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Patterns of colorectal cancer screening and adherence rates among an average-risk population enrolled in a national health insurance provider during 2009–2018 in the United States

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ABSTRACT

While colorectal cancer (CRC) is the second leading cause of cancer-related mortality in the United States (US), outcomes can be improved through timely screening. Despite the benefits and widespread availability of screening tests, adherence to recommended screening strategies is low. The study aimed to provide recent evidence regarding screening rates and adherence to screening recommendations among adults at average risk for CRC in a commercially insured and Medicare Advantage population. De-identified administrative data from a large US research database were examined to determine screening rates for the years 2009 through 2018. The study population included adults aged 50–75 years and annual study population counts ranged from 1,390,594 in 2009 to 1,654,544 in 2018. Incident screening rates were found to be relatively stable across the study years (approximately 15 %) with adherence lowest in the youngest age group (ages 50–54 years). Colonoscopies accounted for approximately 50 % of all screening tests performed, while there was a substantial increase in the use of home-based screening tests over the study timeframe. The use of the fecal immunochemical test increased from 17.2 % in 2009 to 28.9 % in 2018 and the multi-target stool DNA test increased from 0.4 % in 2015 to 9.0 % in 2018. Overall though, CRC screening and adherence rates remain relatively low among adults at average risk for CRC in the US. Improving adherence rates with CRC screening recommendations among individuals at average risk for CRC is required to improve health outcomes.

1. Introduction

Colorectal Cancer (CRC) is the second leading cause of cancer-related mortality in the United States (U.S.). The American Cancer Society (ACS) estimated 52,580 deaths from CRC and 151,030 new CRC cases in 2022 (American Cancer Society, 2023). Typically, CRC progresses slowly, and outcomes are greatly improved if the disease is detected at an early stage—either pre-cancerous or localized within the colon. Regular screening, which has been shown to improve CRC survival rates, is recommended for the early detection of CRC. Substantial declines in the incidence of the disease and mortality in the US from 2000 to 2011 are largely attributable to increased screening, although improved treatment options also contributed to the decline. (Siegel et al., 2017; Young and Womeldorph, 2013).

The risk of CRC increases with age. The ACS recommended the age at which screening commences be lowered from 50 to 45 years in 2018 (Wolf et al., 2018), followed by a similar recommendation from the United States Preventive Services Task Force (USPSTF) in, 2021. This was due to substantial increases in CRC incidence and mortality in adults aged less than 55 years over the past three decades (Baileyet, 2015; Siegel et al., 2017). Moreover, modeling studies have demonstrated that the balance of benefit to harm was more favorable if screening commenced at age 45 as opposed to 50 years. (Meesteret al., 2018; Jones et al., 2020).

Despite the benefits of screening and the wide availability of screening tests, annual screening rates are sub-optimal and in 2020, only 71.6 % of eligible adults aged 50 to 75 years were up to date with recommended CRC screening (U.S. Cancer Society Working Group, 2020).

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Table 1
Demographic characteristics of members who underwent CRC screening: 2009–2018.

Characteristic	2009 (n = 1.39 m[#])	2010 (n = 1.38 m)	2011 (n = 1.42 m)	2012 (n = 1.44 m)	2013 (n = 1.54 M)	2014 (n = 1.56 m)	2015 (n = 1.60 m)	2016 (n = 1.60 m)	2017 (n = 1.62 m)	2018 (n = 1.65 m)
Number screened, %	209,664, 15.1 %	205,322, 14.9 %	206,104, 14.5 %	211,293, 14.6 %	229,266, 14.9 %	221,608, 14.2 %	226,830, 14.2 %	228,999, 14.3 %	237,036, 14.7 %	243,646, 14.7 %
Age (in Years: Mean (SD), Median	59.2 (6.9), 58.0	59.1 (6.8), 58.0	58.9 (6.8), 58.0	58.9 (6.9), 58.0	59.4 (7.2), 58.0	59.4 (7.1), 58.0	59.6 (7.2), 58.0	59.8 (7.3), 59.0	60.4 (7.6), 60.0	61.0 (7.8), 60.0
Age Groups[##](At First Screen), N.%										
50–54	67,254, 17.8 %	65,897, 17.2 %	68,700, 17.3 %	70,407, 17.4 %	73,395, 17.6 %	70,237, 16.9 %	71,281, 16.6 %	70,084, 16.8 %	68,969, 17.0 %	66,725, 16.9 %
55–59	50,691, 15.3 %	50,381, 15.1 %	50,444, 14.7 %	51,679, 14.6 %	53,119, 14.3 %	51,789, 13.7 %	52,077, 13.3 %	51,053, 13.3 %	49,216, 13.1 %	47,454, 13.0 %
60–64	46,128, 16.2 %	46,957, 16.1 %	46,808, 15.6 %	45,540, 15.3 %	47,888, 15.5 %	47,209, 14.8 %	49,041, 14.9 %	49,255, 15.2 %	49,700, 15.3 %	48,941, 15.3 %
65–69	21,628, 12.3 %	20,112, 12.2 %	19,968, 11.4 %	21,067, 11.6 %	24,259, 12.4 %	22,987, 11.5 %	23,372, 11.5 %	24,082, 11.8 %	25,311, 12.5 %	26,208, 12.8 %
70–75	23,963, 10.9 %	21,975, 10.7 %	20,184, 10.0 %	22,600, 11.0 %	30,605, 12.4 %	29,386, 11.9 %	31,059, 12.5 %	34,525, 13.0 %	43,840, 14.3 %	54,318, 14.7 %
Gender[##] (N, %)										
Female	121,639, 16.8 %	119,658, 16.4 %	118,781, 15.8 %	120,530, 15.9 %	129,865, 16.0 %	123,236, 15.1 %	125,258, 15.0 %	126,206, 15.0 %	131,386, 15.4 %	136,193, 15.5 %
Male	88,025, 13.2 %	85,664, 13.2 %	87,323, 13.1 %	90,763, 13.3 %	99,401, 13.6 %	98,372, 13.3 %	101,572, 13.3 %	102,793, 13.6 %	105,650, 13.9 %	107,453, 13.9 %
Type of Insurance[##]										
Commercial	199,426, 15.1 %	193,371, 15.0 %	192,851, 14.6 %	192,458, 14.6 %	198,102, 14.6 %	189,927, 14.0 %	187,160, 13.8 %	183,407, 13.8 %	178,957, 13.9 %	172,541, 13.8 %
Medicare	10,238, 15.2 %	11,951, 13.8 %	13,253, 14.3 %	18,835, 15.5 %	31,164, 16.9 %	31,681, 15.4 %	39,670, 16.3 %	45,592, 16.8 %	58,079, 17.5 %	71,105, 17.4 %
Region[##] (N, %)										
Midwest	45,916, 13.1 %	46,104, 13.1 %	45,189, 12.4 %	48,153, 13.0 %	51,287, 13.1 %	49,634, 12.5 %	49,643, 12.7 %	50,969, 13.1 %	51,847, 13.5 %	56,395, 14.0 %
Northeast	28,629, 15.5 %	27,729, 14.7 %	27,527, 14.3 %	29,543, 15.0 %	31,751, 15.5 %	34,229, 15.6 %	39,739, 15.4 %	39,836, 15.7 %	40,058, 15.7 %	39,760, 15.4 %
South	88,249, 16.6 %	86,839, 16.5 %	90,200, 16.3 %	91,493, 16.2 %	99,965, 16.4 %	94,014, 15.4 %	94,737, 15.2 %	94,728, 15.1 %	101,965, 15.6 %	104,374, 15.5 %
West	46,576, 14.5 %	44,267, 14.4 %	42,781, 14.0 %	41,666, 13.6 %	45,424, 13.7 %	43,093, 13.2 %	42,318, 13.0 %	43,130, 13.3 %	42,841, 13.3 %	42,683, 13.4 %
Other (Alaska, Hawaii, Puerto Rico, and territories)	294, 13.8 %	383, 14.2 %	407, 14.4 %	438, 14.1 %	839, 17.5 %	638, 15.1 %	393, 14.4 %	336, 13.5 %	325, 13.4 %	434, 15.7 %

[#] m = Million; [##]The reported n is the number that screened in the given year and the percent is the number that screened/the total number of members with that demographic. E.g., in 2009, 67,254 members aged 50–54 screened and this meant that 17.8 % of members aged 50–54 had screened.

That rate is below the rate of at least 80 % recommended by the National Colorectal Cancer Roundtable (NCCRT) to substantially improve overall CRC outcomes. Screening options for CRC include colonoscopy and flexible sigmoidoscopy, as well as more convenient and less invasive options such as high sensitivity fecal occult blood test (FOBT), fecal immunochemical test (FIT), CT colonography (CTC), and multitarget stool DNA (mt-sDNA). The stool-based tests (FOBT, FIT, and mt-sDNA) can be completed at home, do not require sedation, and only individuals with a positive result require a follow-up colonoscopy.

Given the importance of screening for CRC and the various screening options available, it is important to assess the most recent data regarding CRC screening trends and utilization patterns in the real-world setting. The aims of this study were to assess screening rates and adherence with screening recommendations among adults at average risk for CRC.

2. Methods

This retrospective study used de-identified administrative claims data from January 2006 to December 2019 for commercially insured and Medicare Advantage enrollees from a large US research database. The database contains medical (emergency, inpatient, outpatient) claims for services submitted for third-party reimbursement, available as International Classification of Diseases, Ninth or Tenth Revision, Clinical Modification (ICD-9-CM or ICD-10-CM), Current Procedural Terminology (CPT), and Healthcare Common Procedure Coding System (HCPCS) claims, respectively. These claims are aggregated following the completion of care encounters and submission of claims for reimbursement. The study data were de-identified in compliance with the HIPAA Privacy Rule and the study team did not utilize protected health information to support this study.

2.1. Participants

The study population included adults aged 50–75 years old as of January of each year; each of the 10 calendar years examined from 2009 to 2018 was considered an 'index year'). For each of the 10 index years examined, individuals were required to be continuously enrolled for three years prior to the index year (the baseline period), and through the entire index year, and be at average risk for CRC (henceforth referred to as members). Average risk for CRC was defined as the absence of any ICD codes and/or procedures indicating high risk for CRC (see Supplementary File: Table 1) during the baseline period. Members were subsequently categorized according to the modality of their first CRC screening for each year, as indicated by a claim that corresponded to a CRC screening test/procedure: colonoscopy, FIT, mt-sDNA, and other (including FOBT, flexible sigmoidoscopy, barium enema, CT colonography - see Supplementary File: Table 2). In addition, to investigate adherence with screening, the subset of patients with at least 10 years of continuous enrollment prior to the index year (baseline period) and through the entire index year, were also identified. Three index years

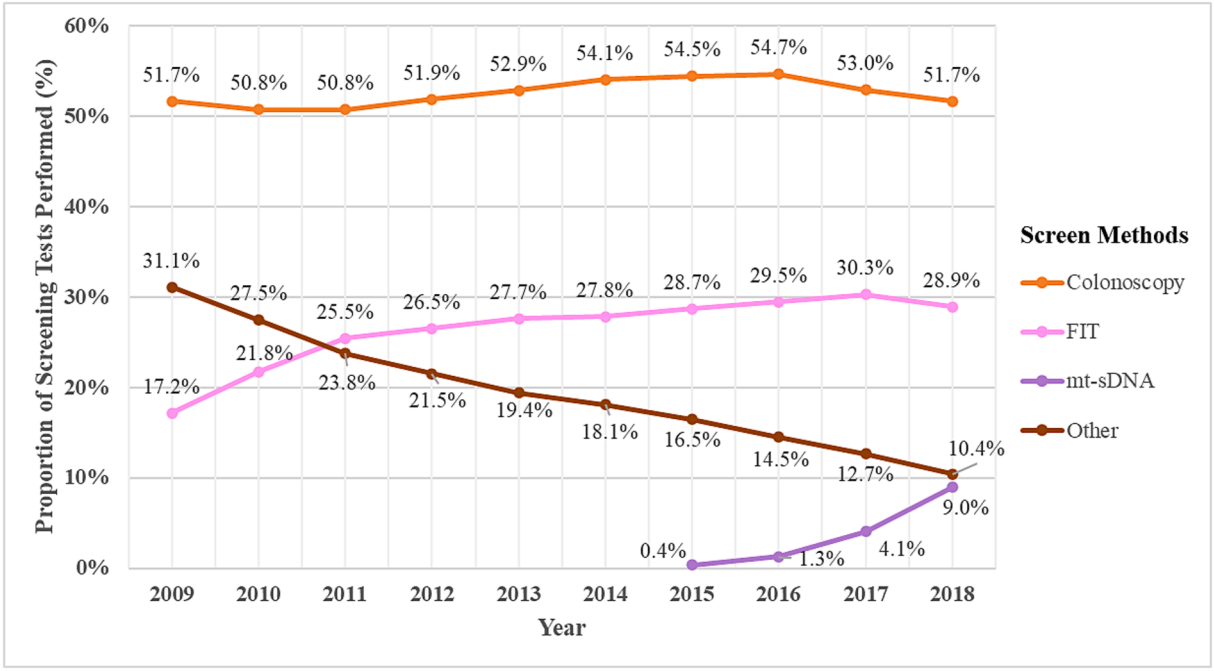

Fig. 1a. Distribution of incidence screening tests performed 2009–2018.

where members had the opportunity for 10 years of baseline data were examined: 2016, 2017 and 2018.

2.2. Member demographics and outcomes

Members' demographic information including age (calculated as analysis year minus birth year), gender (male/female), insurance type (commercial or Medicare Advantage), state, and region (Northeast, Midwest, South, West, Other [Alaska, Hawaii, Puerto Rico, and territories]) were captured. Study outcomes included (1) annual CRC incident screening for each year from 2009 to 2018 and (2) adherence rates for each year from 2016 to 2018. The annual incident screening was the percent of average-risk members who underwent screening each year. This was calculated as the number of members with a claim for CRC screening in a particular year divided by the number of members enrolled that year. Differences in screening rates in 2009 and 2018 were assessed with chi-squared tests. Adherence rates were estimated for members with 10 years of continuous enrollment without prior evidence of USPSTF recommended CRC screening, or a diagnostic code indicating high-risk for CRC in the year prior to commencement of the 10-year period. Adherence rates for 2016, 2017 and 2018 were calculated as the number of adherent members in a particular year divided by the total number of members for that year. A member was considered adherent in a year if that year was covered by their last CRC screening per recommended frequency according to USPSTF guidelines.

3. Results

The demographic characteristics of members who underwent CRC screening for each study year are summarized in Table 1. Results showed that the annual incident screening rates for CRC approximated 15 % across all study years, with the cohort size ranging from 1,390,594 in 2009, to 1,654,544 in 2018. The mean age of members screened remained relatively stable (58–60 years) across study years, with screening rates for women being slightly higher than for men. While the percentage of members screened was similar for those with commercial insurance and Medicare in 2009 (15.1 % and 15.2 % respectively), the percentage estimate of commercially insured members screened decreased slightly from 15.1 % in 2009 to 13.8 % in 2018 ($p < 0.01$) while the percentage estimate of those with Medicare insurance increased from 13.2 % to 17.4 % ($p < 0.01$).

Of those who were screened, colonoscopies accounted for approximately 50 % of all tests performed. The second most frequently performed test was the FIT with rates increasing from 17.2 % in 2009 to 28.9 % in 2018. However, utilization of the mt-sDNA test demonstrated the largest increase from 0.4 % in 2015 to 9.0 % in 2018 (Fig. 1a).

The estimated adherence rates by age group are displayed in Fig. 1b. The youngest group (aged 50–54 years) had the lowest adherence rate ranging from 39.6 % in 2016 to 39.3 % in 2018, while those aged 60–64 years had the highest rates, ranging from 58.0 % in 2016 to 59.3 % in 2018. In addition, the overall estimated adherence rate for all screening modalities was 52.3 % in 2018 (n = 754,867).

4. Discussion

Our findings indicate that CRC screening and adherence rates remained relatively low in the average-risk population who were eligible for CRC screening from 2009 to 2018. This was particularly true among the younger population aged 50–54 years who had the lowest adherence rates. Colonoscopy was the most frequently used test, particularly among the oldest age group (70–75 years) and accounted for around half of all tests performed overall. However, the utilization of stool-based tests that can be performed at home increased substantially during the study years, perhaps due to their convenience and ease of use. During the study period, FIT had the highest utilization as compared to mt-sDNA and other screening tests, however, from 2015 to 2018, there was a large increase in the use of mt-sDNA (0.4 % to 9 %), while the trends in the rates of use of colonoscopy and other screening rates decreased., while the trends in the rates of use of colonoscopy and other screening rates decreased. At home stool-based CRC screening tests saw a further increase after 2018, especially during the coronavirus disease 2019 (COVID-19) pandemic (Liu et al., 2022).

The adherence rate found in this study (52.3 %) is lower than rates previously reported. The Centers for Disease Control and Prevention (CDC) produces estimates of CRC screening compliance based on the National Health Interview Survey (NHIS) data and the Behavioral Risk Factor Surveillance System (BRFSS) which have reported rates of approximately 72 % (CDC, 2021). Unlike our study, however, neither

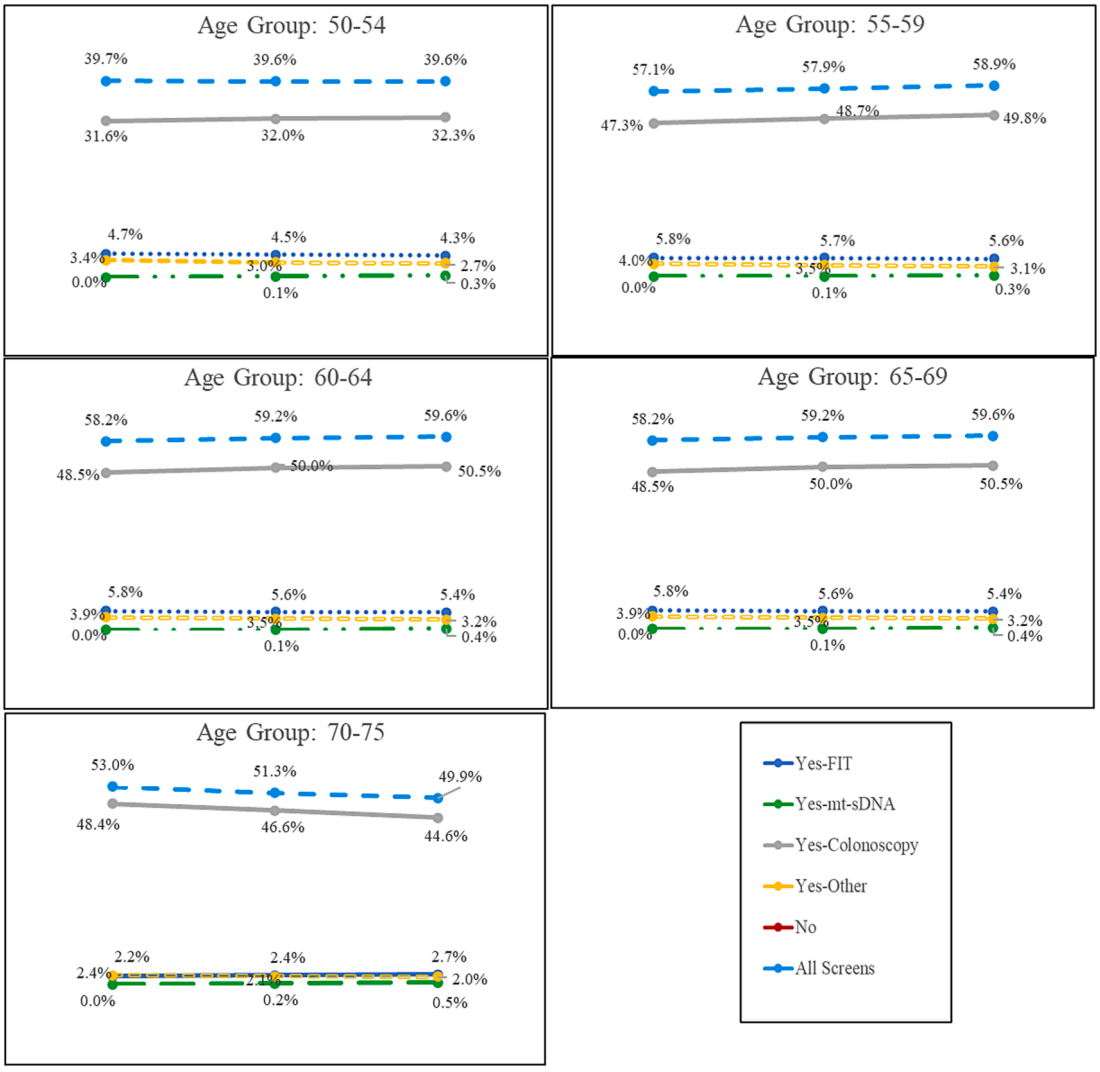

Fig. 1b. Screening adherence by age groups.

the NHIS nor the BRFSS distinguishes between average risk and above average risk individuals, or between screening and diagnostic tests. Other possible reasons for the discrepancy include the longitudinal nature of our study, the stipulation that members be continuously enrolled for inclusion and possible inherent differences in characteristics of the study populations.

A similar compliance rate (64 %) was reported by the authors of another longitudinal study (Cyhaniuk and Coombes, 2016) who adopted a similar approach to ours and required commercially insured participants to have been continuously enrolled in the insurance plan for 10 years. Their cohort was also restricted to members at average risk for CRC aged 50 to 54 years. Another study reported compliance rates of 65 % for women and 59 % for men, aged 50 years and older at average risk for CRC in 2008 (Sinicrope et al., 2012). Unlike our study, those authors examined medical records to estimate population-wide adherence rates in one US county (Olmstead County, Minnesota) and also included diagnostic endoscopies.

Despite the reported discrepancies in compliance rates, all of the studies reported including the present study, confirm that CRC screening is sub-optimal in American adults at average risk for CRC. If CRC outcomes are to improve in the foreseeable future, overall compliance needs to be improved considerably, possibly through extensive public health messaging and other initiatives.

While this study reports recent data regarding CRC screening rates that may inform future public health initiatives to increase adherence rates to recommended screening by those at average risk for CRC, there are also several limitations. It is also conceivable that some members may have purchased FIT/FOBT out of pocket or participated in programs that provided FIT/FOBT without generating a claim, potentially underestimating screening rates in this claims-based analysis. Similarly, it is possible that some screening colonoscopies may have been incorrectly classified as diagnostic when they were performed for screening purposes and did not receive the correct HCPCS modifier code, also leading to an underestimation of screening rates. An additional limitation relates to the requirement for members to be continuously enrolled for a minimum of 4 or 11 years, a necessary step undertaken to be able to examine compliance and risk status of eligible members. However, this requirement is also a potential source of selection bias, as the screening and adherence rates of individuals with shorter enrollment history are unknown. Based on published data assessing member churn within the health insurance industry, approximately 25 % of members changed their Medicaid, Medicare or employer-sponsored coverage from the previous year (Sommers et al., 2016). In our study, among the group of individuals aged 50–75 years old with continuous enrollment during an index year, ~6% of the members were continuously enrolled for an additional 10 years prior to the index year.

5. Conclusion

Overall, CRC screening rates and adherence rates were relatively low for adults at average risk for CRC who were eligible for CRC screening. However, the use of non-invasive stool-based tests such as mt-sDNA and FIT that can be performed at home increased from 2009 to 2018, perhaps reflecting their ease of use and convenience. Improving adherence rates with CRC screening recommendations among individuals at average risk for CRC is required to improve health outcomes.

CRediT authorship contribution statement

Henrik Kowalkowski: . **George Austin:** . **Yinglong Guo:** Conceptualization, Methodology, Writing – review & editing. **Lesley-Ann Miller-Wilson:** Supervision, Conceptualization, Methodology, Writing – review & editing. **Stacey DaCosta Byfield:** Conceptualization, Methodology, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2023.102497.

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