Trends in Wait Time for Colorectal Cancer Screening and Diagnosis 2013-2016

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OBJECTIVES: **Colorectal cancer (CRC) screening has increased in the United States during the past 20 years, resulting in an increased demand for colonoscopy. We tested the hypothesis that such increase resulted in longer wait times for colonoscopy and influenced CRC diagnosis.**

METHODS: **A total of 36,623 consecutive colonoscopies performed at the University of Wisconsin from April 8, 2013, until December 31, 2016, were included in the analysis. Wait times for colonoscopy were stratified by consecutive 6-month periods and indications of screening/surveillance vs diagnostic colonoscopy.**

RESULTS: **Despite unchanged number of endoscopists, more colonoscopies were performed in 2015–2016 than in 2013–2014 (20,897 vs 15,726, respectively, $P = 0.004$). The mean wait time for colonoscopy increased from 68 days in 2013–2014 to 111 days in 2015–2016 ($P < 0.0001$), with most change affecting screening/surveillance colonoscopy. In 170 patients with a newly diagnosed CRC, the wait time did not significantly change between 2013–2014 and 2015–2016 (21 vs 27 days, respectively, $P = 0.2206$).**

DISCUSSION: **An increase in screening/surveillance colonoscopies resulted in a substantial rise in the number of procedures between 2013 and 2016. This increase was associated with longer wait times for screening/surveillance but not diagnostic colonoscopy. Longer wait times did not result in later CRC stage at diagnosis.**

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INTRODUCTION

Based on American Cancer Society estimates, colorectal cancer (CRC) is the third leading cause of cancer-related deaths for both men and women in the United States (1). Most colon cancers arise from normal colon epithelium and develop *via* an adenoma to carcinoma sequence over a long period of time (2). Timely detection and removal of colon adenomas *via* colonoscopy prevents colon cancer (3). The relative 5-year survival rate for early localized colon cancer diagnosed *via* a screening or surveillance colonoscopy or a timely diagnostic procedure is nearly 90% compared with about 7% 5-year survival rate in individuals with advanced cancer that has spread to distant parts of the body (4). For average-risk individuals older than 50 years, colonoscopy was first proposed as the preferred strategy for CRC screening in 2000 (5).

Over the past 2 decades, several guidelines have been published regarding CRC screening and surveillance after polypectomy (5–8). Most recently in 2017, the US Multi-Society Task Force of Colorectal Cancer recommended CRC screening to begin at age 50 years in average-risk individuals and that colonoscopy be offered as the preferred screening option, with fecal immunochemical test and other tests as second and third tier options if colonoscopy is declined (6). After baseline colonoscopy, the recommended screening interval depends on the number and type of polyps removed. If no polyps are detected or only small hyperplastic polyps are removed, the recommended interval for the next colonoscopy is 10 years, whereas an interval of 5–10 years is suggested if 1–2 small tubular adenomas are removed. A follow-up examination in 3 years is recommended if an advanced adenoma (size ≥ 10 mm, high-grade dysplasia, or 3–10 adenomas) or a sessile serrated polyp with high risk features (≥10 mm or with cytologic dysplasia) are removed (8). The intervals are based on the idea that the adenoma-carcinoma sequence takes over 10 years to develop into sporadic cancers, whereas the interval is much shorter in inherited CRCs such as Lynch syndrome (6). Adherence to these screening recommendations is variable, but it is estimated that in 2016, only 65%

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of the US population was up to date with colon cancer screening (9). As a result, an initiative from the National Colorectal Cancer Roundtable called "80% by 2018" was created with the goal of having 80% of the population aged 50 years or older regularly screened for colon cancer by the year 2018.

Many health care systems have made CRC screening a priority, thereby increasing the demand for colonoscopy. For any organization or health care system, access to colonoscopy is influenced by resources allocated to performing the procedure, including number of endoscopists, support staff, and rooms and equipment available to do colonoscopies. As the demand rises and resources become limited, delays can occur. At our institution, the introduction of CRC screening guidelines and the rising adherence to their recommendations has resulted in an increased demand for colonoscopy. There are concerns that the intensified focus on screening and surveillance colonoscopy might lead to a delay in the diagnosis of CRC in patients with alarm symptoms. In the present study, our aim was to test the influence of the guidelines on the number of colonoscopies performed at our institution stratified by their indication. We hypothesized that the increase in referrals for colonoscopy would lead to an increase in wait time for colonoscopy and a possible delay in the diagnosis of CRC.

METHODS

Study setting

We conducted a retrospective analysis of data collected since the opening of a new ambulatory surgical center (ASC) at a large tertiary care center in Madison, WI. The study was determined to be exempt from informed consent by the University of Wisconsin-Madison Institutional Review Board.

Total colonoscopies and indications

All colonoscopies completed at our ASC from April 8, 2013, to December 31, 2016, were included in the analysis. Ileoscopy, pouch endoscopy, and flexible sigmoidoscopy examinations were excluded. The indication for the colonoscopy was categorized as either diagnostic or screening/surveillance procedures based on the original order by the referring provider. The wait time was calculated from the time a colonoscopy was ordered until colonoscopy completion. The full-time equivalent (FTE) was used to estimate the amount of "endoscopist power" dedicated to completing the colonoscopies. It was calculated by adding the total number of endoscopists performing procedures per half day at our ASC. For example, one endoscopist performing one half day of endoscopy was equal to 0.1 FTE. The total FTEs were calculated per 6-month periods.

CRC cohort

All patients with a new diagnosis of CRC at University of Wisconsin from April 8, 2013, to December 31, 2016, were reviewed. Patients were excluded if the index colonoscopy was completed at another institution, if the diagnosis was made while the patient was hospitalized, or if the wait time for colonoscopy exceeded 1 year (because other factors may have accounted for such delay). The list of basic characteristics that were recorded for each patient included indication for the colonoscopy, wait time, location, and stage of CRC.

Statistics

The data were imported into Excel (Microsoft, Redmond, WA). We performed a regression analysis to analyze the change in number of examinations and wait time over the study period. Two Student *t* tests were calculated. One compared the average wait time of the first half-year to the last half-year of the study period and the second *t*-test compared the first 2 years to the last 2 years of the study period. Data from the first 3-month period of the study were extrapolated to account for a full 6-month period. A χ^2 analysis was used to compare the CRC detection rates of screening/surveillance and diagnostic examinations.

RESULTS

All colonoscopies

A total of 36,623 colonoscopies were completed from April 8, 2013, until December 31, 2016, at our ASC. Over that time period, the mean cecal intubation rate was 99.5%. Procedure-related complications, defined as need for cardiopulmonary resuscitation, unplanned hospital admission, perforation, advanced airway management (such as endotracheal intubation), or need for reversal agents, occurred at a mean rate of 0.06% (range 0.02%–0.1%) during the study period. The study population stratified by time period and indication is shown in Table 1. During the 4-year period, there has been a statistically significant increase in the total number of colonoscopy procedures ($r = 0.88$, $P = 0.0041$). Comparing the first and last 2 years, more colonoscopies for any indication were performed in 2015–2016 than in 2013–2014 (20,897 vs 15,726, respectively, $P = 0.004$). Specifically, we performed 4,066 more screening and surveillance colonoscopies in the last 2 years of the study period compared with the first 2 years (13,841 in 2015–2016 vs 9,775 in 2013–2014, $P = 0.005$). The numbers of diagnostic colonoscopies were similar during the 2 time periods, with 7,056 performed in 2015–2016 and 5,951 in 2013–2014 ($P = 0.61$). Approximately 2 thirds of all colonoscopies were completed for screening/surveillance purposes, as opposed to one third for a diagnostic indication. Except for an initial increase during the year 2013, this fraction has remained largely unchanged throughout the study period. Figure 1 shows the trends in the number of colonoscopies during the study period stratified by indication. During the entire study period, there were 553 patients, amounting to less than 2% of the study population, who entered the analysis twice due to a recommended 3-year surveillance interval. Table 2 shows the average wait times (in days) for colonoscopy stratified by period and indication. During the 4-year study period, there has been a statistically significant increase in the average wait time for colonoscopy ($r = 0.98$, $P < 0.0001$). The mean wait time to colonoscopy completion increased from 68 days in 2013–2014 to 111 days in 2015–2016 ($P < 0.0001$), with the largest increase found in colonoscopies for screening or surveillance (79 in 2013–2014 vs 141 days in 2015–2016, $P < 0.001$). The wait time for a diagnostic colonoscopy did not change significantly, with 50 days in 2013–2014 vs 56 days in 2015–2016, $P = 0.270$. Figure 2 shows the change in wait time by indication during the study period.

CRC cohort

A total of 170 patients meeting our inclusion criteria were diagnosed with CRC at the University of Wisconsin-Madison from

Table 1. Study population stratified by period, indication, and cancer diagnosis

Date range	All patients	Screening/ surveillance patients		Diagnostic patients		All CRC	CRC in screening/ surveillance patients		CRC in diagnostic patients	
April 8, 2013–December 31, 2016	1,710	757	44%	953	56%	17	6	35%	11	65%
July 1, 2013–December 31, 2013	4,594	2,716	59%	1,878	41%	23	6	26%	17	74%
January 1, 2014–June 30, 2014	4,931	3,292	67%	1,639	33%	26	2	8%	24	92%
July 1, 2014–December 31, 2014	4,491	3,010	67%	1,481	33%	30	12	40%	18	60%
January 1, 2015–June 30, 2015	4,646	2,966	64%	1,680	36%	22	4	18%	18	82%
July 1, 2015–December 31, 2015	4,998	3,276	66%	1,722	34%	17	4	24%	13	76%
January 1, 2016–June 30, 2016	5,331	3,582	67%	1,749	33%	15	4	27%	11	73%
July 1, 2016–December 31, 2016	5,922	4,017	68%	1,905	32%	20	7	35%	13	65%
Total	36,623	23,616	64%	13,007	36%	170	45	26%	125	74%

CRC, colorectal cancer.

April 8, 2013, to December 31, 2016. Table 1 contains the number of patients diagnosed with CRC stratified by indication and study period. The rate of CRC diagnosis per 1,000 colonoscopies decreased from 6.1 in 2013–2014 to 3.5 in 2015–2016. Although 64% of colonoscopies were performed for screening/surveillance purposes (as opposed to 36% for diagnostic indications), only 26% of CRC were detected through these screening/surveillance examinations, as opposed to the majority (74%) identified during diagnostic examinations. This trend is also reflected by the 4.6-times higher CRC detection rate through diagnostic than screening/surveillance colonoscopies (9.6 vs 1.9 CRC per 1,000 colonoscopies). As shown by the χ^2 value of 106.102, this difference is highly significant with $P < 0.0001$.

In patients with a new diagnosis of CRC made on a screening or surveillance examination, the mean wait time for colonoscopy increased significantly from 2013–2014 to 2015–2016 (68 vs 130 days, respectively, $P = 0.013$), whereas the wait time for diagnostic examinations in this group did not significantly change (21 vs 27 days, $P = 0.221$) (Table 2). Overall, the wait time for a screening or surveillance colonoscopy in the CRC cohort was 4.5 times longer than the wait time for a diagnostic examination (with $P < 0.0001$ for the comparison using χ^2 analysis). There was no trend to later

Table 2. Average wait times (in days) for colonoscopy stratified by period, indication, and cancer diagnosis

Date range	All patients	SD	Screening/ surveillance patients	SD	Diagnostic patients	SD	All CRC	SD	CRC in screening/ surveillance patients	SD	CRC in diagnostic patients	SD
April 8, 2013–December 31, 2016	54.2	29.8	55.5	24.7	53.2	33.4	33.3	24.2	23.3	26.2	22.4	14.9
July 1, 2013–December 31, 2013	61.5	46.4	68.4	43.7	51.6	48.3	32.4	21.0	45.7	23.3	27.7	18.7
January 1, 2014–June 30, 2014	63.6	58.8	73.0	59.4	44.7	52.6	16.8	16.1	35.0	39.6	15.3	13.5
July 1, 2014–December 31, 2014	85.9	66.4	101.8	66.1	53.5	54.0	54.9	67.3	106.9	74.9	20.2	30.4
January 1, 2015–June 30, 2015	98.3	73.8	124.1	69.9	52.8	56.7	59.1	86.3	173.5	134.8	33.7	47.2
July 1, 2015–December 31, 2015	127.6	86.5	159.0	80.0	67.9	64.1	79.7	98.8	234.0	78.9	32.2	32.9
January 1, 2016–June 30, 2016	134.3	101.4	172.8	94.5	55.6	61.5	50.5	84.5	137.3	137.7	18.9	14.0
July 1, 2016–December 31, 2016	138.4	105.8	178.1	98.4	54.6	63.5	84.8	94.5	168.9	95.6	39.5	56.9
Total	101.2	85.6	127.0	88.0	54.3	56.5	50.0	68.1	114.0	90.0	25.6	31.9

CRC, colorectal cancer; S_c/S_c, screening/surveillance.

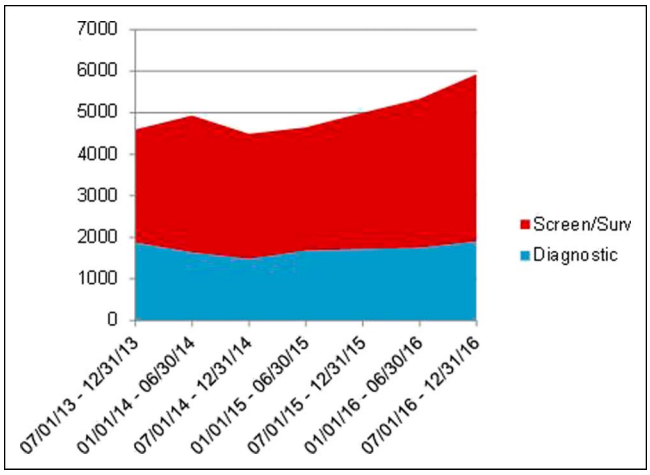

Figure 1. Time trends of the number of referrals for colonoscopy over the study period, stratified by indication for the examination. There was a significant increase in the number of screening/surveillance colonoscopies performed, whereas the number of diagnostic examinations stayed constant.

CRC stage (≥2) during the study period (13 in 2013–2014 vs 5 patients in 2015–2016.

FTE

The total number of endoscopists performing procedures was similar from the start to the end of the study. In the 2-year period from 2015 to 2016, there was a total of 516 FTEs. When adjusting for the number of colonoscopies completed during those 2 years, the number of colonoscopies per FTE was 40.5. In 2013–2014, the total FTEs were 456, with a calculated colonoscopy/FTE ratio of 38.8.

DISCUSSION

Our analysis of the time trends of colonoscopy utilization at the University of Wisconsin-Madison from 2013 until 2016 showed a substantial rise in the overall number of colonoscopies. Approximately 33% more colonoscopies were performed in the last 2 years of the study period compared with the first 2 years. This rise was primarily due to an increase in requests for surveillance and screening colonoscopies, whereas the demand for diagnostic colonoscopies stayed constant during the study period. This trend mirrors a national trend of an increase in the proportion of colonoscopies completed for screening purposes. Lieberman et al. (10) studied colonoscopy utilization and outcomes by analyzing over 1.3 million colonoscopies performed at different sites distributed throughout the United States from 2000 to 2011. The investigators found a 3-fold increase in the proportion of colonoscopies completed for screening purposes from 2000 to 2011 in average-risk individuals aged 50–74 years. This increase was felt to be due to approval of screening colonoscopy for Medicare beneficiaries in 2001 with subsequent adoption by private insurers. There was also an increase in the proportion of examinations performed for polyp surveillance during the time period, an expected finding if there is an increase in screening colonoscopies and polyps being detected.

In the present study, the number of endoscopists performing procedures stayed constant throughout the study period, as measured by the FTE. There was a marginal increase in the number of colonoscopies being completed by individual endoscopists. The suspected reason for this rise was a change made in the time allotted per examination, which decreased from 40 to 30 minutes in early 2016. There was no change in the number of endoscopy rooms or pre/post-procedure space. The procedural output of the endoscopy group grew without a commensurate increase in other resources allocated in terms of equipment, endoscopy rooms, or nursing support.

The increase in demand for colonoscopy was associated with an increase in wait time for colonoscopy completion from 2013 to 2016. The increase in wait times was more pronounced in colonoscopies completed for surveillance and screening purposes than for diagnostic indications. This was an expected finding, as triage guidelines at our institution prioritize scheduling for diagnostic colonoscopies over screening/surveillance examinations. It is important to note that the wait time for diagnostic examinations did not significantly change during the time period when overall wait times increased. With most CRCs being diagnosed during colonoscopies ordered for diagnostic reasons (74% in our study), an increase in wait times in this group could delay CRC diagnosis. Therefore, the wait time for diagnostic examinations represents an important quality metric that ought to be monitored at institutions.

Although the increase in wait times for screening and surveillance colonoscopies was profound during the 4-year study period (mean wait time to nearly 6 months at the end of 2016), there was no trend toward later stages of CRC among patients diagnosed through screening or surveillance colonoscopy. This outcome is

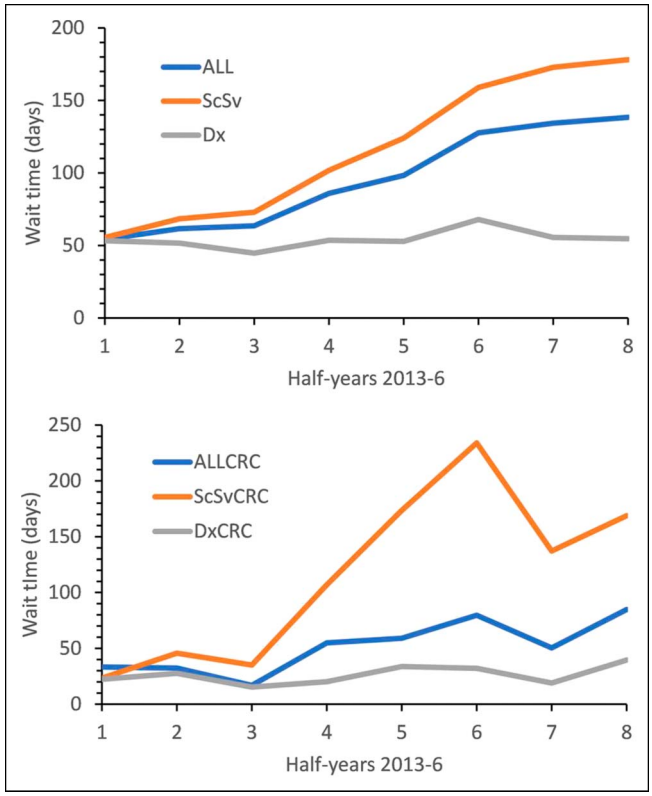

Figure 2. Time trends of wait times stratified by indication for all colonoscopies (top) and for colonoscopies leading to cancer diagnosis (bottom). ALLCRC, all colorectal cancer patients; dx, diagnostic colonoscopy; DxCRC, patients with CRC diagnosed on diagnostic colonoscopy; ScSv, screening/surveillance colonoscopy; ScSvCRC, patients with CRC diagnosed on screening/surveillance colonoscopy.

probably a reflection of the slow natural progression of the adenoma-cancer sequence in conjunction with the fact that advanced cancers are likely to cause more symptoms and result in requests for diagnostic rather than screening or surveillance colonoscopies. Corley et al. (11) studied the association between the timing of a colonoscopy following a positive Fecal Immunochemical Test (FIT) and the incidence, as well as stage, of subsequent CRC in a large cohort of patients. Patients waiting nearly 10 months after a positive FIT test tended to have an increased incidence and advanced stage of CRC compared with patients who waited less than 1 month. It is important to note that this particular study included an enriched population of patients with a positive FIT test who are at markedly higher risk of CRC compared with the general screening/surveillance population.

Data regarding colonoscopy wait times in the United States are limited. In Canada, the Canadian Association of Gastroenterology has established guidelines for maximal wait time for procedures based on the indication (12). These guidelines recommend a maximal wait time of 2 months for diagnostic colonoscopy and 6 months for screening colonoscopy. In a study from 2010, nearly 46% of patients with a new diagnosis of CRC waited longer than these recommended maximum wait times (13).

There are several strengths of our study. One is the relatively large number of patients included in our analysis. The calculation of wait time was accurate throughout the study period, as the exact times from order entry to colonoscopy completion were known for all patients, based on their electronic health records. A potential limitation of our study relates to the applicability of its results to other institutions. Our population has a high rate of using colonoscopy as the primary screening test for CRC (>90% in 2014) (14). Wait times for colonoscopy vary considerably throughout the United States, and some ASCs may not face the same dilemma as our institution. Besides access and availability of colonoscopy, other patient-related factors may also contribute to delays in wait time. The list of such factors includes missed appointments and preference for individual physicians or particular types of sedation. These factors were not accounted for by our analysis and may have falsely increased the wait time in few patients. Finally, given difficulty in separating screening and surveillance colonoscopies, these were grouped together in the overall analysis.

The overall prolongation of waiting times did not cause a substantial delay in cancer diagnosis. Despite this fortunate outcome, however, endoscopists need to monitor their diagnostic performance with respect to CRC and remain vigilant about potential delays in its diagnosis. The wait time for a diagnostic colonoscopy might represent a valuable quality metric to be monitored by endoscopy centers.

CONFLICTS OF INTEREST

Guarantor of the article: Jeffrey Hubers, MD.
Specific author contributions: J.H., A.S., and A.S. were involved in the study design, data collection, data analysis, and generation of the manuscript. T.H. was involved in data collection. D.G. and J.W. assisted with the study design.
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Potential competing interests: None to report.

Study Highlights

WHAT IS KNOWN

- ✓ Guidelines recommend screening for CRC beginning at age 50 years in average-risk individuals.
- ✓ The US Multi-Society Task Force of Colorectal Cancer (US MSTF) recommends colonoscopy be offered as the preferred screening modality.

WHAT IS NEW HERE

- ✓ At the University of Wisconsin, the number of colonoscopies increased by 33% between 2013 until 2016.
- ✓ Increasing demand for colonoscopy resulted in longer wait times for screening/surveillance but not diagnostic colonoscopies.

TRANSLATIONAL IMPACT

- ✓ The increase in wait times during the study period did not delay new cancer diagnoses. Endoscopists should be cognizant of their colonscopy wait times, particularly for diagnostic indications.

REFERENCES

1. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2018. CA Cancer J Clin 2018;68:7–30.
2. Leslie A, Carey FA, Pratt NR, et al. The colorectal adenoma–carcinoma sequence. Br J Surg 2002;89:845–60.
3. Crooke H, Kobayashi M, Mitchell B, et al. Estimating 1- and 5-year relative survival trends in colorectal cancer (CRC) in the United States: 2004-2014. J Clin Oncol 2018;36(4 Suppl):587.
4. Winawer SJ, Zauber AG, Nah Ho M, et al. Prevention of colorectal cancer by colonoscopic polypectomy. N Engl J Med 1993;329:1977–81.
5. Rex DK, Johnson DA, Anderson JC, et al. American College of Gastroenterology guidelines for colorectal cancer screening 2008. Am J Gastroenterol 2009;104:739–50.
6. Rex DK, Boland CR, Dominitiz JA, et al. Colorectal cancer screening: Recommendations for physicians and patients from the U.S. Multi-society task force on colorectal cancer. Am J Gastroenterol 2017;112:1016–30.
7. Bibbins-Domingo K, Grossman DC, Curry SJ, et al. Screening for colorectal cancer: US preventative services task force recommendation statement. JAMA 2016;315:2564–75.
8. Lieberman DA, Rex DK, Winawer SJ, et al. Guidelines for colonoscopy surveillance after screening and polypectomy: A conscenous update by the US multi-society task force on colorectal cancer. Gastroenterology 2012;143:844–57.
9. Levin TR. Colorectal cancer screening: 80% by 2018. Colonoscopists simply cannot do it alone. Gastrointest Endosc 2016;83:552–4.
10. Lieberman DA, Williams JL, Holub JL, et al. Colonoscopy utilization and outcomes 2000-2011. Gastrointest Endosc 2014;80:133–43.
11. Corley DA, Jensen CD, Quinn VP, et al. Association between time to colonoscopy after a positive fecal test result and risk of colorectal cancer and cancer stage at diagnosis. JAMA 2017;317:1631–41.
12. Paterson WG, Depew WT, Pare P, et al. Canadian consensus on medically acceptable wait times for digestive health care. Can J Gastroenterol 2006;20:411–23.
13. Sey MS, Gregor J, Adams P, et al. Wait times for diagnostic colonoscopy among outpatients with colorectal cancer: A comparison with Canadian Association of Gastroenterology targets. Can J Gastroenterol 2012;26:894–6.
14. Weiss J, Benson M, Gopal D, et al. High colorectal cancer screening rates can be achieved with colonoscopy as the dominant screening modality (abstr). Gastrointest Endosc 2016;83(Suppl):AB370.