The Alberta North Zone Endoscopy Quality study: Cohort study of 6212 colonoscopies performed by 16 surgeons, family physicians and internists

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The Alberta North Zone Endoscopy Quality study: Cohort study of 6212 Colonoscopies Performed by 16 Surgeons, Family Physicians and Internists

Introduction

In Canada, over one million endoscopic procedures are performed annually (1) primarily by gastroenterologists and surgeons (1,2) but also by some internists and family physicians. (1,3,4) Non-gastroenterologists perform the majority of endoscopic evaluations in rural and smaller urban Canadian communities. (1,2,5)

Variability exists between individual endoscopists’ colonoscopy performance which may affect future colorectal cancer rates (6,7) or adverse events. (8) Some Canadian studies report that polyp detection may be lower (9) and future cancer rates may be higher when colonoscopies are performed by non-gastroenterologists. (10-12) Other studies demonstrate that non-gastroenterologists perform colonoscopies that exceed quality standards. (3,4) We performed the Alberta North Zone Endoscopy Quality study to determine whether a diverse group of rural and regional based endoscopists within a large health region are achieving standardized quality benchmarks in colonoscopy.

Methods

Alberta is a Canadian province of 4.4 million people, (13) divided into five health zones. The North Zone is the largest region geographically, (14) roughly the size of Sweden, with a population of >530,000 people. (15) Through 13 hospital-based endoscopy units, 25 endoscopists perform over 9000 colonoscopies annually. (15) All North Zone endoscopists actively performing colonoscopies were offered voluntary participation in the study.

Data was entered in real time into a web-based REDCap™ database hosted by the Women and Children’s Health Research Institute at the University of Alberta. (16) Data pertaining to colonoscopy quality were entered using tablets or computers by endoscopy nurses (in collaboration with the endoscopists) on all colonoscopies.

Data was analyzed and synthesized into individual, community and overall report cards with peer group comparisons. Endoscopists were provided with live, quarterly and annual reports and were encouraged to actively reflect on their results. Annual feedback sessions occurred where community and overall results were presented.
Ethics and Funding

The University of Alberta Health Research Ethics Board approved the study. The study was funded by the AHS Quality Innovation fund and supported by the Alberta Rural Health Professionals Action Plan, the University of Alberta Department of Family Medicine and the Enhancing Alberta Primary Care Research Networks (EnACT).

Primary Key Performance Indicators

Key performance indicator (KPI) benchmarks were derived from existing literature where available. If differing benchmarks existed, we used the most stringent or most commonly quoted target for comparison. For example, if the American Society of Gastrointestinal Endoscopy recommends that inadequate bowel preparations should occur in ≤15% of procedures, (17) while the National Health Services Bowel Cancer Screening Program recommend inadequate bowel preparations should occur in ≤10% of colonoscopies, (18) we used ≤10% as the benchmark target. (Appendix 1)

Proportion of successful cecal intubations. The proportion of successful cecal intubations was defined as the number of landmark-confirmed cecal intubations divided by the number of colonoscopies attempted. As study endoscopists performed both diagnostic and screening colonoscopies, 90% was the benchmark for comparison. (17-19,20)

Proportion with at least one polyp at first time colonoscopy (polyp detection rate) The proportion of male and female patients aged 50 and older undergoing a colonoscopy for the first time with at least 1 detected polyp was calculated. Polyp detection rates (PDR) can be extrapolated to estimate adenoma detection rates (ADR). (19) Guidelines recommend that to achieve an ADR of 25%, one should have a PDR of ≥40%. (19) As current ADR benchmarks are 30% in males and 20% in females, (17) study PDR benchmarks were 45% and 35% respectively. ADR benchmarks were initially derived from average risk screening colonoscopies. (17) As average risk screening colonoscopies are infrequently performed in Alberta, (4) we determined PDR from all colonoscopies in the study.

Mean Number of polyps per hundred colonoscopies. We defined the number of polyps per 100 colonoscopies as the sum of all polyps identified divided by the number of colonoscopies performed multiplied by 100. While this variable is likely one of the most important colonoscopy KPI, no benchmark currently exists. We used all colonoscopies performed in the study as the denominator.
We also collected data on procedural indications and findings; who performed sedation (endoscopist or anesthesiologist) and sedation agents used; patient comfort levels and patient level of consciousness; bowel preparation results (excellent, adequate or inadequate); procedure and withdrawal times. For patient comfort we used the modified Gloucester scale (18) for simplicity and equated “moderate” or “severe” discomfort from the modified Gloucester to equal a NAPCOM score of ≥6. (21) As guidelines recommend that <10% of patients should have a NAPCOM ≥6, (22) we set the benchmark at <10% having moderate or severe discomfort. As no benchmark target for patient level of consciousness exists, we suggested that <33% of patients should be unresponsive or only respond when stimulated. *(See appendix 1 for all outcome definitions and benchmark targets).*

**Statistical analysis and Reporting Results**

Binary outcomes were reported as percentages with 95% confidence intervals (CIs), and if necessary, were compared with quality standards using z statistics. Continuous variables were reported as means and standard deviations or medians and inter-quartile ranges, as appropriate.

**Results**

**Participating Endoscopists and Sites**

The study commenced June 2018 with 9 endoscopists from 4 hospitals and grew to 16 endoscopists and 6 hospitals by fall 2019. Data collection ended in March 2020 when, in response to the COVID-19 pandemic restrictions, all non-urgent endoscopies were temporarily halted.

The 16 endoscopists (9 surgeons, 5 family physicians and 2 general internists) varied in their endoscopy experience [range 0-20 years (mean 9.5 years)]. Participating sites ranged from a solo family physician endoscopist site to a regional hospital endoscopy unit with 7 general surgeons and 2 internists. Two sites were ‘satellite’ endoscopy units, serviced by visiting endoscopists.

Procedures were performed using Olympus™ 180 or 190 series or Pentax™ 90i series without routine use of a scope Guide. Most units had a pediatric colonoscope, half had CO2 for insufflation, and all aimed for two nurses in their endoscopy suites.
Procedures and Patients and Indications

Patient demographics were inputted for 7615 patients. After excluding no shows [525 (7.2%)] and procedures where staffing shortage prohibited data collection, we had 6212 procedures available for analysis. Individual endoscopists participated in the study for an average of 16 months (range 2-21) and performed an average of 388.3 colonoscopies (range 40 to 937). (Table 1)

Patients were an average of 56.9 years old, 49.4% were female and 41.3% underwent their first colonoscopy in the study. (Table 1) Symptom investigation was the most common indication category, and the three most common specific indications were: polyp surveillance (18.6%), positive fecal immunochemical (FIT) test (17.0%) and rectal bleeding (15.5%). Sedation was performed by the endoscopist in 68.2% of cases, while 31.8% [predominantly from three sites (table 3 Appendix)] had anaesthesiologists provide sedation. Midazolam, Fentanyl and Propofol were used in 97.9%, 78.2% and 31.4% of cases respectively, while in 54 cases (<1%), no sedation was used.

Key Performance Indicators: Overall

Cecal Intubation: Cecal intubation was confirmed in 6006/6212 [96.7% (95% CI; 96.2, 97.1)] colonoscopies. (Table 2) Poor bowel preparation was the most common reason (33.0%) for an incomplete colonoscopy.

Polyp detection Rate:

Males: 898 males ≥50 years old had their first colonoscopy in the study and 592 [66.1%; (95% CI; 62.8, 69.0)] had at least one polyp. (Table 2)

Females: 699 females ≥50 years old had their first colonoscopy in the study and 348 [49.8%; (95% CI; 46.1, 53.5)] had at least one polyp.

Mean Number of Polyps per 100 colonoscopies: Overall, there were 7542 polyps detected in the 6212 colonoscopies for an average of 121.4 polyps / 100 colonoscopies.

Inadequate bowel preparations occurred in 4.6% of cases, and patient discomfort was moderate or severe in 5.8% of cases. (Table 2) Procedure time averaged 19.7 minutes and withdrawal time (when no lesions were detected) averaged 7.2 minutes. Sedation level of consciousness was the
only benchmark that collectively was not achieved as 54.9% of patients were unresponsive or only responded when stimulated.

The most common findings were polyp that appeared adenomatous (37.1%). Colorectal cancer was reported in 1.4% of all procedures.

**FIT positive Results**

A total of 1058 colonoscopies were performed for a FIT positive patient. FIT positive patients were older (61.8 years), more often male (62.8%) and more likely (66.4%) to be having their first colonoscopy in the study. For the FIT positive males, 498/664 had a polyp (75.1%), while in FIT positive females, 232/394 had a polyp (58.9%).

Compared to all indications, FIT positive patients were ~40% relatively less likely to have a normal colonoscopy (22.3% versus 36.8%), ~50% more likely to have an adenomatous appearing polyp (56.5% versus 37.1%) and ~50% more likely (2.1% vs 1.4%) to have a colorectal cancer.

**Benchmarks Achieved by Endoscopists**

Overall, the sixteen endoscopists achieved 87/96 (90.6%) of the six key benchmarks (cecal intubation, bowel preparation, polyp detection (male/females), patient comfort and withdrawal times). *(Table 3)* Eleven endoscopists achieved all of six benchmarks, while four achieved the six benchmarks plus the study specific sedation benchmark. *(Table 2,3).*

Fourteen endoscopists achieved cecal intubation rates of ≥90%. *(Table 2)* The two endoscopists who did not achieve the cecal intubation benchmark performed under 70 procedures in the study and had 95% confidence intervals include the 90% benchmark. For polyp detection rates, 14 endoscopists achieved male PDR and female PDR rates of 45% and 35% respectively.

**Variability in Individual Results**

There was a ~20 fold range (from 5.4% to 99.2%) between the proportion of patients being unresponsive or only responding with stimuli. A five-fold difference also existed between endoscopists’ mean number of polyps per 100 colonoscopies (from 42.7 to 218.1).
Post Study Experience Survey

All respondents agreed that participating in the study improved their endoscopic performance and the study had a minimal impact on procedure flow.

Discussion

To our knowledge, this is the largest prospective study of the quality of colonoscopies performed by a diverse group of endoscopists (surgeons, family physicians and internists) in rural and regional centres. Our study demonstrated that collectively the participating Alberta North Zone endoscopists are meeting or exceeding standard published benchmarks in colonoscopy. Individual participating endoscopists achieved 90.6% of the key published benchmarks (cecal intubation, bowel preparation, polyp detection, patient comfort and withdrawal times), with eleven endoscopists achieving all six key benchmarks. We found that collectively the endoscopists did not meet the study specific sedation benchmark of having less than 33% of their patients being relatively unresponsive.

Like other studies, (23,24) we found variability in individual endoscopists’ performance. For example, while overall cecal intubation rates were over 96%, two participants did not achieve this standard. Both performed under 70 procedures in the study and had 95% confidence intervals did include the 90% benchmark. Conclusions pertaining to performance should be made with caution when a small number of procedures are analyzed. The mean number of polyps per colonoscopy is likely one of the most meaningful outcomes in colonoscopy; incorporating patient (age, gender, procedure indications, first time or surveillance); system (surveillance intervals, bowel preparations); and endoscopist performance variables. We found a 5-fold difference between the lowest and highest polyp detecting endoscopists. This variability is likely explained by differences in patient demographics, procedure indications and surveillance intervals and other quality metrics (like bowel preparation), but also may partially reflect endoscopist performance.

The only benchmark not obtained collectively by the group was the patient level of consciousness. While seven endoscopists achieved this benchmark, overall ~55% of patients were relatively unresponsive during their procedure. Efforts exist to complete colonoscopies with minimal sedation and patient discomfort, (25) and these results should stimulate endoscopist self-reflection or discussions with their anesthesiologists to consider aiming for less sedated patients.
This study also highlights findings from over 1000 FIT positive colonoscopies. We found that FIT positive patients were 50% more likely to have either an adenomatous appearing polyp or a colorectal cancer. Our results will aid discussions between patients and their Family Physicians as well as endoscopists and endoscopy programs when triaging FIT positive patients.

Our study demonstrated that busy endoscopy units were able to incorporate data collection into their workflow. All Canadian endoscopy programs are encouraged to participate in the Global Rating Scale (GRS): (26,27) a quality improvement program that emphasizes the patient experience and clinical outcomes, including the measurement of KPIs in colonoscopy. (26) Using similar data collection tools, all units should be measuring and receiving reports pertaining to their individual and program KPIs in colonoscopy.

These results can also be used as a starting point for any individual or unit-based quality improvement initiatives. Future similar studies may provide insight into the value of participating in an endoscopy quality study where results are synthesized and presented to participants for personal and programmatic reflection.

Limitations:
There are a few limitations with this study. Pathological verification remains the gold standard for determining the incidence of adenomas and cancers. Instead of using requiring pathological verification of lesions, we calculated the polyp detection rate and mean number of polyps per colonoscopy. While polyp detection correlates to adenoma detection, (28-30) we did not determine the specific adenoma to polyp quotient for the participating endoscopists prior to commencing the study. In addition, we did not adjudicate and verify potential adverse events and therefore complications were not reported. Finally, while we had 16 of 25 North Zone endoscopists participate, we are unable to determine whether non-participating North Zone endoscopists would have had similar results.

Conclusions
Participating Alberta North Zone endoscopists (surgeons, family physicians and general internists) meet most standard benchmarks in colonoscopy quality. Variability exists in individual endoscopist performance, especially in patient sedation and mean number of polyps per colonoscopy, likely due to patient, system and endoscopist factors. To better understand individual
and group endoscopy performance, we encourage all Canadian endoscopists to participate in similar colonoscopy quality studies.

References

22. Sadowski DC for Alberta Colorectal Cancer Screening Program. Quality Reporting of Colonoscopy Performance Standards for the Alberta Colorectal Cancer Screening Program 2013.
## Indications

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<th>Months Participating</th>
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Screening: FIT+, FHx of CRC, average risk screen, Lynch/FAP
Symptoms: pain, diarrhea, constipation, rectal bleeding, or anemia
Surveillance: Follow up colonoscopies for IBD, colorectal cancer or polyps.
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<th>Total number of Polyps per 100 colonoscopies</th>
<th>Proportion of FIT positive males with ≥ 1 polyp</th>
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<th>Proportion of Patients with Moderate or Severe Discomfort (%)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>438</td>
<td>2.3</td>
<td>95.7</td>
<td>(93.8, 97.6)</td>
<td>36.3</td>
<td>30.7</td>
<td>42.7</td>
<td>49.1</td>
<td>39.5</td>
<td>7.1</td>
<td>48.6</td>
<td>6.2</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>397</td>
<td>5</td>
<td>(95.6, 98.8)</td>
<td>77.1</td>
<td>65.9</td>
<td>218.1</td>
<td>77.6</td>
<td>68.2</td>
<td>2.5</td>
<td>32.5</td>
<td>8.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>47</td>
<td>4.3</td>
<td>(100, 100)</td>
<td>100</td>
<td>55.6</td>
<td>210.6</td>
<td>90</td>
<td>80</td>
<td>6.4</td>
<td>17</td>
<td>13.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>40</td>
<td>5</td>
<td>(70.7, 94.3)</td>
<td>88.9</td>
<td>66.7</td>
<td>122.5</td>
<td>100</td>
<td>100</td>
<td>17.5</td>
<td>35</td>
<td>7.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Totals**

|    | 6212 | 4.60% | 96.7 | 66.1 | 49.8 | 121.4 | 75.1 | 58.9 | 5.7 | 54.9 | 7.3 |

* = no females > 50
1st time scoped
<table>
<thead>
<tr>
<th>Outcome</th>
<th>Benchmark</th>
<th>Mean</th>
<th>Low</th>
<th>High</th>
<th># Endoscopists Achieving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bowel Prep</td>
<td>10% inadequate</td>
<td>4.6</td>
<td>2</td>
<td>9.7</td>
<td>16</td>
</tr>
<tr>
<td>Cecal Intubation</td>
<td>≥90%</td>
<td>96.7</td>
<td>82.5</td>
<td>100</td>
<td>14</td>
</tr>
<tr>
<td>PDR: Males</td>
<td>≥45%</td>
<td>66.1</td>
<td>36.3</td>
<td>88.9</td>
<td>15</td>
</tr>
<tr>
<td>PDR: Females</td>
<td>≥35%</td>
<td>49.8</td>
<td>27.8</td>
<td>72.7</td>
<td>14</td>
</tr>
<tr>
<td>Patient Comfort</td>
<td>≤10%</td>
<td>5.6</td>
<td>0.5</td>
<td>17.5</td>
<td>13</td>
</tr>
<tr>
<td>Sedation Level of</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consciousness</td>
<td>≤33%</td>
<td>54.9</td>
<td>5.4</td>
<td>99.2</td>
<td>7</td>
</tr>
<tr>
<td>Withdrawal Time</td>
<td>≥6 minutes</td>
<td>7.3</td>
<td>5.7</td>
<td>13.4</td>
<td>15</td>
</tr>
</tbody>
</table>

Total Number of Endoscopists = 16
Standard Benchmarks Achieved: 87/96 = 90.6%
Benchmarks Achieved (Including Sedation): 94/112 = 83.9%
Number of endoscopists Achieving all benchmarks (including sedation) = 4
Appendix 1: Outcome Definitions, Formulas and Benchmark Targets

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Definition</th>
<th>Possible Responses</th>
<th>Formula</th>
<th>Benchmark Target</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cecal Intubation Rate</td>
<td>Proportion of attempted colonoscopies that resulted in Cecal Intubation</td>
<td>Yes, Yes but altered from previous surgery No</td>
<td>Crude # cecal intubations / total number of colonoscopies attempted</td>
<td>≥ 90%</td>
<td>1, 2</td>
</tr>
<tr>
<td>Bowel Preparation</td>
<td>Inadequate Bowel Preparation</td>
<td>Excellent Adequate Inadequate</td>
<td># of inadequate bowel preparation / total number of colonoscopies attempted</td>
<td>≤ 10%</td>
<td>3</td>
</tr>
<tr>
<td>Sedation Level of Consciousness</td>
<td>Proportion of patients that respond only when stimulated or unresponsive</td>
<td>Alert Sleepy but initiates conversation Responds only when asked or stimulated Unresponsive or only responds with pronounced stimulation</td>
<td>Responds only when stimulated + unresponsive / total number of colonoscopies attempted</td>
<td>≤ 33%</td>
<td>Defined for Alberta North Zone Study</td>
</tr>
<tr>
<td>Patient Discomfort</td>
<td>Proportion with moderate or severe discomfort</td>
<td>None: resting comfortably throughout Minimal: 1 or 2 episodes of mild discomfort, well tolerated Mild: &gt;2 episodes of discomfort, adequately tolerated Moderate: significant discomfort experienced several times Severe: extreme discomfort experienced frequently</td>
<td>Proportion of moderate or severe discomfort</td>
<td>≤ 10%</td>
<td>3</td>
</tr>
<tr>
<td>Polyp Detection Rate</td>
<td>Proportion of patients ≥ 50 years old having 1st time colonoscopy with at least one polyp</td>
<td>Yes / No</td>
<td># of colons with ≥ 1 polyp / total number of colonoscopies attempted</td>
<td>Males: ≥ 45% Females: ≥ 35%</td>
<td>Adapted from 1</td>
</tr>
</tbody>
</table>

For Peer Review Only
### Mean # polyps per 100 Colonoscopies

<table>
<thead>
<tr>
<th>Mean # polyps per 100 Colonoscopies</th>
<th>Count the total number of polyps / number of colonoscopies attempted x 100</th>
<th>No Benchmark</th>
</tr>
</thead>
</table>

### Withdrawal Time

<table>
<thead>
<tr>
<th>Withdrawal Time</th>
<th>Any number possible</th>
<th>Automatically calculated with study tool</th>
<th>≥ 6.0 minutes</th>
<th>1, 2, 3</th>
</tr>
</thead>
</table>

**References**

Definitions ABNZ EQ Study

**Indications - General Groupings:**
Screening: FIT+, FHx of CRC, average risk screen, Lynch/FAP Symptoms: pain, diarrhea, constipation, rectal bleeding or anemia Follow up: follow up colonoscopies for IBD, colorectal cancer or polyps.

2. **Bowel Preparation:**
Excellent: No or minimal solid stool and only clear fluid requiring suction Adequate: Collections of semi-solid debris that are cleared with washing or suction Inadequate: Solid or semi-solid debris that cannot be cleared effectively

3. **Sedation Level Of Consciousness:**
Alert: alert Sleepy: sleepy but initiates conversation Responsive: responds only when asked or stimulated Unresponsive: Unresponsive or only responds with pronounced stimulation

4. **Patient Discomfort: (Modified Gloucster2)**
None: no discomfort - resting comfortably throughout procedure Minimal: one or two episodes of mild discomfort, well tolerated Mild: more than two episodes of discomfort, adequately tolerated Moderate: significant discomfort, experienced several times during procedure Severe: extreme discomfort, experienced frequently during the procedure

5. **Cecal Intubation:**
Proportion of successful cecal intubations divided by number of colonoscopies attempted. Adjustment for incomplete colonoscopies was not made due to inadequate bowel preparation or intent was not to perform a complete colonoscopy.

6. **Proportion of Patients With At Least One Polyp:**
Proportion of patients who had at least one polyp. Calculated for males or females ≥ 50 years having first time colonoscopy for any indication as denominator. Polyp detection does not require pathological verification.

7. **Polyp Detection per 100 Colonoscopies:**
Any polyp removed from all colonoscopies, irrespective of indication, is counted to include the total number of polyps. The total number of polyps divided by the total number of colonoscopies gives the mean number of polyps per colonoscopy and multiplied by 100 gives the total number per 100 colonoscopies.

8. **Total Procedure Time:**
Time from insertion of the colonoscope until it is removed from the anus.
9. **Withdrawal Time:**
Withdrawal times (time from leaving the cecum until the colonoscope exits the anus) for completed colonoscopies (i.e. successful cecal intubation) when no polyps were detected.

10. **Cancer Incidence:**
Cancers found at endoscopy (as per “predominant finding”) divided by number of colonoscopies performed.
July 1, 2020

Dear Alberta North Zone Endoscopist,

Thank you for participating in the Alberta North Zone Endoscopy Quality Study, funded by the North Zone Quality Assurance team and facilitated by the emprss™ team. Emprss's main objective is to provide a means for health care practitioners to collect and receive reporting on their quality metrics related to procedural medicine.

The results enclosed should be self-explanatory, but definitions of outcomes and calculations are provided where necessary. Benchmarks were derived from existing literature and when benchmark targets differed between guidelines, the most commonly quoted or most stringent target was used. For example, for the quality of bowel preparations, American Society of Gastrointestinal Endoscopy recommends that inadequate bowel preparations should occur in ≤15% of procedures1, while the National Health Services Bowel Cancer Screening Program2 and others3 recommend ≤10%. Therefore in the study, ≤10% benchmark target was used.

For ease of reflection, we have provided a summary page, which directly compares your results to standard benchmarks, and also provide a comparison of your results separated by year.

We acknowledge that some records are incomplete due to staffing shortages or local wifi issues. For this reason, please review the flow diagram (Figure 1), which outlines the number of procedures that are used for your report card.

We have added a summary of your FIT positive cases and at we also report on the number of missing or potentially inaccurate results. Throughout the report card, for specific variables that have missing data, we add a statement: “this variable is based on X entries out of Y records.”

We would like to sincerely thank all the participating endoscopists and their teams for their participation in the Alberta North Zone Endoscopy Quality Study. We wish to especially thank Dr. Dereck Mok, co-principle investigator for his leadership role in the study and Dr. Mark Forder (North Zone Quality Lead) for his efforts in supporting and securing funding for this work. The study was supported by a grant from the Alberta Health Services Quality Innovation fund and indirectly supported by Alberta Rural Physician Action Plan.

We encourage feedback or ideas for future use of our data collection tool. If you have any questions pertaining to this data or your report, please contact:

Mike Kolber  Dereck Mok  
Co-Principle Investigator  Co-Principle Investigator

Nicole Olivier  
Research Coordinator

ABNZ Endoscopy Quality Study - Community Comparison Report Card (3)  
For Peer Review Only
# Summary of Results
(based on 721 colonoscopies)

<table>
<thead>
<tr>
<th>Benchmark Target</th>
<th>Overall North Zone Results</th>
<th>Your Community's Results</th>
<th>Benchmark Obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cecal Intubation Rate</strong></td>
<td>Cecal intubation rate &gt;= 90%</td>
<td>96.73% 95% CI: (96.3%, 97.2%)</td>
<td>97.78% 95% CI: (96.7%, 98.9%)</td>
</tr>
<tr>
<td><strong>Bowel Preps</strong></td>
<td>Inadequate preparation &lt; 10%</td>
<td>4.64%</td>
<td>3.33%</td>
</tr>
<tr>
<td><strong>Patient Comfort</strong></td>
<td>Moderate or Significant Discomfort &lt; 10%</td>
<td>5.75%</td>
<td>7.35%</td>
</tr>
<tr>
<td><strong>Sedation - Level of Consciousness</strong></td>
<td>Responds when Stimulated or Unresponsive &lt; 33%</td>
<td>54.87%</td>
<td>12.34%</td>
</tr>
<tr>
<td><strong>Polyp Detection Rate 1st time colon, males over 50</strong></td>
<td>Polyps detected &gt; 45%</td>
<td>66.07% 95% CI: (62.8%, 69.0%)</td>
<td>72.66% 95% CI: (65.3%, 80.1%)</td>
</tr>
<tr>
<td><strong>Polyp Detection Rate 1st time colon, females over 50</strong></td>
<td>Polyps detected &gt; 35%</td>
<td>49.79% 95% CI: (46.1%, 53.5%)</td>
<td>57.29% 95% CI: (47.4%, 67.2%)</td>
</tr>
<tr>
<td><strong>Polyps per 100 colonoscopies</strong></td>
<td>No standard benchmark</td>
<td>121.4/100</td>
<td>143.8/100</td>
</tr>
</tbody>
</table>

Community Start Date: 2018-06-13
Study End Date: 2020-03-25
No-Shows and Cancellations:
NZ Cohort vs your Community:
Overall: 7.2% (95% CI: 6.6%, 7.8%),
Community: 11.2% (95% CI: 9.0%, 13.4%)
### Patient Demographics and Indications:

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Overall</th>
<th>Your Community</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of completed colonoscopies</td>
<td>6212.0</td>
<td>721.0</td>
</tr>
<tr>
<td>Mean patient age (years)</td>
<td>56.9</td>
<td>57.1</td>
</tr>
<tr>
<td>Female (%)</td>
<td>49.4</td>
<td>49.4</td>
</tr>
<tr>
<td>First-time colon (%)</td>
<td>41.3</td>
<td>47.0</td>
</tr>
<tr>
<td>Screening (%)</td>
<td>28.3</td>
<td>34.0</td>
</tr>
<tr>
<td>Symptoms (%)</td>
<td>37.8</td>
<td>34.7</td>
</tr>
<tr>
<td>Follow Up (%)</td>
<td>26.3</td>
<td>25.5</td>
</tr>
</tbody>
</table>

---

### Total Colonoscopies Performed, by Community:

![Bar chart showing number of colonoscopies performed in different communities](chart.png)
Top 10 Indications (in descending order):

1. Follow Up
2. Polyp
3. Symptoms: Rectal Bleed
4. OIF Screen: Family History
5. Symptoms: Pain
6. Symptoms: Diarrhea
7. Follow Up: IBD
8. Other Indication
9. Symptoms: Anemia
10. Follow Up: OIC
Bowel Preparation Results:²

Benchmark Obtained! ✔

*Benchmark Target: At least 90% bowel preparation should be described as excellent or adequate. ¹⁻³ Therefore inadequate bowel preparations benchmark ≤10%.

1
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50
51
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55
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57
58
59
60
**Procedural Sedation:**

![Bar chart showing Proportion (%) of Procedural Agents Used by Endoscopist and Anesthetist.]

**Procedural Agents Used:**

<table>
<thead>
<tr>
<th>Agent</th>
<th>Overall</th>
<th>Your Community</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fentanyl</td>
<td>4855 (78.2%)</td>
<td>675 (93.6%)</td>
</tr>
<tr>
<td>Versed (Midazolam)</td>
<td>6079 (97.9%)</td>
<td>671 (93.1%)</td>
</tr>
<tr>
<td>Buscopan</td>
<td>492 (7.9%)</td>
<td>43 (6.0%)</td>
</tr>
<tr>
<td>Propofol</td>
<td>1952 (31.4%)</td>
<td>42 (5.8%)</td>
</tr>
<tr>
<td>Ketamine</td>
<td>122 (2.0%)</td>
<td>38 (5.3%)</td>
</tr>
<tr>
<td>None used</td>
<td>54 (0.9%)</td>
<td>32 (4.4%)</td>
</tr>
<tr>
<td>Diazemuls</td>
<td>27 (0.4%)</td>
<td>3 (0.4%)</td>
</tr>
<tr>
<td>Other agent</td>
<td>16 (0.3%)</td>
<td>3 (0.4%)</td>
</tr>
<tr>
<td>Demerol</td>
<td>21 (0.3%)</td>
<td>2 (0.3%)</td>
</tr>
<tr>
<td>Remifentanil</td>
<td>589 (9.5%)</td>
<td>1 (0.1%)</td>
</tr>
</tbody>
</table>
Sedation - Level of Consciousness

Benchmark Obtained! ✔

*Benchmark Target: No benchmark exists. We suggest that <33% of patients only respond when stimulated, or are unresponsive during colonoscopy.

Patient Discomfort during Colonoscopy

Benchmark Obtained! ✔

*Benchmark Target: Alberta Colorectal Cancer Screening Program (ACRCSP) recommends <10% of patients have NAPCOMs score of ≥6. Moderate or severe discomfort on Gloucester scale is equivalent to NAPCOMs score of 6 (see appendix). Therefore study benchmark: <10% of patients experienced moderate or severe discomfort.
Cecal Intubations: 5

Proportion of Successful Cecal Intubations:

Overall: 6006 out of 6209* - 96.7% (95% CI: 96.3%, 97.2%)
Community: 705 out of 721* - 97.8% (95% CI: 96.7%, 98.9%)

*number of procedures to which cecal intubation was captured

Benchmark Obtained! ✔

Benchmark Target: Cecal intubation rates should be > 90% for all colonoscopies and >95% for colonoscopies performed for screening1. Given that colonoscopies in the study were performed for a variety of indications, a cecal intubation rate ≥90% is the benchmark target.

Reasons for Incomplete Colonoscopies:

<table>
<thead>
<tr>
<th>Reason</th>
<th>Overall</th>
<th>Your Community</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technically difficult</td>
<td>56.0 (27.6%)</td>
<td>6.0 (37.5%)</td>
</tr>
<tr>
<td>Stricture</td>
<td>15.0 (7.4%)</td>
<td>3.0 (18.8%)</td>
</tr>
<tr>
<td>Intent not to perform complete colonoscopy</td>
<td>12.0 (5.9%)</td>
<td>3.0 (18.8%)</td>
</tr>
<tr>
<td>Poor bowel prep</td>
<td>68.0 (33.5%)</td>
<td>2.0 (12.5%)</td>
</tr>
<tr>
<td>Other reason</td>
<td>42.0 (20.7%)</td>
<td>2.0 (12.5%)</td>
</tr>
<tr>
<td>Equipment problem</td>
<td>1.0 (0.5%)</td>
<td>0.0 (0.0%)</td>
</tr>
<tr>
<td>Severe colitis</td>
<td>9.0 (4.4%)</td>
<td>0.0 (0.0%)</td>
</tr>
</tbody>
</table>
Polyp Detection:

Proportion of Patients with at Least One Polyp: 6

MALES (>50 years, 1st time colonoscopy, any indication):

Overall: 898 males, 592 with ≥1 polyp (66.1%) (95% CI: 62.8%, 69.0%)
Community: 139 males, 101 with ≥1 polyp (72.7%) (95% CI: 65.3%, 80.1%)

Benchmark Obtained! ✔

FEMALES (>50 years, 1st time colonoscopy, any indication):

Overall: 699 females, 348 with ≥1 polyp (49.8%) (95% CI: 46.1%, 53.5%)
Community: 96 females, 55 with ≥1 polyp (57.3%) (95% CI: 47.4%, 67.2%)

Benchmark Obtained! ✔

Benchmark Target: Studies suggest that PDRs may be used to extrapolate to ADRs and suggest that to reach an adenoma detection benchmark of 25%, one should have a PDR of at least 40%13. As ADR benchmarks are 30% in males and 20% in females1, PDR benchmarks could be 45% in males and 35% for females.

Polyp Detection / 100 colonoscopies: 7

Overall: 7542 polyps in 6212 colons: 121.4 polyps / 100 colons
Community: 1037 polyps in 721 colons: 143.8 polyps / 100 colons

Benchmark Target: none exists
Procedure Times (In Minutes):

Total Procedure Time: 8

Overall: Mean: 19.7 (SD: 11.0, range: 0-148)
Community: Mean: 34.0 (SD: 16.3, range: 10-148)

For this variable, your results are based on 720 entries out of 721 records

Mean Withdrawal Times When no Lesions Detected: 9

Overall: 7.3 (SD: 3.4, range: 0-67) - in 3095 procedures when no lesions detected
Community: 8.2 (SD: 4.2, range: 0-50) - in 295 procedures when no lesions detected

Benchmark Obtained! ✔

Benchmark Target: Withdrawal phase of colonoscopy in patients in whom no biopsies or polypectomies are performed, should be (on average) ≥ 6 minutes1.

Cancer Incidence: 10

Overall: 87.0/6193.0, colons (1.40%)
Community: 13.0/721.0, colons (1.80%)
Predominant Findings - All Scopes:

Overall:

- Polyp - appears adenomatous: 37.12%
- Colorectal Cancer 1.40%
- OTH 0.02%
- IBD - new diagnosis 1.65%
- IBD - previously known 2.84%
- Polyp - appears hyperplastic 4.36%
- Diverticulosis 4.62%
- 5.25%
- Other 5.94%
- Hemorrhoids / Fissure

Community:

- Polyp - appears adenomatous: 44.66%
- Colorectal Cancer 1.80%
- OTH 0.14%
- IBD - new diagnosis 2.08%
- IBD - previously known 3.88%
- Polyp - appears hyperplastic 6.10%
- Diverticulosis 1.39%
- 5.69%
- Other 4.72%
- Hemorrhoids / Fissure
FIT Report:

Demographics:

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Overall</th>
<th>Your Community</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of completed colonoscopies</td>
<td>1058.0</td>
<td>148.0</td>
</tr>
<tr>
<td>Mean patient age (years)</td>
<td>61.8</td>
<td>62.5</td>
</tr>
<tr>
<td>Female (%)</td>
<td>37.2</td>
<td>35.8</td>
</tr>
<tr>
<td>First-time colon (%)</td>
<td>66.4</td>
<td>75.7</td>
</tr>
</tbody>
</table>

**MALES (with positive FIT):**

**Overall:** 664 males, 498 with ≥1 polyp (75.1%) (95% CI: 71.7%, 78.3%)

**Community:** 95 males, 80 with ≥1 polyp (84.2%) (95% CI: 76.9%, 91.5%)

**FEMALES (with positive FIT):**

**Overall:** 394 females, 232 with ≥1 polyp (58.9%) (95% CI: 54.0%, 63.7%)

**Community:** 53 females, 40 with ≥1 polyp (75.5%) (95% CI: 63.9%, 87.1%)

Polyp Detection / 100 colonoscopies: 7

**Overall:** 1998 polyps in 1058 colons: 188.8 polyps / 100 colons

**Community:** 327 polyps in 148 colons: 220.9 polyps / 100 colons

Cancer Incidence: 10

**Overall:** 22.0/1058.0, colons (2.08%)

**Community:** 4.0/148.0, colons (2.70%)
Predominant Findings - FIT + Scopes:

Overall:

- Polyp - appears adenomatous: 56.56%
- Normal: 22.34%
- Colorectal Cancer: 2.09%
- IBD - new diagnosis: 1.05%
- Polyp - appears hyperplastic: 6.18%
- Diverticulosis: 3.52%
- Other: 4.09%
- Hemorrhoids / Fissure: 4.18%

Community:

- Polyp - appears adenomatous: 70.27%
- Normal: 14.86%
- Colorectal Cancer: 2.70%
- IBD - new diagnosis: 2.03%
- Polyp - appears hyperplastic: 4.05%
- Diverticulosis: 4.05%
- Other: 4.05%
- Hemorrhoids / Fissure: 1.35%
References:


Appendix 1: Data Management

Data in the ABNZ Endoscopy Quality study was collected in real time (at the time of colonoscopy) using iPads™ or an existing computer within the site. Study data were collected and managed using REDCap™ electronic data capture tools hosted by the Women and Children's Health Research Institute at the University of Alberta. Data entry was performed by both nurses and physicians, of which the proportions of reporting by each group varied by endoscopy units.

Typically, unit clerks or nurses would enter the patient information a few days prior to the endoscopy date. This would allow for sites to capture no show or cancellation rates. Then, details pertaining to patient demographics, indications, bowel preparations used and whether first time colonoscopy were entered prior to the procedure start. Procedural times, sedation agents and patient comfort, cecal landmarks (or reasons for incomplete colonoscopy) and information pertaining to polyps were typically entered in a collaborative fashion by the nursing team and endoscopist. The endoscopist would also render a ‘most responsible diagnosis’ at the end of the procedure.

Using the REDCap™ system allowed for individual colonoscopists to review their statistics in real time if so desired. Statistical analysis was performed with the help of the University of Alberta REDCap™ team, including Kyle Androschuk, study programmer. We employed one decimal rounding, so cumulative numbers may be slightly greater than anticipated.

Data continues to be anonymized by physician, with only the study team knowing the identity of participating physicians. Any publication pertaining to these or future results will continue to have anonymized participants.

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Appendix 2: Definitions

1. **Indications - General Groupings:**
   - **Screening:** FIT+, FHx of CRC, average risk screen, Lynch/FAP
   - **Symptoms:** pain, diarrhea, constipation, rectal bleeding or anemia
   - **Follow up:** follow up colonoscopies for IBD, colorectal cancer or polyps.

2. **Bowel Preparation:**
   - **Excellent:** No or minimal solid stool and only clear fluid requiring suction
   - **Adequate:** Collections of semi-solid debris that are cleared with washing or suction
   - **Inadequate:** Solid or semi-solid debris that cannot be cleared effectively

3. **Sedation Level Of Consciousness:**
   - **Alert:** alert
   - **Sleepy:** sleepy but initiates conversation
   - **Responsive:** responds only when asked or stimulated.
   - **Unresponsive:** Unresponsive or only responds with pronounced stimulation

4. **Patient Discomfort: (Modified Gloucster²)**
   - **None:** no discomfort - resting comfortably throughout procedure
   - **Minimal:** one or two episodes of mild discomfort, well tolerated
   - **Mild:** more than two episodes of discomfort, adequately tolerated
   - **Moderate:** significant discomfort, experienced several times during procedure
   - **Severe:** extreme discomfort, experienced frequently during the procedure

5. **Cecal Intubation:**
   Proportion of successful cecal intubations divided by number of colonoscopies attempted. Adjustment for incomplete colonoscopies was not made due to inadequate bowel preparation or intent was not to perform a complete colonoscopy.

6. **Proportion of Patients With At Least One Polyp:**
   Proportion of patients who had at least one polyp. Calculated for males or females ≥ 50 years having first time colonoscopy for any indication as denominator. Polyp detection does not require pathological verification.

7. **Polyp Detection per 100 Colonoscopies:**
   Any polyp removed from all colonoscopies, irrespective of indication, is counted to include the total number of polyps. The total number of polyps divided by the total number of colonoscopies gives the mean number of polyps per colonoscopy and multiplied by 100 gives the total number per 100 colonoscopies.

8. **Total Procedure Time:**
   Time from insertion of the colonoscope until it is removed from the anus.

9. **Withdrawal Time:**
   Withdrawal times (time from leaving the cecum until the colonoscope exits the anus) for completed colonoscopies (i.e. successful cecal intubation) when no polyps were detected.

10. **Cancer Incidence:**
    Cancers found at endoscopy (as per “predominant finding”) divided by number of colonoscopies performed.