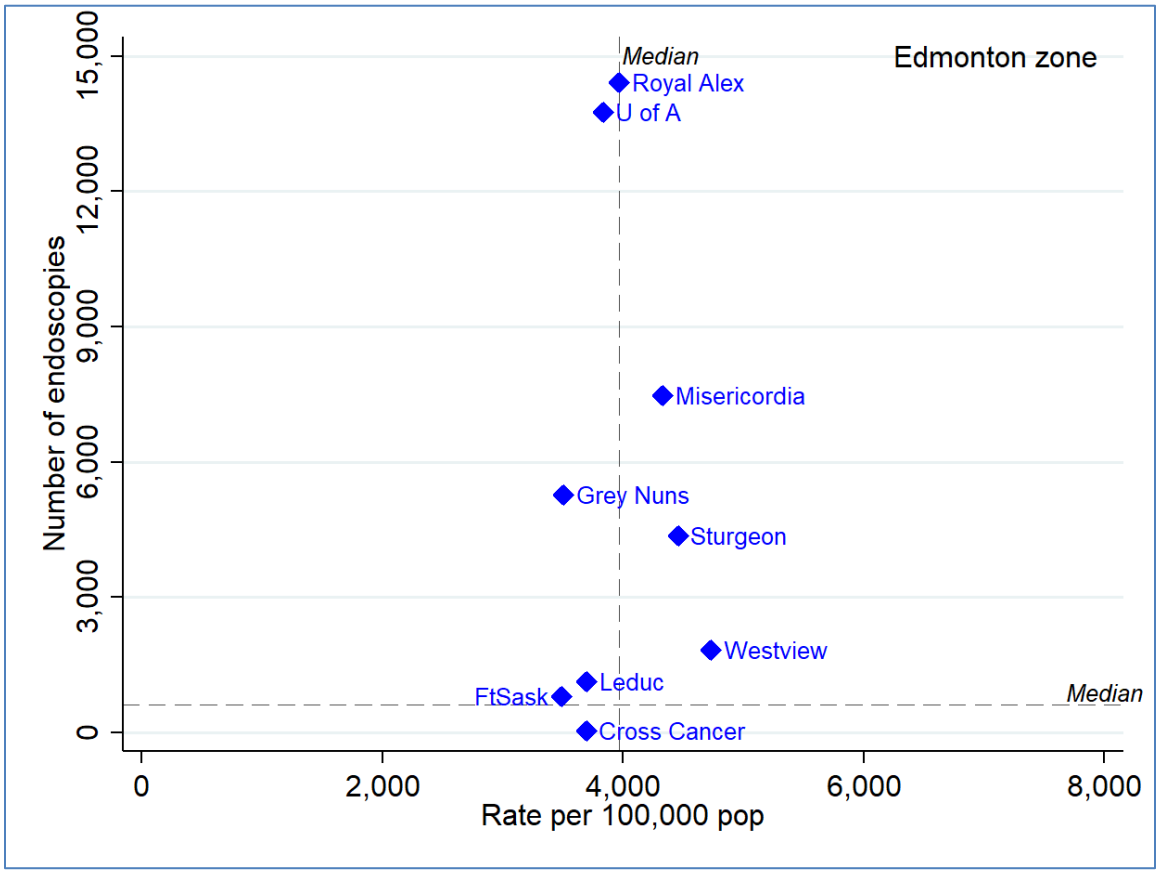


In this left figure, the left side is the geographic areas (FSA). The right side is the endoscopy facilities. The high of the bars (left and right) corresponds to the number of endoscopies provided (from an FSA and at a facility, respectively). Similarly, the thickness of the river connecting the geographic area to the facility indicates the number of endoscopies of patients from a geographic area at a facility. The right figure is the location of FSAs with corresponding number of endoscopies (to all facilities in the zone) from the FSA. A red star represents an endoscopy facility. Red border represents Central zone boundary.

Edmonton zone

There were 9 endoscopy facilities in Edmonton zone in 2018. Four facilities (Royal Alex, University of Alberta, Grey Nuns, and Misericordia) had high number of endoscopies provided and were among the 1st pentile in the province. However, none of them had weighted population rate in the 1st pentile. Instead, Westview Health Center, which provided 1,835 endoscopy procedures, equal to 4,731 procedures per 100,000 population, was among the top 10 performers in weighted population rate in the province (see Table 6.6 and Figure 6.17).

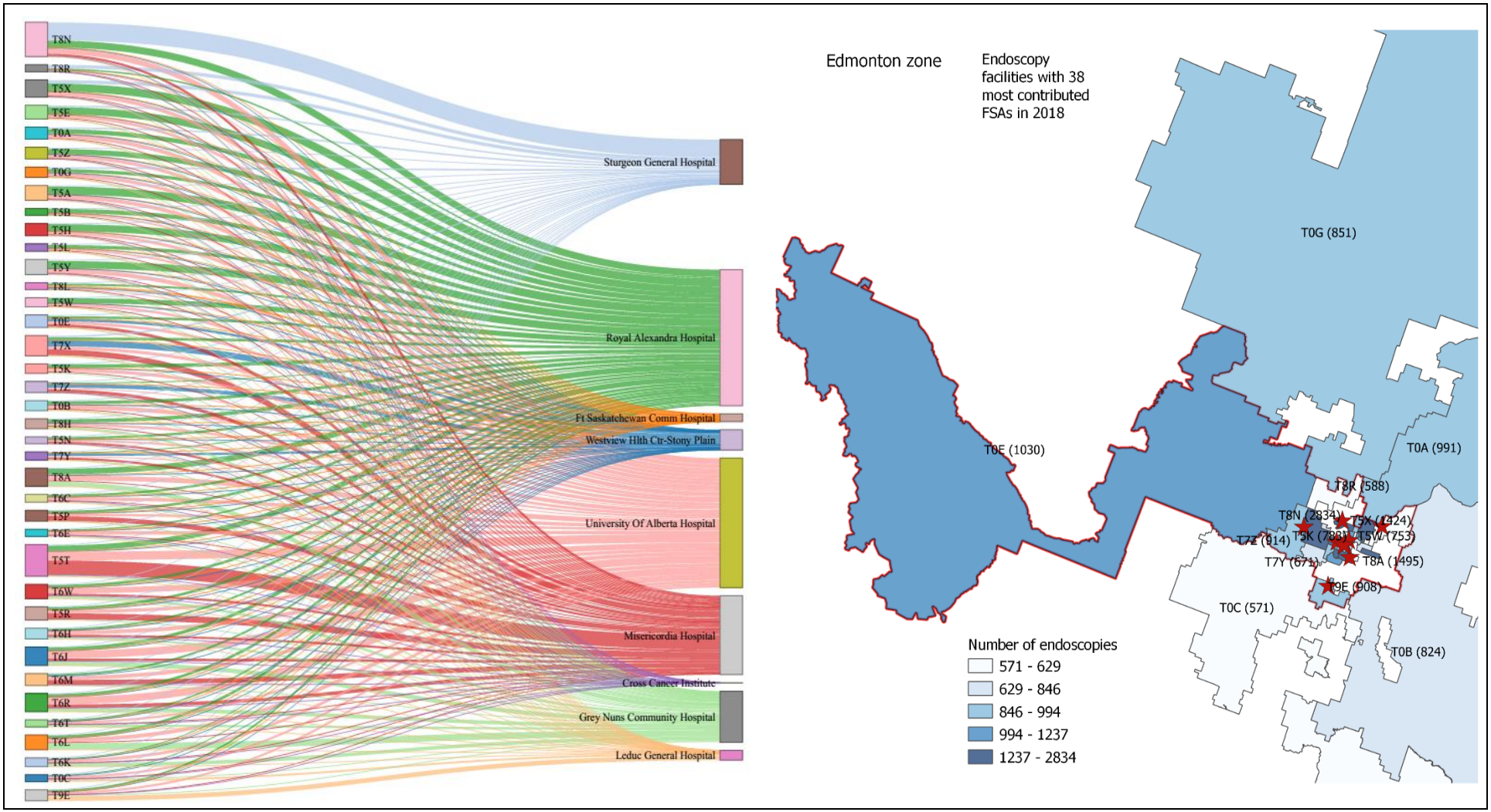
Figure 6.17: Endoscopy provision in 2018 in Edmonton zone, Alberta



Population rate was calculated using a weighted method. The population count for a facility in an FSA was set proportional to the number of endoscopies provided by the facility in the FSA out of total endoscopies performed for patients at that FSA. Horizontal median line is the median number of endoscopies at a facility and vertical median line is the median population use rate at a facility in the province.

The 9 facilities in Edmonton zone provided 49,047 endoscopy procedures in 2018. The overall endoscopy use rate in Edmonton zone was 4,004 procedures per 100,000 population The coverage spread widely where the first 38 FSAs contributed 80.4% of the total endoscopy procedures provided in the zone. Similar to Calgary zone, the contribution of the top FSAs appeared similar. This may be the reason why large facilities like Grey Nuns and University of Alberta hospitals had relatively modest weighted population use rate while providing high number of procedures. Of note, Edmonton zone facilities also served patients in the North and Central zones (see Figure 6.18).

Figure 6.18: Source of patients with endoscopy from the first 38 FSAs in 2018 in Edmonton zone, Alberta

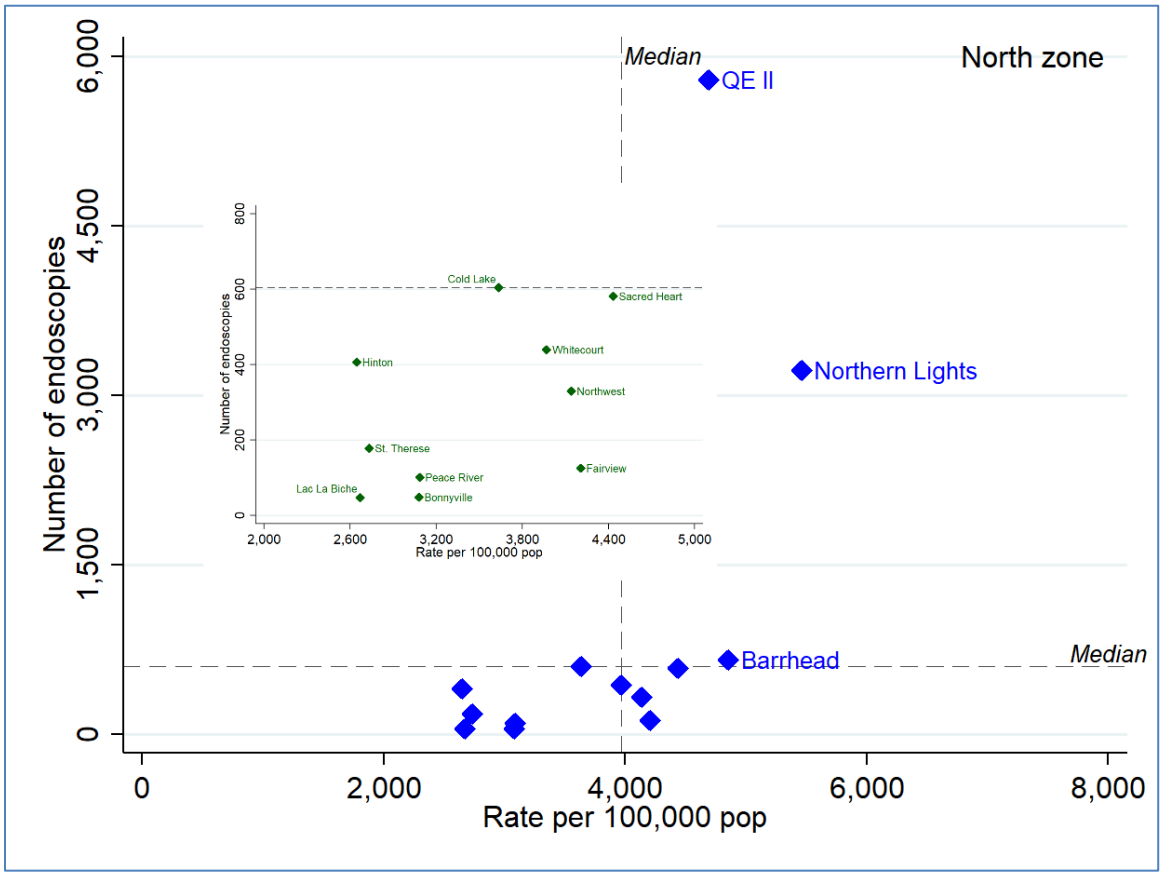


In this left figure, the left side is the geographic areas (FSA). The right side is the endoscopy facilities. The high of the bars (left and right) corresponds to the number of endoscopies provided (from an FSA and at a facility, respectively). Similarly, the thickness of the river connecting the geographic area to the facility indicates the number of endoscopies of patients from a geographic area at a facility. The right figure is the location of FSAs with corresponding number of endoscopies (to all facilities in the zone) from the FSA. A red star represents an endoscopy facility. Red border represents Edmonton zone boundary.

North zone

There were 13 endoscopy facilities in North zone in 2018. None of them were among the top providers of endoscopy in the province. However, 4 facilities (Queen Elizabeth II, Northern Lights, Hinton, and Whitecourt) were the top performers in weighted population use rate (all in 1st pentile). More than half (6 facilities) had coverage (weighted population use rate) lower than the province average (see Table 6.6 and Figure 6.19).

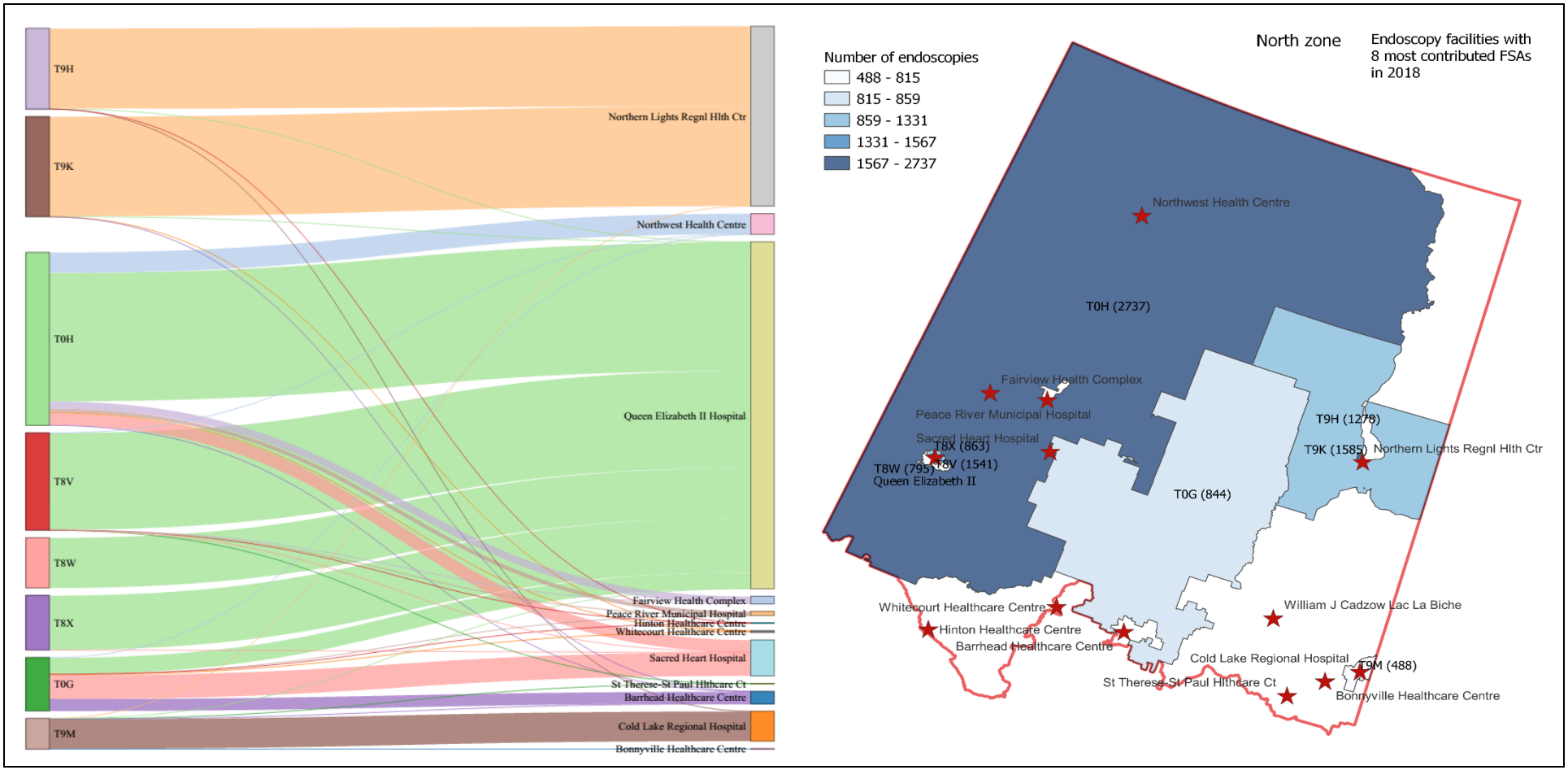
Figure 6.19: Endoscopy provision in 2018 in North zone, Alberta



Population rate was calculated using a weighted method. The population count for a facility in an FSA was set proportional to the number of endoscopies provided by the facility in the FSA out of total endoscopies performed for patients at that FSA. Horizontal median line is the median number of endoscopies at a facility and vertical median line is the median population use rate at a facility in the province. Inset figure (in green) is a zoom-out of the facilities around the median lines crossing.

The 13 endoscopy facilities in the North zone provided 12,532 procedures in 2018. The overall endoscopy use rate in North zone was 4,464 procedures per 100,000 population. About 80% of the total procedures in the zone were from eight most contributed FSAs. The coverage in the North zone appeared highly focused on the Northern side. Northern Lights Health Center mainly served patients from T9H and T9K and Queen Elizabeth II hospital's patients were from 4 FSAs of T0H, T8V, T8W, and T8X (see Figure 6.20).

Figure 6.20: Source of patients with endoscopy from the first 8 FSAs in 2018 in North zone, Alberta



In this left figure, the left side is the geographic areas (FSA). The right side is the endoscopy facilities. The high of the bars (left and right) corresponds to the number of endoscopies provided (from an FSA and at a facility, respectively). Similarly, the thickness of the river connecting the geographic area to the facility indicates the number of endoscopies of patients from a geographic area at a facility. The right figure is the location of FSAs with corresponding number of endoscopies (to all facilities in the zone) from the FSA. A red star represents an endoscopy facility. Red border represents North zone boundary.

6.3.4. Colonoscopy for Adenoma Surveillance in Alberta

In total, 243,783 patients underwent a screening or surveillance colonoscopy for potential adenoma and/or CRC detection in Alberta during the study period, with a total of 312,997 colonoscopy procedures. Adenoma and/or CRC detection colonoscopies accounted for 26.8% of all colonoscopy procedures performed. The proportion of adenoma and/or CRC detection colonoscopies, out of all colonoscopy procedures, decreased over time (2010: 29.3%; 2018: 17.6%; p=0.010). More than half of the patients with adenoma and/or CRC detection colonoscopies had a diagnosis of adenoma before or at the index event. Of the patients with a colonoscopy related to adenoma and/or CRC detection, 38,837 (15.9%) had more than one colonoscopy event and the mean time interval between colonoscopies was 3.4 years. This interval increased over time (p<0.001). Approximately 40% of colonoscopy events were provided within 3 years from the previous event (Table 6.12).

Table 6.12: Colonoscopy intervals in Alberta, 2010–2018

Variable	Value
Overall number of patients with an adenoma and/or CRC detection colonoscopy, N	243,783
Overall follow-up time, in years, mean (SD)	5.0 (2.3)
Overall number of adenoma and/or CRC detection colonoscopy procedures, n	312,997
Proportion of patients by adenoma diagnosis, n (%)	
Adenoma recorded before or at first event	124,386 (51)
Adenoma recorded after first event	13,328 (5.5)
Adenoma not recorded	106,069 (43.5)
Patients with ≥2 colonoscopy events, n (%)	38,837 (15.9)
Number of adenoma and/or CRC detection colonoscopy procedure for those with more than ≥2 colonoscopy events, n	45,776
Time between colonoscopy events, years, mean (SD)	3.4 (2.1)
Proportion of time interval between colonoscopy events, n (%)	
<3 years	17,677 (38.6)
3–5 years	13,230 (28.9)
5–7 years	13,909 (30.4)
≥7 years	960 (2.1)

CRC: colorectal cancer SD: standard deviation.

6.3.5. Esophagogastroduodenoscopy in Dyspepsia and Gastroesophageal Reflux

Approximately 8.8% to 9.5% (70,733 to 76,552 procedures) of EGD procedures were provided to patients with GERD while 3.8% (30,342 procedures) of EGD procedures were provided to patients with dyspepsia who were younger than 60 years old (Table 6.13).

Table 6.13: Utilization of esophagogastroduodenoscopy for patients with dyspepsia and gastroesophageal reflux in Alberta, 2010–2018

Variable	Value
All EGD procedures in the province, N	803,901
Potential guidelines nonadherence	
Canada ACG-CAG 2017: Gastroscopy procedure for patients aged <60 years with dyspepsia, n (%)	30,342 (3.8)
Canada CTFPHC 2020: Gastroscopy procedures for patients aged ≥18 years with GERD, excluding those also had esophageal adenocarcinoma or Barrett esophagus, n (%)	70,733 (8.8)
United States ASGE 2015 gastroscopy in patients with GERD: Number of procedures, n (%)	76,552 (9.5)

ACG: American College of Gastroenterology; ASGE: American Society of Gastrointestinal Endoscopy; CAG: Canadian Association of Gastroenterology; CTFPHC: Canadian Task Force on Preventive Health Care; EGD: esophagogastroduodenoscopy; GERD: gastroesophageal reflux disease.

6.3.6. Characteristics of Endoscopist in Alberta

We classified 329 physicians as endoscopists in Alberta during the study period. Of these, only 80 (24.3%) were female. The mean age at the last endoscopy encounter was 50 years. Close to 80% of the endoscopists were either gastroenterologists or general surgeons. Calgary (30.1%) and Edmonton (28.9%) zones had the most endoscopists while there were only 28 (8.5%) endoscopists practising in the South zone (Table 6.14).

Table 6.14: Characteristics of endoscopist in Alberta, 2010–2018

Variable	Value
Number of endoscopist	329
Female, n (%)	80 (24.3)
Age at the last endoscopy encounter, in years, mean (SD)	49.8 (11.8)
Age at the last endoscopy encounter, in years, median (IQR)	47 (40–60)
Specialty, n (%)	
Gastroenterology	130 (39.5)
General surgery	123 (37.4)
General practice	46 (14)
Internal medicine	27 (8.2)
Others	3 (0.9)
Health zone, n (%)	
South	28 (8.5)
Calgary	99 (30.1)
Central	59 (17.9)
Edmonton	95 (28.9)
North	48 (14.6)
Institution country	

Variable	Value
Canada	229 (69.6)
Others	100 (30.4)

IQR: Interquartile range; SD: standard deviation.

Of 329 endoscopists, 242 (73.6%) endoscopists provided 229,137 endoscopies (92.1% of total endoscopies) in 2018, equivalent to 946 procedures per endoscopist. There were great variations in the number of endoscopy procedure performed by each endoscopist ranging from 103 to 3,606 procedures in 2018 (Table 6.15). Number of procedures by each endoscopist in 2018 is presented in Figure 6.21 and 6.22.

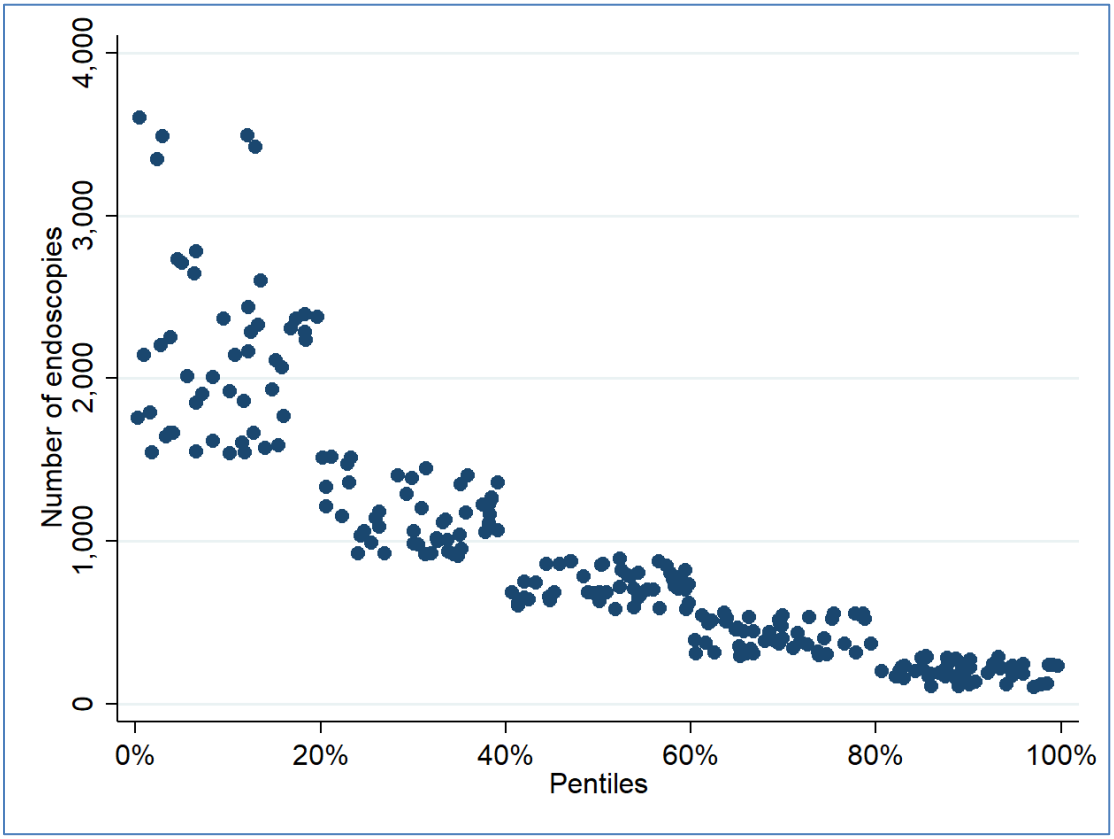
Almost all endoscopists (237, 98%) had at least a day in which she/he provided both gastroscopy and colonoscopy in 2018, with the average daily number of combined procedures of 12.8 per endoscopist (ranged from 2 to 47 procedures). Of these, the average daily number of colonoscopies were 6.8 (ranged from 1 to 31 procedures) and the average daily number of gastroscopies were 5.5 (ranged from 1 to 27 procedures).

There were 223 (92%) endoscopists who reported single specialty in 2018. Variation in provision of endoscopy by reported specialty is presented in Table 6.16. Distribution of endoscopies provided in 2018 by endoscopist specialty and age is presented in Figure 6.23.

Table 6.15: Performance of 242 endoscopists in Alberta in 2018

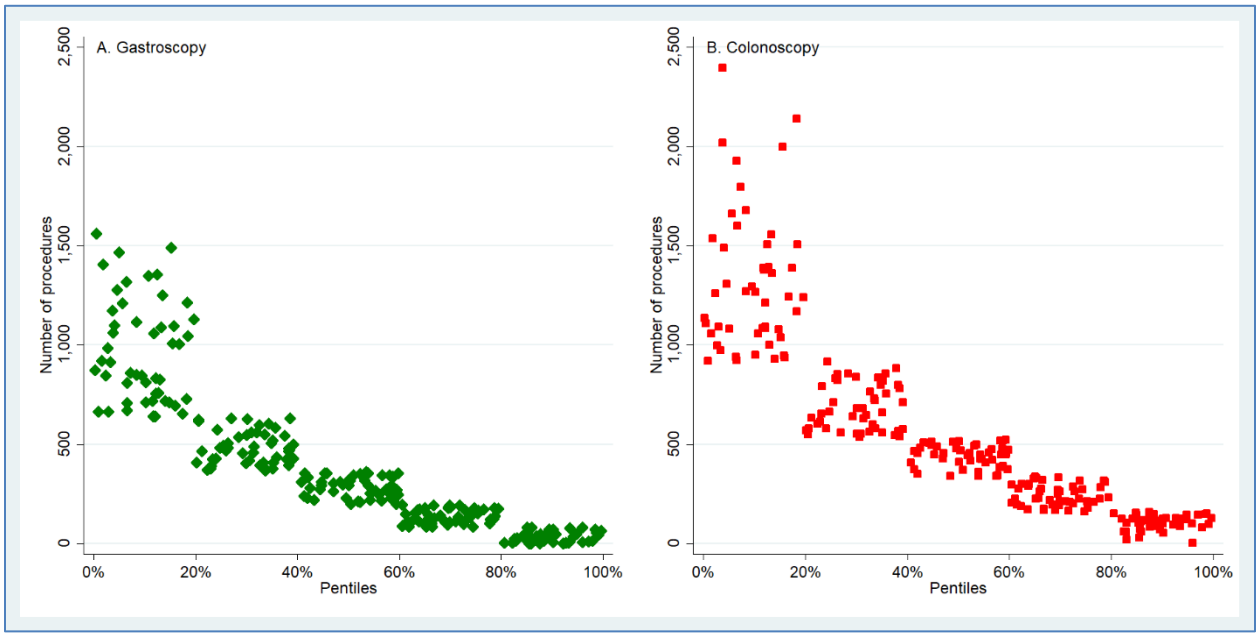
Variable	Endoscopy	Colonoscopy	EGD
Max procedure, n	3,606	2,397	1,560
Min procedure, n	103	3	0
Procedure range by pentiles, n			
1st pentile - max	3,606	2,397	1,560
1st pentile - min	1,541	921	640
2nd pentile - max	1,520	918	632
2nd pentile - min	907	537	368
3rd pentile - max	892	524	361
3rd pentile - min	581	340	198
4th pentile - max	558	336	196
4th pentile - min	292	163	84
5th pentile - max	290	160	81
5th pentile - min	103	3	0

Figure 6.21: Performance of endoscopist in 2018 by pentiles



Each dot represents an endoscopist

Figure 6.22: Performance of endoscopist in 2018 by pentiles for gastroscopy and colonoscopy.



Each dot represents an endoscopist

Table 6.16: Performance of endoscopists in Alberta in 2018 by reported medical specialty

Variable	N endoscopist	Average endoscopies provided, n	Min endoscopies provided, n	Max endoscopies provided, n
Gastroenterology	79	1,304	158	3,606
General Surgery	93	694	103	1,934
General Practice	30	447	109	1,644
Internal Medicine	20	1,325	208	2,603
Others	1	237	237	237

Figure 6.23: Distribution of endoscopies provided in 2018 by reported specialty and age.

Each dot represents an endoscopist

6.4. Discussion

Our population-based study of GI endoscopy (that is, EGD and colonoscopy) uses, for diagnosis and treatment of GI disorders in Alberta between 1 April 2010 and 31 March 2019, identified 1,972,688 GI endoscopy procedures performed for a cohort of 791,563 patients (equal to 2.49

procedures per patient). The annual number of patients receiving GI endoscopy, the annual number of procedures provided, and the utilization rate, increased significantly during the study period. Females and patients aged less than 60 years had higher number of procedures than male and senior (60 years or older) patient groups. The majority of GI endoscopy procedures were performed in either the Calgary or Edmonton zones. These zones also had the highest number of endoscopists compared to other health zones in Alberta. However, the Central zone had the highest GI endoscopy utilization rate while the Calgary zone had the lowest endoscopy utilization rate per 100,000 population.

There were about 18,000 colonoscopy procedures provided for adenoma and/or CRC detection within an interval less than three years, which is shorter than guidelines-recommended intervals of three to 10 years. In addition, approximately 100,000 EGD procedures were potentially unnecessarily provided to patients with dyspepsia and/or GERD during the study period.

We found that the use of GI endoscopy in Alberta was substantial, and rapidly increased during the study period. We observed a 37% increase in procedures during the eight years of the study. The increasing trend was observed in both colonoscopy and EGD, and in both sexes, as well as in all age groups, and across health zones in Alberta. Our findings are in line with GI endoscopy utilization in other Canadian provinces where there was an increasing trend in both the absolute number of endoscopy procedures, and the utilization rate per 100,000 population during the study period.[3] When compared to other provinces, utilization rates in Alberta were lower than those in British Columbia, Ontario, Newfoundland and Labrador, New Brunswick, and Quebec, and higher than those in Saskatchewan, Price Edward Island, Nova Scotia, and Manitoba.[3] Increases in usage have also been observed in other jurisdictions over time; using a population-based colon cancer screening registry, Decker et al. (2015) also found a substantial increase in the use of colonoscopy for CRC screening in all age groups and in both sexes in Winnipeg (which accounted for two-thirds of the population in Manitoba) between 1995 and 2012.[181]

Our study of 143,835 endoscopy procedures provided in 49 facilities in Alberta 2018 showed that there was a great variation between facilities in both the number of procedures provided and the weighted population rate of endoscopies per 100,000 people. Large centers like Foothills, Rockyview, Red Deer, Royal Alex, and University of Alberta hospitals provided high number of endoscopies. However, smaller centers like Rocky Mountain and Drayton Valley led the province in weighted population rate. Red Deer hospital stood out with both high number of procedures provided and a high weighted population rate.

There was a clear trend of coverage between zones. While the coverage was quite focused in the North, Central, and South zones, the coverage was widely spread out in Calgary and Edmonton zones. It may be the case that large centers in Calgary and Edmonton provided tertiary level of care, so they also received referral patients from other small centers in other zones. It should be also noted that most centers in Calgary and Edmonton are located close to one another in urban areas, while facilities in other zones are more geographically dispersed, so they were more likely to serve patients in surrounding localities given the large geographic areas in Alberta as can be seen in the South and North zones.

Double procedure practice appeared to vary slightly between zones (15.1% in Central zone to 19.8% in North zone). However, there was a significant variation in the proportion of double procedures between facilities, especially in small sites. In larger facilities, the proportion of double procedures remained at around 14% in Central zone (Red Deer), 15% in Edmonton zone (Royal Alex and University of Alberta hospitals), and 19% in Calgary zone (Foothills and Rockyview).

There were similar trends in providing more endoscopies to older patients. Both the number of endoscopy procedures and the weighted population rates were higher for patients aged ≥ 50 years than those for their younger counterparts and this trend was consistent across facilities.

We found that a quarter of total colonoscopy procedures performed during the study period were for adenoma and/or CRC detection, which is similar to screening/surveillance colonoscopy use in the United States. Using a registry of the national endoscopic database, Lieberman et al. (2005) reported that screening and surveillance colonoscopies accounted for 23.9% of all colonoscopy procedures during 2000-2011 and the proportion increased significantly between the beginning and end of the study period (9.5% to 28.9%, $p<0.001$).[182] The fast-increasing trend seen in the United States may due to the improved awareness on the survival benefit of CRC screening during early 2000s.[183, 184] The decreased proportion of screening and surveillance colonoscopy over time in a more contemporary cohort of patients in the present study may be a composite effect of variation in clinical indications of colonoscopy for other conditions and potentially improved adherence to guidelines for the use of surveillance colonoscopy, as evident by the increased time interval between colonoscopy events over the study period. Nonetheless, a significant proportion of colonoscopy events with time intervals less than three years suggests that there could be nonadherence to guidelines that has also been seen in other jurisdictions,[185, 186] and would need to be addressed.[51, 53, 71] Although it should be acknowledged that there could be valid clinical reasons for sooner follow-up colonoscopy such as patients with suboptimal bowel preparations or patients with large polyps and the polyps need to be removed in phases.

Clinical guidelines do not recommend use of EGD for patients with dyspepsia and/or GERD.[45, 72, 73] However, we found that approximately 100,000 EGD procedures (equal to approximately $12.2 million Canadian in practitioner claims and associated with $94 million Canadian in outpatient costs) were performed for these patient groups during the study period. These procedures could be considered low yield and potentially be averted if they were performed for patients without an alarm symptom such as dysphagia or patients who had incomplete or no response to proton pump inhibitor therapy. Removing these potentially avoidable procedures will reduce resource use and associated costs for the health system, free up resources, and could subsequently reduce wait time for patients who need endoscopy services. Barua et al. (2018) has reported long median wait times for colonoscopy in Alberta in 2018 ranged from 8 to 13 weeks, double that in Ontario or Saskatchewan. The wait times for EGD were even longer at 7 to 18 weeks, triple those in Ontario or Sasakatchewan.[30] It has been pointed out that delayed access to medical care could result in missed treatment opportunity and increased mortality.[5] Further research could be warranted to explore clinical justifications on providing EGD to these patient groups and develop interventions to reduce EGD overuse in Alberta.

Although the present study provides novel data on GI endoscopy utilization in Alberta, it has limitations. We used administrative health datasets which do not contain clinical data elements reflecting severity, pathology, and clinical symptoms of patients with endoscopy (for example, data on number, size of adenoma for each patient, and completeness of a polyp removal during health encounter). Therefore, we were not able to benchmark the interval between colonoscopy events against specific guideline recommendations. We were also not able to examine provision of EGD for patients with dyspepsia and/or GERD with clinical symptoms (for example, recurrent vomiting, unexplained weight loss, anemia, or loss of appetite) taken into consideration. In addition, information on the quality of GI endoscopy was not available, and therefore was not taken into consideration. A registry for GI endoscopy quality, which currently does not exist, would be

required to capture these important data elements to help evaluate and improve quality of endoscopy services in Alberta.

For the geographical analysis limitations, the analysis used a weighted method when calculating population rate for each facility. This method implied that every person in an FSA had the same preference of where to have endoscopy which may not be the case in reality. The decision of where to have endoscopy may be complex and may involve a couple of factors such as travel distance, availability of appointments, and physician references. All of these factors were out of scope of this analysis and were not examined. Second, we did not have population count by age group and FSA and assumed that the proportion of patients aged ≥ 50 years was the same across FSAs in the province. Lastly, we did not have data on population structure and pattern of practice in the 49 endoscopy facilities, so were not able to adjust for these factors in the population rate calculation.

Section SEVEN: Economic analyses

Charles Yan, PhD, Dat Tran, PhD, Negar Razavilar, PhD, Jeff Round, PhD

7.1. Introduction

The objective of this economic analysis was on the cost-effectiveness of interventions for reducing endoscopy overuse. An additional aim of the analysis is to evaluate the potential cost savings available to the system, should management strategies identified in the systematic review be adopted within the Alberta context.

7.2. Methods

On consideration of the evidence available from the systematic review, and of the administrative data available, we adopted a relatively uncomplicated approach for our analysis. The nature of the interventions under consideration is that they are typically complex, and highly dependent on context for evaluation. The success of these interventions depends on factors that are often beyond the control of those implementing them, such as the structure of the health system payment models (for example, fee-for-service compared with bundled payments), and differences between jurisdictions in patient access to specialist care (whereby some jurisdictions allow direct access to specialists and others employ a gate-keeping model that requires a referral). As a result, we have chosen to identify those approaches that have been tested in Alberta or other settings, and have been found to reduce the number and/or cost of procedures which have been recommended not to be routinely used. We then estimated the potential savings available to Alberta based on the reduction in procedures performed, assuming the same observed effectiveness from the studies could be achieved here. While this approach has some shortcomings (most notably, it excludes downstream costs and savings), it is informative. It is simply not possible, given the available data, to undertake a more complex analysis that is also robust.

Our analysis focuses on management strategies in patients who are undergoing colorectal adenoma surveillance, and patients with symptoms of dyspepsia and/or GERD. The estimates of cost savings we make are based on results from studies identified as part of the systematic review of interventions to reduce GI endoscopic procedure overuse (Section Five). Studies that were included in the systematic review were considered for their relevance to the economic analysis. Estimates of effectiveness were obtained from the relevant studies, and combined with the epidemiological and activity presented in Section Six. The focus of the analysis is on the direct cost of any activity related to GI endoscopy (EGD or colonoscopy).

7.3. Results

7.3.1. Interventions for Colorectal Adenoma Surveillance

Five studies[89, 154-157] were identified in the systematic review that assessed management strategies for reducing colonoscopy overuse for patients undergoing colorectal adenoma surveillance. Four of the five studies were conducted in the United States and the other one[156] in the United Kingdom. These studies have assessed a variety of the management strategies, including endoscopist training on surveillance interval accuracy,[155] a report card initiative on colonoscopy quality improvements,[157] a registry notification program,[154] an EMR–based CoRS system,[89] and replacing three-yearly colonoscopy surveillance with annual FITs.[156] Details of the studies are reported in Appendix J.

The aim of the economic analysis was to translate the effect of the management strategies, if they were adopted in Alberta, on reducing colonoscopy overuse, and associated costs in a local context. We did not use four out of the five studies identified in the review in our economic analysis. The four studies did not have endoscopy use as an outcome measure, did not find a positive effect on reducing use, or were not relevant to the Alberta context. Detailed reasons for exclusion presented in Table 7.1.

Table 7.1: Reasons why interventions identified in the systematic review were omitted from further consideration in the economic analysis

Author	Intervention	Reason for omission
Coe et al. (2018)[155]	Training: Quality improvement training for endoscopists	The study did not report outcomes data on colonoscopy use, and the study results showed little evidence suggesting that training had a meaningful impact on the optical prediction accuracy.
Alvarado et al. (2016)[154]	Enablement: Polyp-tracking registry and notification system for endoscopy units	The study did not report outcomes data on colonoscopy use, though the program significantly improved the adherence to surveillance recommendations.
Magrath et al. (2018)[89]	Enablement: Colonoscopy pathology reporting and clinical decision support system for endoscopists	The study did not report outcomes data on colonoscopy use, though the study concluded that endoscopists who used CoRS were more likely to be adherent to the surveillance recommendations.
Uche-Anya et al. (2020)[157]	Persuasion: quarterly quality metrics report cards for endoscopists	The study did not report outcomes data on colonoscopy use, though the authors concluded that the implementation of a quarterly report card initiative was associated with improved quality indicators including adenoma detection, cecal intubation, bowel preparation adequacy rates, and adherence to the 10-year follow-up surveillance recommendation.

CoRS: colonoscopy pathology reporting and clinical decision support system.

The remaining study[156] reported on the effectiveness of a change to surveillance timing and modality, to reduce the use of colonoscopy. We translated it to the avoidance of direct colonoscopy cost in an Alberta context (Table 7.2). Cross et al. (2019)[156] assessed the effect of replacing three-year colonoscopy surveillance with annual FITs in patients at intermediate-risk of CRC. The authors

report that annual FIT reduced colonoscopies by 71%, compared to three-year colonoscopy surveillance in intermediate-risk patients.

When considering the results of the study in the Alberta context, it is important to note the intervention was targeted at patients under surveillance, and known to be at intermediate risk of developing cancer. While the administrative data available as part of our analysis includes information on patients undergoing colonoscopy surveillance, there is no information on the risk level as defined in the study. We therefore used data reported in other published literature to estimate the proportion of patients at intermediate risk in Alberta. An additional study by Cross et al. (2020)[187] reported 41% of patients under surveillance as being at intermediate risk.

When assuming that the estimate of effectiveness observed in Cross et al. (2019),[156] and applying it to 41% of the Albertan colorectal surveillance population (as in Cross et al. 2020),[187] replacing three-year colonoscopy surveillance with annual FIT could result in annual cost avoidance of $1.12 million in physician claims and $6.13 million in outpatient care, with overall system costs savings of $7.25 million associated with colonoscopies.

We also assessed two additional scenarios where we estimate possible savings generated through reduction in procedures in lower risk patient groups. Given the absence of evidence identified in the review on switching low-risk patients to FIT, we assume that the reduction in procedures is the same as that in intermediate risk patients from the Cross (2019)[156] study.

The additional scenarios were based on the classification of patients with screening intervals between 3 to 5 years and 5 to 7 years as low risk. Under these additional scenarios, the potential cost avoidance would be $9.20 and $9.67 million, respectively. It is important to emphasize that this approach only provides a rough estimate of how the intervention would potentially save costs – we cannot be certain what the percent reduction in colonoscopies would be in the lower risk patient group.

Table 7.2: Effectiveness outcomes and cost avoidance owing to reduced colonoscopy overuse

Evidence reported in published studies		Cost estimates if Alberta adopts the reported outcomes[d]						
Study[a]	**Outcomes[b]**	**Risk group**	**Annual number of colonoscopies**	**Reduced number of colonoscopies**	**Cost**	**Annual cost avoidance ($ millions)**	**Interpretation**	**Comment**
Population: Intermediate-risk patients aged 60–72 years with (3–4 adenomas <10 mm, or at least one ≥ 10 mm in size) *Intervention:* Annual FIT vs. 3- yearly colonoscopy surveillance Cross et al. (2019))[156] United Kingdom	Annual FIT reduced colonoscopies by 71%, compared to 3- yearly colonoscopy surveillance in intermediate-risk patients. Proportion of patients at intermediate-risk was: 41% [187]	**Intermediate risk[c]**	10,425	7,402	Claim $151.00 Outpatient $828.00 Overall system	$1.12 $6.13 **$7.25**	It is estimated that there will be $7.25 million avoidance in overall colonoscopy costs per year to the system if the reported outcomes are applied in Alberta. When considering the effectiveness is applied to patients with screening interval between 3-5 years and 5-7 years, the cost avoidance would be $9.20 and $9.67 million, respectively.	The study reported that the use of annual FIT could miss 30–40% of CRCs and 40–70% of advanced adenomas. A trade-off between cost avoidance and testing accuracy would be taken into account when making decision on whether to accept the annual FIT. We only estimated direct cost avoidance to colonoscopies. Potential implication of the surveillance interventions on healthcare cost and patient outcomes were not included. The study suggested further economic analysis and longer-term studies to define a clear role for
		Screening interval: 3-5 years[e]	13,230	9,393	Claim $151.00 Outpatient $828.00 Overall system	$1.42 $7.78 **$9.20**		
		Screening interval: 5-7 years[e]	13,909	9,875	Claim $151.00 Outpatient $828.00 Overall system	$1.49 $8.18 **$9.67**		

Evidence reported in published studies		Cost estimates if Alberta adopts the reported outcomes[d]						
Study[a]	Outcomes[b]	Risk group	Annual number of colonoscopies	Reduced number of colonoscopies	Cost	Annual cost avoidance ($ millions)	Interpretation	Comment
								FIT in surveillance. The effectiveness reported was for patients at intermediate risk. Here we applied it to patients with screening interval from 3–5 and 5–7 years to estimate the cost avoidance. This application only provides a rough estimate of how the intervention would save costs.

[a] This defines patients and endoscopy interventions in which the outcomes were estimated.
[b] Cited study outcomes used to estimate the costs in Alberta. Details of the study are reported in Appendix J.
[c] It is impossible to identify the patients at intermediate-risk, as defined in the intervention study, using administrative data; we therefore used data reported in a study[187] that has estimated the proportion of patients at intermediate-risk from the total patients under surveillance (that is, 41%).
[d] The estimates are based on Alberta data in fiscal year 2018 (Section 6).
[e] The study did not report effectiveness for the patient groups. We assumed the reported effectiveness can be applied to them. The assumption was only to provide a rough estimate of how the intervention would impact the cost.

CRC: colorectal cancer; FIT: fecal immunochemical tests.

7.3.2. Dyspepsia and Gastroesophageal reflux

One study [160] was identified in the systematic review that assessed management strategies for reducing endoscopy overuse for those undergoing investigations for dyspepsia and/or GERD symptoms. This study, conducted in Calgary, assessed a nurse-led shared medical appointment pathway compared with usual care. Details of the study are reported in Appendix J.

Novak et al. (2020)[160] assessed the effectiveness of a nurse-led shared medical appointment pathway for patients aged 18 years or older with symptoms of dyspepsia/GERD, with usual care (that is, referral by primary care to a gastroenterologist) and reported a reduction in endoscopic examinations (41.6% nurse-led versus 68.6% usual care, in patients younger than 50 years; 65.2% nurse-led versus 89.4% usual care, in patients older than 50 years). Based on the results of this study, we estimated the potential cost savings from reducing endoscopies in Alberta (Table 7.3). Uniquely, this study was conducted in Alberta, and therefore has high relevance to the Alberta context. We estimate that replacing usual care with the nurse-led shared medical appointment pathway would result in annual cost avoidance of $319,790 in physician claims and $2,200,000 in outpatient visits. When considering overall procedure costs to the system, the potential cost savings are $2.52 million. As with the analysis related to colonoscopies, this estimate does not consider downstream costs or savings associated with a reduction in the number of procedures performed.

Table 7.3: Effectiveness outcomes and cost avoidance in patients with dyspepsia and/or gastroesophageal reflux

Evidence reported in published studies						
Study	**Patients and interventions[a]**	**Outcomes**	**Nurse-led appointment (<50 years old)**	**Usual Care (<50 years old)**	**Nurse-led appointment (≥50 years old)**	**Usual care (≥50 years old)**
Authors: Novak et al. (2020) [160] Canada	*Population:* patients aged ≥18 years with referral by primary care specifically for dyspepsia and/or GERD symptoms *Intervention:* nurse-led shared medical appointment pathway vs. usual care	Endoscopic examinations	41.6%	68.6%	65.2%	89.4%
		Type of Endoscopy[b]				
		Colonoscopy	26.0%		39.3%	
		EGD	74.0%		60.7%	

Cost estimates if Alberta adopts the reported outcomes[c]					
	age <50 years old		**≥50 years old**		**Total**
	GERD	**dyspepsia**	**GERD**	**dyspepsia**	
Annual number of patients	2,430	1,306	4,098	1,760	9,594
Reduced endoscopic examinations	656	353	992	426	2,426
Number of reduced COL	171	92	390	168	820

Evidence reported in published studies						
Study	**Patients and interventions[a]**	**Outcomes**	**Nurse-led appointment (<50 years old)**	**Usual Care (<50 years old)**	**Nurse-led appointment (≥50 years old)**	**Usual care (≥50 years old)**
Number of reduced EGD	486	261	602	258	1,607	
Cost of endoscopy, physician claim						
Cost per claim, COL	$151					
Cost per claim, EGD	$122					
Annual cost, COL	$25,751.33	$13,840.02	$58,901.32	$25,296.81	$123,789	
Annual cost, EGD	$59,238.49	$31,837.64	$73,400.21	$31,523.76	$196,000	
Sub total					**$319,790**	
Cost of endoscopy, outpatient visits						
Cost per visit, COL	$828					
Cost per visit, EGD	$947					
Annual cost, COL	$141,205.98	$75,890.95	$322,982.07	$138,713.63	$678,793	
Annual cost, EGD	$459,826.62	$247,133.15	$569,754.06	$244,696.72	$1,521,411	
Sub total					**$2,200,203**	
Total system cost					**$2.52 million**	

[a] This defines patients and interventions in which the outcomes were estimated.
[b] Cited outcomes used to estimate the costs in Alberta. Details are reported in Appendix J.
[c] The estimates are based on Alberta data in fiscal year 2018 (Section 6).
COL: colonoscopy; EGD: esophagogastroduodenoscopy; GERD: gastroesophageal reflux disease.

7.4. Discussion

In this section we presented an analysis undertaken to try and understand the potential cost-savings available in Alberta from a reduction of the use of colonoscopy and EGD for indications where it is not recommended. The analysis included two studies that reported effectiveness in reducing overuse of GI endoscopy. If the reported management strategies and associated effectiveness are applied to Alberta, we estimated that there would be an annual avoidance of costs from physician claims of $1.12 million in patients undergoing adenoma surveillance and $319,790 in patients with symptoms of dyspepsia and/or GERD. When considering procedure costs in their entirety, the potential cost avoidance would be $7.25 million for patients undergoing adenoma surveillance, and $2.52 million for patients with symptoms of dyspepsia and/or GERD.

It is important to note that the scope of the economic analysis is to assess the direct cost due to overuse of GI endoscopy. We therefore only considered the benefit of the management strategies in reduction in the utilization of GI endoscopy. Other potential costs and benefits, such as the cost of implementing the management strategies, as well as medical costs, and patient outcomes affected by the strategies, were not included in our cost estimations. Given the limited value of the potential savings, the costs associated with introducing and maintaining alternative strategies should be explored before widespread adoption of either approach considered here.

Appendix A: Scoping Review Methods and Search Strategy

Data extraction for indications which recommend endoscopy not be used routinely or to be used less frequently included:

- title, first author, year of publication, country, and methodology
- clinical condition(s)
- the recommendation(s)
- the rationale and supporting evidence used to justify the recommendation(s) (examples: epidemiology of the clinical condition incidence and progression; diagnostic yield, accuracy [sensitivity and/or specificity] or positive predictive values; other measures of clinical effectiveness; cost-effectiveness; expert opinion; and/or patient opinion and preferences)
- the strength of the recommendation(s) and/or the quality of the supporting evidence.

Data extraction regarding the prevalence or cost associated with GI endoscopy overuse included:

- title, first author, year of publication, country, and methodology
- clinical condition(s) and endoscopy type(s)
- recommendation(s) or indication(s)
- outcomes relating to endoscopy overuse (prevalence, cost, wait times)

Data extraction from guidelines regarding the recommendations of select indications included:

- guideline profile information (title, country, endorsement group, guideline year, guideline methodology, and clinical condition)
- the recommendation(s)
- the number and types of studies referenced by the guideline to support its recommendation(s)
- the strength of the recommendation(s) and/or the quality of the supporting evidence

Table A.1: Scoping Search

Database Edition or date searched	Search terms ††
Ovid MEDLINE(R) ALL 1946 to February 26, 2020 2020-02-27 Results: 1732	1. exp Endoscopy, Digestive System/ 2. (colonoscop* or gastroscop* or sigmoidoscop* or esophagogastroduodenoscop* or enteroscop* or rectoscop* or anoscop*).tw,kf. 3. (upper adj2 endoscop*).tw,kf. 4. (endoscop* and (duodenum* or gastro* or stomach or esophag* or intestin* or digestiv*)).tw,kf. 5. exp Cholangiopancreatography, Endoscopic Retrograde/ 6. Endoscopic Retrograde Cholangio Pancreatography.tw,kf. 7. or/1-6 8. exp Health Services Misuse/

	9. (unnecessar* or necessary or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or appropriate* or unneeded or ineffective).ti,kf. 10. (unnecessar* or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or unneeded or appropriateness or ineffective).ab. /freq=2 11. Guideline Adherence/ 12. (guideline adj2 (adhere* or complian* or comply or follow* or concordan*)).ti,kf. 13. (guideline adj2 (adhere* or complian* or comply or follow* or concordan*)).ab. /freq=2 14. ((gaps or gap) adj2 evidence adj2 practice).ti,ab,kf. 15. diagnostic yield.tw,kf. 16. or/8-15 17. 7 and 16 18. limit 17 to (english language and yr="2010 -Current") 19. remove duplicates from 18
Embase 1974 to 2020 July 06 2020-07-07 Results: 120 (Reviews) 1353 (Primary Studies)	1. exp digestive tract endoscopy/ 2. (colonoscop* or gastroscop* or sigmoidoscop* or esophagogastroduodenoscop* or enteroscop* or rectoscop* or anoscop*).tw,kw. 3. (upper adj2 endoscop*).tw,kw. 4. (endoscop* and (duodenum* or gastro* or stomach or esophag* or intestin* or digestiv*)).tw,kw. 5. exp endoscopic retrograde cholangiopancreatography/ 6. Endoscopic Retrograde Cholangio Pancreatography.tw,kw. 7. or/1-6 8. exp Health Services Misuse/ 9. (unnecessar* or necessary or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or appropriate* or unneeded or ineffective).ti,kw. 10. (unnecessar* or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or unneeded or appropriateness or ineffective).ab. /freq=2 11. Guideline Adherence/ 12. (guideline adj2 (adhere* or complian* or comply or follow* or concordan*)).ti,kw. 13. (guideline adj2 (adhere* or complian* or comply or follow* or concordan*)).ab. /freq=2 14. ((gaps or gap) adj2 evidence adj2 practice).ti,ab,kw. 15. diagnostic yield.tw,kw. 16. or/9-15 17. 7 and 16 18. limit 17 to (english language and yr="2010 -Current") 19. limit 18 to embase 20. meta-analysis.pt. 21. (meta-anal$ or metaanal$).mp. 22. ((quantitativ$ adj3 review$1) or (quantitativ$ adj3 overview$)).mp. 23. ((systematic$ adj3 review$) or (systematic adj3 overview$)).mp. 24. ((methodologic adj3 review$1) or (methodologic adj3 overview$)).mp. 25. (integrat$ adj5 research).mp. 26. (quantitativ$ adj3 synthes$).mp.

	27. or/20-26 28. review.pt. or (review$ or overview$).mp. 29. (medline or medlars or pubmed or index medicus or embase or cochrane).mp. 30. (scisearch or web of science or psycinfo or psychinfo or cinahl or cinhal).mp. 31. (excerpta medica or psychlit or psyclit or current contents or science citation index or sciences citation index or scopus).mp. 32. (hand search$ or manual search$).mp. 33. ((electronic adj3 database$) or (bibliographic adj3 database$) or periodical index$).mp. 34. (pooling or pooled or mantel haenszel).mp. 35. (peto or der simonian or dersimonian or fixed effect$).mp. 36. ((combine$ or combining) adj5 (data or trial or trials or studies or study or result or results)).mp. 37. or/29-36 38. 28 and 37 39. 27 or 38 40. (hta$ or health technology assessment$ or biomedical technology assessment$).mp. 41. technology assessment, biomedical/ or biomedical technology assessment/ 42. 40 or 41 43. 39 or 42 44. exp clinical trial/ 45. randomi?ed.ti,ab. 46. placebo.ti,ab. 47. dt.fs. 48. randomly.ti,ab. 49. trial.ti,ab. 50. groups.ti,ab. 51. or/44-50 52. animal/ 53. human/ 54. 52 not (52 and 53) 55. 51 not 54 56. Epidemiologic Methods/ or exp Epidemiologic Studies/ 57. "surveys and questionnaires"/ or exp health care surveys/ 58. "types of study"/ or comparative study/ or controlled study/ or experimental study/ or feasibility study/ or observational study/ or panel study/ or pilot study/ or prevention study/ or quality improvement study/ or quasi experimental study/ or trend study/ or twin study/ or validation study/ or clinical study/ or exp case control study/ or exp intervention study/ or exp longitudinal study/ or exp major clinical study/ or exp prospective study/ or exp retrospective study/ or cohort analysis/ or control group/ or correlational study/ or cross-sectional study/ or crossover procedure/ or double blind procedure/ or exp evidence based practice/ or experimental design/ or factorial design/ or intermethod comparison/ or latin square design/ or multimethod study/ or nonequivalent control group/ or parallel design/ or exp participatory research/ or exp practice guideline/ or pretest posttest control group design/ or pretest posttest design/ or exp quality control/ or quantitative study/ or sample size/ or secondary analysis/ or single blind procedure/ or study design/ or triangulation/ or triple blind procedure/ 59. (observational adj3 (study or studies or design or analysis or analyses)).ti,ab,kw. 60. cohort*.ti,ab,kw.

	61. (prospective adj7 (study or studies or design or analysis or analyses)).ti,ab,kw. 62. ((follow up or followup) adj7 (study or studies or design or analysis or analyses)).ti,ab,kw. 63. ((longitudinal or longterm or (long adj term)) adj7 (study or studies or design or analysis or analyses or data)).ti,ab,kw. 64. (retrospective adj7 (study or studies or design or analysis or analyses or data or review)).ti,ab,kw. 65. ((case adj control) or (case adj comparison) or (case adj controlled)).ti,ab,kw. 66. (case-referent adj3 (study or studies or design or analysis or analyses)).ti,ab,kw. 67. (population adj3 (study or studies or analysis or analyses)).ti,ab,kw. 68. (descriptive adj3 (study or studies or design or analysis or analyses)).ti,ab,kw. 69. ((multidimensional or (multi adj dimensional)) adj3 (study or studies or design or analysis or analyses)).ti,ab,kw. 70. (cross adj sectional adj7 (study or studies or design or research or analysis or analyses or survey or findings)).ti,ab,kw. 71. ((natural adj experiment) or (natural adj experiments)).ti,ab,kw. 72. (quasi adj (experiment or experiments or experimental)).ti,ab,kw. 73. ((non experiment or nonexperiment or non experimental or nonexperimental) adj3 (study or studies or design or analysis or analyses)).ti,ab,kw. 74. (prevalence adj3 (study or studies or analysis or analyses)).ti,ab,kw. 75. or/56-74 [based on CADTH Observational Studies Filter - added surveys No Case Reports or Series] 76. 43 or 55 or 75 77. 19 and 76
Grey Literature	
Choosing Wisely CANADA *https://choosingwiselycanada.org/* 2020-04-15 Results: 2	Browsed site
Choosing Wisely AUSTRALIA *https://evolve.edu.au/* 2020-04-15 Results: 1	Browsed site
Choosing Wisely US *https://www.choosingwisely.org/* 2020-04-15 Results: 1	Browsed site
Choosing Wisely UK *https://www.choosingwisely.co.uk/*	Browsed site

2020-04-15 Results: 0	
HTA database 2020-04-15 Results: 7	"Endoscopy, Digestive System"[mh] OR (endoscop* or colonoscop* or gastroscop* or sigmoidoscop* or esophagogastroduodenoscop* or enteroscop* or rectoscop* or anoscop*) AND (appropriate* OR inappropriate* or adhere* or unnecessar* or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or unneeded or ineffective) FROM 2010 TO 2020
Clinical practice guidelines	
CPG Infobase *https://joulecma.ca/cpg/homepage* 2020-04-15 Results: 13	Selected: Gastroenterology (69) > Diagnosis (10) Preventive (1) English MeSH: Colonoscopy (5) Unnecessary Procedures (5) Referral and Consultation (2) Endoscopy, Gastrointestinal (2) Endosonography (1) Endoscopy, Digestive System (1) Early Detection of Cancer (2)
ECRI *https://guidelines.ecri.org/* 2020-04-16 Results: 21	Endoscopy Selected from left hand menu: Gastroenterology Diagnosis Screening Prevention Not stated Aged, 80 and over Aged (65 to 79 years) Middle Age (45 to 64 years) Adult (19 to 44 years)
GIN Guidelines *https://g-i-n.net/library/international-guidelines-library/* 2020-04-16 Results: 8	English Search Text: endoscop* or colonoscop* or gastroscop* or sigmoidoscop* or esophagogastroduodenoscop* or enteroscop* or rectoscop* or anoscop* Publication Type: Guideline Systematic review Evidence Report Guideline Clearing Report
Canadian Association of Gastroenterology	Browsed guideline library

https://www.cag-acg.org/publications/guideline-library 2020-04-16 Results: 8	
American Society for Gastrointestinal Endoscopy (ASGE) *https://www.asge.org/home/guidelines* 2020-04-16 Results: 15	Browsed guidelines - Newly Published and Quality sections: selected
Google 2020-04-20 Browsed 1st 100 results	inappropriate* OR role endoscopy* OR colonoscop* OR gastroscop* OR sigmoidoscop* OR esophagogastroduodenoscop* OR enteroscop* OR rectoscop* OR anoscop* Jan1, 2010-Apr 20, 2020

Appendix B: Scoping Review Excluded Studies

Excluded articles and reason for exclusion

Pediatric population (*N*=1)

Ofei S, Boyle B, Ediger T, Hill I. Adherence to endoscopy biopsy guidelines for celiac disease. *J Pediatr Gastroenterol Nutr* 2015;61(4):440-4.

Emergency indication (*N*=3)

Arvanitakis M, Dumonceau JM, Albert J, Badaoui A, Bali MA, Barthet M, et al. Endoscopic management of acute necrotizing pancreatitis: European Society of Gastrointestinal Endoscopy (ESGE) evidence-based multidisciplinary guidelines. *Endoscopy* 2018;50(5):524-46.

Jang BI. Lower gastrointestinal bleeding: Is urgent colonoscopy necessary for all hematochezia? *Clin Endosc* 2013;46(5):476-9.

Tapper EB, Friderici J, Borman ZA, Alexander J, Bonder A, Nuruzzaman N, et al. A multicenter evaluation of adherence to 4 major elements of the baveno guidelines and outcomes for patients with acute variceal hemorrhage. *J Clin Gastroenterol* 2018;52(2):172-7.

Non-endoscopic procedure, excluded endoscopic procedure, or nonspecific endoscopy indication (*N*=29)

Adler DG, Lieb JG, Cohen J, Pike IM, Park WG, Rizk MK, et al. Quality indicators for ERCP. *Gastrointest Endosc* 2015;81(1):54-66.

Armstrong D, Barkun A, Bridges R, Carter R, de Gara C, Dube C, et al. Canadian Association of Gastroenterology consensus guidelines on safety and quality indicators in endoscopy. *Can J Gastroenterol* 2012;26(1):17-31.

ASGE Endoscopy Unit Quality Indicator Taskforce, Day LW, Cohen J, Greenwald D, Petersen BT, Schlossberg NS, et al. Quality indicators for gastrointestinal endoscopy units. *VideoGIE* 2017;2(6):119-40.

Barkun AN, Almadi M, Kuipers EJ, Laine L, Sung J, Tse F, et al. Management of nonvariceal upper gastrointestinal bleeding: Guideline recommendations from the international consensus group. *Ann Intern Med* 2019;171(11):805-22.

Buxbaum JL, Abbas Fehmi SM, Sultan S, Fishman DS, Qumseya BJ, Cortessis VK, et al. ASGE guideline on the role of endoscopy in the evaluation and management of choledocholithiasis. *Gastrointest Endosc* 2019;89(6):1075-105.

Cusumano VT, May FP. Making fit count: Maximizing appropriate use of the fecal immunochemical test for colorectal cancer screening programs. *J Gen Intern Med* 2020;35(6):1870-4.

Expert Panels on Vascular Imaging and Gastrointestinal Imaging, Singh-Bhinder N, Kim DH, Holly BP, Johnson PT, Hanley M, et al. ACR appropriateness criteria nonvariceal upper gastrointestinal bleeding. *JACR* 2017;14(5S):S177-S88.

Faigel DO, Baron TH, Lewis B, Petersen B, Petrini J, Popp JW, et al. *Ensuring competence in endoscopy*. Oak Brook, Illinois: American Society for Gastrointestinal Endoscopy. Available from: https://www.asge.org/docs/default-source/education/practice_guidelines/doc-competence.pdf?sfvrsn=6.

Gawron AJ, Bell R, Abu Dayyeh BK, Buckley FP, Chang K, Dunst CM, et al. Surgical and endoscopic management options for patients with gerd based on proton pump inhibitor symptom response: Recommendations from an expert US Panel. *Gastrointest Endosc* 2020; 92(1) 78-87.

Ip S, Chung M, Moorthy D, Yu WW, Lee J, Chan JA, et al. *Comparative effectiveness of management strategies for gastroesophageal reflux disease: Update*. Rockville, Maryland: Agency for Healthcare Research and Quality; 2011. Available from: http://www.effectivehealthcare.ahrq.gov/ehc/products/165/781/GERD_ExecSumm.pdf.

Jackson BD, Con D, Liew D, De Cruz P. Clinicians' adherence to international guidelines in the clinical care of adults with inflammatory bowel disease. *Scand J Gastroenterol* 2017;52(5):536-42.

Janda M, Hughes KL, Auster JF, Leggett BA, Newman BM. Repeat participation in colorectal cancer screening utilizing fecal occult blood testing: A community-based project in a rural setting. *J Gastroenterol Hepatol* 2010;25(10):1661-7.

Khashab MA, Vela MF, Thosani N, Agrawal D, Buxbaum JL, Abbas Fehmi SM, et al. ASGE guideline on the management of achalasia. *Gastrointest Endosc* 2020;91(2):213-27.

Lebwohl B, Genta RM, Kapel RC, Sheehan D, Lerner NS, Green PH, et al. Procedure volume influences adherence to celiac disease guidelines. *Eur J Gastroenterol Hepatol* 2013;25(11):1273-8.

Liu LWC, Andrews CN, Armstrong D, Diamant N, Jaffer N, Lazarescu A, et al. Clinical practice guidelines for the assessment of uninvestigated esophageal dysphagia. *J Can Assoc Gastroenterol* 2018;1(1):5-19.

Menees SB, Kim HM, Schoenfeld P. Split-dose bowel preparation improves adequacy of bowel preparation and gastroenterologists' adherence to national colorectal cancer screening and surveillance guidelines. *World J Gastroenterol* 2018;24(6):716-24.

Panaccione R, Steinhart AH, Bressler B, Khanna R, Marshall JK, Targownik L, et al. Canadian Association of Gastroenterology clinical practice guideline for the management of luminal crohn's disease. *Clin Gastroenterol Hepatol* 2019;17(9):1680-713.

Park WG, Shaheen NJ, Cohen J, Pike IM, Adler DG, Inadomi JM, et al. Quality indicators for EGD. *Gastrointest Endosc* 2015;81(1):17-30.

Parra-Membrives P, Diaz-Gomez D, Vilegas-Portero R, Molina-Linde M, Gomez-Bujedo L, Lacalle-Remigio JR. Appropriate management of common bile duct stones: A RAND corporation/UCLA appropriateness method statistical analysis. *Surg Endosc* 2010;24(5):1187-94.

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Rizk MK, Sawhney MS, Cohen J, Pike IM, Adler DG, Dominitz JA, et al. Quality indicators common to all GI endoscopic procedures. *Gastrointest Endosc* 2015;81(1):3-16.

Schenker MP, Majdalany BS, Funaki BS, Yucel EK, Baum RA, Burke CT, et al. ACR appropriateness criteria on upper gastrointestinal bleeding. *JACR* 2010;7(11):845-53.

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Steinhart AH, Panaccione R, Targownik L, Bressler B, Khanna R, Marshall JK, et al. Clinical practice guideline for the medical management of perianal fistulizing crohn's disease: The Toronto consensus. *Inflamm Bowel Dis* 2019;25(1):1-13.

Wani S, Wallace MB, Cohen J, Pike IM, Adler DG, Kochman ML, et al. Quality indicators for EUS. *Gastrointest Endosc* 2015;81(1):67-80.

Inpatient setting (*N*=3)

Cohen M, Niv Y. Appropriateness of gastrointestinal consultations for hospitalized patients in an academic medical center. *J Postgrad Med* 2010;56(1):17-20.

Lu Y, Barkun AN, Martel M, REASON investigators. Adherence to guidelines: A national audit of the management of acute upper gastrointestinal bleeding. The reason registry. *Can J Gastroenterol Hepatol* 2014;28(9):495-501.

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No relevant recommendation (*N*=46)

Allen JI. Quality assurance for gastrointestinal endoscopy. *Curr Opin Gastroenterol* 2012;28(5):442-50.

Alzoubaidi D, Ragunath K, Wani S, Penman ID, Trudgill NJ, Jansen M, et al. Quality indicators for barrett's endotherapy (QBET): UK consensus statements for patients undergoing endoscopic therapy for barrett's neoplasia. *Frontline Gastroenterol* 2020;11(4):259-71.

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Appendix C: Indications Where Endoscopy Use Should be Reduced or Avoided and Endoscopy Overuse Evidence

Table C.1: Non-selected indications where endoscopy use should be reduced or avoided

Indication	Recommendation	Source(s)[a]	Rationale	Strength/quality of recommendation
Abdominal pain	• Do not consider EDG for abdominal pain unless the patient is over 55 years and has the following concurrent symptoms: weight loss, low hemoglobin levels, raised platelet count, or nausea and vomiting. • Do not consider colonoscopy for abdominal pain unless the patient is 40 years and has concurrent unexplained weight loss, or over 50 and has concurrent rectal bleeding.	• *NICE 2017 guidelines*[47] • ASGE 2012 guidelines[44]	• The pooled positive predictive value of abdominal pain is 0.23%, 95% CI [0.14%, 0.36] for esophageal cancer, 0.34%, 95% CI [0.16%, 0.71%] for stomach cancer, and 2.04%, 95% CI [0.53%, 7.55%] for colon cancer.	
Barrett's esophagus screening	There is insufficient evidence to recommend general population screening for BE, although a subset of population may benefit from endoscopic surveillance based on their risk factors.	• *ASGE 2019 guidelines*[67] • NICE 2019 guidelines[46] • ACG 2016 guidelines[55]	• There is a high uncertainty in the evidence, with potential for unnecessary risk or harms. • There is a linear relationship between the number of risk factors and the risk of BE (1.2% per additional risk factor). • Only endoscopic screening of individuals with GERD was found to be cost-effective if the willingness-to-pay threshold was <$100,000/ QALY.	NICE: Very-low and low-quality evidence ACG: conditional recommendation, low level of evidence
Barrett's esophagus (non-	In men and women with BE and no dysplasia, surveillance examinations	• *ASGE 2019 guidelines*[67] • NICE 2019 guidelines[46]	• There is a paucity of evidence comparing surveillance with the natural history of BE.	ACG: strong recommendation,

Indication	Recommendation	Source(s)[a]	Rationale	Strength/quality of recommendation
dysplastic) surveillance	should occur at intervals no more frequent than 3–5 years.	• ACG's 2016 BE guidelines[55] • ACP 2012 best practice advice[49] • Choosing Wisely US[78] and AUS[76]	• In patients with BE without dysplasia the risk of cancer is very low (0.1%–0.5%). • There was no significant difference in cancer-related mortality in patients with BE who were under surveillance compared to those who were not (pooled OR 5.68, 95% CI [0.59, 55.1]). • Systematic surveillance has not been shown to be cost-effective (0.11–0.94 probability cost-effective at threshold of £30,000/QALY).	moderate level of evidence NICE: Very low-quality evidence
Barrett's esophagus (dysplastic-indefinite, low grade dysplasia, high-grade dysplasia) surveillance	• For patients with indefinite dysplasia, surveillance is recommended no more frequently than 3–6 months, and annually after dysplasia confirmation. • After ablation for those with high-grade dysplasia, surveillance is recommended no more frequently than 3 months in the first year, no more frequently than 6 months in the second year, and annually thereafter. • For patients with low grade dysplasia, surveillance is recommended no more frequently than 6 months in the first year, and annually thereafter.	• *ACG's 2016 guidelines*[55]	• More recent data suggest there is an especially high risk of progression to higher grades of dysplasia within the first year of diagnosis, but a risk comparable to non-dysplastic BE after the first year. • Following complete elimination of intestinal metaplasia, the recurrence rate for carcinoma is not inconsiderable, with some cohorts demonstrating rates of ≥20% at 2–3 years following ablation.	ACG: conditional recommendation, low level of evidence

Indication	Recommendation	Source(s)[a]	Rationale	Strength/quality of recommendation
CRC population screening initiation and termination	• For asymptomatic patients without a CRC family history, screening is recommended to begin no earlier than at age 50 years. • For asymptomatic patients with a CRC family history, screening is recommended to begin no earlier than age 40, or 10 years younger than the age at which the relative was first diagnosed (whichever is earlier). • CRC screening should discontinue at age 75 or when life expectancy is less than 10 years.	• *CTF 2016 guidelines (Recommendation 1, 3)*[62] • *CAG 2018 guidelines (Recommendation 2)*[68] • BSG 2020 guidelines[71] • ACS 2018 guidelines[66] • USMSTF 2017 guidelines[57] • USPSTF 2016 guidelines[50] • SIGN 2016 guidelines[65] • Cancer Care Ontario 2015 guidelines[61] • TOPs 2013 guidelines[70] • Choosing Wisely[79]	• Most cases of CRC occur among adults older than 50 years (mean age of diagnosis is 68 years). • There is convincing evidence that screening for CRC in adults aged 50–75 years reduces CRC mortality (RR 0.74, 95% CI [0.67, 0.82]), with the benefit declining after age 75. • CRC screening by any available modality is cost-effective compared with no screening. • Risk could exceed potential benefit for screening after 85 years (models estimate few additional life-years gained, with higher rates of complications). • A family history of CRC in a first-degree relative increases the risk of CRC regardless of the age at diagnosis of the affected relative. There is a gradient of risk such that the younger the age of the affected relative, the greater the risk.	CTF, age 50–59: weak recommendation; moderate-quality evidence CTF, age 60–74: strong recommendation; moderate-quality evidence CTF, age ≥75: weak recommendation; low-quality evidence CAG: conditional recommendation, very-low-quality evidence BSG: strong recommendation, low quality evidence ACS: qualified recommendation. USMSTF: strong recommendation; moderate-quality evidence USPSTF: grade A recommendation; high certainty evidence SIGN: grade D recommendation
Colorectal cancer population screening modality	We recommend not using colonoscopy as a primary screening test for CRC, but rather a high-sensitivity stool-based test.	• *CTF 2016 guidelines*[62] • Cancer Care Ontario 2015 guidelines[61] • TOPs 2013 guidelines[70]	• Direct evidence of colonoscopy efficacy in comparison with the other screening tests is lacking. • Colonoscopy harms include intestinal perforation (0.05% of patients), minor bleeding (0.08%), major bleeding requiring hospital admission (0.1%), and death (0.002%).	CTF: weak recommendation; low-quality evidence USMSTF: strong recommendation; moderate-quality evidence

Indication	Recommendation	Source(s)[a]	Rationale	Strength/quality of recommendation
			Compliance with stool-based tests is higher.	
Colorectal cancer screening for inflammatory bowel	Screening colonoscopy should commence no sooner than after 8 years after the onset of inflammatory bowel disease symptoms in those with at least distal (left-sided) ulcerative colitis or Crohn's colitis with involvement of at least one-third of the colon.	• *NHMRC 2019 guidelines*[54] • SIGN 2016 guidelines[65] • ASGE 2015 guidelines[64] • Choosing Wisely AUS[76]	• CRC rates were relatively low for the first decade after ulcerative colitis diagnosis, after which some studies reported significantly higher CRC rates in ulcerative colitis patients, compared to the general population. • Those with Crohn's disease have a greater risk of CRC than the general population (1.5–2.0-fold increase within 10 years).	NHMRC: grade C recommendation SIGN: grade D recommendation. ASGE: moderate quality evidence
Colonic adenoma surveillance for inflammatory bowel	Surveillance colonoscopies should be performed no sooner than yearly, 3-yearly or 5-yearly according to risk stratification.	• *SIGN 2016 guidelines*[65] • ASGE 2015 guidelines[64]	• Optimal surveillance intervals are uncertain.	SIGN: grade D recommendations. ASGE: moderate quality evidence
Constipation	Avoid performing a colonoscopy for constipation in those under the age of 50 years without family history of CRC or alarm features.	• *Choosing Wisely CND*[17]	Constipation is a common problem and systematic review data suggests this is not an accurate symptom in diagnosing organic disease (change in bowel habit, colonoscopy pooled negative LR 1.00, 95% CI [0.86, 1.16].	Not described
Diverticulitis	Routine colonoscopy is not required in uncomplicated diverticulitis.[b]	• *de Vries et al. (2014)*[75] • Agarwal et al. (2014)[74]	The rate of cancer and advanced adenomas is patients with uncomplicated diverticulitis is equal or less than the rates encountered in asymptomatic individuals (incidence of malignancy detected 1–2%, lifetime risk 5%).	Not described
Duodenal ulcer	Endoscopy (EGD or colonoscopy) is generally not indicated for or evaluating radiographic findings or surveillance of healed benign disease that has responded to therapy.	• *ASGE 2012 guidelines*[44]	Not described	Not described

Indication	Recommendation	Source(s)[a]	Rationale	Strength/quality of recommendation
Gastric cancer surveillance	EGD is generally not indicated for surveillance for malignancy in patients with gastric atrophy, pernicious anemia, fundic gland or hyperplastic polyps, gastric intestinal metaplasia, or previous gastric operations for benign disease.	• *ASGE 2012 guidelines*[44]	Not described	Not described
Hiatal hernia	EGD is not indicated for evaluating radiographic findings of asymptomatic or uncomplicated sliding hiatal hernia.	• *ASGE 2012 guidelines*[44]	Not described	Not described
Iron deficiency	Only postmenopausal women and men aged >50 years should have endoscopy investigation of iron deficiency without anemia.	• *BSG 2011 guidelines*[63] • NICE 2017 suspected cancer guidelines[47]	• There is a very low prevalence of malignancy in patients with iron deficiency alone (0.9% of postmenopausal women and men, and 0% of premenopausal women). • The pooled positive predictive value of anemia is 0.94%, 95% CI [0.54%, 1.77%].	BSG: Grade C recommendation NICE: moderate-high quality evidence
Irritable bowel	We suggest against IBS patients <50 years of age with or without alarm features routinely having a colonoscopy to exclude alternate diagnoses.	• *CAG 2019 guidelines*[69] • ASGE 2012 guidelines[44]	• There appears to be little or no evidence that IBS increases the risk of CRC over the short-term compared with the general population.	CAG: Strong recommendation, very low-quality evidence
Metastatic cancer	EGD/colonoscopy is not indicated for routine cancer screening or surveillance, nor evaluating cancer with an unknown primary site when the results will not alter management.	• *ASGE 2012 guidelines*[44] • Choosing Wisely CND[77]	• In general, patients with metastatic cancer have competing mortality risks that would outweigh benefits of screening or surveillance. • Patients with metastatic disease may be more likely to experience harm since patients with limited life expectancy are more likely to be frail	Not described

Indication	Recommendation	Source(s)[a]	Rationale	Strength/quality of recommendation
			and more susceptible to complications of testing and treatments.	
Proton-pump inhibitor trial for dyspepsia, erosive esophagitis, or GERD	Do not perform endoscopy in dyspeptic patients unless they are H pylori negative and 4–8 weeks of twice-daily empirical PPI therapy is unsuccessful.	• *ASGE 2015 guidelines*[48] • ACP 2012 best practice advice[49]	• A meta-analysis evaluating PPI and endoscopic strategies showed no difference in dyspepsia symptoms or quality of life, but the endoscopic arm was more costly. • GERD symptoms have poor sensitivity and specificity as predictors of cancer risk (40% of patients who develop adenocarcinoma of the esophagus have no heartburn). • Patients' severe erosive esophagitis have a substantial rate of incomplete healing.	ASGE: Low quality evidence ACG: conditional recommendation, low level of evidence

[a] Recommendation details are reported from the italicized source. All other listed sources have recommendations regarding the indications, but details within the recommendation may vary from the recommendation, as is reported.

[b] This contradicts other current guidelines.

AB: Alberta; ACG: American College of Gastroenterology; ACP: American College of Physicians; ACS: American Cancer Society; ASCO: American Society of Clinical Oncology ASGE: American Society of Gastrointestinal Endoscopy; BC: British Colombia; BE: Barrett's esophagus; BSG: British Society of Gastroenterology; CAG: Canadian Association of Gastroenterology; CI: confidence interval; CND: Canada; CRC: colorectal cancer; CTF: Canadian Task Force; EGD: Esophagogastroduodenoscopy; ESGE: European Society of Gastrointestinal Endoscopy; GERD: gastroesophageal reflux disease; LR: likeliness ratio; NHMRC: National Health and Medical Research Council; NICE: National Institute for Health and Care Excellence; QALY: quality-adjusted life-years; RR: relative risk; SIGN: Scottish Intercollegiate Guidelines Network; TOP: Toward Optimized Practice; USMSTF: United States Multi-Society Task Force; USPSTF: United States Preventive Services Task Force; US: United States.

Table C.2: Evidence summaries, primary studies on endoscopy overuse

Study	Indication Guideline and recommendation(s)	Methods	Findings
Canada			
Hol et al. (2015)[86] Cohort Study Jan. 2000–June 2013	*Colonic adenoma surveillance* Canadian Association of Gastroenterology:[56] • A 10-year interval for follow-up surveillance in patients with negative findings.	*Data Source* • Five administrative databases *Population* • Ontario patients 50–79 years who underwent a complete outpatient colonoscopy with a negative result between Jan.1 2000 – Dec. 31 2007 • *N*=546,467 *Primary Outcome* • Time to early repeat colonoscopy (between 6 months and 5.5 years after the index colonoscopy)	• Cumulative repeat colonoscopy after 5.5 years: 33.7% (Kaplan-Meier analysis) • The rate decreased with every subsequent index year from 45.6% in 2000 to 20.5% in 2007 (HR 0.35, 95% CI [0.3, 0.36])* • Factors related to early colonoscopy: ○ Age 65–69 years: HR 1.21, 95% CI [1.19, 1.22]* compared to age 50–54 years ○ Comorbidity: HR 1.25, 95% CI [1.23, 1.28]* ○ SES, urban 60-80%: HR 1.24, 95% CI [1.21, 1.26]* compared to urban bottom 20% ○ Open access <36 months: HR 1.24, 95% CI [1.21, 1.26]* compared to not open access ○ Open access ≥36 month: HR 1.55, 95% CI [1.51, 1.59]* compared to not open access ○ General Surgeon: HR 1.27, 95% CI [1.25, 1.28]* compared to gastroenterologist ○ Private clinic: HR 1.26, [95% CI [1.22, 1.30]* compared to hospital
McAlister et al. (2017)[90] Retrospective Cohort Study Apr. 2012–March 2015	*Colorectal cancer screening* Choosing Wisely:[78] • Avoid performing colorectal cancer screening in patients over the age of 85. TOP colorectal cancer screening:[70] • Avoid performing colorectal cancer screening in patients over the age of 75.	*Data Source* • Five administrative databases *Population* • All patients ≥18 years, presenting to an Albertan healthcare provider at least once; relevant comorbidities for each patient were identified from any hospitalizations, any ED visits and any outpatient visits in the 2 years prior to and including the relevant index visit • N=218,882	*Recommendation 1,* n=45,577 • Total number patient receiving service: 137 (0.3%) • Regional:‡ ○ Edmonton: 0.5% ○ Calgary: 0.1% ○ Other regional centres (population>100 000): 0.1% ○ Rural:0.4% • Estimated total cost of procedures performed (n=147) was $98,343 *Recommendation 2,* n=218,882 • Total number patient receiving service: 3,692 (1.7%)

Study	Indication Guideline and recommendation(s)	Methods	Findings
		Primary Outcomes • Proportion of patients receiving the low value service, with comparison by region • Estimated costs (cost per test multiplied by total number preformed)	• Regional:‡ ○ Edmonton: 2.6% ○ Calgary: 0.8% ○ Other regional centres (population>100 000): 1.2% ○ Rural:1.8% • Estimated total cost of procedures performed (n=4,035): $2,699,415
Soril et al. (2018)[80] Low value care prioritization report FY 2015/16 and 2016/17	*Colorectal cancer screening* Choosing Wisely Canada:[17] 1. Avoid colorectal cancer screening tests on asymptomatic patients with a life expectancy of less than 10 years and no family or personal history of colorectal neoplasia. *Dyspepsia* Choosing Wisely Canada:[17] 2. Avoid performing an endoscopy for dyspepsia without alarm symptoms for patients younger than 55 years.	*Data Source* • Physician claims data recommendation *Population* • Not described *Primary Outcomes* • Claim frequency • Cost • Prioritization, based on high budgetary impact (a high total cost from the use of a low value technology due to the high cost per technology, high volume or use, or an aggregate measure of both)	Recommendation 1 • Total inappropriate physician claims: 303,407 • Total cost: $22,731.252.44 • Ranked 1/56 non-drug technology recommendation for high budget impact Recommendation 2 • Total inappropriate physician claims: 7,770 • Total cost: $418,453.35 • Ranked 13/56 non-drug technology recommendation for high budget impact
United States			
Cai et al. (2015)[83] Retrospective Cohort Study Sep 2013–Dec 2013	*BE surveillance/GERD/ Erosive esophagitis* American College of Physicians:[49] • In men and women with non-dysplastic BE, surveillance examinations should occur no more frequently than 3–5 years. • EGD is indicated in men and women with typical GERD symptoms that persist despite a therapeutic trial of 4–8 weeks of twice-daily PPI therapy.	*Data Source* • Not described *Population* • All adult outpatient EGDs for indications of GERD, dyspepsia, esophagitis, and BE, performed at a general hospital • *N*=550 *Primary Outcomes* • Discordance with guidelines	• 208 (37.8%) of procedures were discordant with guidelines ○ Surveillance for BE within 3 years: 59 (28.4%) ○ Chronic GERD in patients <50 years: 20 (9.6%) ○ Chronic GERD in women: 40 (19.2%) ○ Chronic GERD in women <50 years: 5 (2.4%) ○ Duration of chronic symptoms <5 years: 3 (1.4%) ○ Inappropriate PPI trial before endoscopy: 63 (30.3%) ○ Mild or moderate erosive esophagitis: 7 (3.4%)

Study	Indication Guideline and recommendation(s)	Methods	Findings
	• EGD may be indicated in men older than 50 years with chronic GERD symptoms (symptoms >5 years). • EGD is indicated in men and women with heartburn and alarm symptoms (dysphagia, bleeding, anemia, weight loss, and recurrent vomiting). • EGD is indicated in men and women with severe erosive esophagitis after a 2-month course of PPI therapy. Recurrent endoscopy after this follow-up examination is not indicated in the absence of BE.		○ No designated indication for repeat endoscopy: *N*=11 (5.3%)
Desai et al. (2016)[84] Retrospective cross-sectional cohort study 2008–2014	*Colonic adenoma surveillance* USMSTF:[52] • Colonoscopy surveillance is recommended in 10 years if the baseline examination detects no adenomas or polyps, or distal small (<10 mm) hyperplastic polyps. • Colonoscopy surveillance is recommended in 5–10 years if the baseline examination detects 1–2 tubular adenomas <10 mm. • Colonoscopy surveillance is recommended in 3 years if the baseline examination detects ≥3 adenomas, one or more tubular adenomas >10 mm, one or more adenomas with villous features of any size, or one or more adenomas with high-grade dysplasia. • Colonoscopy surveillance is recommended in 1–5 years if the baseline examination detects serrated polyps.	*Data Sources* • Electronic medical records *Population* • Patients 50–75 at the time of their screening colonoscopy, who completed their first surveillance colonoscopy, at two sites • *N*=700 *Primary outcome* • Minimum interval since last colonoscopy, divided into *adherent* and *premature* (<6 months to the date of the recommended surveillance guideline)	• Premature surveillance occurred in 301 (40.3%) ○ Without rationale listed: 184 (61.1%) ○ Poor bowel preparation: 52 (17.3%) ○ Clinical rationale (bleeding, altered bowel habits, anemia, abdominal pain, abnormal imaging): 65 (21.6%) • Factors associated with premature colonoscopy: ○ Hispanic: AOR 2.12, 95% CI [1.31, 3.38]† ○ Medicaid/charity: AOR 3.12, 95% CI [1.54, 6.25]† ○ Presence hyperplastic polyp only: AOR 14.5, 95% CI [3.20, 66.7)]‡ • Factors associated with premature colonoscopy without rationale: ○ Medicaid/charity: AOR 0.45, 95% CI [0.23, 0.91]* ○ Presence hyperplastic polyp only: AOR 1.71, 95% CI [1.05, 2.76)]*

Study	Indication Guideline and recommendation(s)	Methods	Findings
Fisher et al. (2018)[85] Retrospective cohort study *Not described*	*Colorectal Cancer Screening* Choosing Wisely[188] • Don't recommend screening for breast, colorectal, or prostate cancer if life expectancy is estimated to be less than 10 years.	*Data Sources* • Electronic medical records *Population* • Patients with new diagnosis of pancreatic cancer in 2013 • *N*=7,393 *Primary outcome* • Frequency and cost associated with preventive health screening tests occurring after cancer diagnosis	• 339 patients (4.6%) had a colonoscopy after their cancer diagnosis • Total cost: US $451,000 • Factors associated with colonoscopy screening: ○ Age: OR 0.967, 95% CI [0.958, 0.976]‡ ○ 5 or more emergency room visits in the year prior: OR 0.207, 95% CI [0.049, 0.875],* compared to none ○ Positive lymph node status: OR 0.687, 95% CI [0.529, 0.892],† compared to a negative status ○ Treatment with surgery only: OR 1.481, 95% CI [1.046, 2.097],* compared to no treatment ○ Treatment with surgery and chemotherapy: OR 1.614, 95% CI [1.119, 2.330],* compared to no treatment ○ Hospice entry: OR 0.656, 95% CI [0.485, 0.888]†
Kahn et al. (2015)[87] Retrospective Cohort Study June 2011–Dec. 2013	*Colonic adenoma surveillance* USMSTF: [52] • Colonoscopy surveillance is recommended in 10 years if the baseline examination detects no adenomas or polyps, or distal small (<10 mm) hyperplastic polyps. • Colonoscopy surveillance is recommended in 5–10 years if the baseline examination detects 1–2 tubular adenomas <10 mm. • Colonoscopy surveillance is recommended in 3 years if the baseline examination detects ≥3 adenomas, one or more tubular adenomas >10 mm, one or more adenomas with villous features of any size, or one or more adenomas with high-grade dysplasia. • Colonoscopy surveillance is recommended in 1–5 years if the	*Data Sources* • Electronic medical records and colonoscopy results letters *Population* • Patients who underwent colonoscopy with polypectomy, performed at a single endoscopy unit • *N*=1,822 *Primary outcome* • Surveillance recommendation discordance with guidelines	• 263 surveillance recommendations were deemed potential overuse (14.4% of population, 63.8 % of total discordant [overuse, underuse and no recommendation combined *n*=412]) ○ 1–2 years shorter: 124 (47%) ○ 3–5 years shorter: 113 (43%) ○ >5 years shorter: 26 (10%) • Overuse of colonoscopy was associated with: ○ presence of high-grade dysplasia: AOR 9.6, 95% CI [3.5, 26.6]* ○ fair bowel preparation: AOR 3.3, 95% CI [2.5, 4.4]* ○ piecemeal resection: AOR 0.19, 95% CI [0.04, 0.80]* ○ ≥3 adenomas: AOR 0.44, 95% CI [0.28, 0.68]* ○ age >65 years: AOR 0.63, 95% CI [0.44, 0.90]* ○ Hispanic: AOR 0.68, 95%CI [0.50, 0.92]*

Study	Indication Guideline and recommendation(s)	Methods	Findings
	baseline examination detects serrated polyps.		
Kapila et al. (2019)[88] Retrospective cohort study Jan. 2013–June 2016	*Colonic adenoma surveillance* USMSTF:[52] • Colonoscopy surveillance is recommended in 10 years if the baseline examination detects no adenomas or polyps, or distal small (<10 mm) hyperplastic polyps. • Colonoscopy surveillance is recommended in 5–10 years if the baseline examination detects 1–2 tubular adenomas <10 mm. • Colonoscopy surveillance is recommended in 3 years if the baseline examination detects >3 adenomas, one or more tubular adenomas >10 mm, one or more adenomas with villous features of any size, or one or more adenomas with high-grade dysplasia. • Colonoscopy surveillance is recommended in 1–5 years if the baseline examination detects serrated polyps.	*Data Sources* • Electronic medical records *Population* • Patients >50 years who underwent a colonoscopy for cancer screening or polyp surveillance, performed at a single endoscopy site • *N*=5,211 *Primary outcome* • Adherence to guidelines (within 12 months), with comparisons between open access and gastroenterologist referral	• Direct referral to endoscopy (open access): 15.4% were inappropriate (12 months early or late from recommendations)[§] ○ Screening: 8.4% overall[§] with 78.3% being too early[§] ○ Surveillance: 32.6% overall,[†] with 81.7% being too early[§] ○ On average, 41.6 months early • Gastroenterologist referral: 14.1% were inappropriate ○ Screening: 7.1% overall, with 83.1% being too early[§] ○ Surveillance: 26.4% overall, with 80.9% being too early[§]
Magrath et al. (2018)[89] Retrospective cohort study Oct. 2014–Sept. 2015	*Colonic adenoma surveillance* USMSTF:[52] • Colonoscopy surveillance is recommended in 10 years if the baseline examination detects no adenomas or polyps, or distal small (<10 mm) hyperplastic polyps. • Colonoscopy surveillance is recommended in 5–10 years if the	*Data Sources* • Electronic medical records *Population* • Patients who underwent colonoscopy with polypectomy, performed at a single endoscopy unit • *N*=1,320 *Primary outcome*	• Clinical decision support system was used for 1,186 recommendations (89.9%) • Potential overuse: 143 (10.8%) ○ 1–2 years shorter: 72 (50.4%) ○ 3–5 years shorter: 47 (32.9%) ○ >5 years shorter: 24 (16.8%) • Factors associated with overuse: ○ Support system used: RR 0.55, 95% CI [0.33, 0.88]* ○ 1-2 adenomas: RR 0.55, 95% CI [0.38, 0.79]* ○ ≥3 adenomas: RR 0.12, 95% CI [0.06, 0.25]*

Study	Indication Guideline and recommendation(s)	Methods	Findings
	baseline examination detects 1–2 tubular adenomas <10 mm. • Colonoscopy surveillance is recommended in 3 years if the baseline examination detects ≥3 adenomas, one or more tubular adenomas >10 mm, one or more adenomas with villous features of any size, or one or more adenomas with high-grade dysplasia. • Colonoscopy surveillance is recommended in 1–5 years if the baseline examination detects serrated polyps.	• Surveillance recommendation supported by a clinical decision support system discordance with guidelines	○ Fair bowel preparation: RR 3.77, 95% CI [2.65, 5.12]* ○ Family history of colorectal cancer: RR 1.74, 95% CI [1.08, 2.68]*
Murphy et al. (2016)[91] Retrospective cohort study Oct. 2007–Sept. 2014	*Colonic adenoma surveillance* USMSTF:[52] • Colonoscopy surveillance is recommended in 10 years if the baseline examination detects no adenomas or polyps, or distal small (<10 mm) hyperplastic polyps. • Colonoscopy surveillance is recommended in 5–10 years if the baseline examination detects 1–2 tubular adenomas <10 mm. • Colonoscopy surveillance is recommended in 3 years if the baseline examination detects ≥3 adenomas, one or more tubular adenomas >10 mm, one or more adenomas with villous features of any size, or one or more adenomas with high-grade dysplasia.	*Data Sources* • Electronic medical records *Population* • Outpatients 50–64 years who underwent a screening colonoscopy between Oct. 2007-Sept 2008, in one of 25 VHA facilities, and had no history of CRC, inflammatory bowel disease, or colonoscopy during the 10 years preceding the index screening (representative sample strata of facility, race, and sex, with oversampling of women and minorities) • *N*=1,455 *Primary outcome* • Proportion of patients who received a follow-up colonoscopy as per guidelines (2-month grace period)	*Recommendation 1, n*=1,096 • Overuse: 208 (19.0%) • Factors associated with overuse: ○ Non-academic associated facility: OR 5.26, 95% CI [1.96, 14.29]* ○ Non-adherent follow-up recommendation: OR 3.80, 95% CI [2.31, 6.25]* *Recommendation 2*, *n*=231 • Overuse: 73 (31.6%) • Factors associated with overuse: ○ Female: OR 2.08, 95% CI [1.02, 4.23]* ○ General Surgeon: OR 3.28, 95% CI [1.06, 10.16],* compared to gastroenterologists ○ Non-academic associated facility: OR 3.45, 95% CI [1.52, 7.69]* ○ Complex case: OR 1.55, 95% CI [0.57—4.23]* ○ Non-adherent follow-up recommendation: OR 5.28, 95% CI [1.88, 14.83]* *Recommendation 3, n*=128 • Overuse: 34 (26.6%)

Study	Indication Guideline and recommendation(s)	Methods	Findings
Pohl et al. (2014)[92] Retrospective cohort study 2004–2009	Two investigators divided 70 diagnoses into 14 meaningful diagnostic categories. A modified Delphi was used to further divided the 14 diagnostic categories into 3 broad diagnostic groups. Given the diagnosis at index EGD, those in which repeated EGD was: • *Expected*: stenosis, fistula, cancer, BE, gastrointestinal bleeding, or varices. • *Uncertain*: Suspected gastrointestinal bleeding without findings, esophagitis, ulcer, or Helicobacter pylori. • *Not expected*: Gastritis or duodenitis, abdominal pain, dyspepsia and nonspecific symptoms, nonspecific EGD findings, reflux disease, dysphagia, or other diagnoses/symptoms.	*Data Sources* • Medicare database *Population* • Random 5% sample of Medicare beneficiaries, who had an index EGD between 2004–2006 • *N*=108,785 *Primary outcome* • Proportion of patients with repeated EGD within 3 years of an index EGD, divided as *expected*, *uncertain* or *unexpected*	• Index EGD categorized *not expected*: 66,307 (61%), ○ Repeat EDG within 3 years: 19,687 (29.7%) ▪ Gastritis: 7,266 (36.9%); with same diagnosis in 2,923 (40.2%) ▪ Abdominal pain/dyspepsia/nonspecific symptoms: 3,318 (16.9%); with same diagnosis 822 (24.8%) ▪ nonspecific EGD findings: 3,196 (16.2%); with same diagnosis in 1,021 (30.8%) ▪ reflux disease: 2,200 (11.2%); with same diagnosis in 473 (21.5%) ▪ dysphagia: 2,821 (14.3%); with same diagnosis in 965 (34.3%) ▪ other diagnoses/symptoms: 886 (4.5%); with same diagnosis in 8 (0.9%)
Tavakkoli et al. (2018)[94] Retrospective cohort study 2002–2016	*BE surveillance* American College of Gastroenterology: [55] • For BE patients without dysplasia, endoscopic surveillance should take place at intervals of 3–5 years	*Data Sources* • BE Registry • Electronic medical records *Population* • Patients with endoscopic and histologic confirmation of non-dysplastic BE and had at least 3 EGDs or at least 5 years of follow-up since their last EGD, at a single site • *N*=477 *Primary outcome* • The effects of patient factors, year, and referring providers on appropriateness of surveillance intervals	• Overuse: 181 (37.9%) patients had less than 3 years between their 2nd and 3rd EGD • Factors associated with overuse: ○ Referring provider or primary care physician: aOR 0.51, 95% CI [0.27, 0.95],* compared to gastroenterologist ○ Long-segment BE (*n*=157): aOR 3.78, 95% CI [1.51, 9.46]* ○ 2nd endoscopy between 2006-2011: OR 0.46, 95% CI [0.21, 0.99],* compared to 2002-2005 ○ Charlson Comorbidity Index ≥2: OR 2.46, 95% CI [1.07, 5.63]*
United Kingdom			

Study	Indication Guideline and recommendation(s)	Methods	Findings
Adams et al. (2020)[81] Retrospective Cohort study July 2009-Jan. 2014	*Colonic adenoma surveillance* British Society of Gastroenterology:[189] • For those with high penetrance familial syndromes, or 3 first-degree relatives with at least one relative <50 years old, we recommend colonoscopy every 1–5 years starting at age 25. • For those with 3 first-degree relatives, no relative <50 years, or two first-degree relatives with a mean age ≤60 years, we recommend colonoscopy every 5 years, from ages 50–75. • For those with 2 first-degree relatives ≥ 60 years, or 1 first degree relative < 50 years, we recommend a single colonoscopy at age 55 years. • For those with 1 first-degree relative >50 years old, colonoscopy surveillance is not required.	*Data Sources* • Electronic medical records *Population* • Patients with "family history" was the indication for colonoscopy surveillance, prior to (July 2009–Apr. 2011) and after (Apr. 2011–Jan. 2014) the establishment of a dedicated family history of bowel cancer service at a single hospital site. • *N*=389*: n*=182 pre-service *and n*= 207 post-service. *Primary outcome* • Adherence to the guidelines for age at which to initiate surveillance	• Pre-service: 110 (60.4%) had colonoscopy surveillance ○ 39 colonoscopies (35.5%) were completed too early by a median 10.6 years ○ Subsequent 'out of guideline' follow up colonoscopies were offered to 47 of 182 patients (25.8%) • Post-service: 195 (94.2%) had colonoscopy surveillance ○ 31 colonoscopies (15.9%) were completed too early by a median of 5.9 years ○ Subsequent 'out of guideline' follow up colonoscopies were offered to 25 of 207 patients (12%).
Australia			
Bunjo et al. (2019)[82] Audit Nov. 2017	*Colonic adenoma surveillance* NHMRC:[190] • Colonoscopy surveillance is recommended in 10 years (or FOBT in 2 years) if the baseline examination is normal. • Colonoscopy surveillance is recommended in 5 years if the baseline examination detects 1–2 tubular adenomas <10 mm. • Colonoscopy surveillance is recommended in 3 years if the baseline examination detects ≥3 adenomas, >10 mm, tubulovillous, villous histology, high grade dysplasia, or sessile serrated adenomas >10 mm and without dysplasia.	*Data Sources* • Colorectal unit surveillance colonoscopy waiting list • Electronic medical records *Population* • Patients who previously had a colonoscopy and were booked on the surveillance colonoscopy waiting list, at a single site • *N*=467 *Primary outcome* • Booked interval for surveillance colonoscopy (calculated from the booking date and date of last colonoscopy), then compared with guidelines (within 2 months).	• Incorrect booking interval: 251 (53.7%) ○ Booked too early: 197 (88.7%) ○ Surveillance not required: 29 (11.6%) • Recommended Surveillance: ○ 3 years: 59 of 186 (81.9%) too early ○ 5 years: 124 of 197 (99.2%) too early ○ 10 years: 14 of 14 (100%) too early • Of those booked too early (*n*=197), 172 (87.3%) had surveillance interval was greater than 20% of the recommended interval. • Incorrect bookings were most common in the low-risk and past history colorectal cancer patients.

Study	Indication Guideline and recommendation(s)	Methods	Findings
	• Colonoscopy surveillance is recommended in 1 year if the baseline examination detects ≥5 adenomas, or large sessile serrated adenomas with dysplasia.		
Symonds et al. (2018)[93] Prospective audit Jan.–Dec. 2015	*Colonic adenoma surveillance* NHMRC:[190] • Colonoscopy surveillance is recommended in 10 years (or FOBT in 2 years) if the baseline examination is normal. • Colonoscopy surveillance is recommended in 5 years if the baseline examination detects 1–2 tubular adenomas <10 mm. • Colonoscopy surveillance is recommended in 3 years if the baseline examination detects ≥3 adenomas, >10 mm, tubulovillous, villous histology, high grade dysplasia, or sessile serrated adenomas >10 mm and without dysplasia. • Colonoscopy surveillance is recommended in 1 year if the baseline examination detects ≥5 adenomas, or large sessile serrated adenomas with dysplasia.	*Data Sources* • Electronic medical records *Population* • Patients 50–74 years who underwent colonoscopy, enrolled in the Southern Co-operative Program for the Prevention of Colorectal Cancer in 6 hospitals. *Primary outcome* • Proportions of recall recommendations that matched the guidelines (March–May). • Colonoscopies performed more than 6 months before the scheduled date (Jan.-Dec.) • Comparisons between a nurse-led model (2 sites; a nurse coordinator writes the recall recommendation letter, which is reviewed by the responsible physician) and gastroenterologist-led model (4 sites).	*Nurse-led model* • 12 (*n*=410, 2.9%) recall recommendations were discordant with guidelines by at least 6 months‡ ○ 7 were given surveillance intervals shorter than guidelines • 236 (*n*=884, 27%) of colonoscopies were performed early (mean [SD]: 27.4 [12.9] months)‡ ○ 86 (36%) were due to symptoms§ ○ 124 (52%) were due to a positive FOBT result§ *Gastroenterologist-led model* • 53 (*n*=310, 17.1%) recall recommendations were discordant with guidelines • 253 (*n*=1,279, 20%) of colonoscopies were performed early (mean [SD] 22.9 [11.5] months) ○ 94 (37%) were due to symptoms ○ 124 (49%) were due to a positive FOBT result

* p<0.05.

†p<0.01.
‡p<0.001.
§not significant.

aOR: adjusted odds ratio; BE: Barrett's esophagus; CI: confidence interval; ED: emergency department; EGD: esophagogastroduodenoscopy, FOBT: fecal occult blood test; FY: fiscal year; GERD: gastroesophageal reflux disease; HR: hazard ratio; OR: odds ratio PPI: proton pump inhibitor; SES: socioeconomic status; TOP: Toward Optimized Practice; USMSTF: United States Multi-Society Task Force: VHA Veteran's Health Authority.

Appendix D: Clinical Practice Guidelines Quality Assessment

Table D.1: Colorectal adenoma surveillance guideline quality assessment

Criteria from AGREE-II tool[a]		USMSTF 2020[53]	ESGE 2020[51]	BSG 2020[71]	NHMRC 2019[54]
Scope/ purpose	1. Objectives	8	5	7	8
	2. Health question	7	8	8	8
	3. Target population	7	7	7	7
Domain satisfaction		22 (88.9%)	20 (77.8%)	22 (88.9%)	23 (94.4%)
Stakeholder involvement	4. Relevant professional groups represented	5	6	8	7
	5. Target population preferences	2	3	5	8
	6. Target users defined	3	5	7	7
Domain satisfaction		10 (22.2%)	14 (44.4%)	20 (77.8%)	22 (88.9%)
Rigour of development	7. Systematic search conducted	8	5	8	8
	8. Selection criteria described	8	2	8	8
	9. Evidence strengths and limitations described	7	8	7	8
	10. Methods used to formulate recommendations described	7	5	8	8
	11. Benefits, side effects, risks considered	7	8	8	8
	12. Link between recommendations and evidence	7	8	8	8
	13. External review by experts	3	5	4	8
	14. Updating procedure described	2	6	7	7
Domain satisfaction		48 (66.7%)	47 (64.6%	58 (87.5%)	63 (97.9%)
Clarity/ presentation	15. Specific, unambiguous recommendations	8	8	8	8
	16. Different management options presented	8	8	7	8
	17. Key recommendations easily identifiable	8	8	8	8
Domain satisfaction		24 (100%)	24 (100%)	23 (94.4%)	24 (100%)
Applicability	18. Facilitators and barriers discussed	2	6	8	8

Criteria from AGREE-II tool[a]		USMSTF 2020[53]	ESGE 2020[51]	BSG 2020[71]	NHMRC 2019[54]
	19. Support materials provided	8	3	8	8
	20. Resource implications considered	2	2	7	8
	21. Monitoring or audit criteria presented	3	7	6	3
Domain satisfaction		15 (29.2%)	18 (41.7%)	29 (87.5%)	27 (79.2%)
Editorial independence	22. Editorially independent from funding body	7	8	7	7
	23. Competing interests reported	8	8	8	8
Domain satisfaction		15 (91.7%)	16 (100%)	15 (91.7%)	15 (91.7%)
Quality Rating[b]	Seven criteria (systematic search, method of formulating recommendations, recommendations-evidence link, external review, clear recommendations, editorial independence, conflict of interest)	Good 24 (85.7%)	Good 23.5 (83.9%)	Good 25.5 (91.1%)	Good 27.5 (98.2%)

[a]Appraisal of Guidelines for Research & Evaluation II (AGREE II) tool was used for quality assessment.[42] Item maximum score is eight and minimum score is two.

[b]Boolean-Based User Guide for The AGREE II Instrument was used for quality rating.[43]. Good rating: average score across seven items of 22 to 28; average rating: average score across seven items of 15 to 21; poor rating – average score across seven items zero to 14.

BSG: British Society of Gastroenterology; ESGE: European Society of Gastrointestinal Endoscopy; NHMRC: National Health and Medical Research Council; USMSTF: United States Multi-Society Task Force.

Table D.2: Dyspepsia/gastroesophageal reflux guideline quality assessment

Criteria from AGREE II tool[a]		ACG-CAG 2017[45]	CTFPHC 2020[72]	ASGE 2015 Dyspepsia[4] [8]	ASGE 2015 GERD[73]	NICE 2017 [47]
Scope/ purpose	1. Objectives	7	7	3	3	8
	2. Health question	7	8	2	3	8
	3. Target population	7	7	4	4	6
Domain satisfaction		21 (83.3%)	22 (88.9%)	9 (16.7%)	10 (22.2%)	22 (88.9%)
Stakeholder involvement	4. Relevant professional groups represented	3	8	3	3	8
	5. Target population preferences	2	8	3	2	8
	6. Target users defined	2	8	8	8	8
Domain satisfaction		7 (5.6%)	24 (100%)	14 (44.4%)	13 (38.9%)	24 (100%)
Rigour of development	7. Systematic search conducted	8	8	3	5	8
	8. Selection criteria described	6	8	2	2	5
	9. Evidence strengths and limitations described	7	8	3	4	8
	10. Methods used to formulate recommendations described	8	6	3	3	8
	11. Benefits, side effects, risks considered	8	7	4	5	8
	12. Link between recommendations and evidence	8	8	3	3	8
	13. External review by experts	2	8	2	3	8
	14. Updating procedure described	2	7	5	5	7
Domain satisfaction		49 (68.8%)	60 (91.7%)	25 (18.8%)	30 (29.2%)	60 (91.7%)
Clarity/ presentation	15. Specific, unambiguous recommendations	7	7	8	6	8
	16. Different management options presented	8	8	7	7	8
	17. Key recommendations easily identifiable	8	8	7	8	8
Domain satisfaction		23 (94.4%)	23 (94.4%)	22 (88.9%)	21 (83.3%)	24 (100%)
Applicability	18. Facilitators and barriers discussed	2	8	2	2	8
	19. Support materials provided	8	8	8	2	8

Criteria from AGREE II tool[a]		ACG-CAG 2017[45]	CTFPHC 2020[72]	ASGE 2015 Dyspepsia[48]	ASGE 2015 GERD[73]	NICE 2017[47]
	20. Resource implications considered	2	5	2	2	8
	21. Monitoring or audit criteria presented	3	7	2	2	8
Domain satisfaction		15 (29.2%)	28 (83.3%)	14 (25%)	8 (0%)	32 (100%)
Editorial independence	22. Editorially independent from funding body	8	8	3	3	2
	23. Competing interests reported	8	8	8	7	8
Domain satisfaction		16 (100%)	16 (100%)	11 (58.3%)	10 (50%)	10 (50%)
Quality Rating[b]	Seven criteria (systematic search, method of formulating recommendations, recommendations-evidence link, external review, clear recommendations, editorial independence, conflict of interest)	Good 24.5 (87.5%)	Good 26.5 (94.6%)	Average 15 (53.6%)	Average 15 (53.6%)	Good 25 (89.3%)

[a]Appraisal of Guidelines for Research & Evaluation II (AGREE II) tool was used for quality assessment.[42] Item maximum score is eight and minimum score is two.

[b]Boolean-Based User Guide for The AGREE II Instrument was used for quality rating.[43]. Good rating: average score across seven items of 22 to 28; average rating: average score across seven items of 15 to 21; poor rating – average score across seven items zero to 14.

ACG: American College of Gastroenterology; ASGE: American Society for Gastrointestinal Endoscopy; CAG: Canadian Association of Gastroenterology; CTFPHC: Canadian Task Force on Preventive Health Care; GERD: gastroesophageal reflux disease; NICE: National Institute for Health and Care Excellence.

Appendix E: Systematic Review of New Evidence to Clarify Guideline Discordance Search Strategy

Table E: Colorectal adenoma surveillance search strategy for new evidence

Database **Edition or date searched**	Search terms ††
Ovid MEDLINE(R) ALL 1946 to November, 19, 2019 Searched:2020-11-20 Results: 353	1. exp *Colorectal Neoplasms/di, ep, et, mo, su or *cecal neoplasms/di, ep, et, mo, su 2. ((colon* or colorectal* or rectal or anal or anus or rectum or bowel) adj3 (cancer* or carcinoma* or tumour* or tumor* or neoplas* or malignan*)).ti,kf. 3. ((colon* or colorectal* or rectal or anal or anus or rectum or bowel) adj3 (cancer* or carcinoma* or tumour* or tumor* or neoplas* or malignan*)).ab. /freq=2 4. or/1-3 [COLON CANCER] 5. exp Colonoscopy/ or exp Colonography, Computed Tomographic/ or exp Sigmoidoscopes/ 6. (colonoscop* or sigmoidoscop*).ti,ab,kf. 7. or/5-6 [COLONOSCOPY] 8. exp Colonic Polyps/ or exp Adenomatous Polyps/ or Adenoma/ 9. (polyp* or asymptomatic or adenoma* or adenocarcino*).ti,kf. 10. (polyp* or asymptomatic or adenoma* or adenocarcino*).ab. /freq=2 11. or/8-10 [POLYPS OR ADENOMAS] 12. exp *Early Detection of Cancer/ 13. exp Sentinel Surveillance/ or mass screening/ or risk assessment/ or risk factors/ or follow-up studies/ or Neoplasm recurrence/ 14. (surveill* or interval* or monitor* or follow up or recurrence or screen* or monitor*).ti,kf. 15. (surveill* or interval* or monitor* or follow up or recurrence or screen* or monitor*).ab. /freq=2 16. exp recall/ or recall.ti,kf. 17. or/12-16 [SURVEILLANCE] 18. Precancerous Conditions/ 19. (low risk or non advanced or nonadvanced or tubular or low grade or lowgrade or non serrated or nonserrated).ti,kf. 20. (low risk or non advanced or nonadvanced or tubular or low grade or lowgrade or non serrated or nonserrated).ab. /freq=2 21. (1 cm or 1cm or 10 mm or 10mm or LRA).ti,kf. 22. (1 cm or 1cm or 10 mm or 10mm or LRA).ab. /freq=2 23. (dysplasia or high risk or highrisk or high grade or high-grade or serrated or serration or tubulovillous or villous or advanced or hyperplastic).ti,kf. 24. (dysplasia or high risk or highrisk or high grade or high-grade or serrated or serration or tubulovillous or villous or advanced or hyperplastic).ab. /freq=2 25. exp Adenoma, Villous/

	26. or/19-25 [RISK FACTORS OR PROGNOSTIC FACTORS] 27. incidence/ or mortality/ or "cause of death"/ or fatal outcome/ or hospital mortality/ or mortality, premature/ or survival rate/ 28. inciden*.ti,kf. 29. inciden*.ab. /freq=2 30. or/27-29 31. 7 and (11 or 26) and 17 and (4 or 30) 32. (201911* or 201912*).dt,dp,ed,ez. 33. 31 and 32 34. limit 31 to yr="2020 -Current" 35. 33 or 34 36. limit 35 to english language
OVID Embase 1974 to 2020 November 19 Searched: 2020-11-20 Results: 411	1. exp colorectal tumor/co, di, ep, et, pc, su 2. ((colon* or colorectal* or rectal or anal or anus or rectum or bowel) adj3 (cancer* or carcinoma* or tumour* or tumor* or neoplas* or malignan*)).ti,kw. 3. ((colon* or colorectal* or rectal or anal or anus or rectum or bowel) adj3 (cancer* or carcinoma* or tumour* or tumor* or neoplas* or malignan*)).ab. /freq=2 4. or/1-3 [COLON CANCER] 5. exp Colonoscopy/ or computed tomographic colonography/ or sigmoidoscopy/ 6. (colonoscop* or sigmoidoscop*).ti,ab,kw. 7. or/5-6 [COLONOSCOPY] 8. exp colon polyp/ or colorectal polyp/ or rectum polyp/ or exp Adenomatous Polyps/ or Adenoma/ or adenomatosis/ 9. (polyp* or asymptomatic or adenoma* or adenocarcino*).ti,kw. 10. (polyp* or asymptomatic or adenoma* or adenocarcino*).ab. /freq=2 11. or/8-10 [POLYPS OR ADENOMAS] 12. exp early cancer diagnosis/ 13. exp Sentinel Surveillance/ or mass screening/ or risk assessment/ or risk factor/ or follow up/ or tumor recurrence/ or cancer recurrence/ 14. (surveill* or interval* or monitor* or follow up or recurrence or screen* or monitor*).ti,kw. 15. (surveill* or interval* or monitor* or follow up or recurrence or screen* or monitor*).ab. /freq=2 16. recall.ti,kw. 17. or/12-16 [SURVEILLANCE] 18. precancer/ 19. (low risk or non advanced or nonadvanced or tubular or low grade or lowgrade or non serrated or nonserrated).ti,kw. 20. (low risk or non advanced or nonadvanced or tubular or low grade or lowgrade or non serrated or nonserrated).ab. /freq=2 21. (1 cm or 1cm or 10 mm or 10mm or LRA).ti,kw.

	22. (1 cm or 1cm or 10 mm or 10mm or LRA).ab. /freq=2 23. (dysplasia or high risk or highrisk or high grade or high-grade or serrated or serration or tubulovillous or villous or advanced or hyperplastic).ti,kw. 24. (dysplasia or high risk or highrisk or high grade or high-grade or serrated or serration or tubulovillous or villous or advanced or hyperplastic).ab. /freq=2 25. colorectal adenoma/ or villous adenoma/ 26. or/19-25 [RISK FACTORS OR PROGNOSTIC FACTORS] 27. incidence/ or cancer incidence/ or mortality/ or cancer mortality/ or hospital mortality/ or mortality rate/ or premature mortality/ or survival rate/ 28. inciden*.ti,kw. 29. inciden*.ab. /freq=2 30. or/27-29 31. 7 and (11 or 26) and 17 and (4 or 30) 32. (201911* or 201912*).dc,dd. 33. 31 and 32 34. limit 31 to yr="2020 -Current" 35. 33 or 34 36. limit 35 to english language 37. limit 36 to embase
Cochrane Central Register of Controlled Trials Searched: 2020-11-20 Results: **155**	ID Search #1 [mh "Colorectal Neoplasms"] OR [mh ^"cecal neoplasms"] #2 ((colon* OR colorectal* OR rectal OR anal OR anus OR rectum OR bowel) NEAR/3 (cancer* OR carcinoma* OR tumour* OR tumor* OR neoplas* OR malignan*)) #3 #1 OR #2 #4 [mh Colonoscopy] OR [mh "Colonography, Computed Tomographic"] OR [mh Sigmoidoscopes] #5 (colonoscop* OR sigmoidoscop*) #6 #4 OR #5 #7 [mh "Colonic Polyps"] OR [mh "Adenomatous Polyps"] OR [mh ^Adenoma] #8 (polyp* OR asymptomatic OR adenoma* OR adenocarcino*) #9 #7 OR #8 #10 [mh "Early Detection of Cancer"] OR [mh "Sentinel Surveillance"] OR [mh ^"mass screening"] OR [mh ^"risk assessment"] OR [mh ^"risk factors"] OR [mh ^"follow-up studies"] OR [mh ^"Neoplasm recurrence"] #11 (surveill* OR interval* OR monitor* OR "follow up" OR recurrence OR screen* OR monitor*) #12 [mh recall] OR recall #13 #10 OR #11 OR #12 #14 [mh ^"Precancerous Conditions"] #15 ("low risk" OR "non advanced" OR nonadvanced OR tubular OR "low grade" OR lowgrade OR "non serrated" OR nonserrated)

	#16 (1 cm OR 1cm OR 10 mm OR 10mm OR LRA) #17 (dysplasia or "high risk" OR highrisk OR "high grade" OR high-grade OR serrated OR serration OR tubulovillous OR villous OR advanced OR hyperplastic) #18 [mh "Adenoma, Villous"] #19 #14 OR #15 OR #16 OR #17 OR #18 #20 [mh ^incidence] OR [mh ^mortality] OR [mh ^"cause of death"] OR [mh ^"fatal outcome"] OR [mh ^"hospital mortality"] OR [mh ^"mortality, premature"] OR [mh ^"survival rate"] #21 inciden* #22 #20 OR #21 #23 #6 AND (#9 OR #19) AND #13 AND (#3 OR #22) with Publication Year from 2019 to 2020, with Cochrane Library publication date in The last year, in Trials #24 #6 AND (#9 OR #19) AND #13 AND (#3 OR #22) with Cochrane Library publication date in The last year, in Cochrane Reviews #25 #23 OR #24
EBSCO CINAHL Searched: 2020-11-20 Results: 352	# Query S1 ((MM "Colorectal Neoplasms+/DI/EP/MO/SU/TD") OR (MM "cecal neoplasms"+/DI/EP/MO/SU/TD)) OR (((colon* or colorectal* or rectal or anal or anus or rectum or bowel) N3 (cancer* or carcinoma* or tumour* or tumor* or neoplas* or malignan*))) S2 ((MH "Colonoscopy+") OR (MH "Colonography, Computed Tomographic+") OR (MH "Sigmoidoscopes+")) OR (colonoscop* or sigmoidoscop*) S3 ((MH "Colonic Polyps+") OR (MH "Adenomatous Polyps+") OR (MH "Adenoma")) OR (polyp* or asymptomatic or adenoma* or adenocarcino*) S4 ((MM "Early Detection of Cancer+") OR (MH "Sentinel Surveillance+") OR (MH "mass screening") OR (MH "risk assessment") OR (MH "risk factors") OR (MH "follow-up studies") OR (MH "Neoplasm recurrence") OR (MH "recall+")) OR (surveill* or interval* or monitor* or follow up or recurrence or screen* or monitor*) OR TI recall OR SU recall S5 ((MH "Precancerous Conditions") OR ((low risk or non advanced or nonadvanced or tubular or low grade or lowgrade or non serrated or nonserrated)) OR (("1 cm" or "1cm" or "10 mm" or "10mm" or LRA)) OR ((dysplasia or high risk or highrisk or high grade or high-grade or serrated or serration or tubulovillous or villous or advanced or hyperplas*)) OR (MH "Adenoma, Villous+")) S6 ((MH "incidence") OR (MH "mortality") OR (MH "cause of death") OR (MH "fatal outcome") OR (MH "hospital mortality") OR (MH "mortality, premature") OR (MH "survival rate")) OR inciden* S7 S2 AND (S3 OR S5) AND S4 AND (S1 OR S6) Limiters - English Language; Published Date: 20190101-20201231

Note: ‡‡ "*", "# ", and "?" are truncation characters that retrieve all possible suffix variations of the root word, e.g., surg* retrieves surgery, surgical, surgeon, etc. Searches separated by commas have been entered separately into the search interface

Appendix F: Systematic Review of New Evidence to Clarify Guideline Discordance, Excluded Studies

Excluded articles and reason for exclusion

Excluded population (*n*=3)

Bleijenberg AGC, Ijspeert JEG, Hazewinkel Y, Boparai KS, Oppeneer SC, Bastiaansen BAJ, et al. The long-term outcomes and natural disease course of serrated polyposis syndrome: Over 10 years of prospective follow-up in a specialized center. *Gastrointest Endosc* 2020;92(5):1098-107.e1.

Bleijenberg AG, Ijspeert JE, van Herwaarden YJ, Carballal S, Pellise M, Jung G, et al. Personalised surveillance for serrated polyposis syndrome: Results from a prospective 5-year international cohort study. *Gut* 2020;69(1):112-21.

Rodriguez-Alcalde D, Carballal S, Moreira L, Hernandez L, Rodriguez-Alonso L, Rodriguez-Moranta F, et al. High incidence of advanced colorectal neoplasia during endoscopic surveillance in serrated polyposis syndrome. *Endoscopy* 2019;51(2):142-51.

Incorrect exposure (*n*=3)

Jian D, Minman W, Jiarong M, Ullah Khan RS, Tao Z, Tianmei Z, et al. Optimal colonoscopic surveillance interval after normal baseline screening colonoscopy. *Gastroenterol Nurs* 2020;43(3):225-31.

Pilonis ND, Bugajski M, Wieszczy P, Franczyk R, Didkowska J, Wojciechowska U, et al. Long-term colorectal cancer incidence and mortality after a single negative screening colonoscopy. *Ann Intern Med* 2020;173(2):81-91

Robbins EC, Wooldrage K, Stenson I, Pack K, Duffy S, Weller D, et al. Heterogeneity in colorectal cancer incidence among people recommended 3-yearly surveillance post-polypectomy: A validation study. *Endoscopy* 2020;epub10.1055/a-1217-0155.

Excluded article type (*n*=3)

Anderson JC, Srivastava A. Colorectal cancer screening for the serrated pathway. *Gastrointest Endosc Clin N Am* 2020;30(3):457-78.

Lee JG, Han DS. Identifying the low-risk population for metachronous colorectal neoplasia: A first step towards personalized surveillance. *Endoscopy* 2020;52(3):172-3.

Meester RGS, Lansdorp-Vogelaar I, Winawer SJ, Zauber AG, Knudsen AB, Ladabaum U. Intensity of surveillance for patients with colorectal adenomas. *Ann Intern Med* 2020;172(6):442-3.

No relevant outcome (*n*=2)

Okagawa Y, Sumiyoshi T, Tomita Y, Uozumi T, Iida R, Sakano H, et al. Association of second surveillance colonoscopy findings with index and first surveillance colonoscopy results. *J Dig Dis* 2020;21(5):272-8.

Sekiguchi M, Kakugawa Y, Matsumoto M, Nakamura K, Mizuguchi Y, Takamaru H, et al. Prevalence of serrated lesions, risk factors, and their association with synchronous advanced colorectal neoplasia in asymptomatic screened individuals. *J Gastroenterol Hepatol* 2020;epub10.1111/jgh.15116.

Published prior to November 2019 (*n*=2)

Symonds EL, Cole SR, Lau SY, Steele S, Meng R, Woodman RJ, et al. The significance of the small adenoma: A longitudinal study of surveillance colonoscopy in an Australian population. *Eur J Gastroenterol Hepatol* 2019;31(5):563-9.

Tollivoro TA, Jensen CD, Marks AR, Zhao WK, Schottinger JE, Quinn VP, et al. Index colonoscopy-related risk factors for postcolonoscopy colorectal cancers. *Gastrointest Endosc* 2019;89(1):168-76.e3.

No relevant comparator (*n*=1)

Wieszczy P, Waldmann E, Loberg M, Regula J, Rupinski M, Bugajski M, et al. Colonoscopist performance and colorectal cancer risk after adenoma removal to stratify surveillance: Two nationwide observational studies. *Gastroenterology* 2020;10.1053/j.gastro.2020.10.009.

Appendix G: Summary of findings, new evidence to clarify guideline discordance

Table G: Colorectal adenoma surveillance evidence

Study	Exposure	Study details	Event rate	Relative effect	Certainty of the evidence (GRADE)
Anderson et al. (2020)[150] Retrospective cohort study United States 2005–2018	*Small HPs* 5–9 mm proximal to the sigmoid colon *SPs* HPs ≥10 mm, serrated SP, and/or traditional SP *High-risk adenomas* ≥3 non-AA, or at least 1 AA (adenoma ≥10 mm in size, villous histology, HGD, or CRC) and no serrated polyps *Low-risk adenoma* <3 nonadvanced adenomas and no serrated polyps *Non-significant HPs* HP< 10 mm in the rectosigmoid colon, or <5 mm and proximal to the sigmoid colon	*Outcome* Metachronous advanced neoplasia (AAs or CRC) *Follow up period [mean months (SD)]* 53.8 (24.5) N=8,560	*Exposure* Small HP 8.0% (30 of 376) SPs 4.8% (53 of 1,130) Low-risk adenomas 4.3% (127 of 2,962) High-risk adenomas 9.7% (158 of 1,635) *Comparison* Non-significant HPs 4.5% (111 of 2,484)	**aOR [95% CI][a]** Small HPs 1.83 [1.19, 2.81] Sessile polyps 0.95 [0.66, 1.38] Low-risk adenomas 1.07 [0.82, 1.40] High-risk adenomas 2.05 [1.55, 2.70]	Moderate due to dose response
Li et al. (2020)[149] Retrospective cohort study United States 2006–2017	*SPs* HP, sessile SP, traditional SPs, and/or unspecified SPs *No polyp* No polyps identified	*Outcome* CRC *Follow up period [median years (IQR)]* 3.6 (1.7–5.8) N=233,393	**Cumulative Incidence rate per 1,000 persons at 5 years post-index colonoscopy [95% CI]** *Exposure* Proximal small SP 2.5 [1.4, 4.3] Proximal large SP 6.2 [2.3, 17.0] Distal SP 1.7 [1.1, 2.6] Proximal SP + adenoma 4.2 [2.9, 6.3]	**aHR [95% CI][b]** SP alone 1.7 [1.3, 2.2] SP + adenoma 3.1 [2.4, 4.0]	Moderate due to a large magnitude of effect

Study	Exposure	Study details	Event rate	Relative effect	Certainty of the evidence (GRADE)
			Distal SP + adenoma 3.0 [2.0, 4.5] *Comparison* No Polyp 1.2 [1.0, 1.4]		
Park et al. (2019)[148] Retrospective cohort study South Korea 2009–2016	*SPs* HP, serrated SP, and/or traditional SP *AA* adenomas ≥10mm or 75% villous component, and/or HGD	*Outcome* Metachronous advanced neoplasia (AAs or CRC) *Follow up period [mean years (SD)]* Non-AA: 4.3 (0.1) Non-AA + SP: 3.6 (0.1) AA: 3.5 (0.7) AA + SP: 3.0 (0.1) N=2,209	**Incidence per 100 person-years [95% CI]** *Exposure* Non-AA + SP 2.1 [1.4, 3.0] Non-AA 1.5 [1.2, 2.1] AA + SP 7.7 [5.7, 10.4] *Comparison* AA 4.7 [3.8, 5.8]	**aHR [95% CI][c]** AA+ SP 2.24 [1.38, 3.64]	Low, no quality concerns
Sullivan et al. (2020)[146] Prospective cohort study United States 1994–not reported	Low risk findings <3 non-AAs High risk findings ≥3 non-AAs or at least one AA (adenoma ≥10mm, villous histology, or HGD)	Outcome High risk findings Follow up period Up to 15 years N=891	*Exposure* Low risk findings 10.0% (33 of 331) High risk findings 18.3% (53 of 289) *Comparison* No adenoma 10.3% (28 of 271)	**OR [95% CI]** Low risk findings 0.96 [0.57, 1.64] High risk findings 1.95 [1.20, 3.22]	Very low due to risk of bias, and imprecision
Waldmann et al. (2020)[147] Prospective cohort study Austria 2008–2019	Low risk findings 1–2 adenomas ≤10mm or with LGD, or SPs ≤10mm or without dysplasia High risk findings adenomas ≥10mm or HGD or villous histology, or SP ≥10mm or with dysplasia, or ≥3 adenomas	Outcome CRC Follow up period [median months (IQR)] 55.4 (33.9–85.7)	*Exposure* Low risk findings 0.14% (21 of 15,400) High risk findings 0.63% (58 of 9,153) HPs	**aHR [95% CI][d]** Low risk findings 0.92 [0.57, 1.49] High risk findings 3.27 [2.36, 4.53] HPs	Moderate due to dose response

Study	Exposure	Study details	Event rate	Relative effect	Certainty of the evidence (GRADE)
	HPs Hyperplastic polyps	N=336,419	0.18% (29 of 16,409) *Comparison* No adenoma 0.16% (125 of 77,277)	1.16 [0.78,1.71]	

[a]Adjusted for age, sex, body mass index, previous neoplasia, smoking history, family history for CRC, clinically significant SP detection rates, and month to surveillance.

[b]Adjusted for year of first colonoscopy, age, sex, race/ethnicity, body mass index, and smoking history.

[c]Adjusted for age, sex, family history of CRC, obesity, smoking status, and Aspirin use.

[d]Adjusted for age, sex, adenoma detection rate, and cecal intubation.

AA: advanced adenoma; aHR: adjusted hazard ratio; aOR: adjusted odds ratio; CI: confidence interval; CRC: colorectal cancer; HGD: high grade dysplasia; HP: hyperplastic polyp; IQR: Interquartile range; LGD: low grade dysplasia; SD: standard deviation; SP: serrated polyp.

Appendix H: Search Strategies for the Systematic Review for Interventions for Reducing Endoscopy Overuse

Table H.1: Colorectal adenoma surveillance, search strategy for interventions to reduce endoscopy overuse

Database Edition or date searched	Search terms ††
Ovid MEDLINE(R) ALL 1946 to July 30, 2020 Searched: 2020-07-31 Results: • Primary Studies: 2014 • Systematic Reviews: 118	**CRC Surveillance:** 1. exp Colorectal Neoplasms/ 2. ((colon* or colorectal*) adj3 (cancer* or carcinoma* or adenocarcinoma* or tumour* or tumor* or neoplasm*)).ti,ab,kw. 3. exp Colonoscopy/ or exp Colonography, Computed Tomographic/ or exp Sigmoidoscopes/ 4. (colonoscop* or sigmoidoscop*).ti,ab,kf. 5. exp Colonic Polyps/ 6. ((colon or colorectal or rectal) adj10 (polypectomy or asymptomatic)).ti,kf. 7. ((colon or colorectal or rectal) adj10 (polypectomy or asymptomatic)).ab. /freq=2 8. or/1-7 9. exp *Early Detection of Cancer/ 10. exp Sentinel Surveillance/ 11. surveill*.ti,kw. 12. surveill*.ab. /freq=2 13. interval*.ti,kw. 14. interval*.ab. /freq=2 15. exp recall/ or recall.ti,kw. 16. or/9-15 17. 8 and 16 [CRC SURVEILLANCE] 18. exp Health Services Misuse/ 19. (unnecessar* or necessary or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or appropriate* or unneeded or ineffective).ti,kf. 20. (unnecessar* or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or unneeded or appropriateness or ineffective).ab. /freq=2 21. Guideline Adherence/ 22. ((guideline or protocol) adj2 (adhere* or complian* or comply or follow* or concordan*)).ti,kf. 23. ((guideline or protocol) adj2 (adhere* or non-adhere* or complian* or comply or follow* or concordan*)).ab. /freq=2 24. (non-adhere* or interval*).ti,kf. 25. ((gaps or gap) adj2 evidence adj2 practice).ti,ab,kf.

	26. (uptake or adopt or implement*).ti,kf. 27. (uptake or adopt).ab. /freq=2 28. "Guidelines as Topic"/ 29. (commitment adj2 (guideline? or protocol?)).tw. 30. performance.ti,ab,kf. 31. exp "reproducibility of results"/ or reliability.ti,ab,kw. 32. or/18-31 [GUIDELINE ADHERENCE and other outcomes] 33. exp Practice Patterns, Physicians'/ 34. "Early Detection of Cancer"/st, sn [Standards, Statistics & Numerical Data] 35. "quality of health care"/ or advance directive adherence/ or exp "outcome and process assessment, health care"/ or peer review, health care/ or "professional review organizations"/ or exp program evaluation/ or exp quality indicators, health care/ 36. exp waiting lists/ or (wait adj3 (time or times or list or lists)).tw. 37. exp time factors/ 38. exp "Referral and consultation"/ 39. ((frequency or number or interval) adj25 (preprocedur* or procedur* or postprocedur* or colonoscop*)).tw. 40. exp Follow-Up Studies/ 41. follow?up.ti,kw. 42. follow?up.ab. /freq=2 43. exp "Sensitivity and Specificity"/ or (Sensitivity adj1 Specificity).tw. 44. "predictive value of tests"/ 45. or/33-44 [OUTCOMES 2] 46. Quality Improvement/ 47. (quality adj5 (manag* or improv* or enhanc*)).tw. 48. (CQI or TQM).tw. 49. total quality management/ 50. quality assurance, health care/ 51. ((process or processes or system or systems) adj3 (improving or improvement* or improve or redesign* or enhanc*)).tw. 52. (model adj3 improve*).ti,kf. 53. (model adj3 improve*).ab. /freq=2 54. ((improvement or QI or quality assurance or QA) adj5 (team? or microsystem? or cycle?)).tw. 55. (PDSA or PDCA or TQIS or plan do study or plan do check).tw. 56. ((shewhart or shewart or deming) adj3 (cycle or method)).tw. 57. (breakthrough adj3 (series or project or collaborative?)).tw. 58. (lean adj (approach or management or method? or methodology or thinking or enterpri#e or practice or philosophy or principles)).tw. 59. six sigma.tw. 60. Health Services Administration/ or Health Plan Implementation/

	61. ((change or improv*) adj3 (bundle* or package*)).tw. 62. QIC.ti,ab. 63. or/46-62 [QI INERVENTIONS] 64. ((provider? or clinician? or practitioner? or pharmacist? or provider? or physician? or doctor? or gastroenterologist* or endoscop*) adj2 intervention*).ti,ab,kf. 65. (ed or ps or sn or st).fs. 66. (advice or counsel* or interven* or campaign* or program* or initiative* or project* or service* or approach* or strategy or strategies or framework).ti,kf. 67. (advice or counsel* or interven* or campaign* or program* or initiative* or project* or service* or approach* or strategy or strategies or framework).ab. /freq=2 68. exp Education, Medical, Continuing/ or exp Education, Professional/ 69. exp *education,continuing/ 70. ((education$ adj3 (program$ or intervention? or meeting? or session? or strateg$ or workshop? or visit?)) or disease management program).tw. 71. (behavio?r$ adj2 intervention?).tw. 72. pamphlets/ 73. (leaflet? or booklet? or poster? or pamphlet?).tw. 74. ((written or printed or oral) adj information).tw. 75. information dissemination/ 76. (information$ adj2 (campaign or dissemination)).tw. 77. (education$ adj1 (method? or material?)).tw. 78. "social control, formal"/ or government regulation/ or mandatory reporting/ or mandatory programs/ 79. (legislat* or policy or policies or directive* or mandat* or by-law* or regulat*).ti,kf. 80. *advance directives/ 81. outreach.tw. 82. (((opinion or education$ or influential) adj1 leader?) or ((opinion or education$ or influential) adj1 champion)).tw. 83. facilitator?.tw. 84. (academic detailing or train the trainer).tw. 85. consensus conference?.tw. 86. (consult* or coach*).ti,kf. 87. (Continuing education or competence training or learning collaborative).tw. 88. (("use" or procedur*) adj2 (restrict* or ration*)).ti,kf. 89. (guideline? adj2 (compl$ or implement$ or introduc$ or issu$ or impact or effect$ or disseminat$ or distribut$ or learn or adopt$ or rollout or roll-out)).tw. 90. "DO NOT DO".tw. 91. (toolkit? adj2 (compl$ or implement$ or introduc$ or issu$ or impact or effect$ or disseminat$ or distribut$ or learn or adopt$ or rollout or roll-out)).tw. 92. (evidence-based adj2 (compl$ or implement$ or introduc$ or issu$ or impact or effect$ or disseminat$ or distribut$ or learn or adopt$ or rollout or roll-out)).tw. 93. ((compl$ or effect$ or impact or evaluat$ or introduc$ or compar$) adj2 training program$).tw.

	94. reminder systems/ 95. exp decision support techniques/ 96. (decisional adj2 support).tw. 97. (reminder? or clinical support tool).tw. 98. (recall adj2 system$).tw. 99. (prompter? or prompting).tw. 100. (real time adj10 assess*).tw. 101. algorithm?.tw. 102. clinical audit/ or exp medical audit/ 103. *feedback/ or feedback.tw. 104. chart review$.tw. 105. ((effect? or impact or records or chart?) adj2 audit).tw. 106. exp reimbursement mechanisms/ 107. exp Reimbursement, Incentive/ 108. (incentivise or incentivize or incentivization or incentivisation or incentive*).tw. 109. fee for service.tw. 110. ("pay for performance" or P4P).tw. 111. or/64-110 [OTHER INTERVENTIONS] 112. 17 and (32 or 45) and (63 or 111) 113. limit 112 to (english language and yr="2010 -Current") [FINAL SET BEFORE DESIGNS AND FILTERS] 114. remove duplicates from 113 115. Developing Countries.sh,kf. 116. (Africa or Asia or West Indies or South America or Central America).hw,kf,ti,ab,cp. 117. (Caribbean or Latin* America*).hw,kf,ti,cp. 118. (Afghanistan or Albania or Algeria or Angola or Antigua or Barbuda or Argentina or Armenia or Armenian or Aruba or Azerbaijan or Bahrain or Bangladesh or Barbados or Benin or Byelarus or Byelorussian or Belarus or Belorussian or Belorussia or Belize or Bhutan or Bolivia or Bosnia or Herzegovina or Hercegovina or Botswana or Brasil or Brazil or Bulgaria or Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cambodia or Khmer Republic or Kampuchea or Cameroon or Cameroons or Cameron or Camerons or Cape Verde or Central African Republic or Chad or Chile or China or Colombia or Comoros or Comoro Islands or Comores or Mayotte or Congo or Zaire or Costa Rica or Cote d'Ivoire or Ivory Coast or Croatia or Cuba or Cyprus or Czechoslovakia or Czech Republic or Slovakia or Slovak Republic or Djibouti or French Somaliland or Dominica or Dominican Republic or East Timor or East Timur or Timor Leste or Ecuador or United Arab Republic or El Salvador or Eritrea or Estonia or Ethiopia or Fiji or Gabon or Gabonese Republic or Gambia or Gaza or Georgia Republic or Georgian Republic or Ghana or Gold Coast or Greece or Grenada or Guatemala or Guinea or Guam or Guiana or Guyana or Haiti or Honduras or Hungary or India or Maldives or Indonesia or Iran or Iraq or Isle of Man or Jamaica or Jordan or Kazakhstan or Kazakh or Kenya or Kiribati or Korea or Kosovo or Kyrgyzstan or Kirghizia or Kyrgyz Republic or Kirghiz or Kirgizstan or Lao PDR or Laos or Latvia or Lebanon or Lesotho or Basutoland or Liberia or Libya or Lithuania or Macedonia or Madagascar or Malagasy Republic or Malaysia or Malaya or Malay or Sabah or Sarawak or Malawi or Nyasaland or Mali or Malta or Marshall Islands or Mauritania or Mauritius or Agalega Islands or Mexico or Micronesia or Middle East or Moldova or Moldovia or Moldovian or Mongolia or Montenegro or Morocco or Ifni or Mozambique or Myanmar or Myanma or Burma or Namibia or Nepal or Netherlands Antilles or New Caledonia or

	Nicaragua or Niger or Nigeria or Northern Mariana Islands or Oman or Muscat or Pakistan or Palau or Palestine or Panama or Paraguay or Peru or Philippines or Philipines or Phillipines or Phillippines or Poland or Portugal or Puerto Rico or Romania or Rumania or Roumania or Russia or Russian or Rwanda or Ruanda or Saint Kitts or St Kitts or Nevis or Saint Lucia or St Lucia or Saint Vincent or St Vincent or Grenadines or Samoa or Samoan Islands or Navigator Island or Navigator Islands or Sao Tome or Saudi Arabia or Senegal or Serbia or Montenegro or Seychelles or Sierra Leone or Slovenia or Sri Lanka or Ceylon or Solomon Islands or Somalia or South Africa or Sudan or Suriname or Surinam or Swaziland or Syria or Tajikistan or Tadzhikistan or Tadjikistan or Tadzhik or Tanzania or Thailand or Togo or Togolese Republic or Tonga or Trinidad or Tobago or Tunisia or Turkey or Turkmenistan or Turkmen or Uganda or Ukraine or Uruguay or USSR or Soviet Union or Union of Soviet Socialist Republics or Uzbekistan or Uzbek or Vanuatu or New Hebrides or Venezuela or Vietnam or Viet Nam or West Bank or Yemen or Yugoslavia or Zambia or Zimbabwe or Rhodesia).hw,kf,ti,ab,cp. 119. ((developing or less* developed or under developed or underdeveloped or low* income or underserved or under served or deprived or poor*) adj (countr* or nation? or population? or world)).ti,ab. 120. (middle income adj (countr* or nation? or population? or world)).ti. 121. (low* adj (gdp or gnp or gross domestic or gross national)).ti,ab. 122. (low adj3 middle adj3 countr*).ti. 123. (lmic or lmics or third world or lami countr*).ti,ab. 124. transitional countr*.ti,ab. 125. or/115-124 [LMIC FILTER] 126. (children* or infant? or adolesc* or juvenil* or p?ediatr*).ti. [PEDIATRIC] 127. 114 not (125 or 126) 128. meta-analysis.pt. 129. (meta-anal$ or metaanal$).mp. 130. ((quantitativ$ adj3 review$1) or (quantitativ$ adj3 overview$)).mp. 131. ((systematic$ adj3 review$) or (systematic adj3 overview$)).mp. 132. ((methodologic adj3 review$1) or (methodologic adj3 overview$)).mp. 133. (integrat$ adj5 research).mp. 134. (quantitativ$ adj3 synthes$).mp. 135. or/128-134 136. review.pt. or (review$ or overview$).mp. 137. (medline or medlars or pubmed or index medicus or embase or cochrane).mp. 138. (scisearch or web of science or psycinfo or psychinfo or cinahl or cinhal).mp. 139. (excerpta medica or psychlit or psyclit or current contents or science citation index or sciences citation index or scopus).mp. 140. (hand search$ or manual search$).mp. 141. ((electronic adj3 database$) or (bibliographic adj3 database$) or periodical index$).mp. 142. (pooling or pooled or mantel haenszel).mp. 143. (peto or der simonian or dersimonian or fixed effect$).mp. 144. ((combine$ or combining) adj5 (data or trial or trials or studies or study or result or results)).mp. 145. or/137-144 146. 136 and 145

	147. 135 or 146 148. (hta$ or health technology assessment$ or biomedical technology assessment$).mp. 149. technology assessment, biomedical/ or biomedical technology assessment/ 150. 148 or 149 151. 147 or 150 [SR FILTER] 152. 127 and 151 [SRS] 153. 127 not 152 [EVERYTHING ELSE]
OVID Embase Searched: 2020-07-31 Results: • Primary Studies: 714 • Reviews: 69	1. exp colon tumor/ 2. ((colon* or colorectal*) adj3 (cancer* or carcinoma* or adenocarcinoma* or tumour* or tumor* or neoplasm*)).ti,kw. 3. ((colon* or colorectal*) adj3 (cancer* or carcinoma* or adenocarcinoma* or tumour* or tumor* or neoplasm*)).ab. /freq=2 4. exp Colonoscopy/ or exp Colonography, Computed Tomographic/ or exp Sigmoidoscopes/ 5. (colonoscop* or sigmoidoscop*).ti,ab,kw. 6. ((colon or colorectal or rectal) adj10 (polypectomy or asymptomatic)).ti,kw. 7. ((colon or colorectal or rectal) adj10 (polypectomy or asymptomatic)).ab. /freq=2 8. or/1-7 9. surveill*.ti,kw. 10. surveill*.ab. /freq=2 11. interval*.ti,kw. 12. interval*.ab. /freq=2 13. exp recall/ or recall.ti,kw. 14. or/9-13 15. 8 and 14 [CRC surveillance] 16. exp Health Service/ 17. (unnecessar* or necessary or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or appropriate* or unneeded or ineffective).ti,kw. 18. (unnecessar* or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or unneeded or appropriateness or ineffective).ab. /freq=2 19. exp protocol compliance/ 20. ((guideline or protocol) adj2 (adhere* or complian* or comply or follow* or concordan*)).ti,kw. 21. ((guideline or protocol) adj2 (adhere* or non-adhere* or complian* or comply or follow* or concordan*)).ab. /freq=2 22. (non-adhere* or interval*).ti,kw. 23. ((gaps or gap) adj2 evidence adj2 practice).ti,ab,kw. 24. (uptake or adopt or implement*).ti,kw. 25. (uptake or adopt).ab. /freq=2 26. exp practice guideline/ and (adher* or complia* or comply* or complies).tw. 27. (commitment adj2 (guideline? or protocol?)).tw.

	28. exp follow up/ 29. performance.ti,ab,kw. 30. reliability/ or reliability.ti,ab,kw. 31. or/16-30 [GUIDELINE ADHERENCE] 32. exp clinical practice/ 33. exp health care quality/ 34. exp "outcome assessment"/ or exp "professional standards review organization"/ or exp program evaluation/ 35. (quality adj3 indicator*).ti,ab,kw. 36. (wait adj3 (time or times or list or lists)).tw. 37. exp time factor/ 38. exp patient Referral/ 39. ((frequency or number or interval) adj25 (preprocedur* or procedur* or postprocedur* or colonoscop*)).tw. 40. follow?up.ti,kw. 41. follow?up.ab. /freq=2 42. or/32-41 [OUTCOMES 2] 43. Quality Improvement/ 44. (quality adj5 (manag* or improv* or enhanc*)).tw. 45. (CQI or TQM).tw. 46. total quality management/ 47. exp quality control/ 48. ((process or processes or system or systems) adj3 (improving or improvement* or improve or redesign* or enhanc*)).tw. 49. (model adj3 improve*).ti,kw. 50. (model adj3 improve*).ab. /freq=2 51. ((improvement or QI or quality assurance or QA) adj5 (team? or microsystem? or cycle?)).tw. 52. (PDSA or PDCA or TQIS or plan do study or plan do check).tw. 53. ((shewhart or shewart or deming) adj3 (cycle or method)).tw. 54. (breakthrough adj3 (series or project or collaborative?)).tw. 55. (lean adj (approach or management or method? or methodology or thinking or enterpri#e or practice or philosophy or principles)).tw. 56. six sigma.tw. 57. Health Services Administration/ or Health Plan Implementation/ 58. ((change or improv*) adj3 (bundle* or package*)).tw. 59. QIC.ti,ab. 60. or/43-59 [QUALITY IMPROVEMENT interventions] 61. ((provider? or clinician? or practitioner? or pharmacist? or provider? or physician? or doctor? or gastroenterologist* or endoscop*) adj2 intervention*).ti,ab,kw.

	62. medical education/ or clinical education/ or clinical supervision/ or medical school/ or physician assistant education/ or residency education/ or surgical training/ or medical education research study quality instrument/ 63. exp continuing education/ 64. ((education$ adj3 (meeting? or session? or strateg$ or workshop? or visit?)) or disease management program).tw. 65. (behavio?r$ adj2 intervention?).tw. 66. (leaflet? or booklet? or poster? or pamphlet?).tw. 67. ((written or printed or oral) adj information).tw. 68. exp information dissemination/ 69. (information$ adj2 (campaign or dissemination)).tw. 70. (education$ adj1 (method? or material?)).tw. 71. exp social control/ or government regulation/ or mandatory reporting/ or mandatory programs/ 72. (legislat* or policy or policies or directive* or mandat* or by-law* or regulat*).ti,kw. 73. outreach.tw. 74. (((opinion or education$ or influential) adj1 leader?) or ((opinion or education$ or influential) adj1 champion)).tw. 75. facilitator?.tw. 76. (academic detailing or train the trainer).tw. 77. consensus conference?.tw. 78. (consult* or coach*).ti,kw. 79. (Continuing education or competence training or learning collaborative).tw. 80. (("use" or procedur*) adj2 (restrict* or ration*)).ti,kw. 81. (guideline? adj2 (compl$ or implement$ or introduc$ or issu$ or impact or effect$ or disseminat$ or distribut$ or learn or adopt$ or rollout or roll-out)).tw. 82. "do not do".tw. 83. (toolkit? adj2 (compl$ or implement$ or introduc$ or issu$ or impact or effect$ or disseminat$ or distribut$ or learn or adopt$ or rollout or roll-out)).tw. 84. (evidence-based adj2 (compl$ or implement$ or introduc$ or issu$ or impact or effect$ or disseminat$ or distribut$ or learn or adopt$ or rollout or roll-out)).tw. 85. ((compl$ or effect$ or impact or evaluat$ or introduc$ or compar$) adj2 training program$).tw. 86. reminder system/ 87. exp decision support system/ 88. (decisional adj2 support).tw. 89. (reminder? or clinical support tool).tw. 90. imaging/ or technology/ 91. (program* or intervention?).tw. 92. (prompter? or prompting).tw. 93. algorithm?.tw. 94. clinical audit/ or exp medical audit/ 95. *feedback/ or feedback.tw.

	96. chart review$.tw. 97. ((effect? or impact or records or chart?) adj2 audit).tw. 98. diagnostic accuracy/ 99. exp Reimbursement/ 100. reward/ 101. (incentivise or incentivize or incentivization or incentivisation or incentive*).tw. 102. fee for service.tw. 103. ("pay for performance" or P4P).tw. 104. or/61-103 [INTERVENTIONS] 105. 15 and (31 or 42) and (60 or 104) 106. limit 105 to (english language and yr="2010 -Current") [FINAL SET BEFORE DESIGNS AND FILTERS] 107. developing country/ or low income country/ or middle income country/ 108. (Africa or Asia or West Indies or South America or Central America).hw,ti,ab,kw,cp. 109. (Caribbean or Latin* America*).hw,kw,ti,cp. 110. (Afghanistan or Albania or Algeria or Angola or Antigua or Barbuda or Argentina or Armenia or Armenian or Aruba or Azerbaijan or Bahrain or Bangladesh or Barbados or Benin or Byelarus or Byelorussian or Belarus or Belorussian or Belorussia or Belize or Bhutan or Bolivia or Bosnia or Herzegovina or Hercegovina or Botswana or Brasil or Brazil or Bulgaria or Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cambodia or Khmer Republic or Kampuchea or Cameroon or Cameroons or Cameron or Camerons or Cape Verde or Central African Republic or Chad or Chile or China or Colombia or Comoros or Comoro Islands or Comores or Mayotte or Congo or Zaire or Costa Rica or Cote d'Ivoire or Ivory Coast or Croatia or Cuba or Cyprus or Czechoslovakia or Czech Republic or Slovakia or Slovak Republic or Djibouti or French Somaliland or Dominica or Dominican Republic or East Timor or East Timur or Timor Leste or Ecuador or Egypt or United Arab Republic or El Salvador or Eritrea or Estonia or Ethiopia or Fiji or Gabon or Gabonese Republic or Gambia or Gaza or Georgia Republic or Georgian Republic or Ghana or Gold Coast or Greece or Grenada or Guatemala or Guinea or Guam or Guiana or Guyana or Haiti or Honduras or Hungary or India or Maldives or Indonesia or Iran or Iraq or Isle of Man or Jamaica or Jordan or Kazakhstan or Kazakh or Kenya or Kiribati or Korea or Kosovo or Kyrgyzstan or Kirghizia or Kyrgyz Republic or Kirghiz or Kirgizstan or Lao PDR or Laos or Latvia or Lebanon or Lesotho or Basutoland or Liberia or Libya or Lithuania or Macedonia or Madagascar or Malagasy Republic or Malaysia or Malaya or Malay or Sabah or Sarawak or Malawi or Nyasaland or Mali or Malta or Marshall Islands or Mauritania or Mauritius or Agalega Islands or Mexico or Micronesia or Middle East or Moldova or Moldovia or Moldovian or Mongolia or Montenegro or Morocco or Ifni or Mozambique or Myanmar or Myanma or Burma or Namibia or Nepal or Netherlands Antilles or New Caledonia or Nicaragua or Niger or Nigeria or Northern Mariana Islands or Oman or Muscat or Pakistan or Palau or Palestine or Panama or Paraguay or Peru or Philippines or Philipines or Phillipines or Phillippines or Poland or Portugal or Puerto Rico or Romania or Rumania or Roumania or Russia or Russian or Rwanda or Ruanda or Saint Kitts or St Kitts or Nevis or Saint Lucia or St Lucia or Saint Vincent or St Vincent or Grenadines or Samoa or Samoan Islands or Navigator Island or Navigator Islands or Sao Tome or Saudi Arabia or Senegal or Serbia or Montenegro or Seychelles or Sierra Leone or Slovenia or Sri Lanka or Ceylon or Solomon Islands or Somalia or South Africa or Sudan or Suriname or Surinam or Swaziland or Syria or Tajikistan or Tadzhikistan or Tadjikistan or Tadzhik or Tanzania or Thailand or Togo or Togolese Republic or Tonga or Trinidad or Tobago or Tunisia or Turkey or Turkmenistan or Turkmen or Uganda or Ukraine or Uruguay or USSR or Soviet Union or Union of Soviet Socialist Republics or Uzbekistan or Uzbek or Vanuatu or New Hebrides or Venezuela or Vietnam or Viet Nam or West Bank or Yemen or Yugoslavia or Zambia or Zimbabwe or Rhodesia).hw,ti,ab,kw,cp.

	111. ((developing or less* developed or under developed or underdeveloped or middle income or low* income or underserved or under served or deprived or poor*) adj (countr* or nation? or population? or world)).ti,ab,kw. 112. (low* adj (gdp or gnp or gross domestic or gross national)).ti,ab. 113. (low adj3 middle adj3 countr*).ti,ab,kw. 114. (lmic or lmics or third world or lami countr*).ti,ab. 115. transitional countr*.ti,ab. 116. or/107-115 [LMIC Filter] 117. (children* or infant? or adolesc* or juvenil* or p?ediatr*).ti. 118. 106 not (116 or 117) 119. meta-analysis.pt. 120. (meta-anal$ or metaanal$).mp. 121. ((quantitativ$ adj3 review$1) or (quantitativ$ adj3 overview$)).mp. 122. ((systematic$ adj3 review$) or (systematic adj3 overview$)).mp. 123. ((methodologic adj3 review$1) or (methodologic adj3 overview$)).mp. 124. (integrat$ adj5 research).mp. 125. (quantitativ$ adj3 synthes$).mp. 126. or/119-125 127. review.pt. or (review$ or overview$).mp. 128. (medline or medlars or pubmed or index medicus or embase or cochrane).mp. 129. (scisearch or web of science or psycinfo or psychinfo or cinahl or cinhal).mp. 130. (excerpta medica or psychlit or psyclit or current contents or science citation index or sciences citation index or scopus).mp. 131. (hand search$ or manual search$).mp. 132. ((electronic adj3 database$) or (bibliographic adj3 database$) or periodical index$).mp. 133. (pooling or pooled or mantel haenszel).mp. 134. (peto or der simonian or dersimonian or fixed effect$).mp. 135. ((combine$ or combining) adj5 (data or trial or trials or studies or study or result or results)).mp. 136. or/128-135 137. 127 and 136 138. 126 or 137 139. (hta$ or health technology assessment$ or biomedical technology assessment$).mp. 140. technology assessment, biomedical/ or biomedical technology assessment/ 141. 139 or 140 142. 138 or 141 [SR FILTER] 143. 118 and 142 [SRs RESULTS] 144. 106 not 143 145. limit 143 to embase [SR RESULTS] 146. limit 144 to embase [ALL PRIMARY AND OTHER STUDIES RESULTS]

Cochrane Database of Systematic Reviews **Issue 9 of 12, September 2020** **Searched: 2020-09-04** **Results: 22**	ID Search
	#1 MeSH descriptor: [Colorectal Neoplasms] explode all trees
	#2 ((colon* OR colorectal*) NEAR/3 (cancer* OR carcinoma* OR adenocarcinoma* OR tumour* OR tumor* OR neoplasm*))
	#3 [mh Colonoscopy] OR [mh "Colonography, Computed Tomographic"] OR [mh Sigmoidoscopes]
	#4 MeSH descriptor: [Colonoscopy] explode all trees
Cochrane Central Register of Controlled Trials **Issue 9 of 12, September 2020** **Searched: 2020-09-04** **Results: 285**	#5 MeSH descriptor: [Colonography, Computed Tomographic] explode all trees
	#6 MeSH descriptor: [Sigmoidoscopes] explode all trees
	#7 (colonoscop* OR sigmoidoscop*):ti,kw
	#8 MeSH descriptor: [Colonic Polyps] explode all trees
	#9 ((colon OR colorectal OR rectal) NEAR/10 (polypectomy OR asymptomatic)):ti,kw
	#10 #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9
	#11 [mh "Early Detection of Cancer"[mj]]
	#12 MeSH descriptor: [Sentinel Surveillance] explode all trees
	#13 surveill* OR interval*:ti,kw
	#14 recall:ti,kw
	#15 #11 OR #12 OR #13 OR #14
	#16 #10 AND #15
	#17 [mh "Health Services Misuse"]
	#18 (unnecessar* or necessary or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or appropriate* or unneeded or ineffective):ti,kw
	#19 [mh ^"Guideline Adherence"]
	#20 ((guideline or protocol) NEAR/2 (adhere* or complian* or comply or follow* or concordan*)):ti,kw
	#21 (non-adhere* or interval*):ti,kw
	#22 (gaps or gap) NEAR/4 (evidence OR practice):ti,ab,kw
	#23 (uptake or adopt or implement*):ti,kw
	#24 [mh ^"Guidelines as Topic"]
	#25 (commitment NEAR/2 (guideline? or protocol?)):ti,ab,kw
	#26 performance:ti,ab,kw
	#27 [mh "reproducibility of results"]
	#28 reliability:ti,ab,kw
	#29 #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28
	#30 [mh “Practice Patterns, Physicians”]
	#31 [mh ^"Early Detection of Cancer"/ST,SN]
	#32 [mh ^"quality of health care"] or [mh ^"advance directive adherence"] or [mh "outcome and process assessment, health care"] or [mh ^"peer review, health care"] or [mh ^"professional review organizations"] or [mh "program evaluation"] or [mh "quality indicators, health care"]
	#33 [mh “waiting lists”] or (wait* NEAR/3 (time or times or list or lists)):ti,ab,kw

	#34 [mh "time factors"] #35 [mh "Referral and consultation"] #36 ((frequency or number or interval) NEAR/25 (preprocedur* or procedur* or postprocedur* or colonoscop*)):ti,ab,kw #37 [mh "Follow-Up Studies"] #38 follow?up.ti,kw. #39 [mh "Sensitivity and Specificity"] or (Sensitivity NEAR/1 Specificity):ti,ab,kw #40 [mh ^"predictive value of tests"] #41 #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40 #42 [mh ^"Quality Improvement"] #43 (quality NEAR/5 (manag* or improv* or enhanc*)):ti,ab,kw #44 (CQI or TQM):ti,ab,kw #45 [mh ^"total quality management"] #46 [mh ^"quality assurance, health care"] #47 ((process or processes or system or systems) NEAR/3 (improving or improvement* or improve or redesign* or enhanc*)):ti,ab,kw #48 (model NEAR/53 improve*):ti,kw #49 ((improvement or QI or quality assurance or QA) NEAR/5 (team? or microsystem? or cycle?)):ti,ab,kw #50 (PDSA or PDCA or TQIS or plan do study or plan do check):ti,ab,kw #51 ((shewhart or shewart or deming) NEAR/3 (cycle or method)):ti,ab,kw #52 (breakthrough NEAR/3 (series or project or collaborative?)):ti,ab,kw #53 (lean NEAR/2 (approach or management or method? or methodology or thinking or enterpri?e or practice or philosophy or principles)):ti,ab,kw #54 six sigma:ti,ab,kw #55 [mh ^"Health Services Administration"] or [mh ^"Health Plan Implementation"] #56 ((change or improv*) NEAR/3 (bundle* or package*)):ti,ab,kw #57 QIC:ti,ab #58 #42 OR #43 OR #44 OR #45 OR #46 OR #47 OR #48 OR #49 OR #50 OR #51 OR #52 OR #53 OR #54 OR #55 OR #56 OR #57 #59 ((provider? or clinician? or practitioner? or pharmacist? or provider? or physician? or doctor? or gastroenterologist* or endoscop*) NEAR/2 intervention*):ti,ab,kw #60 [mh /ED,PS,SN,ST] #61 (advice or counsel* or interven* or campaign* or program* or initiative* or project* or service* or approach* or strategy or strategies or framework):ti,kw #62 [mh "Education, Medical, Continuing"] or [mh "Education, Professional"] #63 [mh "Education, Continuing"[mj]] #64 ((education* NEAR/3 (program* or intervention? or meeting? or session? or strateg* or workshop? or visit?)) or disease management program):ti,ab,kw #65 (behavio?r* NEAR/2 intervention?):ti,ab,kw #66 [mh ^"pamphlets"] #67 (leaflet? or booklet? or poster? or pamphlet?):ti,ab,kw

	#68 ((written or printed or oral) NEAR/1 information):ti,ab,kw #69 [mh ^"information dissemination"] #70 (information* NEAR/2 (campaign or dissemination)):ti,ab,kw #71 (education* NEAR/1 (method? or material?)):ti,ab,kw #72 [mh ^"social control, formal"] or [mh ^"government regulation"] or [mh ^"mandatory reporting"] or [mh ^"mandatory programs"] #73 (legislat* or policy or policies or directive* or mandat* or by-law* or regulat*):ti,kw #74 [mh ^"advance directives"[mj]] #75 outreach:ti,ab,kw #76 (((opinion or education* or influential) NEAR/1 leader?) or ((opinion or education* or influential) NEAR/1 champion)):ti,ab,kw #77 facilitator?:ti,ab,kw #78 (academic detailing or train the trainer):ti,ab,kw #79 consensus conference?:ti,ab,kw #80 (consult* or coach*):ti,kw #81 (Continuing education or competence training or learning collaborative):ti,ab,kw #82 (("use" or procedur*) NEAR/2 (restrict* or ration*)):ti,kw #83 (guideline? NEAR/2 (compl* or implement* or introduc* or issu* or impact or effect* or disseminat* or distribut* or learn or adopt* or rollout or roll-out)):ti,ab,kw #84 "DO NOT DO":ti,ab,kw #85 (toolkit? NEAR/2 (compl* or implement* or introduc* or issu* or impact or effect* or disseminat* or distribut* or learn or adopt* or rollout or roll-out)):ti,ab,kw #86 (evidence-based NEAR/2 (compl* or implement* or introduc* or issu* or impact or effect* or disseminat* or distribut* or learn or adopt* or rollout or roll-out)):ti,ab,kw #87 ((compl* or effect* or impact or evaluat* or introduc* or compar*) NEAR/2 training program*):ti,ab,kw #88 [mh ^"reminder systems"] #89 [mh "decision support techniques"] #90 (decision* NEAR/2 support):ti,ab,kw #91 (reminder? or clinical support tool):ti,ab,kw #92 (recall NEAR/2 system*):ti,ab,kw #93 algorithm?:ti,ab,kw #94 [mh ^"clinical audit"] or [mh "medical audit"] #95 [mh ^"feedback" [mj]] or feedback:ti,ab,kw #96 chart review*:ti,ab,kw #97 ((effect? or impact or records or chart?) NEAR/2 audit):ti,ab,kw #98 [mh "reimbursement mechanisms"] #99 [mh "Reimbursement, Incentive"] #100(incentivise or incentivize or incentivization or incentivisation or incentive*):ti,ab,kw #101fee for service:ti,ab,kw #102("pay for performance" or P4P):ti,ab,kw

	#103#59 OR #60 OR #61 OR #62 OR #63 OR #64 OR #65 OR #66 OR #67 OR #68 OR #69 OR #70 OR #71 OR #72 OR #73 OR #74 OR #75 OR #76 OR #77 OR #78 OR #79 OR #80 OR #81 OR #82 OR #83 OR #84 OR #85 OR #86 OR #87 OR #88 OR #89 OR #90 OR #91 OR #92 OR #93 OR #94 OR #95 OR #96 OR #97 OR #98 OR #99 OR #100 OR #101 OR #102 #104#16 AND (#29 OR #41) AND (#58 OR #103) with Cochrane Library publication date Between Jan 2010 and Dec 2020, in Cochrane Reviews, Cochrane Protocols #105#16 AND (#29 OR #41) AND (#58 OR #103) with Publication Year from 2010 to 2020, in Trials
EBSCO CINAHL **Searched: 2020-09-08** **Results: 449**	**# Query** S5 S1 AND S2 AND S3 Limiters - English Language; Published Date: 20100101-20201231; Exclude MEDLINE records Expanders - Apply equivalent subjects Search modes - Find all my search terms S4 S1 AND S2 AND S3 S3 (((MH "Quality Improvement")) OR ((quality N5 (manag* OR improv* OR enhanc*))) OR ((CQI OR TQM)) OR ((MH "total quality management")) OR ((MH "quality assurance, health care")) OR (((process OR processes OR system OR systems) N3 (improving OR improvement* OR improve OR redesign* OR enhanc*))) OR ((model N3 improve*)) OR (((improvement OR QI OR "quality assurance" OR QA) N5 (team# OR microsystem# OR cycle#))) OR ((PDSA OR PDCA OR TQIS OR "plan do study" OR "plan do check")) OR (((shewhart OR shewart OR deming) N3 (cycle OR method))) OR ((breakthrough N3 (series OR project OR collaborative#))) OR (("lean adj" (approach OR management OR method# OR methodology OR thinking OR enterpri*e OR practice OR philosophy OR principles))) OR ("six sigma") OR ((MH "Health Services Administration") OR (MH "Health Plan Implementation")) OR (((change OR improv*) N3 (bundle* OR package*))) OR (TI QIC OR AB QIC)) OR ((((provider# OR clinician# OR practitioner# OR pharmacist# OR provider# OR physician# OR doctor# OR gastroenterologist* OR endoscop*) N2 intervention*)) OR ((MW ed OR MW ps OR MW sn OR MW st)) OR ((MH "Education, Medical, Continuing+") OR (MH "Education, Professional+")) OR ((MM "education,continuing+")) OR (((education* N3 (program* OR intervention# OR meeting# OR session# OR strateg* OR workshop# OR visit#)) OR "disease management program")) OR ((behavio#r* N2 intervention#)) OR ((MH "pamphlets")) OR ((leaflet# OR booklet# OR poster# OR pamphlet#)) OR (((written OR printed OR oral) "adj information")) OR ((MH "information dissemination")) OR ((information* N2 (campaign OR dissemination))) OR ((education* N1 (method# OR material#))) OR ((MH "social control, formal") OR (MH "government regulation") OR (MH "mandatory reporting") OR (MH "mandatory programs")) OR ((legislat* OR policy OR policies OR directive* OR mandat* OR by-law* OR regulat*)) OR ((MM "advance directives")) OR (outreach) OR ((((opinion OR education* OR influential) N1 leader#) OR ((opinion OR education* OR influential) N1 champion))) OR (facilitator#) OR (("academic detailing" OR "train the trainer")) OR ("consensus conference#") OR ((consult* OR coach*)) OR (("Continuing education" OR "competence training" OR "learning collaborative")) OR (((use OR procedur*) N2 (restrict* OR ration*))) OR ((guideline# N2 (compl* OR implement* OR introduc* OR issu* OR impact OR effect* OR disseminat* OR distribut* OR learn OR adopt* OR rollout OR roll-out))) OR ("DO NOT DO") OR ((toolkit# N2 (compl* OR implement* OR introduc* OR issu* OR impact OR effect* OR disseminat* OR distribut* OR learn OR adopt* OR rollout OR roll-out))) OR ((evidence-based N2 (compl* OR

	implement* OR introduc* OR issu* OR impact OR effect* OR disseminat* OR distribut* OR learn OR adopt* OR rollout OR roll-out))) OR (((compl* OR effect* OR impact OR evaluat* OR introduc* OR compar*) N2 "training program*")) OR ((MH "reminder systems")) OR ((MH "decision support techniques+")) OR ((decisional N2 support)) OR ((reminder# OR "clinical support tool")) OR ((recall N2 system*)) OR ((prompter# OR prompting)) OR (algorithm#) OR ((MH "clinical audit") OR (MH "medical audit+")) OR ((MM "feedback") OR feedback) OR ("chart review*") OR (((effect# OR impact OR records OR chart#) N2 audit)) OR ((MH "reimbursement mechanisms+")) OR ((MH "Reimbursement, Incentive+")) OR ((incentivise OR incentivize OR incentivization OR incentivisation OR incentive*)) OR ("fee for service") OR (("pay for performance" OR P4P))) S2 (((MH "Health Services Misuse+")) OR ((unnecessar* OR necessary OR overuse* OR overutili* OR underuse* OR underutili* OR misuse* OR misutili* OR inappropriate* OR appropriate* OR unneeded OR ineffective OR overdo OR overdoing)) OR ((MH "Guideline Adherence")) OR ((guideline OR protocol) N2) OR ((non-adhere* OR interval*)) OR (((gaps OR gap) N2 evidence N2 practice)) OR ((uptake OR adopt OR implement*)) OR ((MH "Guidelines as Topic")) OR ((commitment N2 (guideline# OR protocol#))) OR (performance) OR ((MH "reproducibility of results+") OR reliability)) OR (((MH "Practice Patterns, Physicians'+")) OR ((MH "Early Detection of Cancer")) OR ((MH "quality of health care") OR (MH "advance directive adherence") OR (MH "outcome and process assessment, health care+") OR (MH "peer review, health care") OR (MH "professional review organizations") OR (MH "program evaluation+") OR (MH "quality indicators, health care+")) OR ((MH "waiting lists+") OR (wait N3 (time OR times OR list OR lists))) OR ((MH "time factors+")) OR ((MH "“Referral and consultation”+")) OR (((frequency OR number OR interval) N25 (preprocedur* OR procedur* OR postprocedur* OR colonoscop*))) OR ((MH "Follow-Up Studies+")) OR (follow#up) OR ((MH "Sensitivity and Specificity+"))) S1 ((((MH "Colorectal Neoplasms+")) OR (((colon* OR colorectal*) N3 (cancer* OR carcinoma* OR adenocarcinoma* OR tumour* OR tumor* OR neoplasm*))) OR ((MH "Colonoscopy+") OR (MH "Colonography, Computed Tomographic+") OR (MH "Sigmoidoscopes+")) OR ((colonoscop* OR sigmoidoscop*)) OR ((MH "Colonic Polyps+")) OR (((colon OR colorectal OR rectal) N10 (polypectomy OR asymptomatic)))) AND (((MM "Early Detection of Cancer+")) OR ((MH "Sentinel Surveillance+")) OR (surveill*) OR (interval*) OR ((MH "recall+") OR recall OR (MM "After Care")))) OR ((MH "Colonoscopy+"/UT) OR (MH "Colonoscopy Utilization")
Scopus **Searched 2020-09-10** **Results: 1099**	(((((((TITLE ("colon*") OR TITLE ("colorectal*")) W/3 (TITLE ("cancer*") OR TITLE ("carcinoma*") OR TITLE ("adenocarcinoma*") OR TITLE ("tumour*") OR TITLE ("tumor*") OR TITLE ("neoplasm*")))) OR ((TITLE ("colonoscop*") OR TITLE ("sigmoidoscop*"))) OR (((TITLE ("colon*") OR TITLE ("colorectal") OR TITLE ("rectal")) W/10 (TITLE ("polyp*") OR TITLE ("asymptomatic"))))) AND ((TITLE ("Early Detection")) OR (TITLE ("surveill*")) OR (TITLE ("interval*")) OR (TITLE ("recall")))) OR ((TITLE ("Colonoscopy") W/2 (TITLE ("Utilis*") OR TITLE ("utilize*"))))) AND ((((TITLE ("unnecessar*") OR TITLE ("necessary") OR TITLE ("overuse*") OR TITLE ("overutili*") OR TITLE ("underuse*") OR TITLE ("underutili*") OR TITLE ("misuse*") OR TITLE ("misutili*") OR TITLE ("inappropriate*") OR TITLE ("appropriate*") OR TITLE ("unneeded") OR TITLE ("ineffective"))) OR (((TITLE ("guideline") OR TITLE ("protocol")) W/5 (TITLE ("adhere*") OR TITLE ("complian*") OR TITLE ("comply") OR TITLE ("follow*") OR TITLE ("concordan*")))) OR ((TITLE ("non-adhere*") OR TITLE ("interval*"))) OR (((TITLE ("gaps") OR TITLE ("gap")) W/4 TITLE ("practice"))) OR ((TITLE ("uptake") OR TITLE ("adopt") OR TITLE ("implement*") OR TITLE ("follow*"))) OR ((TITLE ("commitment") W/2 (TITLE ("guideline*") OR TITLE ("protocol*")))) OR (TITLE ("performance")) OR ((TITLE ("reproducibility of results") OR TITLE ("reliability")))) OR (((TITLE ("Practice Patterns") W/3 TITLE ("Physician*"))) OR (TITLE (

	"Early Detection of Cancer")) OR ((TITLE ("wait") W/3 (TITLE ("time") OR TITLE ("times") OR TITLE ("list") OR TITLE ("lists")))) OR (TITLE ("time factors")) OR (TITLE ("Referral and consultation")) OR (((TITLE ("frequency") OR TITLE ("number") OR TITLE ("interval")) W/6 (TITLE ("preprocedur*") OR TITLE ("procedur*") OR TITLE ("postprocedur*") OR TITLE ("colonoscop*")))) OR (TITLE ("follow*up")) OR (TITLE ("Sensitivity and Specificity")))) AND ((((TITLE ("quality") W/5 (TITLE ("manag*") OR TITLE ("improv*") OR TITLE ("enhanc*") OR TITLE ("assur*")))) OR ((TITLE ("CQI") OR TITLE ("TQM"))) OR (((TITLE ("process") OR TITLE ("processes") OR TITLE ("system") OR TITLE ("systems")) W/3 (TITLE ("improving") OR TITLE ("improvement*") OR TITLE ("improve") OR TITLE ("redesign*") OR TITLE ("enhanc*")))) OR ((TITLE ("model") W/3 TITLE ("improve*"))) OR (((TITLE ("improvement") OR TITLE ("QI") OR TITLE ("quality assurance") OR TITLE ("QA")) W/5 (TITLE ("team*") OR TITLE ("microsystem*") OR TITLE ("cycle*")))) OR ((TITLE ("PDSA") OR TITLE ("PDCA") OR TITLE ("TQIS") OR TITLE ("plan do study") OR TITLE ("plan do check"))) OR (((TITLE ("shewhart") OR TITLE ("shewart") OR TITLE ("deming")) W/3 (TITLE ("cycle") OR TITLE ("method")))) OR ((TITLE ("breakthrough") W/3 (TITLE ("series") OR TITLE ("project") OR TITLE ("collaborative*")))) OR ((TITLE ("lean adj") (TITLE ("approach") OR TITLE ("management") OR TITLE ("method*") OR TITLE ("methodology") OR TITLE ("thinking") OR TITLE ("enterpri?e") OR TITLE ("practice") OR TITLE ("philosophy") OR TITLE ("principles")))) OR (TITLE ("six sigma")) OR (((TITLE ("change") OR TITLE ("improv*")) W/3 (TITLE ("bundle*") OR TITLE ("package*")))) OR (TITLE ("QIC"))) OR ((((TITLE ("provider*") OR TITLE ("clinician*") OR TITLE ("practitioner*") OR TITLE ("pharmacist*") OR TITLE ("provider*") OR TITLE ("physician*") OR TITLE ("doctor*") OR TITLE ("gastroenterologis*") OR TITLE ("endoscop*")) W/2 TITLE ("intervention*"))) OR ((TITLE ("Educat*") W/3 (TITLE ("continuing") OR TITLE ("professional")))) OR ((TITLE ("education*") W/3 (TITLE ("program*") OR TITLE ("intervention*") OR TITLE ("meeting*") OR TITLE ("session*") OR TITLE ("strateg*") OR TITLE ("workshop*") OR TITLE ("visit*")))) OR ((TITLE ("disease management program"))) OR (((TITLE ("behavior*") OR TITLE ("behaviour*")) W/2 (TITLE ("intervention*") OR TITLE ("change")))) OR ((TITLE ("leaflet*") OR TITLE ("booklet*") OR TITLE ("poster*") OR TITLE ("pamphlet*"))) OR (((TITLE ("written") OR TITLE ("printed") OR TITLE ("oral")) TITLE ("adj information"))) OR ((TITLE ("information*") W/2 (TITLE ("campaign") OR TITLE ("dissemination")))) OR ((TITLE ("education*") W/1 (TITLE ("method*") OR TITLE ("material*")))) OR ((TITLE ("legislat*") OR TITLE ("policy") OR TITLE ("policies") OR TITLE ("directive*") OR TITLE ("mandat*") OR TITLE ("by-law*") OR TITLE ("regulat*") OR TITLE ("regulatory"))) OR ((TITLE ("Outreach") OR TITLE ("nudg*"))) OR (((TITLE ("opinion") OR TITLE ("education*") OR TITLE ("influential")) W/1 (TITLE ("leader*") OR TITLE ("champion")))) OR (TITLE ("facilitator*")) OR ((TITLE ("academic detailing") OR TITLE ("train the trainer"))) OR (TITLE ("consensus conference*")) OR ((TITLE ("consult*") OR TITLE ("coach*"))) OR ((TITLE ("Continuing education") OR TITLE ("competence training") OR TITLE ("learning collaborative"))) OR (((TITLE ("use") OR TITLE ("procedur*")) W/2 (TITLE ("restrict*") OR TITLE ("ration*")))) OR ((TITLE ("guideline*") W/2 (TITLE ("compl*") OR TITLE ("implement*") OR TITLE ("introduc*") OR TITLE ("issu*") OR TITLE ("impact") OR TITLE ("effect*") OR TITLE ("disseminat*") OR TITLE ("distribut*") OR TITLE ("learn") OR TITLE ("adopt*") OR TITLE ("rollout") OR TITLE ("roll-out")))) OR (TITLE ("DO NOT DO")) OR ((TITLE ("toolkit*") W/2 (TITLE ("compl*") OR TITLE ("implement*") OR TITLE ("introduc*") OR TITLE ("issu*") OR TITLE ("impact") OR TITLE ("effect*") OR TITLE ("disseminat*") OR TITLE ("distribut*") OR TITLE ("learn") OR TITLE ("adopt*") OR TITLE ("rollout") OR TITLE ("roll-out")))) OR ((TITLE ("evidence-based") W/2 (TITLE ("compl*") OR TITLE ("implement*") OR TITLE ("introduc*") OR TITLE ("issu*") OR TITLE ("impact") OR TITLE ("effect*") OR TITLE ("disseminat*") OR TITLE ("distribut*") OR TITLE ("learn") OR TITLE ("adopt*") OR TITLE ("rollout") OR TITLE ("roll-out")))) OR (((TITLE ("compl*") OR TITLE ("effect*") OR TITLE ("impact") OR TITLE ("evaluat*") OR TITLE ("introduc*") OR TITLE ("compar*")) W/2 TITLE ("training program*"))) OR ((TITLE ("decisional") W/2 TITLE ("support"))) OR ((TITLE ("reminder*") OR TITLE (

	"clinical support tool"))) OR ((TITLE ("recall") W/2 TITLE ("system*"))) OR ((TITLE ("prompter*") OR TITLE ("prompting"))) OR (TITLE ("algorithm*")) OR (TITLE ("feedback")) OR (TITLE ("chart review*")) OR (((TITLE ("effect*") OR TITLE ("impact") OR TITLE ("records") OR TITLE ("chart*") OR TITLE ("clinical") OR TITLE ("medical")) W/2 TITLE ("audit"))) OR ((TITLE ("reimburs*") OR TITLE ("incentivise") OR TITLE ("incentivize") OR TITLE ("incentivization") OR TITLE ("incentivisation") OR TITLE ("incentive*"))) OR ((TITLE ("fee for service"))) OR ((TITLE ("pay for performance") OR TITLE ("P4P")))))) OR (((((((KEY ("colon*") OR KEY ("colorectal*")) W/3 (KEY ("cancer*") OR KEY ("carcinoma*") OR KEY ("adenocarcinoma*") OR KEY ("tumour*") OR KEY ("tumor*") OR KEY ("neoplasm*")))) OR ((KEY ("colonoscop*") OR KEY ("sigmoidoscop*"))) OR (((KEY ("colon*") OR KEY ("colorectal") OR KEY ("rectal")) W/10 (KEY ("polyp*") OR KEY ("asymptomatic")))))) AND ((KEY ("Early Detection")) OR (KEY ("surveill*")) OR (KEY ("interval*")) OR (KEY ("recall")))) OR ((KEY ("Colonoscopy") W/2 (KEY ("Utilis*") OR KEY ("utilize*"))))) AND ((((KEY ("unnecessar*") OR KEY ("necessary") OR KEY ("overuse*") OR KEY ("overutili*") OR KEY ("underuse*") OR KEY ("underutili*") OR KEY ("misuse*") OR KEY ("misutili*") OR KEY ("inappropriate*") OR KEY ("appropriate*") OR KEY ("unneeded") OR KEY ("ineffective"))) OR (((KEY ("guideline") OR KEY ("protocol")) W/5 (KEY ("adhere*") OR KEY ("complian*") OR KEY ("comply") OR KEY ("follow*") OR KEY ("concordan*")))) OR ((KEY ("non-adhere*") OR KEY ("interval*"))) OR (((KEY ("gaps") OR KEY ("gap")) W/4 KEY ("practice"))) OR ((KEY ("uptake") OR KEY ("adopt") OR KEY ("implement*") OR KEY ("follow*"))) OR ((KEY ("commitment") W/2 (KEY ("guideline*") OR KEY ("protocol*")))) OR (KEY ("performance")) OR ((KEY ("reproducibility of results") OR KEY ("reliability")))) OR (((KEY ("Practice Patterns") W/3 KEY ("Physician*"))) OR (KEY ("Early Detection of Cancer")) OR ((KEY ("wait") W/3 (KEY ("time") OR KEY ("times") OR KEY ("list") OR KEY ("lists")))) OR (KEY ("time factors")) OR (KEY ("Referral and consultation")) OR (((KEY ("frequency") OR KEY ("number") OR KEY ("interval")) W/4 (KEY ("preprocedur*") OR KEY ("procedur*") OR KEY ("postprocedur*") OR KEY ("colonoscop*")))) OR (KEY ("follow*up")) OR (KEY ("Sensitivity and Specificity")))) AND ((((KEY ("quality") W/5 (KEY ("manag*") OR KEY ("improv*") OR KEY ("enhanc*") OR KEY ("assur*")))) OR ((KEY ("CQI") OR KEY ("TQM"))) OR (((KEY ("process") OR KEY ("processes") OR KEY ("system") OR KEY ("systems")) W/3 (KEY ("improving") OR KEY ("improvement*") OR KEY ("improve") OR KEY ("redesign*") OR KEY ("enhanc*")))) OR ((KEY ("model") W/3 KEY ("improve*"))) OR (((KEY ("improvement") OR KEY ("QI") OR KEY ("quality assurance") OR KEY ("QA")) W/5 (KEY ("team*") OR KEY ("microsystem*") OR KEY ("cycle*")))) OR ((KEY ("PDSA") OR KEY ("PDCA") OR KEY ("TQIS") OR KEY ("plan do study") OR KEY ("plan do check"))) OR (((KEY ("shewhart") OR KEY ("shewart") OR KEY ("deming")) W/3 (KEY ("cycle") OR KEY ("method")))) OR ((KEY ("breakthrough") W/3 (KEY ("series") OR KEY ("project") OR KEY ("collaborative*")))) OR ((KEY ("lean adj") (KEY ("approach") OR KEY ("management") OR KEY ("method*") OR KEY ("methodology") OR KEY ("thinking") OR KEY ("enterpri?e") OR KEY ("practice") OR KEY ("philosophy") OR KEY ("principles")))) OR (KEY ("six sigma")) OR (((KEY ("change") OR KEY ("improv*")) W/3 (KEY ("bundle*") OR KEY ("package*")))) OR (KEY ("QIC"))) OR ((((KEY ("provider*") OR KEY ("clinician*") OR KEY ("practitioner*") OR KEY ("pharmacist*") OR KEY ("provider*") OR KEY ("physician*") OR KEY ("doctor*") OR KEY ("gastroenterologis*") OR KEY ("endoscop*")) W/2 KEY ("intervention*"))) OR ((KEY ("Educat*") W/3 (KEY ("continuing") OR KEY ("professional")))) OR ((KEY ("education*") W/3 (KEY ("program*") OR KEY ("intervention*") OR KEY ("meeting*") OR KEY ("session*") OR KEY ("strateg*") OR KEY ("workshop*") OR KEY ("visit*")))) OR ((KEY ("disease management program"))) OR (((KEY ("behavior*") OR KEY ("behaviour*")) W/2 (KEY ("intervention*") OR KEY ("change")))) OR ((KEY ("leaflet*") OR KEY ("booklet*") OR KEY ("poster*") OR KEY ("pamphlet*"))) OR (((KEY ("written") OR KEY ("printed") OR KEY ("oral")) KEY ("adj information"))) OR ((KEY ("information*") W/2 (KEY ("campaign") OR KEY ("dissemination")))) OR ((KEY ("education*") W/1 (KEY ("method*") OR KEY ("material*")))) OR ((KEY ("legislat*") OR KEY ("policy"

	) OR KEY ("policies") OR KEY ("directive*") OR KEY ("mandat*") OR KEY ("by-law*") OR KEY ("regulat*") OR KEY ("regulatory"))) OR ((KEY ("Outreach") OR KEY ("nudg*"))) OR (((KEY ("opinion") OR KEY ("education*") OR KEY ("influential")) W/1 (KEY ("leader*") OR KEY ("champion")))) OR (KEY ("facilitator*")) OR ((KEY ("academic detailing") OR KEY ("train the trainer"))) OR (KEY ("consensus conference*")) OR ((KEY ("consult*") OR KEY ("coach*"))) OR ((KEY ("Continuing education") OR KEY ("competence training") OR KEY ("learning collaborative"))) OR (((KEY ("use") OR KEY ("procedur*")) W/2 (KEY ("restrict*") OR KEY ("ration*")))) OR ((KEY ("guideline*") W/2 (KEY ("compl*") OR KEY ("implement*") OR KEY ("introduc*") OR KEY ("issu*") OR KEY ("impact") OR KEY ("effect*") OR KEY ("disseminat*") OR KEY ("distribut*") OR KEY ("learn") OR KEY ("adopt*") OR KEY ("rollout") OR KEY ("roll-out")))) OR (KEY ("DO NOT DO")) OR ((KEY ("toolkit*") W/2 (KEY ("compl*") OR KEY ("implement*") OR KEY ("introduc*") OR KEY ("issu*") OR KEY ("impact") OR KEY ("effect*") OR KEY ("disseminat*") OR KEY ("distribut*") OR KEY ("learn") OR KEY ("adopt*") OR KEY ("rollout") OR KEY ("roll-out")))) OR ((KEY ("evidence-based") W/2 (KEY ("compl*") OR KEY ("implement*") OR KEY ("introduc*") OR KEY ("issu*") OR KEY ("impact") OR KEY ("effect*") OR KEY ("disseminat*") OR KEY ("distribut*") OR KEY ("learn") OR KEY ("adopt*") OR KEY ("rollout") OR KEY ("roll-out")))) OR (((KEY ("compl*") OR KEY ("effect*") OR KEY ("impact") OR KEY ("evaluat*") OR KEY ("introduc*") OR KEY ("compar*")) W/2 KEY ("training program*"))) OR ((KEY ("decisional") W/2 KEY ("support"))) OR ((KEY ("reminder*") OR KEY ("clinical support tool"))) OR ((KEY ("recall") W/2 KEY ("system*"))) OR ((KEY ("prompter*") OR KEY ("prompting"))) OR (KEY ("algorithm*")) OR (KEY ("feedback")) OR (KEY ("chart review*")) OR (((KEY ("effect*") OR KEY ("impact") OR KEY ("records") OR KEY ("chart*") OR KEY ("clinical") OR KEY ("medical")) W/2 KEY ("audit"))) OR ((KEY ("reimburs*") OR KEY ("incentivise") OR KEY ("incentivize") OR KEY ("incentivization") OR KEY ("incentivisation") OR KEY ("incentive*"))) OR ((KEY ("fee for service"))) OR ((KEY ("pay for performance") OR KEY ("P4P"))))))) AND NOT ((TITLE ("ovarian") OR TITLE ("ovary") OR TITLE ("ovaries") OR TITLE ("prostate*") OR TITLE ("breast*") OR TITLE ("lung") OR TITLE ("paediatr*") OR TITLE ("pediatr*") OR TITLE ("child") OR TITLE ("children") OR TITLE ("SKIN") OR TITLE ("cervical") OR TITLE ("thoracic") OR TITLE ("bladder") OR TITLE ("kidney") OR TITLE ("liver"))) AND (LIMIT-TO (AFFILCOUNTRY , "United States") OR LIMIT-TO (AFFILCOUNTRY , "United Kingdom") OR LIMIT-TO (AFFILCOUNTRY , "Canada") OR LIMIT-TO (AFFILCOUNTRY , "Australia") OR LIMIT-TO (AFFILCOUNTRY , "Netherlands") OR LIMIT-TO (AFFILCOUNTRY , "Germany") OR LIMIT-TO (AFFILCOUNTRY , "Italy") OR LIMIT-TO (AFFILCOUNTRY , "France") OR LIMIT-TO (AFFILCOUNTRY , "Spain") OR LIMIT-TO (AFFILCOUNTRY , "Denmark") OR LIMIT-TO (AFFILCOUNTRY , "Sweden") OR LIMIT-TO (AFFILCOUNTRY , "Norway") OR LIMIT-TO (AFFILCOUNTRY , "Belgium") OR LIMIT-TO (AFFILCOUNTRY , "Switzerland") OR LIMIT-TO (AFFILCOUNTRY , "Ireland") OR LIMIT-TO (AFFILCOUNTRY , "Austria") OR LIMIT-TO (AFFILCOUNTRY , "New Zealand")) AND (LIMIT-TO (SUBJAREA , "MEDI") OR LIMIT-TO (SUBJAREA , "NURS") OR LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "PSYC") OR LIMIT-TO (SUBJAREA , "MULT") OR LIMIT-TO (SUBJAREA , "HEAL") OR LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "DECI") OR LIMIT-TO (SUBJAREA , "ECON")) AND (LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2011) OR LIMIT-TO (PUBYEAR , 2010)) AND (LIMIT-TO (LANGUAGE , "English")) AND (EXCLUDE (EXACTKEYWORD , "Breast Cancer") OR EXCLUDE (EXACTKEYWORD , "Breast Neoplasms") OR EXCLUDE (EXACTKEYWORD , "Mammography") OR EXCLUDE (EXACTKEYWORD , "Breast Tumor") OR EXCLUDE (EXACTKEYWORD , "Prostate Cancer") OR EXCLUDE (EXACTKEYWORD , "Adolescent")) AND (EXCLUDE (SUBJAREA , "BIOC"))

ProQuest Dissertations & Theses Global **Searched 2020-09-18** **Results: 44**	ti(colon OR colonic OR colonoscop* OR colorectal OR rectal OR sigmoidoscop* OR Post-polyp*) AND (ti(unnecessar* OR necessary OR overuse* OR overutili* OR underuse* OR underutili* OR misuse* OR misutili* OR inappropriate* OR appropriate* OR concordan* OR unneeded OR ineffective OR reduc* OR adher* OR surveill* OR recall OR interval* OR frequen*) OR su(unnecessar* OR necessary OR overuse* OR overutili* OR underuse* OR underutili* OR misuse* OR misutili* OR inappropriate* OR appropriate* OR concordan* OR unneeded OR ineffective OR reduc* OR adher* OR surveill* OR recall OR interval* OR frequen*)) 2010-01-01 - 2020-12-31 English
Grey Literature	
TRIP Database *http://www.tripdatabase.com/* Searched: 2020-09-18 Results: 48	(title:(colorectal OR post polypectomy OR colonoscopy) surveillance (unnecessary OR necessary OR overuse OR overutilize OR underuse OR underutilize OR misuse OR misutilize OR inappropriate OR appropriate OR concordant OR concordance OR unneeded OR ineffective OR reduce OR reduced OR reduction OR adherence OR recall OR interval OR frequency) from:2010 to:2020
PDQ Evidence **Searched 2020-09-18** **Results: 63**	title:(colon OR colonic OR colonoscop* OR colorectal OR rectal OR sigmoidoscop* OR Post-polyp*) AND (title:(unnecessar* OR necessary OR overuse* OR overutili* OR underuse* OR underutili* OR misuse* OR misutili* OR inappropriate* OR appropriate* OR concordan* OR unneeded OR ineffective OR reduc* OR adher* OR surveill* OR recall OR interval* OR frequen*) OR abstract:(unnecessar* OR necessary OR overuse* OR overutili* OR underuse* OR underutili* OR misuse* OR misutili* OR inappropriate* OR appropriate* OR concordan* OR unneeded OR ineffective OR reduc* OR adher* OR surveill* OR recall OR interval* OR frequen*)) Publication Year 2010-2020
NICE Evidence https://www.evidence.nhs.uk/ Searched: 2020-09-21 Results: 49	(colorectal cancer OR colonoscopy OR post polypectomy) AND (interval* or overscreen* OR "de implementation" OR adherence OR overuse OR overutilisation OR appropriate) Evidence Type: Policy and Strategy. All Secondary Evidence, All Primary Research, All Practice Based Information, All implementation Support
HTA Database https://database.inahta.org/ Searched: 2020-09-18 Results: 6	(((colon or colorectal or rectal or colonoscop* or sigmoidoscop*)[Title]) AND ((unnecessar* or necessary or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or appropriate* or concordan* or unneeded or ineffective or reduc* or adher* OR surveill* OR recall or interval* or frequen*)[Title] OR (unnecessar* or necessary or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or appropriate* or concordan* or unneeded or ineffective or reduc* or adher* OR surveill* OR recall or interval* or frequen*)[mh] OR (unnecessar* or necessary or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or appropriate* or concordan* or unneeded or ineffective or reduc* or adher* OR surveill* OR recall or interval* or frequen*)[Keywords])) AND (English)[Language] FROM 2010 TO 2020

HTA Agencies	
AHTA – Adelaide Health Technology Assessment https://www.adelaide.edu.au/ahta/pubs/reportsmonographs/	2020-09-21 Browsed site: 0 results
ASERNIP-S – Australian Safety and Efficacy Register of New Interventional Procedures-Surgical https://www.surgeons.org/research-audit/research-evaluation-inc-asernips/publications	2020-09-21 Browsed publications 0 results
CADTH – Canadian Agency for Drugs and Technologies in Health www.cadth.ca	2020-09-21 Searched: colonoscopy Browsed 46 results; selected 14 Searched: “colorectal cancer surveillance” Browsed 3: selected 0 as there were two from first search Restricted to Result Type: Reports; Product Line: Health Technology Assessments, Health Technology Update, Rapid Response, Optimal Use, Therapeutic Review Condition: Colorectal Cancer Restricted to years 2010-2020
HTRG – Health Technology Reference Group https://www.coag.gov.au/ https://www.coaghealthcouncil.gov.au/AHMAC/Health-Technology-Reference-Group/Reports-and-Briefs	2020-09-21 Browsed Health Technology Reports and Health Technology briefs: 1 results
HIQA – Health Information and Quality Authority https://www.hiqa.ie/	2020-09-21 Browsed site: 1 result
HIS – Healthcare Improvement Scotland http://www.healthcareimprovementscotland.org/	2020-09-21 Selected condition: Cancer Browsed 72 results: Selected 2
HQO – Health Quality Ontario https://www.hqontario.ca/	2020-09-21 Browsed Publications: 0 results
HTW – Health Technology Wales http://www.healthtechnology.wales/	2020-09-21 Browsed site: 0 results
ICES	2020-09-21

https://www.ices.on.ca/	Browsed Publications: 0 results
INESSS – Institut national d'excellence en santé et en services sociaux http://www.inesss.qc.ca	2020-09-21 Browsed Publications: 8 results
Eunethta Assessments https://www.eunethta.eu/assessments/	2020-09-21 Browsed site: 0 results
Aetna Medlical clinical Policy Bulletins https://www.aetna.com/health-care-professionals/clinical-policy-bulletins.html	2020-09-21 Browsed site: 1 results
ECRI https://www.ecri.org	2020-09-21 Browsed General Topics: 0 results
ICER - Institute for Clinical and Economic Review https://icer-review.org/materials/	2020-09-21 Browsed site: 0 results
Washington State Health Care Authority – Heath Technology Assessment Program https://www.hca.wa.gov/about-hca/health-technology-assessment	2020-09-21 Browsed site: 0 results 1 result
Medical Services Advisory Committee (MSAC): http://www.msac.gov.au/internet/msac/publishing.nsf/Content/completed-assessments	2020-09-21 Browsed site: 0 results
Veterans Affairs (VA) Evidence-based Synthesis Program (ESP): https://www.hsrd.research.va.gov/publications/esp/reports.cfm	2020-09-21 Browsed site: 1 result related to inappropriate imaging in general
Theta - Toronto Health Economics and Technology Assessment Collaborative https://theta.utoronto.ca/	2020-09-21 Browsed site: 0 results
Associations	
American Society for Gastrointestinal Endoscopy (ASGE) Technology Committee https://www.asge.org/	2020-09-25 Browsed Tech Assessments 1 result CRC 1 result GERD
Canadian Association of Gastroenterology	2020-09-29 Browsed publications

https://www.cag-acg.org/publications/guideline-library	CRC – 3 results
ESEG https://www.esge.com/publications/	2020-09-25 Browsed Technical Reviews and Quality Improvement 0 results both CRC and GERD
British society of gastroenterology https://www.bsg.org.uk/	Browsed site: Clinical Resources > Clinical Trials, Care Bundles Clinical Interest > Colorectal, Endoscopy, Gastroduodenal 0 results CRC and Dyspepsia 0 results
Association of Coloproctology of Great Britain and Ireland https://www.acpgbi.org.uk/research/trials/	0 results CRC or Dyspepsia
Gastroenterological Society of Australia https://www.gesa.org.au/	Browsed site 1 result CRC 0 Results dyspepsia
American Gastroenterology Association https://gastro.org/	Searched 2020-09-30 Results: 20 You searched for guideline adherence in Article title AND surveillance colonoscopy in All Content AND colorectal cancer in All Content
ASCO	
ClinicalTrials.gov Searched: 2020-09-29 Results: 232 unique	surveillance AND colonoscopy | Recruiting, Not yet recruiting, Active, not recruiting, Completed, Enrolling by invitation, Unknown status Studies | Colorectal Polyp | Adult, Older Adult (37 records) 197 Studies found for: (surveillance OR monitor* OR follow-up OR recall) AND (colonoscopy OR colorectal OR colon OR sigmoidoscop*) AND (adherence OR adhere OR compliance OR comply OR condordan*) | Recruiting, Not yet recruiting, Active, not recruiting, Completed, Enrolling by invitation, Unknown status Studies | Adult, Older Adult
Forward Searching in PubMed 2020-09-30 Results: 3	See folder in Endnote with articles that were searched
Search Engines	
Google Scholar Searched: 2020-09-18 Results: 129	allintitle: surveillance interval OR intervals OR necessary OR overuse OR overutilization OR appropriate OR appropriateness OR inappropriate OR concordant OR concordance OR adhere OR adherence colonoscopy OR colorectal OR "Post polypectomy" 2010-2020

Qwant Search Searched 2020-09-30 Results: 98 total	surveillance AND polypectomy AND (colonoscopy OR colorectal OR "colon cancer") AND (improve OR improving OR improved OR improves) Limited to Canada - 47 results Gb-48 RESULTS USA -46 Austalia - 40 surveillance AND polypectomy AND (colonoscopy OR colorectal OR "colon cancer") AND (study OR studies OR intervention OR comparison OR meta-analysis OR impact OR effect OR effects OR trial OR review OR cohort OR observational) USA – 48 GB2 -51 Australia – 40 Canada - 47
Google	NOT SURE IF NEED TO DO surveillance polypectomy improve | improving | improved | improves recall | interval | intervals | necessary | overuse | overutilization | appropriate | appropriateness | inappropriate | concordance | adhere | adherence | overscreening | overscreen colonoscopy OR colorectal OR "colon cancer" 1st 100 results Jan 1, 2010 to Sep 30, 2020 surveillance polypectomy study | studies | intervention | comparison | meta-analysis | impact | effect | effects | trial | review | cohort | observational recall | interval | intervals | necessary | overuse | overutilization | appropriate | appropriateness | inappropriate | concordant | concordance | adhere | adherence | overscreening | overscreen colonoscopy OR colorectal OR colon Jan 1, 2010 to Sep 30, 2020

Table H.2: Dyspepsia/Gastroesophageal reflux, search strategy for interventions to reduce endoscopy overuse

Database Edition or date searched	Search terms ††

Ovid MEDLINE(R) ALL 1946 to October 1, 2020 Searched: 2020-10-07 Results:297	**Dyspepsia:** 1. exp dyspepsia/ 2. dyspep*.tw. 3. indigest*.tw. 4. exp Gastroesophageal Reflux/ 5. gastro?esophageal reflux.tw. 6. gastro-esophageal reflux.tw. 7. gastro-oesophageal reflux.tw. 8. (GERD or GORD).tw. 9. heartburn/ 10. heartburn.tw. 11. (acid adj5 reflux).tw. 12. or/1-11 13. Gastrointestinal Diseases/di [Diagnosis] 14. endoscopy, gastrointestinal/ or gastroscopy/ 15. (endoscop* or gastroscop*).ti,ab,kf. 16. Intestinal Polyps/ 17. (polypectomy or asymptomatic or symptom free).ti,kf. 18. or/13-17 19. exp Health Services Misuse/ 20. (unnecessar* or necessary or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or appropriate* or unneeded or ineffective).ti,kf. 21. (unnecessar* or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or unneeded or appropriateness or ineffective).ab. /freq=2 22. low value care.ti,kf. 23. Guideline Adherence/ 24. ((guideline or protocol) adj2 (adhere* or complian* or comply or follow* or concordan*)).ti,kf. 25. ((guideline or protocol) adj2 (adhere* or non-adhere* or complian* or comply or follow* or concordan*)).ab. /freq=2 26. (non-adhere* or interval*).ti,kf. 27. ((gaps or gap) adj2 evidence adj2 practice).ti,ab,kf. 28. (uptake or adopt or implement*).ti,kf. 29. (uptake or adopt).ab. /freq=2 30. "Guidelines as Topic"/ 31. (commitment adj2 (guideline? or protocol?)).tw. 32. or/19-31 [GUIDELINE ADHERENCE and other outcomes] 33. exp Practice Patterns, Physicians'/ 34. "Early Detection of Cancer"/st, sn [Standards, Statistics & Numerical Data]

	35. "quality of health care"/ or advance directive adherence/ or exp "outcome and process assessment, health care"/ or peer review, health care/ or "professional review organizations"/ or exp program evaluation/ or exp quality indicators, health care/
	36. exp waiting lists/ or (wait adj3 (time or times or list or lists)).tw.
	37. exp time factors/
	38. exp "Referral and consultation"/
	39. ((frequency or number or interval) adj25 (preprocedur* or procedur* or postprocedur* or colonoscop*)).tw.
	40. exp Follow-Up Studies/
	41. follow?up.ti,kw.
	42. follow?up.ab. /freq=2
	43. exp "Sensitivity and Specificity"/ or (Sensitivity adj1 Specificity).tw.
	44. "predictive value of tests"/
	45. or/33-44 [OUTCOMES 2]
	46. Quality Improvement/
	47. (quality adj5 (manag* or improv* or enhanc*)).tw.
	48. (CQI or TQM).tw.
	49. total quality management/
	50. quality assurance, health care/
	51. ((process or processes or system or systems) adj3 (improving or improvement* or improve or redesign* or enhanc*)).tw.
	52. (model adj3 improve*).ti,kf.
	53. (model adj3 improve*).ab. /freq=2
	54. ((improvement or QI or quality assurance or QA) adj5 (team? or microsystem? or cycle?)).tw.
	55. (PDSA or PDCA or TQIS or plan do study or plan do check).tw.
	56. ((shewhart or shewart or deming) adj3 (cycle or method)).tw.
	57. (breakthrough adj3 (series or project or collaborative?)).tw.
	58. (lean adj (approach or management or method? or methodology or thinking or enterpri#e or practice or philosophy or principles)).tw.
	59. six sigma.tw.
	60. Health Services Administration/ or Health Plan Implementation/
	61. ((change or improv*) adj3 (bundle* or package*)).tw.
	62. QIC.ti,ab.
	63. or/46-62 [QI INERVENTIONS]
	64. ((provider? or clinician? or practitioner? or pharmacist? or provider? or physician? or doctor? or gastroenterologist* or endoscop*) adj2 intervention*).ti,ab,kf.
	65. (ed or ps or sn or st).fs.
	66. (advice or counsel* or interven* or campaign* or program* or initiative* or project* or service* or approach* or strategy or strategies or framework).ti,kf.
	67. (advice or counsel* or interven* or campaign* or program* or initiative* or project* or service* or approach* or strategy or strategies or framework).ab. /freq=2
	68. exp Education, Medical, Continuing/ or exp Education, Professional/

	69. exp *education,continuing/ 70. ((education$ adj3 (program$ or intervention? or meeting? or session? or strateg$ or workshop? or visit?)) or disease management program).tw. 71. (behavio?r$ adj2 intervention?).tw. 72. pamphlets/ 73. (leaflet? or booklet? or poster? or pamphlet?).tw. 74. ((written or printed or oral) adj information).tw. 75. information dissemination/ 76. (information$ adj2 (campaign or dissemination)).tw. 77. (education$ adj1 (method? or material?)).tw. 78. "social control, formal"/ or government regulation/ or mandatory reporting/ or mandatory programs/ 79. (legislat* or policy or policies or directive* or mandat* or by-law* or regulat*).ti,kf. 80. *advance directives/ 81. outreach.tw. 82. (((opinion or education$ or influential) adj1 leader?) or ((opinion or education$ or influential) adj1 champion)).tw. 83. facilitator?.tw. 84. (academic detailing or train the trainer).tw. 85. consensus conference?.tw. 86. (consult* or coach*).ti,kf. 87. (Continuing education or competence training or learning collaborative).tw. 88. (("use" or procedur*) adj2 (restrict* or ration*)).ti,kf. 89. (guideline? adj2 (compl$ or implement$ or introduc$ or issu$ or impact or effect$ or disseminat$ or distribut$ or learn or adopt$ or rollout or roll-out)).tw. 90. "DO NOT DO".tw. 91. (toolkit? adj2 (compl$ or implement$ or introduc$ or issu$ or impact or effect$ or disseminat$ or distribut$ or learn or adopt$ or rollout or roll-out)).tw. 92. (evidence-based adj2 (compl$ or implement$ or introduc$ or issu$ or impact or effect$ or disseminat$ or distribut$ or learn or adopt$ or rollout or roll-out)).tw. 93. ((compl$ or effect$ or impact or evaluat$ or introduc$ or compar$) adj2 training program$).tw. 94. reminder systems/ 95. exp decision support techniques/ 96. (decisional adj2 support).tw. 97. (reminder? or clinical support tool).tw. 98. (recall adj2 system$).tw. 99. (prompter? or prompting).tw. 100. (real time adj10 assess*).tw. 101. algorithm?.tw. 102. clinical audit/ or exp medical audit/

	103. *feedback/ or feedback.tw. 104. chart review$.tw. 105. ((effect? or impact or records or chart?) adj2 audit).tw. 106. exp reimbursement mechanisms/ 107. exp Reimbursement, Incentive/ 108. (incentivise or incentivize or incentivization or incentivisation or incentive*).tw. 109. fee for service.tw. 110. ("pay for performance" or P4P).tw. 111. or/64-110 [OTHER INTERVENTIONS] 112. 12 and 18 and 32 and (45 or 63 or 111) 113. 12 and 18 and (32 or 45) and (63 or 111) 114. 112 or 113 115. limit 114 to (english language and yr="2010 -Current") 116. remove duplicates from 115 117. (paediatr* or pediatr* or children or infant*).ti. 118. 116 not 117
Ovid MEDLINE(R) ALL 1946 to October 27, 2020 Oct. 28, 2020 Results: 268	1. exp dyspepsia/ 2. dyspep*.tw. 3. indigest*.tw. 4. exp Gastroesophageal Reflux/ 5. gastro?esophageal reflux.tw. 6. gastro-esophageal reflux.tw. 7. gastro-oesophageal reflux.tw. 8. (GERD or GORD).tw. 9. heartburn/ 10. heartburn.tw. 11. (acid adj5 reflux).tw. 12. (Barrett* adj3 (Esophagus or oesophagus)).ti,kf. 13. exp Barrett Esophagus/ 14. or/1-11 15. Gastrointestinal Diseases/di [Diagnosis] 16. endoscopy, gastrointestinal/ or gastroscopy/ 17. (endoscop* or gastroscop* or esophagogastroduodenoscop* or oesophagogastroduodenoscop*).ti,kf. 18. (endoscop* or gastroscop* or esophagogastroduodenoscop* or oesophagogastroduodenoscop*).ab. /freq=2 19. Intestinal Polyps/ 20. (polypectomy or asymptomatic or symptom free).ti,kf. 21. or/15-20 22. exp Health Services Misuse/

	23. (unnecessar* or necessary or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or appropriate* or unneeded or ineffective).ti,kf. 24. (unnecessar* or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or unneeded or appropriateness or ineffective).ab. /freq=2 25. low value care.ti,kf. 26. Guideline Adherence/ 27. ((guideline* or protocol*) adj3 (adhere* or complian* or comply or follow* or concordan*)).ti,kf. 28. (guideline$ adj3 (adher$ or compl$ or utiliz$ or utilis$ or "use" or uptake or diffus$ or transfer$ or implement$ or translat$ or disseminat$ or adopt$)).mp. 29. ((guideline* or protocol*) adj3 (adhere* or non-adhere* or complian* or comply or follow* or concordan*)).ab. /freq=2 30. (non-adhere* or interval*).ti,kf. 31. ((gaps or gap) adj2 evidence adj2 practice).ti,kf. 32. exp "Diffusion of Innovation"/ 33. (uptake of research or "use of research" or utili?ation of research or diffusion of research or translation of research or transfer of research or dissemination of research or implementation of research or adoption of research).mp. 34. (uptake of knowledge or "use of knowledge" or utili?ation of knowledge or diffusion of knowledge or translation of knowledge or transfer of knowledge or dissemination of knowledge or implementation of knowledge or adoption of knowledge).mp. 35. (uptake of evidence or "use of evidence" or utili?ation of evidence or diffusion of evidence or translation of evidence or transfer of evidence or dissemination of evidence or implementation of evidence or adoption of evidence).mp. 36. (uptake or adopt or implement*).ti,kf. 37. (uptake or adopt).ab. /freq=2 38. "Guidelines as Topic"/ 39. (commitment adj2 (guideline? or protocol?)).ti,kf. 40. ((guideline or protocol) adj2 (adhere* or complian* or comply or follow* or concordan*)).ti,kf. 41. exp Practice Patterns, Physicians'/ 42. exp waiting lists/ or (wait adj3 (time or times or list or lists)).ti,kf. 43. exp "Referral and consultation"/ 44. ((frequency or number or interval) adj10 (preprocedur* or procedur* or postprocedur* or endoscop* or gastroscop* or esophagogastroduodenoscop* or oesophagogastroduodenoscop*)).tw. 45. (reduc* adj5 (resource* or procedur* or endoscop* or gastroscop* or esophagogastroduodenoscop* or oesophagogastroduodenoscop*)).tw. 46. Quality Improvement/ 47. (quality adj5 (manag* or improv* or enhanc*)).ti,kf. 48. quality assurance, health care/ 49. ((process or processes or system or systems) adj3 (improving or improvement* or improve or redesign* or enhanc*)).ti,kf. 50. (model adj3 improve*).ti,kf. 51. (advice or counsel* or interven* or campaign* or program* or initiative* or project* or service* or approach* or strategy or strategies or framework).ti,kf.

	52. exp Education, Medical, Continuing/ or exp Education, Professional/ 53. exp *education,continuing/ 54. ((education$ adj3 (program$ or intervention? or meeting? or session? or strateg$ or workshop? or visit?)) or disease management program).ti,kf. 55. (behavio?r$ adj2 intervention?).ti,kf. 56. pamphlets/ 57. (leaflet? or booklet? or poster? or pamphlet?).ti,kf. 58. ((written or printed or oral) adj information).ti,kf. 59. information dissemination/ 60. (information$ adj2 (campaign or dissemination)).ti,kf. 61. "social control, formal"/ or government regulation/ or mandatory reporting/ or mandatory programs/ 62. (legislat* or policy or policies or directive* or mandat* or by-law* or regulat*).ti,kf. 63. (consult* or coach*).ti,kf. 64. (("use" or procedur*) adj2 (restrict* or ration*)).ti,kf. 65. (guideline? adj2 (compl$ or implement$ or introduc$ or issu$ or impact or effect$ or disseminat$ or distribut$ or learn or adopt$ or rollout or roll-out)).ti,kf. 66. (toolkit? adj2 (compl$ or implement$ or introduc$ or issu$ or impact or effect$ or disseminat$ or distribut$ or learn or adopt$ or rollout or roll-out)).ti,kf. 67. (evidence-based adj2 (compl$ or implement$ or introduc$ or issu$ or impact or effect$ or disseminat$ or distribut$ or learn or adopt$ or rollout or roll-out)).ti,kf. 68. ((compl$ or effect$ or impact or evaluat$ or introduc$ or compar$) adj2 training program$).ti,kf. 69. reminder systems/ 70. exp decision support techniques/ 71. (decisional adj2 support).ti,kf. 72. (reminder? or clinical support tool).ti,kf. 73. (recall adj2 system$).ti,kf. 74. (prompter? or prompting).ti,kf. 75. (real time adj10 assess*).ti,kf. 76. clinical audit/ or exp medical audit/ 77. *feedback/ or feedback.ti,kf. 78. chart review$.ti,kf. 79. ((effect? or impact or records or chart?) adj2 audit).ti,kf. 80. exp reimbursement mechanisms/ 81. exp Reimbursement, Incentive/ 82. (incentivise or incentivize or incentivization or incentivisation or incentive*).ti,kf. 83. fee for service.ti,kf. 84. ("pay for performance" or P4P).ti,kf. 85. Health Resources/ or (resourc* adj3 utili*).tw. 86. or/22-85

	87. 14 and 21 and 86 88. limit 87 to (english language and yr="2010 -Current") 89. (paediatr* or pediatr* or children or infant*).ti. 90. 88 not 89 91. Developing Countries.sh,kf. 92. (Africa or Asia or West Indies or South America or Central America).hw,kf,ti,ab,cp. 93. (Caribbean or Latin* America*).hw,kf,ti,cp. 94. (Afghanistan or Albania or Algeria or Angola or Antigua or Barbuda or Argentina or Armenia or Armenian or Aruba or Azerbaijan or Bahrain or Bangladesh or Barbados or Benin or Byelarus or Byelorussian or Belarus or Belorussian or Belorussia or Belize or Bhutan or Bolivia or Bosnia or Herzegovina or Hercegovina or Botswana or Brasil or Brazil or Bulgaria or Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cambodia or Khmer Republic or Kampuchea or Cameroon or Cameroons or Cameron or Camerons or Cape Verde or Central African Republic or Chad or Chile or China or Colombia or Comoros or Comoro Islands or Comores or Mayotte or Congo or Zaire or Costa Rica or Cote d'Ivoire or Ivory Coast or Croatia or Cuba or Cyprus or Czechoslovakia or Czech Republic or Slovakia or Slovak Republic or Djibouti or French Somaliland or Dominica or Dominican Republic or East Timor or East Timur or Timor Leste or Ecuador or United Arab Republic or El Salvador or Eritrea or Estonia or Ethiopia or Fiji or Gabon or Gabonese Republic or Gambia or Gaza or Georgia Republic or Georgian Republic or Ghana or Gold Coast or Greece or Grenada or Guatemala or Guinea or Guam or Guiana or Guyana or Haiti or Honduras or Hungary or India or Maldives or Indonesia or Iran or Iraq or Isle of Man or Jamaica or Jordan or Kazakhstan or Kazakh or Kenya or Kiribati or Korea or Kosovo or Kyrgyzstan or Kirghizia or Kyrgyz Republic or Kirghiz or Kirgizstan or Lao PDR or Laos or Latvia or Lebanon or Lesotho or Basutoland or Liberia or Libya or Lithuania or Macedonia or Madagascar or Malagasy Republic or Malaysia or Malaya or Malay or Sabah or Sarawak or Malawi or Nyasaland or Mali or Malta or Marshall Islands or Mauritania or Mauritius or Agalega Islands or Mexico or Micronesia or Middle East or Moldova or Moldovia or Moldovian or Mongolia or Montenegro or Morocco or Ifni or Mozambique or Myanmar or Myanma or Burma or Namibia or Nepal or Netherlands Antilles or New Caledonia or Nicaragua or Niger or Nigeria or Northern Mariana Islands or Oman or Muscat or Pakistan or Palau or Palestine or Panama or Paraguay or Peru or Philippines or Philipines or Phillipines or Phillippines or Poland or Portugal or Puerto Rico or Romania or Rumania or Roumania or Russia or Russian or Rwanda or Ruanda or Saint Kitts or St Kitts or Nevis or Saint Lucia or St Lucia or Saint Vincent or St Vincent or Grenadines or Samoa or Samoan Islands or Navigator Island or Navigator Islands or Sao Tome or Saudi Arabia or Senegal or Serbia or Montenegro or Seychelles or Sierra Leone or Slovenia or Sri Lanka or Ceylon or Solomon Islands or Somalia or South Africa or Sudan or Suriname or Surinam or Swaziland or Syria or Tajikistan or Tadzhikistan or Tadjikistan or Tadzhik or Tanzania or Thailand or Togo or Togolese Republic or Tonga or Trinidad or Tobago or Tunisia or Turkey or Turkmenistan or Turkmen or Uganda or Ukraine or Uruguay or USSR or Soviet Union or Union of Soviet Socialist Republics or Uzbekistan or Uzbek or Vanuatu or New Hebrides or Venezuela or Vietnam or Viet Nam or West Bank or Yemen or Yugoslavia or Zambia or Zimbabwe or Rhodesia).hw,kf,ti,ab,cp. 95. ((developing or less* developed or under developed or underdeveloped or low* income or underserved or under served or deprived or poor*) adj (countr* or nation? or population? or world)).ti,ab. 96. (middle income adj (countr* or nation? or population? or world)).ti. 97. (low* adj (gdp or gnp or gross domestic or gross national)).ti,ab. 98. (low adj3 middle adj3 countr*).ti. 99. (lmic or lmics or third world or lami countr*).ti,ab. 100. transitional countr*.ti,ab. 101. or/91-100 [LMIC FILTER]

	102. 90 not 101
OVID Embase **Embase 1974 to 2020 October 05** **Results: 365**	1. exp *dyspepsia/ 2. dyspep*.tw. 3. exp *Gastroesophageal Reflux/ 4. gastro?esophageal reflux.tw. 5. gastro-esophageal reflux.tw. 6. gastro-oesophageal reflux.tw. 7. (GERD or GORD).tw. 8. *heartburn/ 9. heartburn.tw. 10. (acid adj5 reflux).tw. 11. indigest*.tw. 12. or/1-11 13. *gastrointestinal disease/di [Diagnosis] 14. *gastrointestinal endoscopy/ or *gastroscopy/ or *esophagogastroduodenoscopy/ 15. (endoscop* or gastroscop*).ti,ab,kw. 16. exp *intestine Polyp/ 17. (polypectomy or asymptomatic or symptom free).ti,kw. 18. or/13-17 19. exp unnecessary procedure/ 20. low value care.ti,kw. 21. (unnecessar* or necessary or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or appropriate* or unneeded or ineffective).ti,kw. 22. (unnecessar* or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or unneeded or appropriateness or ineffective).ab. /freq=2 23. exp *protocol compliance/ 24. ((guideline or protocol) adj2 (adhere* or complian* or comply or follow* or concordan*)).ti,kw. 25. ((guideline or protocol) adj2 (adhere* or non-adhere* or complian* or comply or follow* or concordan*)).ab. /freq=2 26. (non-adhere* or interval*).ti,kw. 27. ((gaps or gap) adj2 evidence adj2 practice).ti,ab,kw. 28. (uptake or adopt or implement*).ti,kw. 29. (uptake or adopt).ab. /freq=2 30. exp *practice guideline/ and (adher* or complia* or comply* or complies).tw. 31. (commitment adj2 (guideline? or protocol?)).tw. 32. or/19-31 [GUIDELINE ADHERENCE] 33. exp *clinical practice/ 34. exp *health care quality/

	35. exp *"outcome assessment"/ or exp *"professional standards review organization"/ or exp *program evaluation/ 36. (quality adj3 indicator*).ti,ab,kw. 37. (wait adj3 (time or times or list or lists)).tw. 38. (wait adj3 (time or times or list or lists)).ab. /freq=2 39. exp *time factor/ 40. exp *patient Referral/ or referr*.ti,kw. 41. or/33-40 [OUTCOMES 2] 42. *Quality Improvement/ 43. (quality adj5 (manag* or improv* or enhanc*)).ti,kw. 44. (CQI or TQM).ti,kw. 45. *total quality management/ 46. exp *quality control/ 47. ((process or processes or system or systems) adj3 (improving or improvement* or improve or redesign* or enhanc*)).ti,kw. 48. (model adj3 improve*).ti,kw. 49. (model adj3 improve*).ab. /freq=2 50. ((improvement or QI or quality assurance or QA) adj5 (team? or microsystem? or cycle?)).ti,kw. 51. (PDSA or PDCA or TQIS or plan do study or plan do check).ti,kw. 52. ((shewhart or shewart or deming) adj3 (cycle or method)).ti,kw. 53. (breakthrough adj3 (series or project or collaborative?)).ti,kw. 54. (lean adj (approach or management or method? or methodology or thinking or enterpri#e or practice or philosophy or principles)).ti,kw. 55. six sigma.ti,kw. 56. *Health Services Administration/ or *Health Plan Implementation/ 57. ((change or improv*) adj3 (bundle* or package*)).ti,kw. 58. QIC.ti,ab. 59. or/42-58 [QUALITY IMPROVEMENT interventions] 60. 12 and 18 and (32 or 41 or 59) 61. limit 60 to (english language and yr="2010 -Current") [FINAL SET BEFORE DESIGNS AND FILTERS] 62. developing country/ or low income country/ or middle income country/ 63. (Africa or Asia or West Indies or South America or Central America).hw,ti,ab,kw,cp. 64. (Caribbean or Latin* America*).hw,kw,ti,cp. 65. (Afghanistan or Albania or Algeria or Angola or Antigua or Barbuda or Argentina or Armenia or Armenian or Aruba or Azerbaijan or Bahrain or Bangladesh or Barbados or Benin or Byelarus or Byelorussian or Belarus or Belorussian or Belorussia or Belize or Bhutan or Bolivia or Bosnia or Herzegovina or Hercegovina or Botswana or Brasil or Brazil or Bulgaria or Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cambodia or Khmer Republic or Kampuchea or Cameroon or Cameroons or Cameron or Camerons or Cape Verde or Central African Republic or Chad or Chile or China or Colombia or Comoros or Comoro Islands or Comores or Mayotte or Congo or Zaire or Costa Rica or Cote d'Ivoire or Ivory Coast or Croatia or Cuba or Cyprus or Czechoslovakia or Czech

	Republic or Slovakia or Slovak Republic or Djibouti or French Somaliland or Dominica or Dominican Republic or East Timor or East Timur or Timor Leste or Ecuador or Egypt or United Arab Republic or El Salvador or Eritrea or Estonia or Ethiopia or Fiji or Gabon or Gabonese Republic or Gambia or Gaza or Georgia Republic or Georgian Republic or Ghana or Gold Coast or Greece or Grenada or Guatemala or Guinea or Guam or Guiana or Guyana or Haiti or Honduras or Hungary or India or Maldives or Indonesia or Iran or Iraq or Isle of Man or Jamaica or Jordan or Kazakhstan or Kazakh or Kenya or Kiribati or Korea or Kosovo or Kyrgyzstan or Kirghizia or Kyrgyz Republic or Kirghiz or Kirgizstan or Lao PDR or Laos or Latvia or Lebanon or Lesotho or Basutoland or Liberia or Libya or Lithuania or Macedonia or Madagascar or Malagasy Republic or Malaysia or Malaya or Malay or Sabah or Sarawak or Malawi or Nyasaland or Mali or Malta or Marshall Islands or Mauritania or Mauritius or Agalega Islands or Mexico or Micronesia or Middle East or Moldova or Moldovia or Moldovian or Mongolia or Montenegro or Morocco or Ifni or Mozambique or Myanmar or Myanma or Burma or Namibia or Nepal or Netherlands Antilles or New Caledonia or Nicaragua or Niger or Nigeria or Northern Mariana Islands or Oman or Muscat or Pakistan or Palau or Palestine or Panama or Paraguay or Peru or Philippines or Philipines or Phillipines or Phillippines or Poland or Portugal or Puerto Rico or Romania or Rumania or Roumania or Russia or Russian or Rwanda or Ruanda or Saint Kitts or St Kitts or Nevis or Saint Lucia or St Lucia or Saint Vincent or St Vincent or Grenadines or Samoa or Samoan Islands or Navigator Island or Navigator Islands or Sao Tome or Saudi Arabia or Senegal or Serbia or Montenegro or Seychelles or Sierra Leone or Slovenia or Sri Lanka or Ceylon or Solomon Islands or Somalia or South Africa or Sudan or Suriname or Surinam or Swaziland or Syria or Tajikistan or Tadzhikistan or Tadjikistan or Tadzhik or Tanzania or Thailand or Togo or Togolese Republic or Tonga or Trinidad or Tobago or Tunisia or Turkey or Turkmenistan or Turkmen or Uganda or Ukraine or Uruguay or USSR or Soviet Union or Union of Soviet Socialist Republics or Uzbekistan or Uzbek or Vanuatu or New Hebrides or Venezuela or Vietnam or Viet Nam or West Bank or Yemen or Yugoslavia or Zambia or Zimbabwe or Rhodesia).hw,ti,ab,kw,cp. 66. ((developing or less* developed or under developed or underdeveloped or middle income or low* income or underserved or under served or deprived or poor*) adj (countr* or nation? or population? or world)).ti,ab,kw. 67. (low* adj (gdp or gnp or gross domestic or gross national)).ti,ab. 68. (low adj3 middle adj3 countr*).ti,ab,kw. 69. (lmic or lmics or third world or lami countr*).ti,ab. 70. transitional countr*.ti,ab. 71. or/62-70 [LMIC Filter] 72. (children* or infant? or adolesc* or juvenil* or p?ediatr*).ti. 73. 61 not (71 or 72)
Cochrane Database of Systematic Reviews Issue 10 of 12, October 2020 Searched: 2020-10-26 Results: 1	ID Search #1 ([mh dyspepsia]) OR (dyspep*:ti,kw) OR (indigest*:ti,kw) OR ([mh "Gastroesophageal Reflux"]) OR ("gastro*esophageal reflux":ti,kw) OR ("gastro-esophageal reflux":ti,kw) OR ("gastro-oesophageal reflux":ti,kw) OR ((GERD OR GORD):ti) OR ([mh ^heartburn]) OR (heartburn:ti,kw) OR ((acid NEAR/5 reflux):ti,kw) OR (BARRET*:TI) #2 [mh ^"endoscopy, gastrointestinal"] OR [mh ^gastroscopy] OR ((gastroscop* OR esophagogastroduodenoscop* or Oesophagogastroduodenoscop*):ti,kw)
Cochrane Central Register of Controlled Trials Issue 10 of 12, October 2020 Searched: 2020-10-26 Results:92	#3 #1 OR #2 #4 [mh "Health Services Misuse"] #5 (unnecessar* or necessary or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or appropriate* or unneeded or ineffective):ti,kw #6 [mh ^"Guideline Adherence"] OR [mh "Practice Patterns, Physicians"'] #7 ((guideline or protocol) NEAR/2 (adhere* or complian* or comply or follow* or concordan*)):ti,kw

	#8 (uptake or adopt or implement*):ti,kw #9 [mh ^"Guidelines as Topic"] OR [mh "Referral and consultation"] OR [mh ^"quality assurance, health care"] OR [mh ^"feedback" [mj]] or feedback:ti,kw #10 (quality NEAR/5 (manag* or improv* or enhanc*)):ti,kw #11 [mh ^"Diffusion of Innovation"] #12 ((education* NEAR/3 (program* or intervention? or meeting? or session? or strateg* or workshop? or visit?)) or disease management program):ti,kw #13 [mh ^"clinical audit"] or [mh "medical audit"] OR [mh "decision support techniques"] OR [mh ^"reminder systems"] OR [mh "Reimbursement, Incentive"] #14 #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 #15 #3 AND #14 #16 QUALITY OF LIFE:TI #17 #15 NOT #16 with Publication Year from 2010 to 2020, in Trials #18 #15 NOT #16 with Cochrane Library publication date Between Jan 2010 and Dec 2020, in Cochrane Reviews
EBSCO CINAHL **Searched: 2020-10-23** **Results: 246**	# Query S1 (((MH "dyspepsia+") OR (MH "Gastroesophageal Reflux+") OR (MH "heartburn")) OR (dyspep* or indigest* or "gastro*esophgeal reflux" or "gastro*oesophageal reflux") OR TI (heartburn or heart burn) OR acid N3 reflux*) AND (((MH "endoscopy, gastrointestinal") OR (MH "gastroscopy")) OR TI (endoscop* or gastroscop* or polypectom* OR esophagogastroduodenoscop*) OR SU (endoscop* or gastroscop* or polypectom* OR esophagogastroduodenoscop*) OR TI (asymptomatic OR "symptom free")) S2 ((MH "Diffusion of Innovation+") or (MH "Health Services Misuse+") or (MH "Guideline Adherence")) OR (("uptake of research" OR "use of research" OR "utili*ation of research" OR "diffusion of research" OR "translation of research" OR "transfer of research" OR "dissemination of research" OR "implementation of research" OR "adoption of research")) OR (("uptake of knowledge" OR "use of knowledge" OR "utili*ation of knowledge" OR "diffusion of knowledge" OR "translation of knowledge" OR "transfer of knowledge" OR "dissemination of knowledge" OR "implementation of knowledge" OR "adoption of knowledge")) OR (("uptake of evidence" OR "use of evidence" OR "utili#ation of evidence" OR "diffusion of evidence" OR "translation of evidence" OR "transfer of evidence" OR "dissemination of evidence" OR "implementation of evidence" OR "adoption of evidence")) OR (((innovation* N1 adopt*) OR "adoption of innovation*")) OR (unnecessar* or necessary or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or appropriate* or unneeded or ineffective) OR low value care OR ((guideline* or protocol*) N3 (adhere* or complian* or comply or follow* or concordan* or utiliz$ or utilis$ or "use" or diffus$ or transfer$ or translat$ or disseminat$)) OR (non-adhere* or interval* or uptake or adopt or implement*) OR (referr* OR follow*) S3 ((MH "Referral and Consultation+") OR TI (referr* or path*) OR AB (referr*or path*)) S4 (MH "quality of health care") OR (MH "advance directive adherence") OR (MH "outcome and process assessment, health care+") OR (MH "peer review, health care") OR (MH "professional review organizations") OR (MH "program evaluation+") OR (MH "quality indicators, health care+") S5 (MH "waiting lists+") OR ((wait N3 (time or times or list or lists))) S6 (MH "time factors+") S7 (frequency or number or interval) N15 (preprocedur* or procedur* or postprocedur* or enodoscop* or gastroscop*)

	S8 (MH "Follow-Up Studies+") OR follow*up S9 ((MM "Quality Improvement+") OR (MM "Quality Assurance")) OR ((quality N5 (manag* or improv* or enhanc*))) OR (((process or processes or system or systems) N3 (improving or improvement* or improve or redesign* or enhanc*))) S10 MH "Practice Guidelines" S11 (MH "Professional Compliance") OR (MH "Practice Guidelines/SN/ST/EV") S12 S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 S13 S1 AND S12 Limiters - English Language; Published Date: 20100101-20201231 S14 S1 AND S12 Limiters - English Language; Published Date: 20100101-20201231 Expanders - Apply equivalent subjects Narrow by SubjectGeographic: - canada Narrow by SubjectGeographic: - australia & new zealand Narrow by SubjectGeographic: - uk & ireland Narrow by SubjectGeographic: - continental europe Narrow by SubjectGeographic: - europe Narrow by SubjectGeographic: - usa
Scopus Searched 2020-10-27 Results: 436	((((INDEXTERMS ("dyspepsia") OR INDEXTERMS ("Gastroesophageal Reflux") OR INDEXTERMS ("heartburn"))) OR ((TITLE ("dyspep*") OR TITLE ("indigest*") OR TITLE ("gastro*esophageal reflux") OR TITLE ("GERD") OR TITLE ("heart burn"))) OR ((TITLE ("acid") W/5 TITLE ("reflux")))) AND (TITLE ("endoscop*" OR "gastroscop*" OR "esophagogastroduodenoscop*" OR "oesophagogastroduodenoscop*")) AND ((TITLE ("unnecessar*" OR "necessary" OR "overuse*" OR "overutili*" OR "underuse*" OR "underutili*" OR "misuse*" OR "misutili*" OR "inappropriate*" OR "appropriate*" OR "unneeded" OR "ineffective")) OR (TITLE ("low value care")) OR (TITLE (((guideline* OR protocol*) W/3 (adhere* OR complian* OR comply OR follow* OR concordan*)))) OR (INDEXTERMS ("Practice Patterns, Physicians'") OR INDEXTERMS ("Diffusion of Innovation") OR INDEXTERMS ("Referral and consultation") OR INDEXTERMS ("Quality Improvement") OR INDEXTERMS ("quality assurance, health care") OR INDEXTERMS ("Education, Medical, Continuing") OR INDEXTERMS ("Education, Professional") OR INDEXTERMS ("education,continuing") OR INDEXTERMS ("mandatory reporting") OR INDEXTERMS ("mandatory programs") OR INDEXTERMS ("reminder systems")) OR ((TITLE ("uptake of research") OR TITLE ("use of research") OR TITLE ("utili?ation of research") OR TITLE ("diffusion of research") OR TITLE ("translation of research") OR TITLE ("transfer of research") OR TITLE ("dissemination of research") OR TITLE ("implementation of research") OR TITLE ("adoption of research")) OR (TITLE ("uptake") OR TITLE ("adopt") OR TITLE ("implement*")) OR ((TITLE ("frequency") OR TITLE ("number") OR TITLE ("interval")) W/10 (TITLE ("preprocedur*") OR TITLE ("procedur*") OR TITLE ("postprocedur*") OR TITLE ("endoscop*") OR TITLE ("gastroscop*") OR TITLE ("esophagogastroduodenoscop*") OR TITLE ("oesophagogastroduodenoscop*"))) OR (TITLE ("reduc*") W/5 (TITLE ("resource*") OR TITLE ("procedur*") OR TITLE ("endoscop*") OR TITLE ("gastroscop*") OR TITLE ("esophagogastroduodenoscop*") OR TITLE ("oesophagogastroduodenoscop*"))) OR ((TITLE ("process") OR TITLE ("processes") OR TITLE ("system") OR TITLE ("systems")) W/3 (TITLE ("improving") OR TITLE ("improvement*") OR TITLE ("improve") OR TITLE ("redesign*") OR TITLE ("enhanc*"))) OR ((TITLE ("education*") W/3 (TITLE ("program*") OR TITLE ("intervention?") OR TITLE ("meeting?") OR TITLE ("session?") OR TITLE ("strateg*") OR TITLE ("workshop?") OR TITLE ("visit?"))) OR TITLE ("disease management program")) OR (TITLE ("behavio?r*") W/2 TITLE ("intervention?"))) OR (INDEXTERMS ("reimbursement mechanisms") OR INDEXTERMS ("Health Resources") OR (TITLE ("incentivise") OR TITLE (

	"incentivize") OR TITLE ("incentivization") OR TITLE ("incentivisation") OR TITLE ("incentive*")) OR (TITLE ("fee for service")) OR (TITLE ("pay for performance") OR TITLE ("P4P")) OR (TITLE ("resourc*") W/3 TITLE ("utili*"))))) OR ((((INDEXTERMS ("dyspepsia") OR INDEXTERMS ("Gastroesophageal Reflux") OR INDEXTERMS ("heartburn"))) OR ((KEY ("dyspep*") OR KEY ("indigest*") OR KEY ("gastro*esophageal reflux") OR KEY ("GERD") OR KEY ("heart burn"))) OR ((KEY ("acid") W/5 KEY ("reflux"))))) AND (KEY ("endoscop*" OR "gastroscop*" OR "esophagogastroduodenoscop*" OR "oesophagogastroduodenoscop*")) AND ((KEY ("unnecessar*" OR "necessary" OR "overuse*" OR "overutili*" OR "underuse*" OR "underutili*" OR "misuse*" OR "misutili*" OR "inappropriate*" OR "appropriate*" OR "unneeded" OR "ineffective")) OR (KEY ("low value care")) OR (KEY (((guideline* OR protocol*) W/3 (adhere* OR complian* OR comply OR follow* OR concordan*)))) OR (INDEXTERMS ("Practice Patterns, Physicians'") OR INDEXTERMS ("Diffusion of Innovation") OR INDEXTERMS ("Referral and consultation") OR INDEXTERMS ("Quality Improvement") OR INDEXTERMS ("quality assurance, health care") OR INDEXTERMS ("Education, Medical, Continuing") OR INDEXTERMS ("Education, Professional") OR INDEXTERMS ("education,continuing") OR INDEXTERMS ("mandatory reporting") OR INDEXTERMS ("mandatory programs") OR INDEXTERMS ("reminder systems")) OR ((KEY ("uptake of research") OR KEY ("use of research") OR KEY ("utili?ation of research") OR KEY ("diffusion of research") OR KEY ("translation of research") OR KEY ("transfer of research") OR KEY ("dissemination of research") OR KEY ("implementation of research") OR KEY ("adoption of research")) OR (KEY ("uptake") OR KEY ("adopt") OR KEY ("implement*")) OR ((KEY ("frequency") OR KEY ("number") OR KEY ("interval")) W/10 (KEY ("preprocedur*") OR KEY ("procedur*") OR KEY ("postprocedur*") OR KEY ("endoscop*") OR KEY ("gastroscop*") OR KEY ("esophagogastroduodenoscop*") OR KEY ("oesophagogastroduodenoscop*"))) OR (KEY ("reduc*") W/5 (KEY ("resource*") OR KEY ("procedur*") OR KEY ("endoscop*") OR KEY ("gastroscop*") OR KEY ("esophagogastroduodenoscop*") OR KEY ("oesophagogastroduodenoscop*"))) OR ((KEY ("process") OR KEY ("processes") OR KEY ("system") OR KEY ("systems")) W/3 (KEY ("improving") OR KEY ("improvement*") OR KEY ("improve") OR KEY ("redesign*") OR KEY ("enhanc*"))) OR ((KEY ("education*") W/3 (KEY ("program*") OR KEY ("intervention?") OR KEY ("meeting?") OR KEY ("session?") OR KEY ("strateg*") OR KEY ("workshop?") OR KEY ("visit?"))) OR KEY ("disease management program")) OR (KEY ("behavio?r*") W/2 KEY ("intervention?"))) OR (INDEXTERMS ("reimbursement mechanisms") OR INDEXTERMS ("Health Resources") OR (KEY ("incentivise") OR KEY ("incentivize") OR KEY ("incentivization") OR KEY ("incentivisation") OR KEY ("incentive*")) OR (KEY ("fee for service")) OR (KEY ("pay for performance") OR KEY ("P4P")) OR (KEY ("resourc*") W/3 KEY ("utili*"))))) AND (LIMIT-TO (SUBJAREA , "MEDI") OR LIMIT-TO (SUBJAREA , "NURS") OR LIMIT-TO (SUBJAREA , "HEAL") OR LIMIT-TO (SUBJAREA , "MULT")) AND (LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2011) OR LIMIT-TO (PUBYEAR , 2010)) AND (LIMIT-TO (LANGUAGE , "English"))

ProQuest Dissertations & Theses Global Searched 2020-10-27 Results: 91	(ti(dyspepsia OR indigest* OR gastroesophageal reflux OR GERD or gastroscop* OR endoscop* or esophagogastroduodenoscopy* or oesophagogastroduodenoscopy*) OR su(dyspepsia OR indigest* OR gastroesophageal reflux OR GERD or gastroscop* OR endoscop* or esophagogastroduodenoscopy* or oesophagogastroduodenoscopy*)) AND ((noft(unnecessar*) OR noft(necessary) OR noft(overuse*) OR noft(overutili*) OR noft(underuse*) OR noft(underutili*) OR noft(misuse*) OR noft(misutili*) OR noft(inappropriate*) OR noft(appropriate*) OR noft(concordan*) OR noft(unneeded) OR noft(ineffective) OR noft(reduc*) OR noft(adher*) OR noft(surveill*) OR noft(recall) OR noft(interval*) OR noft(frequen*))) 2010-01-01 - 2020-12-31 English
Grey Literature	
TRIP Pro Database *http://www.tripdatabase.com/* Searched: 2020-10-28 Results:	(title:dyspepsia or "Gastroesophageal Reflux") (title:gastroscop* OR endoscop* or esophagogastroduodenoscopy*)(title:unnecessary OR necessary OR overu* OR overscreen* OR underuse OR underutilize OR misuse OR misutilize OR inappropriate OR appropriate OR concordant OR concordance OR unneeded OR ineffective OR reduce OR reduced OR reduction OR adher*) "dyspepsia endoscop* "~25 (unnecessary or necessary or overu* or overscreen* or underuse or underutilize or misuse or misutilize or inappropriate or appropriate or concordant or concordance or unneeded or ineffective or reduce or reduced or reduction or adher*) from:2010 to:2020 33 results
PDQ Evidence Searched 2020-10-26 Results: 20	(title:(dyspepsia OR gastroscop* OR esophagogastroduodenoscopy* OR oesophagogastroduodenoscopy* OR endoscop*) OR abstract:(dyspepsia OR gastroscop* OR esophagogastroduodenoscopy* OR oesophagogastroduodenoscopy* OR endoscop*)) AND (title:(referr* OR unnecessar* OR necessary OR overuse* OR overutili* OR underuse* OR underutili* OR misuse* OR misutili* OR inappropriate* OR appropriate* OR concordan* OR unneeded OR ineffective OR reduc* OR adher*) OR abstract:(referr* OR unnecessar* OR necessary OR overuse* OR overutili* OR underuse* OR underutili* OR misuse* OR misutili* OR inappropriate* OR appropriate* OR concordan* OR unneeded OR ineffective OR reduc* OR adher*))Publication Year 2010-2020
NICE Evidence https://www.evidence.nhs.uk/ Searched: 2020-10-28 Results:163 Results: 64	(dyspeps* or "Gastroesophageal Reflux") AND (gastroscop* or endoscop* or esophagogastroduodenoscop* or oesophagogastroduodenoscop*) AND (overscreen* OR "de implementation" OR adherence OR overu* OR appropriate)) Evidence Type: Policy and Strategy. All Secondary Evidence, All Primary Research, All Practice Based Information, All implementation Support, Areas of Interest: Clinical, Public Health Date Jan. 1 2010 to Oct. 28, 2020
HTA Database https://database.inahta.org/ Searched: 2020-09-18 Results: 5	(((dyspepsia or gastroscop* OR endoscop* or esophagogastroduodenoscopy*)[Title]) AND ((unnecessar* or necessary or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or appropriate* or concordan* or unneeded or ineffective or reduc* or adher*)[Title] OR (unnecessar* or necessary or overuse* or overutili* or underuse* or underutili* or misuse* or misutili* or inappropriate* or appropriate* or concordan* or unneeded or ineffective or reduc* or adher*)[mh] OR (unnecessar* or necessary or overu* or underuse* or underutili* or misuse* or misutili* or inappropriate* or appropriate* or

	concordan* or unneeded or ineffective or reduc* or adher*)[Keywords])) AND (English)[Language] FROM 2010 TO 2020
HTA Agencies	
AHTA – Adelaide Health Technology Assessment https://www.adelaide.edu.au/ahta/pubs/reportsmonographs/	2020-09-21 Browsed site: 0 results
ASERNIP-S – Australian Safety and Efficacy Register of New Interventional Procedures-Surgical https://www.surgeons.org/research-audit/research-evaluation-inc-asernips/publications	2020-09-21 Browsed publications 0 results
CADTH – Canadian Agency for Drugs and Technologies in Health www.cadth.ca	2020-10-28 Searched: gastroscopy Browsed 16: selected 3 results Searched: endoscopy AND dyspepsia Browsed 16: selected 0 Searched: endoscopy AND GERD Results: 7 selected: 1 Restricted to years 2010-2020
HTRG – Health Technology Reference Group https://www.coag.gov.au/ https://www.coaghealthcouncil.gov.au/AHMAC/Health-Technology-Reference-Group/Reports-and-Briefs	2020-10-28 Browsed Health Technology Reports and Health Technology briefs: 0 results
HIQA – Health Information and Quality Authority https://www.hiqa.ie/	2020-10-28 Browsed site: 0 result
HIS – Healthcare Improvement Scotland http://www.healthcareimprovementscotland.org/	2020-10-29 Searched: endoscopy, gastroscopy, dyspepsia, reflux, GERD, GORD Results: 0

HQO – Health Quality Ontario https://www.hqontario.ca/	2020-10-29 Browsed Publications: 0 results
HTW – Health Technology Wales http://www.healthtechnology.wales/	2020-10-29 Browsed site: 0 results
ICES https://www.ices.on.ca/	2020-10-28 Browsed Publications: 0 results
INESSS – Institut national d'excellence en santé et en services sociaux http://www.inesss.qc.ca	2020-10-29 Browsed Publications: 8 results
Eunethta Assessments https://www.eunethta.eu/assessments/	2020-10-29 Browsed site: 0 results
Aetna Medlical clinical Policy Bulletins https://www.aetna.com/health-care-professionals/clinical-policy-bulletins.html	2020-10-29 Browsed site: 1 result
ECRI https://www.ecri.org	2020-10-29 Browsed General Topics: 0 results
ICER - Institute for Clinical and Economic Review https://icer-review.org/materials/	2020-10-29 Browsed site: 0 results
Washington State Health Care Authority – Heath Technology Assessment Program https://www.hca.wa.gov/about-hca/health-technology-assessment	2020-09-21 Browsed site: 1 result
Medical Services Advisory Committee (MSAC): http://www.msac.gov.au/internet/msac/publishing.nsf/Content/completed-assessments	2020-09-21 Browsed site: 0 results
Veterans Affairs (VA) Evidence-based Synthesis Program (ESP): https://www.hsrd.research.va.gov/publications/esp/reports.cfm	2020-09-21 Browsed site: 0 results
Theta - Toronto Health Economics and Technology Assessment Collaborative https://theta.utoronto.ca/	2020-09-21 Browsed site: 0 results

Associations	
American Society for Gastrointestinal Endoscopy (ASGE) **Technology Committee** **https://www.asge.org/**	2020-09-25 Browsed Tech Assessments 1 result
Canadian Association of Gastroenterology **https://www.cag-acg.org/publications/guideline-library**	2020-10-28 Browsed publications 0 results Handsearched Canadian Journal of Gastroenterology 1 result
ESEG **https://www.esge.com/publications/**	2020-09-25 Browsed Technical Reviews and Quality Improvement 0 results
British society of gastroenterology **https://www.bsg.org.uk/**	2020-09-25 Browsed site: Clinical Resources > Clinical Trials, Care Bundles Clinical Interest > Colorectal, Endoscopy, Gastroduodenal 0 results
Association of Coloproctology of Great Britain and Ireland **https://www.acpgbi.org.uk/research/trials/**	2020-09-25 0 results
Gastroenterological Society of Australia **https://www.gesa.org.au/**	2020-09-25 Browsed site: 0 Results
American Gastroenterology Association **https://gastro.org/**	Searched 2020-10-21 AGA journals site search: Oct. 21-22 Results: 17
Forward Searching in PubMed **2020-dd** **Results: 23**	See folder in Endnote with articles that were searched Oct. 21-22 23 results
Search Engines	
Google Scholar **Searched: 2020-10-26** **Results: 14**	Forward and similar searche Results:14

Google	29-Oct2020 Find strategies in search history Novak dyspepsia Searched researchers with relevant studies Jan 1, 2010 to Sep 30, 2020

Note: †† "*", "# ", and "?" are truncation characters that retrieve all possible suffix variations of the root word, e.g., surg* retrieves surgery, surgical, surgeon, etc. Searches separated by commas have been entered separately into the search interface.

Appendix I: Systematic Review for Interventions for Reducing Endoscopy Overuse, Excluded Studies

I.1 Colorectal adenoma surveillance excluded articles and reason for exclusion

Excluded article type (*N*=30)

Abadir AP, Ali MF, Karnes W, Samarasena JB. Artificial intelligence in gastrointestinal endoscopy. *Clin Endosc* 2020;53(2):132-41.

Borgaonkar M, Pace D, McGrath JS, Harding J. Improving compliance with colonoscopy surveillance interval guidelines. *J Can Assoc Gastroenterol* 2018;1(suppl 1):34.

Bortniker E, Tadros M, Birk J. Surveillance colonoscopy interval: A regression model that renders pathology unnecessary. *Am J Gastroenterol* 2014;109:S597-S8.

Bouwens M, Masclee A, De Ridder RJ, Kaltenbach T, Soetikno RM, Winkens B, et al. Optical diagnosis of colorectal polyps using HD I-scan is feasible and correctly predicts surveillance intervals. *Gastrointest Endosc* 2013;77(5):AB550-AB1.

Chandran S. Can we ease the financial burden of colonoscopy? Using real-time endoscopic assessment of polyp histology to predict surveillance intervals. *Int J Collab Res Intern Med Public Health* 2016;8(3):266.

Chircop AC, Zammit SC, Gerada J, Brincat A. Stricter adherence to surveillance colonoscopy guidelines for colorectal adenomas could result in reduced burden on endoscopy services. *Gut* 2016;65:A197.

Coe SG, Thomas CS, Crook J, Diehl N, Wallace MB. Colorectal surveillance interval assignment based on in-vivo prediction of polyp histology: Impact of endoscopic quality improvement program. *Gastrointest Endosc* 2012;75(4):AB335.

Hassan C, Kaminski MF, Repici A. How to ensure patient adherence to colorectal cancer screening and surveillance in your practice. *Gastroenterology* 2018;155(2):252-7.

Hewett DG, Rex DK. Improving colonoscopy quality through health-care payment reform. *Am J Gastroenterol* 2010;105(9):1925-33.

Holden DJ, Harris R, Deborah S, Porterfield MD, Jonas DE, Laura C, et al. Evidence-based practice center presentation iii: Effective strategies in increasing the appropriate use of colorectal cancer screening and surveillance. *NIH State-of-the-Science Conference* 2010:75.

Kaltenbach T, Hewett D, Rex D, Sato T, Ponchon T, Sano Y, et al. Resect and discard strategy in real-time colonoscopy using the validated narrow band imaging international colorectal endoscopic (NICE) classification provides accurate surveillance interval recommendations. *Am J Gastroenterol* 2011;106:S167-S8.

Karwa A, Patell R, Lopez R, Burke CA. Enabling adherence to colorectal cancer screening and surveillance guidelines in a value-based healthcare system: A mobile solution. *Am J Gastroenterol* 2016;111:S132.

Kishfy L, Dimino J, Borges L. Improving the accuracy of health maintenance reminders in the electronic medical record to promote adherence to colonoscopy surveillance guidelines. *Am J Gastroenterol* 2019;114:S650.

Lee E, Singh H, Simms A, Restall G, Shafer L, Walker J, et al. Development of a decision tool to improve utilisation of recommended surveillance intervals for individuals with colorectal polyps: A focus group analysis. *J Can Assoc Gastroenterol* 2020;3(Suppl 1):34.

Magrath M, Yang E, Murphy CC, Halm EA, Ahn C, Gopal P, et al. Impact of EMR-based colonoscopy results reporting and clinical decision support system on guideline-concordant surveillance recommendations: 263. *Am J Gastroenterol* 2017;112:S143-S4.

Neumann H, Sen HN, Thieringer F, Rahman KF, Tontini GE, Adami B, et al.Blue light imaging (BLI) meets the PIVI recommendations for leaving distal colorectal polyps in place and for prediction of surveillance intervals. *Gastrointest Endosc* 2018;87(6):AB468.

Parthasarathy G, Karwa A, Lopez R, McMichael J, Burke CA. Development of an automated algorithm to generate evidence based recommendations for colonoscopy surveillance intervals. *Gastrointest Endosc* 2018;87(6):AB115-AB6.

Peter S. Electronic clinical decision tools for improving adherence to colon cancer surveillance guidelines: Can the chips finally fall into place? *JNCCN* 2018;16(11):1406-8.

Prabakaran R, Jacobson B, Calderwood A. Assessing appropriate surveillance colonoscopy using the PQRS clinical performance measure# 185: 1986. *Am J Gastroenterol* 2012;107:S810.

Roy A, Latorre M, Spyrou E, Garcia-Carrasquillo R, Rosenberg R, Lebwohl B. Adherence to surveillance guidelines after removal of advanced colorectal adenomas: Experience from a patient navigator program. *Gastroenterology* 2016;151(1):201-3.

Shandro B, Chang V, Mathur JAI, O'Neill P, Groves C, Sadler G, et al. Real-life cost savings and capacity improvements on implementation of the new BSG post-polypectomy surveillance guideline. *Clin Med* 2020;20(1):116-7.

Shung DL, Byrne MF. How artificial intelligence will impact colonoscopy and colorectal screening. *Gastrointest Endosc Clin N Am* 2020;30(3):585-95.

Symonds EL, Cornthwaite K, Fraser RJL, Bampton P, Cock C, Young GP. Reducing the number of surveillance colonoscopies with faecal immunochemical tests. *Gut* 2020;69(4):784-5.

Thomas RA, Rao DS, Gupta N, Gaddam S, Wani SB, Singh V, et al. Does cap-assisted colonoscopy (CAC) significantly impact surveillance interval recommendations compared to standard colonoscopy (SC)? Results from a randomized controlled trial. *Gastrointest Endosc* 2011;73(4):AB287-AB8.

Turner JK, Wright M, Morgan M, Williams GT, Dolwani S. A prospective study of the accuracy and concordance between in-situ and postfixation measurements of colorectal polyp size and their potential impact upon surveillance. *Eur J Gastroenterol Hepatol* 2013;25(5):562-7.

Vahabzadeh B, Overhiser A, Thomas R, Gupta N, Wani S, Gaddam S, et al. How accurate are colonoscopy surveillance intervals based on real-time polyp histology prediction by narrow band imaging (NBI)? *Am J Gastroenterol* 2010;105:S565.

Veerappan A, Gupta S. A standardized pathology reporting workflow improves frequency of guideline concordant post polypectomy surveillance recommendations: 2016 ACG presidential poster award. *Am J Gastroenterol* 2016;111:S137.

Vleugels JLA, Dijkgraaf MGW, Hazewinkel Y, Fockens P, Dekker E. Implementation of an optical diagnosis strategy for diminutive polyps including sessile serrated lesions: Training and long-term quality assurance. *United European Gastroenterol J* 2017;5(5):A105.

Weinberg A, Rivera MA, Khullar V, Riverso M, Estores DS. Adherence to guidelines for repeat colonoscopy before and after distribution of educational material: A single academic medical center quality-improvement experience. *Gastroenterology* 2016;151(1):200-1.

Excluded comparator (*N*=17)

Abu Dayyeh BK, Thosani N, Konda V, Wallace MB, Rex DK, Chauhan SS, et al. ASGE technology committee systematic review and meta-analysis assessing the ASGE PIVI thresholds for adopting real-time endoscopic assessment of the histology of diminutive colorectal polyps. *Gastrointest Endosc* 2015;81(3):502.e1-.e16.

Chandran S, Parker F, Lontos S, Vaughan R, Efthymiou M. Can we ease the financial burden of colonoscopy? Using real-time endoscopic assessment of polyp histology to predict surveillance intervals. *Intern Med J* 2015;45(12):1293-9.

Denis B, Bottlaender J, Weiss AM, Peter A, Breysacher G, Chiappa P, et al. Some diminutive colorectal polyps can be removed and discarded without pathological examination. *Endoscopy* 2011;43(2):81-6.

Imler TD, Morea J, Imperiale TF. Clinical decision support with natural language processing facilitates determination of colonoscopy surveillance intervals. *J Clin Gastroenterol Hepatol* 2014;12(7):1130-6.

Kuruvilla N, Paramsothy R, Gill R, Selby WS, Remedios ML, Kaffes AJ. A prospective dual-center proof-of-principle study evaluating the incremental benefit of narrow-band imaging with a fixed zoom function in real-time prediction of polyp histology. Can we resect and discard? *Gastrointest Endosc* 2015;82(2):362-9.

McGill SK, Soetikno R, Rastogi A, Rouse RV, Sato T, Bansal A, et al. Endoscopists can sustain high performance for the optical diagnosis of colorectal polyps following standardized and continued training. *Endoscopy* 2015;47(3):200-6.

Mori Y, Kudo SE, Chiu PWY, Singh R, Misawa M, Wakamura K, et al. Impact of an automated system for endocytoscopic diagnosis of small colorectal lesions: An international web-based study. *Endoscopy* 2016;48(12):1110-8.

Paggi S, Rondonotti E, Amato A, Terruzzi V, Imperiali G, Mandelli G, et al. Resect and discard strategy in clinical practice: A prospective cohort study. *Endoscopy* 2012;44(10):899-904.

Paggi S, Rondonotti E, Amato A, Fuccio L, Andrealli A, Spinzi G, et al. Narrow-band imaging in the prediction of surveillance intervals after polypectomy in community practice. *Endoscopy* 2015;47(9):808-14.

Picot J, Rose M, Cooper K, Pickett K, Lord J, Harris P, et al. Virtual chromoendoscopy for the real-time assessment of colorectal polyps in vivo: A systematic review and economic evaluation. *Health Technol Assess* 2017;21(79):1-307.

Sola-Vera J, Cuesta R, Uceda F, Morillo E, Perez E, Pico MD, et al. Accuracy for optical diagnosis of colorectal polyps in clinical practice. *Revista Espanola de Enfermedades Digestivas* 2015;107(5):255-61.

Taylor JL, Coleman HG, Gray RT, Kelly PJ, Cameron RI, O'Neill CJ, et al. A comparison of endoscopy versus pathology sizing of colorectal adenomas and potential implications for surveillance colonoscopy. *Gastrointestl Endosc* 2016;84(2):341-51.

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Appendix J: Evidence Summaries for Interventions for Reducing Endoscopy Overuse

Table J.1: Colorectal adenoma surveillance, intervention evidence summaries

Study	Intervention	Assessment methods	Assessment findings	Facilitators and barriers
Training				
Coe et al. (2012)[155] United States Aug. 2 2010–1 Dec. 2010 (pre-intervention) 5 Jan 2011–12 Apr 2011 (post-intervention)	Description: • An Endoscopic Quality Improvement Program (EQUIP) training • Two, 1-hour, small group, in-person training sessions, which discussed "resect and discard" or "diagnose and "leave behind" strategies, using in-vivo pathology predictions, focusing on methods and techniques to increase adenoma detection and recognition of subtle neoplasia and non-neoplasia lesions • Training was concluded with a post-test to confirm competency • Endoscopists who completed training were subsequently provided monthly feedback on their ADR Rationale: • 90% agreement with polypectomy surveillance guidelines is recommended for adopting diagnose and leave strategies, with training needed to achieve accurate predictions Target population: Endoscopists Setting: Ambulatory practices with routine screening, surveillance or diagnostic colonoscopy performance Funding: Not reported	Randomized controlled trial • At the end of the baseline phase (Dec 2010), endoscopists were randomized to receive training or no training (stratified by baseline ADR) • Comparison of surveillance interval assignment before and after the training/no training period N=15 endoscopists n=8 endoscopists with EQUIP training n= 7 endoscopist without EQUIP training	• Surveillance interval accuracy (optically predicted vs pathology determined interval): ○ Trained group: 521 of 692 colonoscopies (75%) in pre-intervention phase vs. 554 of 774 colonoscopies (72%) in post-intervention phase ○ Untrained group: 491 of 695 colonoscopies (71%) in pre-intervention phase vs. 543 of 819 colonoscopies (66%) in post-intervention phase	Facilitators • Not reported Barriers • Group education, when designed for individual instruction
Enablement				

Study	Intervention	Assessment methods	Assessment findings	Facilitators and barriers
Alvarado et al. (2016)[154] United States Apr 2004–Dec 2005 (pre-intervention) Jan. 2006–June 2007 (post-intervention)	Description: • Polyp-tracking registry and notification system, using an excel-based program • All patients with adenomatous polyps and a corresponding 3–5 year surveillance recommendation were recorded in the registry, then a monthly list of those due for surveillance would be generated; those due for surveillance would be contacted by the endoscopy centre and referred Rationale: Having patients and their primary care providers request surveillance colonoscopy at the appropriate interval leads to non-adherence Target population: Colonoscopist, patient, primary care provider Setting: Military medical center Funding: Not reported	Retrospective cohort study • Comparison before and after implementation of the registry in Jan 2006 N=853 patients	• Scoped within a year of recommendation ○ Pre-registry: 107 of 340 (31.5%) ○ Post-registry: 312 of 513 (60.8%) • Scoped >1 year after recommendation ○ Pre-registry: 70 of 340 (20.6%) ○ Post-registry: 17 of 513 (3.3%) • Scoped early (due to symptoms or abnormal imaging): 12 (3.5%) ○ Pre-registry: 12 of 340 (3.5%) ○ Post-registry: 16 of 513 (3.1%) • Surveillance colonoscopy not completed: ○ Pre-registry: 125 of 340 (36.8%) ▪ Referred, but no-show or cancellation: 25 of 125 (20.3%) ○ Post-registry: 134 of 513 (26.1%) ▪ Referred, but no-show or cancellation: 82 of 134 (61.2%) • Other (deceased, too sick, no longer eligible for services): ○ Pre-registry: 26 of 340 (7.6%) ○ Post-registry: 34 of 513 (6.6%)	Facilitators • Institution-level integration with Patient Centered Medical Home • Stakeholder engagement • Potential for improved reimbursement Barriers • Not reported
Magrath et al. (2018) [89, 158] United States June 2011–Nov. 2013 (pre-intervention) Oct. 2014 -Sep 2015 (post-intervention)	Description: • EMR–based Colonoscopy Pathology Reporting and Clinical Decision Support System (CoRS) • Colonoscopist select procedure (indication, completeness, bowel preparation quality) and pathology (number of polyps found, worst finding on pathology, piecemeal resection) variables in EMR, then CoRS generates a recommendation (which can be overridden) with accompanying progress note and patient letter.	Retrospective cohort Study • Comparison before and after implementation of CoRS in Dec 2013 N=3,142 colonoscopies	• Pre-CoRS (n=1,822) ○ Guideline-discordance: 415 (22.6%) ▪ Interval too long (underuse): 85 (20.6%) ▪ Interval too short (overuse): 263 (63.8%) ▪ No recommendation: 64 (15.5%) • Post-CoRS (n=1,320) ○ CoRS used for 1,186 (89.9%) of colonoscopies ▪ Likelihood of guidelines-adherent recommendation with use (87.0% adherent with CoRS use vs.	Facilitators • Stakeholder engagement Barriers • Disruption in workflow • Distrust in accuracy

Study	Intervention	Assessment methods	Assessment findings	Facilitators and barriers
	Rationale: Provider and patient correspondence influences surveillance adherence. Target population: Colonoscopist Setting: Parkland-UT Southwestern Colonoscopic Reporting System, using NoteWriter feature in Epic System Funding: developed with funds through NCI		63.4% adherent without CoRS, aRR 1.34, 95% CI [1.24, 1.42])‡ ○ Guideline-discordance: 203 (15.3%)‡ ▪ Interval too long (underuse): 41 (20.2%) ▪ Interval too short (overuse): 143 (70.4%) ▪ No recommendation: 19 (9.4%) ▪ Overuse was less likely with CoRS use (RR 0.55, 95% CI [0.33, 0.88])*	
Environmental restructuring				
Cross et al. (2019)[156, 159] United Kingdom Jan 2012–Dec 2013	Description: • Yearly fecal immunochemical tests (FIT) for those patients at intermediate risk for CRC (age 60–72, with 3–4 small adenomas or one ≥10 mm in size) • Individuals were given a FIT kit, instructions, and a pre-paid return envelope at 1-, 2-, and 3-years post-polypectomy • FIT results were reported to the patient and primary care provider, while affiliated screening centres were notified of individuals with a positive FIT (hemoglobin >20–40 µg/g) and instructed to offer a colonoscopy • FIT positive patients in years 1 or 2 were not offered further FIT testing after their positive result Rationale: • Current polypectomy surveillance is burdensome for both patients and endoscopy services Target population: Patients	Prospective cohort study • Calculation of diagnostic yield, patient satisfaction and preferences and the incremental costs per additional advanced adenoma and CRC detected by colonoscopy vs FIT N=8,009 intermediate risk patients	• FIT Uptake: ○ Year 1: 5,938 of 8,009 (74.1%) ○ Year 2: 5,329 of 5,479 (97.3%) ○ Year 3: 5,022 of 5,179 (97.0%) • Colonoscopies preformed: ○ Due to positive FIT: 713 of 785 (90.7%) ○ Routine 3-year surveillance colonoscopy (no FIT or negative FIT): 4,420 of 7,224 (61.2%) ○ By using annual FIT instead of a 3-year colonoscopy, up to 71% of colonoscopies could be reduced. • Diagnostic yield: ○ Positive FIT: ▪ Colorectal cancer: 17 of 713 (2.8%) ▪ Advanced adenomas: 151 of 713 (24.0%) ○ Routine colonoscopy: ▪ Colorectal cancer: 12 of 4,420 (0.3%)	Facilitators • Frequent reassurance for patients • Easy to administer Barriers • Distrust in FIT accuracy

Study	Intervention	Assessment methods	Assessment findings	Facilitators and barriers
	Setting: National Bowel Cancer Screening Program Funding: Not reported		▪ Advanced adenomas: 295 of 4,420 (6.7%) ○ By using annual FIT instead of a 3-year colonoscopy, up to 30–40% of CRCs and 40–70% of advanced adenomas could be missed • Patient satisfaction:[136] ○ FIT makes me anxious: 1,307 of 4,840 (26.8%) ○ Concerned about FIT's ability to detect polyps: 1,416 of 4,856 (29.2%) ○ Worried while waiting for FIT results: 362 of 4,990 (7.3%) • Patient preference (n=4,279):[136] ○ Routine colonoscopy every 3 years and no FIT: 379 (8.9%) ○ Routine colonoscopy every 3 years plus yearly annual FIT: 2,478 (57.9%) ○ Yearly FIT with colonoscopy if there is a positive result: 1,347 (31.5%) ○ No surveillance: 75 (1.8%) • Cost analysis (3-year colonoscopy surveillance vs 3 annual FITs): ○ Mean incremental cost per participant was £365 ○ Total cost difference was £2,169,341 ○ Incremental cost per additional CRC detected by colonoscopy: £7,354 ○ Incremental cost per additional advanced adenoma detected by colonoscopy: £180,778 ○ Total estimated savings, over one screening cycle: £4,700,000.	
Persuasion				

Study	Intervention	Assessment methods	Assessment findings	Facilitators and barriers
Uche-Anya et al. (2020)[157] United States Jan 2013–Dec 2014	Description: • Feedback initiative, whereby report cards are generated from the colonoscopy quality registry and distributed quarterly to participating endoscopists via email • Report card metrics (individual endoscopist, site, city) included ADR, cecal intubation rate, withdrawal time, bowel preparation, surveillance interval recommendations following a colonoscopy with no neoplasia identified Rationale: • Colonoscopy utility is a function of the quality of the examination • performance on quality metrics varies widely among endoscopists Target population: Endoscopists Setting: Sites participating in colonoscopy quality registry Funding: Registry was developed with funding by the CDC	Prospective Cohort Study • Trends over time in colonoscopy quality indicators at site and provider levels N=194 endoscopists at 10 sites	• 37,258 screening colonoscopies were preformed • Provider characteristics: ○ Gastroenterologist: 83.2% ○ Average annual colonoscopy volume: 96.0 (24.7–133.1) • Guideline-discordant surveillance interval for no neoplasia identified (10 years) ○ 2013 Q1: 72% (range 13.9–100%) ○ 2013 Q2: 63.1% ○ 2013 Q3: 61.9% ○ 2013 Q4: 59.4% ○ 2014 Q1: 55.3% ○ 2014 Q2: 52.4% ○ 2014 Q3: 52.3% ○ 2014 Q4: 45.0% ○ There was a statistically significant trend toward adherence‡ • Reason for endoscopist non-adherence (n=33 endoscopists): 50% reported they may recommend a shorter interval due to fear of interval cancer or patient preference	Not reported

*p<0.05
†p<0.01
‡p<0.001
§not significant.

ADR: adenoma detection rate; aRR: adjusted relative risk; CDC: Centers for Disease Control and Prevention CI; confidence interval; CoRS: Colonoscopy Pathology Reporting and Clinical Decision Support System; CRC: colorectal cancer; EMR: electronic medical record; EQUIP: Endoscopic Quality Improvement Program; FIT: fecal immunochemical test; NCI: National Cancer Institute; RR: relative risk.

Table J.2: Dyspepsia/Gastroesophageal reflux, intervention evidence summaries

Study	Intervention	Assessment methods	Assessment findings	Facilitators and barriers
Environmental restructuring				
Novak et al. (2020)[160] Canada Nov. 2011–Dec. 2014	Description: • Nurse-led shared medical appointment pathway • Patients who were centrally referred for non-urgent gastroenterology consultation were offered a multi-disciplinary education session and shared medical appointment instead of seeing a gastroenterologist • At the time of booking the patient into the appointment, a GI-experienced registered nurse took detailed phone history • The nurse-facilitated group education session included a pharmacist, behaviour change consultant, and dietitian provided information with the goal of improving patient knowledge on symptoms and self-management techniques • After completing the group session, patients were individually assessed by a primary care physician with interest in gastroenterology or a gastroenterologist • The nurse completed telephone follow up 6 months after their appointment Rationale: • Shared medical appointments have been successful implemented elsewhere and support chronic disease management within the patient's medical home Target population: Adults patients with dyspepsia, GERD, IBS, or abdominal	Prospective Cohort study • Comparison of patients receiving the intervention (Calgary Foothills Primary network) vs. usual care (other Primary Care Networks) for safety, accessibility and feasibility N=7,70 patients n=411 patients receiving the intervention n= 359 patients receiving usual care	• Total endoscopies completed: ○ Usual care cohort: 307 procedures for 193 patients (76.3%) ▪ Colonoscopy: 90 of 307 (29.3%) ▪ EGD: 203 of 307 (66.1%) ▪ Other (sigmoidoscopy, thin scope endoscopy, endoscopic ultrasound): 14 of 307 (4.6%) • Significant disease/precursor conditions identified: ○ Intervention cohort: 298 procedures for 209 patients (50.9%)‡ ▪ Colonoscopy: 100 of 298 (33.6%) ▪ EGD: 184 of 298 (61.7%) ▪ Other (sigmoidoscopy, thin scope endoscopy, endoscopic ultrasound): 14 of 298 (4.7%) • Significant disease/precursor conditions identified: ○ Usual care cohort: 21 (5.8%) ○ Intervention cohort: 15 (3.6%)§ • Median wait time to endoscopy (weeks [IQR]): ○ Usual care cohort: 65.00 [46.14–131.64] ○ Intervention cohort: 36.69 [23.29–64.14]‡ • Re-referrals: ○ Usual care cohort: 56 (15.6%) ○ Intervention cohort: 19 (4.6%)‡	Facilitators • Patient empowerment • Peer to peer support • Interdisciplinary collaboration Barriers • Not reported

Study	Intervention	Assessment methods	Assessment findings	Facilitators and barriers
	pain, but without alarm symptoms, referred for gastroenterology consult Setting: Primary care Funding: Quality improvement grants for intervention development, general physician and primary care network funding for ongoing intervention sustainment.			

*p<0.05.
†p<0.01.
‡p<0.001.
§not significant.

EGD: esophagogastroduodenoscopy; GERD: gastroesophageal reflux disease; GI: gastrointestinal; IBS: irritable bowel syndrome; IQR: interquartile range.

Appendix K: Epidemiology of Endoscopy Use in Alberta and Endoscopy Rates by Health Zone

Table K.1: Endoscopy procedures included in the study based on Canadian Classification of Health Interventions

Procedure description	CCI code
Gastroscopy	
Capsule endoscopy	3.OZ.94.^^
Esophagogastroduodenoscopy (EGD)	2.NK.70.^^
Gastroscopy (for inspection)	2.NF.70.^^
Gastroscopy with biopsy	2.NF.71.^^
Double balloon enteroscopy	2.NK.70.^^
Colonoscopy	
Colonoscopy (for inspection)	2.NM.70.^^
Colonoscopy with biopsy	2.NM.71.^^
Virtual colonoscopy (using computed tomography)	3.NM.20.^^
Sigmoidoscopy (for inspection)	2.NM.70.^^
Sigmoidoscopy with biopsy	2.NM.71.^^
Rectoscopy (for inspection)	2.NQ.70.^^
Rectoscopy with biopsy	2.NQ.71.^^
Anoscopy (for inspection)	2.NT.70.^^

CCI: Canadian Classification of Health Interventions.

Table K.2: Endoscopy procedures included in the study based on Health Service Canadian Classification of Procedures Extended Code

Procedure description	HSCCPC
Gastroscopy	
Other nonoperative esophagoscopy, rigid	01.12
Other nonoperative esophagoscopy (Functional endoscopic esophageal study)	01.12A
Other nonoperative esophagoscopy (Other nonoperative esophagoscopy, rigid	01.12B
Other nonoperative gastroscopy (Esophagogastroscopy)	01.14
Other nonoperative endoscopy of small intestine (Small bowel capsule endoscopy, interpretation, per 15 minutes or major portion thereof)	01.16A
Other nonoperative endoscopy of small intestine (Balloon [single or double] enteroscopy, rectal route)	01.16B
Other nonoperative endoscopy of small intestine (Balloon [single or double] enteroscopy, oral route)	01.16C
Colonoscopy	
Other nonoperative colonoscopy [Other nonoperative colonoscopy]	01.22

Procedure description	HSCCPC
Nonoperative endoscopy of lower gastrointestinal tract [Other nonoperative colonoscopy for screening of high-risk patients]	01.22A
Nonoperative endoscopy of lower gastrointestinal tract [Other nonoperative colonoscopy for screening of moderate risk patients]	01.22B
Nonoperative endoscopy of lower gastrointestinal tract [Other nonoperative colonoscopy for screening of average risk patients]	01.22C
Other nonoperative proctosigmoidoscopy [Rigid proctosigmoidoscopy]	01.24A
Other non-operative proctosigmoidoscopy [Flexible proctosigmoidoscopy, diagnostic only]	01.24B
Other nonoperative proctosigmoidoscopy [Flexible proctosigmoidoscopy for screening of patients considered to be of high risk for CRC due to a family history of Familial Adenomatous Polyposis]	01.24BA
Other nonoperative proctosigmoidoscopy [Flexible proctosigmoidoscopy for screening of patients who are considered to be of average risk for CRC]	01.24BB

CRC: colorectal cancer; HSCCPC: Health Service Canadian Classification of Procedures Extended Code.

Table K.3: Endoscopy procedures based on Canadian Classification of Health Interventions, for geographic analysis

Procedure description	CCI code
Gastroscopy	
Esophagogastroduodenoscopy	2.NK.70.^^
Gastroscopy (for inspection)	2.NF.70.^^
Gastroscopy with biopsy	2.NF.71.^^
Colonoscopy	
Colonoscopy (for inspection)	2.NM.70.^^
Colonoscopy with biopsy	2.NM.71.^^

CCI: Canadian Classification of Health Interventions.

Table K.4: Endoscopy procedures based on Health Service Canadian Classification of Procedures Extended Code, for geographic analysis

Procedure description	HSCCPC
Gastroscopy	
Other nonoperative gastroscopy (Esophagogastroscopy)	01.14
Colonoscopy	
Other nonoperative colonoscopy [Other nonoperative colonoscopy]	01.22
Nonoperative endoscopy of lower gastrointestinal tract [Other nonoperative colonoscopy for screening of high-risk patients]	01.22A
Nonoperative endoscopy of lower gastrointestinal tract [Other nonoperative colonoscopy for screening of moderate risk patients]	01.22B
Nonoperative endoscopy of lower gastrointestinal tract [Other nonoperative colonoscopy for screening of average risk patients]	01.22C

HSCCPC: Health Service Canadian Classification of Procedures Extended Code.

Table K.5: International Statistical Classification of Diseases and Related Health Problems and Health Service Canadian Classification of Procedures Extended Code for colon screening and surveillance

Condition description	ICD-10	ICD-9-CA	HSCCPC
ICD code for screening			
Screening colonoscopy encounter	Z12.11	V76.51	
HSCCPC code for colon screening			
Nonoperative endoscopy of lower gastrointestinal tract (Other nonoperative colonoscopy for screening of high-risk patients)			1.22A
Nonoperative endoscopy of lower gastrointestinal tract (Other nonoperative colonoscopy for screening of moderate risk patients)			1.22B
Nonoperative endoscopy of lower gastrointestinal tract (Other nonoperative colonoscopy for screening of average risk patients)			1.22C
Other nonoperative proctosigmoidoscopy (Flexible proctosigmoidoscopy for screening of patients considered to be of high risk for CRC due to a family history of Familial Adenomatous Polyposis)			01.24BA
Other nonoperative proctosigmoidoscopy (Flexible proctosigmoidoscopy for screening of patients who are considered to be of average risk for CRC)			01.24BB

CRC: colorectal cancer; HSCCPC: Health Service Canadian Classification of Procedures Extended Code; ICD: International Statistical Classification of Diseases and Related Health Problems.

TABLE K.6: International Statistical Classification of Diseases and Related Health Problems code for identification of adenoma

Condition description	ICD-10	ICD-9-CA
ICD code for adenoma		
Personal history of colonic polyps	Z86.010	V12.72
Adenomatosis of colon (Benign neoplasm of colon)	D12.6	211.3
Anal polyp	K62.0	569.0
Rectal polyp	K62.1	569.0
Polyp of colon	K63.5	211.3

ICD: International Statistical Classification of Diseases and Related Health Problems.

TABLE K.7: International Statistical Classification of Diseases and Related Health Problems code for identification of gastroesophageal reflux and dyspepsia

Condition description	ICD-10	ICD-9-CA
Gastroesophageal reflux disease	K21	530.81
Dyspepsia	K30; R10.1	536.8

ICD: International Statistical Classification of Diseases and Related Health Problems.

Table K.8: International Statistical Classification of Diseases and Related Health Problems code for identification of excluded conditions when evaluating esophagogastroduodenoscopy for patients with gastroesophageal reflux

Condition description	ICD-10	ICD-9-CA
Barrett esophagus	K22.7	530.85
Malignant neoplasm of esophagus	C15	150

ICD: International Statistical Classification of Diseases and Related Health Problems.

Table K.9: Endoscopy rate by health zones in 2018

Zone	Procedure rate per 100,000 pops in 2018	Number of endoscopists per 100,000 pops in 2018*	Procedures provided by gastroenterologist in 2018, n (%)	Procedures provided by general surgeon in 2018, n (%)	Procedures provided by other providers in 2018, n (%)
South	7,532	8.5	2,549 (14.3)	11,419 (64.3)	3,796 (21.4)
Calgary	6,711	5.9	55,397 (64.3)	17,177 (19.9)	13,605 (15.8)
Central	9,283	9.5	12,439 (36.3)	9,658 (28.2)	12,142 (35.5)
Edmonton	7,543	7.8	43,689 (53.6)	14,395 (17.7)	23,421 (28.7)
North	7,808	7.3	5,654 (19.5)	13,748 (47.4)	9,587 (33.1)

Table K.10: Gastroscopy rate by health zones in 2018

Zone	Procedure rate per 100,000 pops in 2018	Number of endoscopists per 100,000 pops in 2018	Procedures provided by gastroenterologist in 2018, n (%)	Procedures provided by general surgeon in 2018, n (%)	Procedures provided by other providers in 2018, n (%)
South	3,130	8.5	1,235 (16.7)	4,514 (61.1)	1,634 (22.1)
Calgary	2,689	5.9	25,283 (73.2)	2,361 (6.8)	6,886 (19.9)
Central	4,500	9.5	6,728 (40.5)	3,885 (23.4)	5,984 (36.1)
Edmonton	2,962	7.8	18,162 (56.8)	3,708 (11.6)	10,131 (31.7)
North	3,762	7.3	2,726 (19.5)	6,391 (45.8)	4,852 (34.7)

Table K.11: Colonoscopy rate by health zones in 2018

Zone	Procedure rate per 100,000 pops in 2018	Number of endoscopists per 100,000 pops in 2018	Procedures provided by gastroenterologist in 2018, n (%)	Procedures provided by general surgeon in 2018, n (%)	Procedures provided by other providers in 2018, n (%)
South	4,402	8.5	1,314 (12.7)	6,905 (66.5)	2,162 (20.8)
Calgary	4,022	5.9	30,114 (58.3)	14,816 (28.7)	6,719 (13)
Central	4,783	9.5	5,711 (32.4)	5,773 (32.7)	6,158 (34.9)
Edmonton	4,582	7.8	25,527 (51.6)	10,687 (21.6)	13,290 (26.8)
North	4,045	7.3	2,928 (19.5)	7,357 (49)	4,735 (31.5)

*Endoscopist can performed services in more than a health zone. Therefore, assignment of an endoscopist by health zone was based on the health zone where the endoscopist performed the most endoscopy procedures.

Table K.12: Endoscopy utilization in Alberta by health zone and age group, 2010-2018

Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018
Procedure by health zone, n (%)									
South	14,857	15,895	15,876	16,524	16,662	17,330	17,950	16,572	17,764
18-29 years	804 (5.4)	1,023 (6.4)	990 (6.2)	1,018 (6.2)	986 (5.9)	1,057 (6.1)	1,053 (5.9)	976 (5.9)	1,056 (5.9)
30-39 years	1,185 (8)	1,179 (7.4)	1,194 (7.5)	1,389 (8.4)	1,420 (8.5)	1,527 (8.8)	1,650 (9.2)	1,462 (8.8)	1,589 (8.9)
40-49 years	2,180 (14.7)	2,142 (13.5)	2,106 (13.3)	2,009 (12.2)	2,069 (12.4)	2,076 (12)	2,069 (11.5)	1,993 (12)	2,224 (12.5)
50-59 years	4,036 (27.2)	4,463 (28.1)	4,531 (28.5)	4,526 (27.4)	4,109 (24.7)	4,266 (24.6)	4,190 (23.3)	3,810 (23)	3,934 (22.1)
60-69 years	3,443 (23.2)	3,731 (23.5)	3,811 (24)	3,932 (23.8)	4,127 (24.8)	4,440 (25.6)	4,803 (26.8)	4,327 (26.1)	4,726 (26.6)
70-79 years	2,225 (15)	2,293 (14.4)	2,187 (13.8)	2,459 (14.9)	2,825 (17)	2,701 (15.6)	2,958 (16.5)	2,911 (17.6)	3,136 (17.7)
≥80 years	984 (6.6)	1,064 (6.7)	1,057 (6.7)	1,191 (7.2)	1,126 (6.8)	1,263 (7.3)	1,227 (6.8)	1,093 (6.6)	1,099 (6.2)
Calgary	60,329	62,942	71,448	75,775	81,219	82,443	86,502	84,089	86,179
18-29 years	3,762 (6.2)	3,799 (6)	3,770 (5.3)	3,853 (5.1)	4,240 (5.2)	4,453 (5.4)	5,004 (5.8)	4,464 (5.3)	4,550 (5.3)
30-39 years	4,989 (8.3)	5,330 (8.5)	5,573 (7.8)	5,883 (7.8)	6,638 (8.2)	7,417 (9)	8,745 (10.1)	8,261 (9.8)	8,429 (9.8)
40-49 years	10,071	9,478	9,389	9,896	10,543	11,428	12,762	12,161	12,732
	(16.7)	(15.1)	(13.1)	(13.1)	(13)	(13.9)	(14.8)	(14.5)	(14.8)
50-59 years	18,543 (30.7)	19,337 (30.7)	24,739 (34.6)	27,267 (36)	27,098 (33.4)	25,176 (30.5)	23,943 (27.7)	22,983 (27.3)	22,700 (26.3)

Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018
60-69 years	12,776 (21.2)	14,343 (22.8)	17,186 (24.1)	17,834 (23.5)	19,631 (24.2)	20,197 (24.5)	21,808 (25.2)	21,497 (25.6)	22,068 (25.6)
70-79 years	7,164 (11.9)	7,592 (12.1)	7,805 (10.9)	7,831 (10.3)	9,620 (11.8)	10,210 (12.4)	10,643 (12.3)	11,090 (13.2)	11,981 (13.9)
≥80 years	3,024 (5)	3,063 (4.9)	2,986 (4.2)	3,211 (4.2)	3,449 (4.2)	3,562 (4.3)	3,597 (4.2)	3,633 (4.3)	3,719 (4.3)
Central	24,181	25,979	27,196	27,800	29,082	29,364	32,176	32,807	34,239
18-29 years	1,540 (6.4)	1,505 (5.8)	1,671 (6.1)	1,738 (6.3)	1,684 (5.8)	1,615 (5.5)	1,791 (5.6)	1,718 (5.2)	1,796 (5.2)
30-39 years	1,881 (7.8)	1,953 (7.5)	2,133 (7.8)	2,250 (8.1)	2,323 (8)	2,404 (8.2)	2,646 (8.2)	2,645 (8.1)	2,752 (8)
40-49 years	3,725 (15.4)	3,863 (14.9)	3,718 (13.7)	3,846 (13.8)	3,594 (12.4)	3,589 (12.2)	3,954 (12.3)	4,038 (12.3)	4,078 (11.9)
50-59 years	6,163 (25.5)	6,830 (26.3)	7,291 (26.8)	7,373 (26.5)	7,611 (26.2)	7,689 (26.2)	8,007 (24.9)	8,014 (24.4)	8,053 (23.5)
60-69 years	5,416 (22.4)	6,047 (23.3)	6,258 (23)	6,536 (23.5)	7,250 (24.9)	7,562 (25.8)	8,450 (26.3)	8,823 (26.9)	9,362 (27.3)
70-79 years	3,771 (15.6)	3,933 (15.1)	4,316 (15.9)	4,131 (14.9)	4,774 (16.4)	4,655 (15.9)	5,376 (16.7)	5,626 (17.1)	6,262 (18.3)
≥80 years	1,685 (7)	1,848 (7.1)	1,809 (6.7)	1,926 (6.9)	1,846 (6.3)	1,850 (6.3)	1,952 (6.1)	1,943 (5.9)	1,936 (5.7)
Edmonton	59,439	61,609	66,526	67,985	69,740	70,785	79,280	79,035	81,505
18-29 years	4,206 (7.1)	4,313 (7)	4,814 (7.2)	4,582 (6.7)	4,673 (6.7)	4,622 (6.5)	4,884 (6.2)	5,053 (6.4)	4,954 (6.1)
30-39 years	5,259 (8.8)	5,661 (9.2)	5,946 (8.9)	6,359 (9.4)	6,532 (9.4)	6,341 (9)	7,074 (8.9)	7,528 (9.5)	8,054 (9.9)
40-49 years	9,502	9,503	10,256	9,662	9,033	9,052	10,286	10,126	10,836

Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018
	(16)	(15.4)	(15.4)	(14.2)	(13)	(12.8)	(13)	(12.8)	(13.3)
50-59 years	15,131	15,901	16,803	17,475	17,343	17,640	20,195	19,336	19,151
	(25.5)	(25.8)	(25.3)	(25.7)	(24.9)	(24.9)	(25.5)	(24.5)	(23.5)
60-69 years	12,557	13,161	14,359	15,195	16,559	17,704	20,531	20,235	20,595
	(21.1)	(21.4)	(21.6)	(22.4)	(23.7)	(25)	(25.9)	(25.6)	(25.3)
70-79 years	8,577	8,718	9,746	9,917	10,717	10,651	11,773	12,006	13,199
	(14.4)	(14.2)	(14.6)	(14.6)	(15.4)	(15)	(14.8)	(15.2)	(16.2)
≥80 years	4,207	4,352	4,602	4,795	4,883	4,775	4,537	4,751	4,716
	(7.1)	(7.1)	(6.9)	(7.1)	(7)	(6.7)	(5.7)	(6)	(5.8)
North	22,945	22,747	23,913	24,492	25,724	27,087	28,698	29,009	28,989
18-29 years	1,736	1,811	1,939	2,037	2,040	1,887	2,051	1,958	1,914
	(7.6)	(8)	(8.1)	(8.3)	(7.9)	(7)	(7.1)	(6.7)	(6.6)
30-39 years	2,318	2,471	2,492	2,520	2,843	2,895	3,168	3,309	3,186
	(10.1)	(10.9)	(10.4)	(10.3)	(11.1)	(10.7)	(11)	(11.4)	(11)
40-49 years	4,406	4,131	4,334	4,248	4,026	4,294	4,391	4,482	4,516
	(19.2)	(18.2)	(18.1)	(17.3)	(15.7)	(15.9)	(15.3)	(15.5)	(15.6)
50-59 years	6,477	6,192	6,683	6,933	7,283	7,738	7,772	7,658	7,589
	(28.2)	(27.2)	(27.9)	(28.3)	(28.3)	(28.6)	(27.1)	(26.4)	(26.2)
60-69 years	4,424	4,572	4,621	4,713	5,390	6,121	6,470	6,665	6,859
	(19.3)	(20.1)	(19.3)	(19.2)	(21)	(22.6)	(22.5)	(23)	(23.7)
70-79 years	2,615	2,592	2,721	2,912	3,094	3,253	3,760	3,792	3,819
	(11.4)	(11.4)	(11.4)	(11.9)	(12)	(12)	(13.1)	(13.1)	(13.2)
≥80 years	969	978	1,123	1,129	1,048	899	1,086	1,145	1,106
	(4.2)	(4.3)	(4.7)	(4.6)	(4.1)	(3.3)	(3.8)	(3.9)	(3.8)

Table K.13: Gastroscopy utilization in Alberta by health zone and age group, 2010-2018

Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018
Procedure by health zone, n (%)									
South	5,555	5,937	6,095	6,612	6,742	7,124	7,478	6,967	7,383
18-29 years	393 (7.1)	502 (8.5)	518 (8.5)	572 (8.7)	499 (7.4)	571 (8)	549 (7.3)	497 (7.1)	511 (6.9)
30-39 years	539 (9.7)	567 (9.6)	562 (9.2)	687 (10.4)	740 (11)	785 (11)	894 (12)	732 (10.5)	789 (10.7)
40-49 years	887 (16)	894 (15.1)	898 (14.7)	935 (14.1)	917 (13.6)	960 (13.5)	998 (13.3)	959 (13.8)	1,067 (14.5)
50-59 years	1,288 (23.2)	1,410 (23.7)	1,382 (22.7)	1,517 (22.9)	1,553 (23)	1,588 (22.3)	1,498 (20)	1,444 (20.7)	1,451 (19.7)
60-69 years	1,152 (20.7)	1,166 (19.6)	1,305 (21.4)	1,308 (19.8)	1,397 (20.7)	1,584 (22.2)	1,734 (23.2)	1,552 (22.3)	1,698 (23)
70-79 years	838 (15.1)	852 (14.4)	864 (14.2)	967 (14.6)	1,061 (15.7)	991 (13.9)	1,144 (15.3)	1,157 (16.6)	1,285 (17.4)
≥80 years	458 (8.2)	546 (9.2)	566 (9.3)	626 (9.5)	575 (8.5)	645 (9.1)	661 (8.8)	626 (9)	582 (7.9)
Calgary	21,682	21,605	25,172	27,108	30,738	32,752	34,278	33,921	34,530
18-29 years	1,693 (7.8)	1,752 (8.1)	1,781 (7.1)	1,752 (6.5)	2,067 (6.7)	2,070 (6.3)	2,251 (6.6)	2,033 (6)	2,008 (5.8)
30-39 years	2,232 (10.3)	2,340 (10.8)	2,496 (9.9)	2,621 (9.7)	3,114 (10.1)	3,342 (10.2)	3,654 (10.7)	3,659 (10.8)	3,482 (10.1)
40-49 years	3,881 (17.9)	3,723 (17.2)	3,850 (15.3)	4,190 (15.5)	4,640 (15.1)	5,161 (15.8)	5,412 (15.8)	5,368 (15.8)	5,537 (16)
50-59 years	5,429 (25)	5,077 (23.5)	7,175 (28.5)	7,922 (29.2)	8,805 (28.6)	8,947 (27.3)	8,732 (25.5)	8,308 (24.5)	8,302 (24)
60-69 years	4,079	4,230	5,205	5,758	6,614	7,292	7,885	7,872	8,148

Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018
	(18.8)	(19.6)	(20.7)	(21.2)	(21.5)	(22.3)	(23)	(23.2)	(23.6)
70-79 years	2,787	2,920	3,085	3,133	3,724	4,063	4,373	4,614	4,949
	(12.9)	(13.5)	(12.3)	(11.6)	(12.1)	(12.4)	(12.8)	(13.6)	(14.3)
≥80 years	1,581	1,563	1,580	1,732	1,774	1,877	1,971	2,067	2,104
	(7.3)	(7.2)	(6.3)	(6.4)	(5.8)	(5.7)	(5.8)	(6.1)	(6.1)
Central	11,287	11,920	12,605	13,006	13,047	13,213	15,131	15,880	16,597
18-29 years	813	837	917	1,010	916	907	1,020	982	1,032
	(7.2)	(7)	(7.3)	(7.8)	(7)	(6.9)	(6.7)	(6.2)	(6.2)
30-39 years	985	996	1,122	1,199	1,244	1,304	1,392	1,436	1,541
	(8.7)	(8.4)	(8.9)	(9.2)	(9.5)	(9.9)	(9.2)	(9)	(9.3)
40-49 years	1,792	1,872	1,772	1,917	1,824	1,731	1,998	2,098	2,120
	(15.9)	(15.7)	(14.1)	(14.7)	(14)	(13.1)	(13.2)	(13.2)	(12.8)
50-59 years	2,649	2,892	3,112	3,199	3,243	3,255	3,615	3,609	3,666
	(23.5)	(24.3)	(24.7)	(24.6)	(24.9)	(24.6)	(23.9)	(22.7)	(22.1)
60-69 years	2,404	2,576	2,635	2,832	2,887	3,150	3,567	3,974	4,178
	(21.3)	(21.6)	(20.9)	(21.8)	(22.1)	(23.8)	(23.6)	(25)	(25.2)
70-79 years	1,750	1,749	2,076	1,841	2,024	1,899	2,446	2,660	2,988
	(15.5)	(14.7)	(16.5)	(14.2)	(15.5)	(14.4)	(16.2)	(16.8)	(18)
≥80 years	894	998	971	1,008	909	967	1,093	1,121	1,072
	(7.9)	(8.4)	(7.7)	(7.8)	(7)	(7.3)	(7.2)	(7.1)	(6.5)
Edmonton	24,236	25,648	27,705	27,746	26,548	27,006	28,626	30,150	32,001
18-29 years	1,847	1,931	2,139	2,006	2,091	1,986	2,146	2,205	2,296
	(7.6)	(7.5)	(7.7)	(7.2)	(7.9)	(7.4)	(7.5)	(7.3)	(7.2)
30-39 years	2,186	2,485	2,617	2,772	2,720	2,673	3,050	3,321	3,594
	(9)	(9.7)	(9.4)	(10)	(10.2)	(9.9)	(10.7)	(11)	(11.2)
40-49 years	3,729	3,887	4,364	3,951	3,821	3,935	4,116	4,172	4,574
	(15.4)	(15.2)	(15.8)	(14.2)	(14.4)	(14.6)	(14.4)	(13.8)	(14.3)

Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018
50-59 years	5,620 (23.2)	6,121 (23.9)	6,265 (22.6)	6,427 (23.2)	5,837 (22)	6,031 (22.3)	6,263 (21.9)	6,377 (21.2)	6,711 (21)
60-69 years	4,996 (20.6)	5,077 (19.8)	5,623 (20.3)	5,794 (20.9)	5,750 (21.7)	6,002 (22.2)	6,581 (23)	6,813 (22.6)	7,168 (22.4)
70-79 years	3,659 (15.1)	3,784 (14.8)	4,220 (15.2)	4,165 (15)	3,891 (14.7)	3,895 (14.4)	4,136 (14.4)	4,635 (15.4)	5,079 (15.9)
≥80 years	2,199 (9.1)	2,363 (9.2)	2,477 (8.9)	2,631 (9.5)	2,438 (9.2)	2,484 (9.2)	2,334 (8.2)	2,627 (8.7)	2,579 (8.1)
North	10,741	10,440	11,281	11,475	11,849	12,472	13,746	13,897	13,969
18-29 years	948 (8.8)	964 (9.2)	1,035 (9.2)	1,091 (9.5)	1,122 (9.5)	1,025 (8.2)	1,157 (8.4)	1,072 (7.7)	1,047 (7.5)
30-39 years	1,197 (11.1)	1,265 (12.1)	1,289 (11.4)	1,304 (11.4)	1,545 (13)	1,522 (12.2)	1,696 (12.3)	1,851 (13.3)	1,729 (12.4)
40-49 years	2,176 (20.3)	1,966 (18.8)	2,097 (18.6)	2,065 (18)	1,999 (16.9)	2,152 (17.3)	2,211 (16.1)	2,242 (16.1)	2,393 (17.1)
50-59 years	2,722 (25.3)	2,516 (24.1)	2,829 (25.1)	2,905 (25.3)	3,123 (26.4)	3,274 (26.3)	3,439 (25)	3,312 (23.8)	3,384 (24.2)
60-69 years	1,924 (17.9)	2,025 (19.4)	2,071 (18.4)	2,084 (18.2)	2,183 (18.4)	2,556 (20.5)	2,805 (20.4)	2,919 (21)	3,007 (21.5)
70-79 years	1,248 (11.6)	1,231 (11.8)	1,346 (11.9)	1,427 (12.4)	1,316 (11.1)	1,464 (11.7)	1,812 (13.2)	1,850 (13.3)	1,774 (12.7)
≥80 years	526 (4.9)	473 (4.5)	614 (5.4)	599 (5.2)	561 (4.7)	479 (3.8)	626 (4.6)	651 (4.7)	635 (4.5)

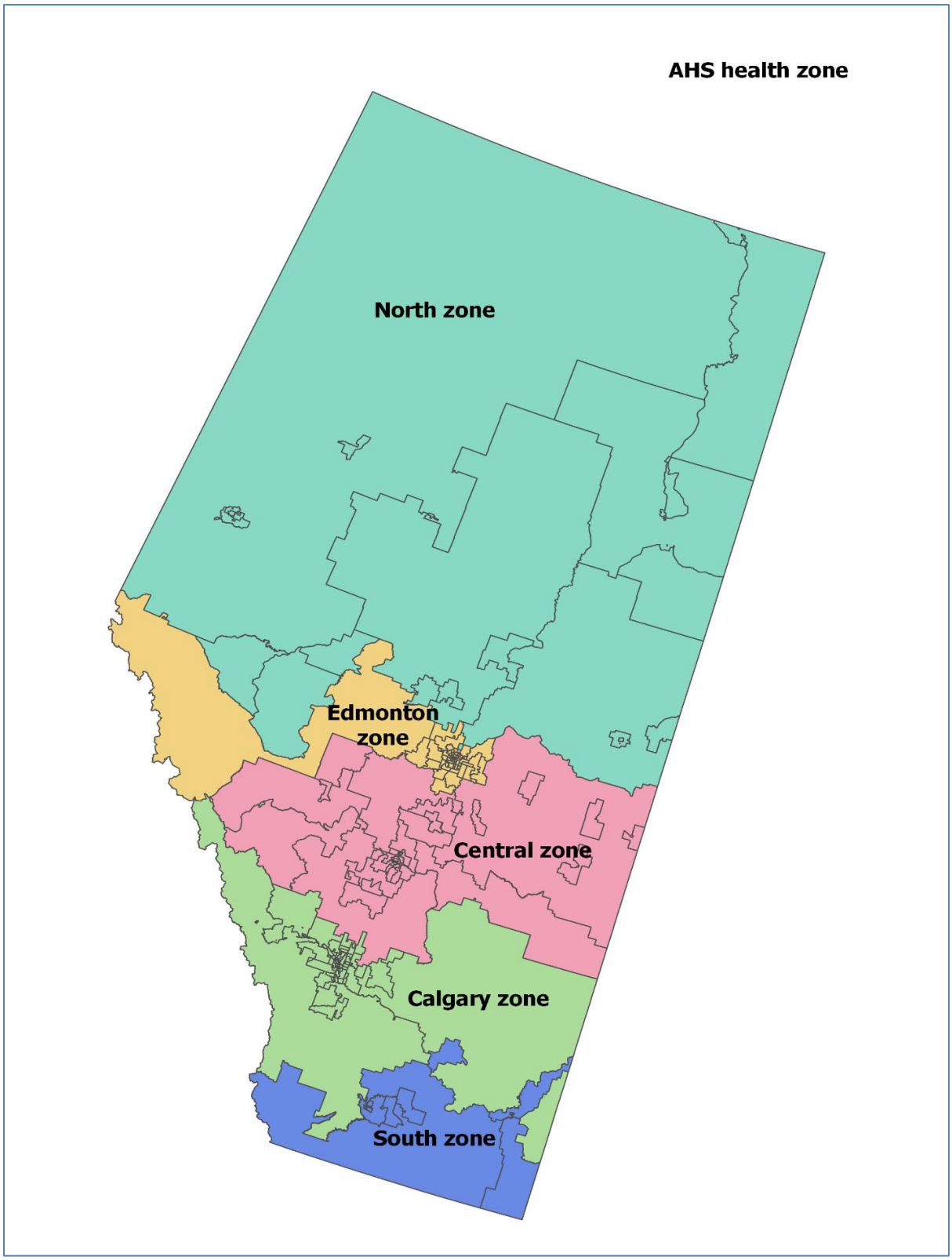
Table K.14: Colonoscopy utilization in Alberta by health zone and age group, 2010-2018

Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018
Procedure by health zone, n (%)									
South	9,302	9,958	9,781	9,912	9,920	10,206	10,472	9,605	10,381
18-29 years	411 (4.4)	521 (5.2)	472 (4.8)	446 (4.5)	487 (4.9)	486 (4.8)	504 (4.8)	479 (5)	545 (5.2)
30-39 years	646 (6.9)	612 (6.1)	632 (6.5)	702 (7.1)	680 (6.9)	742 (7.3)	756 (7.2)	730 (7.6)	800 (7.7)
40-49 years	1,293 (13.9)	1,248 (12.5)	1,208 (12.4)	1,074 (10.8)	1,152 (11.6)	1,116 (10.9)	1,071 (10.2)	1,034 (10.8)	1,157 (11.1)
50-59 years	2,748 (29.5)	3,053 (30.7)	3,149 (32.2)	3,009 (30.4)	2,556 (25.8)	2,678 (26.2)	2,692 (25.7)	2,366 (24.6)	2,483 (23.9)
60-69 years	2,291 (24.6)	2,565 (25.8)	2,506 (25.6)	2,624 (26.5)	2,730 (27.5)	2,856 (28)	3,069 (29.3)	2,775 (28.9)	3,028 (29.2)
70-79 years	1,387 (14.9)	1,441 (14.5)	1,323 (13.5)	1,492 (15.1)	1,764 (17.8)	1,710 (16.8)	1,814 (17.3)	1,754 (18.3)	1,851 (17.8)
≥80 years	526 (5.7)	518 (5.2)	491 (5)	565 (5.7)	551 (5.6)	618 (6.1)	566 (5.4)	467 (4.9)	517 (5)
Calgary	38,647	41,337	46,276	48,667	50,481	49,691	52,224	50,168	51,649
18-29 years	2,069 (5.4)	2,047 (5)	1,989 (4.3)	2,101 (4.3)	2,173 (4.3)	2,383 (4.8)	2,753 (5.3)	2,431 (4.8)	2,542 (4.9)
30-39 years	2,757 (7.1)	2,990 (7.2)	3,077 (6.6)	3,262 (6.7)	3,524 (7)	4,075 (8.2)	5,091 (9.7)	4,602 (9.2)	4,947 (9.6)
40-49 years	6,190 (16)	5,755 (13.9)	5,539 (12)	5,706 (11.7)	5,903 (11.7)	6,267 (12.6)	7,350 (14.1)	6,793 (13.5)	7,195 (13.9)
50-59 years	13,114 (33.9)	14,260 (34.5)	17,564 (38)	19,345 (39.7)	18,293 (36.2)	16,229 (32.7)	15,211 (29.1)	14,675 (29.3)	14,398 (27.9)
60-69 years	8,697	10,113	11,981	12,076	13,017	12,905	13,923	13,625	13,920

Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018
	(22.5)	(24.5)	(25.9)	(24.8)	(25.8)	(26)	(26.7)	(27.2)	(27)
70-79 years	4,377	4,672	4,720	4,698	5,896	6,147	6,270	6,476	7,032
	(11.3)	(11.3)	(10.2)	(9.7)	(11.7)	(12.4)	(12)	(12.9)	(13.6)
≥80 years	1,443	1,500	1,406	1,479	1,675	1,685	1,626	1,566	1,615
	(3.7)	(3.6)	(3)	(3)	(3.3)	(3.4)	(3.1)	(3.1)	(3.1)
Central	12,894	14,059	14,591	14,794	16,035	16,151	17,045	16,927	17,642
18-29 years	727	668	754	728	768	708	771	736	764
	(5.6)	(4.8)	(5.2)	(4.9)	(4.8)	(4.4)	(4.5)	(4.3)	(4.3)
30-39 years	896	957	1,011	1,051	1,079	1,100	1,254	1,209	1,211
	(6.9)	(6.8)	(6.9)	(7.1)	(6.7)	(6.8)	(7.4)	(7.1)	(6.9)
40-49 years	1,933	1,991	1,946	1,929	1,770	1,858	1,956	1,940	1,958
	(15)	(14.2)	(13.3)	(13)	(11)	(11.5)	(11.5)	(11.5)	(11.1)
50-59 years	3,514	3,938	4,179	4,174	4,368	4,434	4,392	4,405	4,387
	(27.3)	(28)	(28.6)	(28.2)	(27.2)	(27.5)	(25.8)	(26)	(24.9)
60-69 years	3,012	3,471	3,623	3,704	4,363	4,412	4,883	4,849	5,184
	(23.4)	(24.7)	(24.8)	(25)	(27.2)	(27.3)	(28.6)	(28.6)	(29.4)
70-79 years	2,021	2,184	2,240	2,290	2,750	2,756	2,930	2,966	3,274
	(15.7)	(15.5)	(15.4)	(15.5)	(17.1)	(17.1)	(17.2)	(17.5)	(18.6)
≥80 years	791	850	838	918	937	883	859	822	864
	(6.1)	(6)	(5.7)	(6.2)	(5.8)	(5.5)	(5)	(4.9)	(4.9)
Edmonton	35,203	35,961	38,821	40,239	43,192	43,779	50,654	48,885	49,504
18-29 years	2,359	2,382	2,675	2,576	2,582	2,636	2,738	2,848	2,658
	(6.7)	(6.6)	(6.9)	(6.4)	(6)	(6)	(5.4)	(5.8)	(5.4)
30-39 years	3,073	3,176	3,329	3,587	3,812	3,668	4,024	4,207	4,460
	(8.7)	(8.8)	(8.6)	(8.9)	(8.8)	(8.4)	(7.9)	(8.6)	(9)
40-49 years	5,773	5,616	5,892	5,711	5,212	5,117	6,170	5,954	6,262
	(16.4)	(15.6)	(15.2)	(14.2)	(12.1)	(11.7)	(12.2)	(12.2)	(12.6)

Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018
50-59 years	9,511 (27)	9,780 (27.2)	10,538 (27.1)	11,048 (27.5)	11,506 (26.6)	11,609 (26.5)	13,932 (27.5)	12,959 (26.5)	12,440 (25.1)
60-69 years	7,561 (21.5)	8,084 (22.5)	8,736 (22.5)	9,401 (23.4)	10,809 (25)	11,702 (26.7)	13,950 (27.5)	13,422 (27.5)	13,427 (27.1)
70-79 years	4,918 (14)	4,934 (13.7)	5,526 (14.2)	5,752 (14.3)	6,826 (15.8)	6,756 (15.4)	7,637 (15.1)	7,371 (15.1)	8,120 (16.4)
≥80 years	2,008 (5.7)	1,989 (5.5)	2,125 (5.5)	2,164 (5.4)	2,445 (5.7)	2,291 (5.2)	2,203 (4.3)	2,124 (4.3)	2,137 (4.3)
North	12,204	12,307	12,632	13,017	13,875	14,615	14,952	15,112	15,020
18-29 years	788 (6.5)	847 (6.9)	904 (7.2)	946 (7.3)	918 (6.6)	862 (5.9)	894 (6)	886 (5.9)	867 (5.8)
30-39 years	1,121 (9.2)	1,206 (9.8)	1,203 (9.5)	1,216 (9.3)	1,298 (9.4)	1,373 (9.4)	1,472 (9.8)	1,458 (9.6)	1,457 (9.7)
40-49 years	2,230 (18.3)	2,165 (17.6)	2,237 (17.7)	2,183 (16.8)	2,027 (14.6)	2,142 (14.7)	2,180 (14.6)	2,240 (14.8)	2,123 (14.1)
50-59 years	3,755 (30.8)	3,676 (29.9)	3,854 (30.5)	4,028 (30.9)	4,160 (30)	4,464 (30.5)	4,333 (29)	4,346 (28.8)	4,205 (28)
60-69 years	2,500 (20.5)	2,547 (20.7)	2,550 (20.2)	2,629 (20.2)	3,207 (23.1)	3,565 (24.4)	3,665 (24.5)	3,746 (24.8)	3,852 (25.6)
70-79 years	1,367 (11.2)	1,361 (11.1)	1,375 (10.9)	1,485 (11.4)	1,778 (12.8)	1,789 (12.2)	1,948 (13)	1,942 (12.9)	2,045 (13.6)
≥80 years	443 (3.6)	505 (4.1)	509 (4)	530 (4.1)	487 (3.5)	420 (2.9)	460 (3.1)	494 (3.3)	471 (3.1)

Figure K.1: Alberta health zone boundary



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Bing Guo oversaw the conduct of the overall health evidence review and reviewed the Alberta Context, Scoping Review, and both Systematic Reviews sections.

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