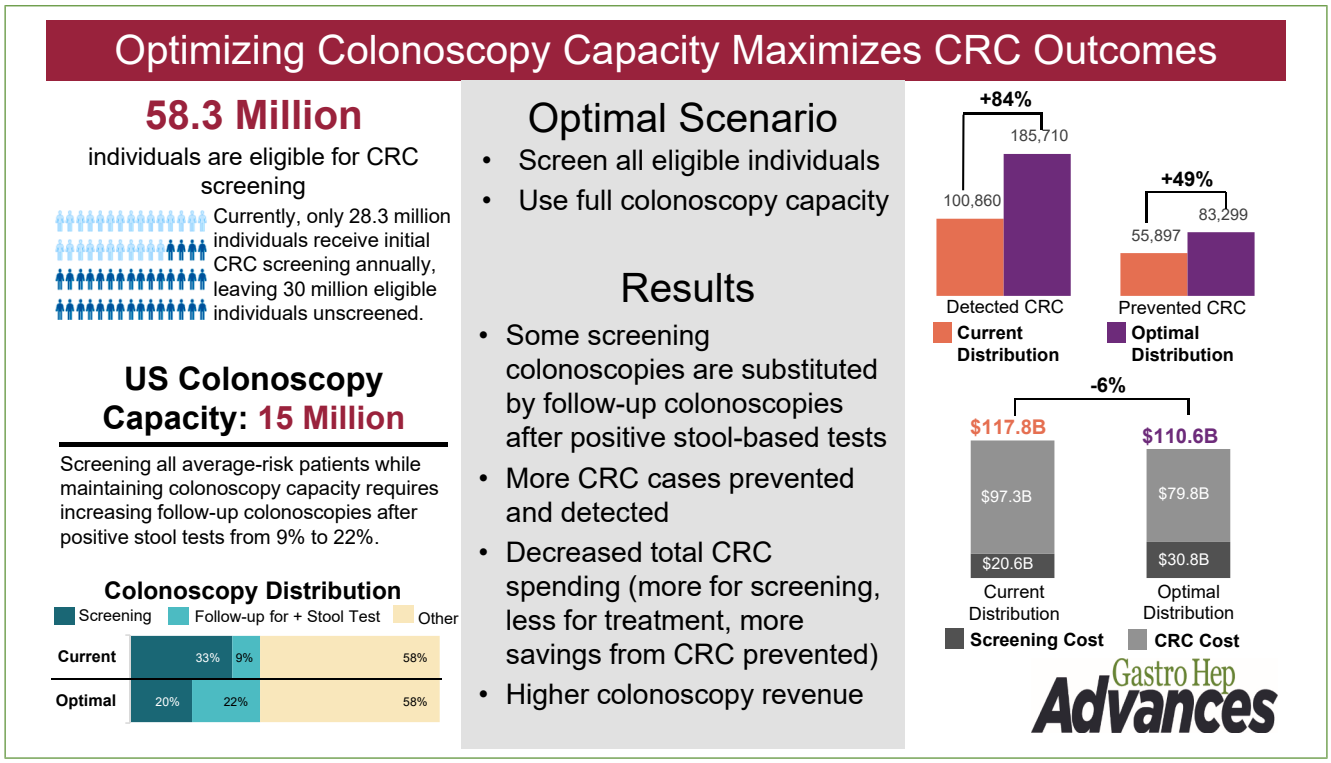
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ORIGINAL RESEARCH—CLINICAL

Optimizing Colonoscopy Capacity to Maximize Colorectal Cancer Outcomes

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BACKGROUND AND AIMS: Guidelines support endoscopic and stool-based testing for average-risk colorectal cancer (CRC) screening, but colonoscopy capacity is limited. With an aim to screen all eligible individuals, we identified scenarios that maximized the benefits of colonoscopy utilization for both screening and follow-up of noninvasive screening. **METHODS:** Annual current screening modality distribution in the United States was modeled. Clinical outcomes and costs were compared between the current distribution and alternative scenarios that substituted initial colonoscopy screening with stool-based tests, such that the total number of follow-up colonoscopies after positive stool-based tests plus screening colonoscopies would maintain the full colonoscopy capacity. **RESULTS:** To screen all eligible individuals in the United States (58.3 million) and utilize full colonoscopy capacity (15 million/y), stool-based tests must increase 2.4-fold, follow-up colonoscopies after positive stool-based tests must increase from the current 9% of capacity to 22% (1.4–3.3 million), and screening colonoscopies must decrease from the current 33% of capacity to 20% (4.9–3.0 million). In this optimal screening modality distribution scenario, the number of detected CRC cases would increase by 84% vs current distribution (185,710 vs 100,860), 49% more CRC cases would be prevented (83,299 vs 55,897), total CRC costs (ie, CRC screening, treatment, and savings from CRC prevented) would decrease from $117.8 billion to $110.6 billion, and colonoscopy revenue would

Abbreviations used in this paper: **CRC, colorectal cancer; FIT, fecal immunochemical test; mt-sDNA, multitarget stool DNA.**

Most current article

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increase from $13.4 billion to $13.9 billion due to a higher proportion of therapeutic procedures with polypectomy. **CONCLUSION:** Reallocating indications for colonoscopies by substituting some screening colonoscopies with follow-up colonoscopies—while performing at full capacity—along with a shift in initial CRC screening modalities to more stool-based testing, could increase health benefits, maximize colonoscopy efficiency and revenue, and reduce expenditures.

Keywords: Backlog; Endoscopy; Stool Test; Substitute

Introduction

Despite robust evidence that colorectal cancer (CRC) screening can reduce CRC cases and save lives,[1,2] as well as zero cost sharing for insured individuals, nearly 40% of the eligible US population is not up-to-date with CRC screening.[3] This gap is in part driven by an additional 20 million Americans aged 45–50 years recently included in average-risk screening recommendations, the COVID pandemic-related screening backlog, and finite colonoscopy capacity.[4–6] Although colonoscopy is the most commonly used CRC screening modality in average-risk individuals,[7] colonoscopy capacity is limited by facility, hours of operation, and personnel constraints. Limitations in colonoscopy capacity are likely to persist as the United States has a current shortage of 500 gastroenterologists, which is expected to rise to 1450 by 2034.[8] This combination of factors jeopardizes the goal of population-wide screening and threatens to undermine the timeliness, equity, and outcomes for patients with gastrointestinal conditions who require diagnostic and therapeutic endoscopy procedures.

Stool-based CRC screening tests—next-generation multitarget stool DNA (mt-sDNA) and fecal immunochemical test (FIT)—are home-based options endorsed by the US Preventive Services Task Force and are not constrained by capacity limitations. Since a follow-up colonoscopy is necessary when the stool-based test result is positive (13.2% of next-generation mt-sDNA and 7.4% of FIT tests),[9] the expanded use of stool-based tests has the potential to overcome the recognized colonoscopy capacity limitations. This expanded use of noninvasive stool-based testing could increase screening test accessibility and increase the clinical benefits and revenue generated, given the available colonoscopy capacity, by substituting initial screening colonoscopy examinations with follow-up examinations.[10] However, the optimal balance between the use of stool-based and endoscopic modalities to screen all eligible individuals remains unknown. Given the logistical and ethical challenges of conducting population-level randomized trials to compare complex screening strategies, decision models can provide a flexible framework to evaluate the clinical and economic outcomes of potential screening scenarios. With an aim to screen all eligible individuals, we identified scenarios that maximized the benefits of colonoscopy utilization for both screening and follow-up of noninvasive screening.

Methods

Study Design Overview

A decision model was developed using assumptions derived from published literature (Table). First, the *current* screening modality distribution in the United States was modeled using the estimated screening-eligible population, colonoscopy screening capacity, and the number of individuals who could not receive CRC screening because of limited colonoscopy capacity. Alternatively, to identify the *optimal* modality distribution in which all eligible individuals are screened, the distribution of mt-sDNA that has an updated marker panel (next-generation mt-sDNA), FIT, and colonoscopy was modified to remove the screening backlog while fully using the colonoscopy capacity. The remaining colonoscopy capacity not utilized by follow-up examinations on individuals with positive stool-based tests would be devoted to initial screening colonoscopies. Scenarios were modeled to determine the optimal allocation of colonoscopies for screening and follow-up that produced the best clinical and economic outcomes. Real-world adherence for follow-up colonoscopy evaluations after a positive FIT or mt-sDNA test was based on published literature (Table).[16] Institutional review board approval was not required since no human subject research was conducted.

Clinical and Economic Outcome Estimation

Clinical outcomes calculated for each scenario were the number of individuals screened by each modality and the number of detected and prevented CRC cases. These outcomes were modeled based on published rates of precancerous lesion and CRC prevalence[14] and publicly available data on the sensitivity and specificity values for colonoscopy,[14,15] FIT,[9] and next-generation mt-sDNA (Table).[9]

Economic outcomes for each scenario were screening costs by modality (including follow-up colonoscopy for stool-based strategies), costs of CRC treatment, total CRC costs, and the revenue for all colonoscopies with and without polypectomy. Screening costs for next-generation mt-sDNA and FIT were obtained from the Centers for Medicare and Medicaid services.[19,20] Colonoscopy costs, which included the procedure, anesthesiology, pathology, and polypectomy (if performed), were obtained from closed-form claims data from Komodo Health as described in Supplementary Methods. These costs were the amount an insurer agreed to pay for covered colonoscopy services (ie, allowed amount). Claims codes for colonoscopy procedures, anesthesiology, and pathology used in the Komodo Health analysis are shown in Supplementary Table 1. Total CRC costs included CRC screening costs (including the cost of a follow-up colonoscopy after a positive stool-based test), CRC treatment costs, and cost savings from prevented CRCs. CRC treatment costs were modeled based on published 4-year costs by disease stage (eg, local, regional, or distant)[21] adjusted for survival[17] and inflation to July 2025 USD[22] (Table). The estimated cost difference between detected and undetected CRC was based on the distribution of detected symptomatic CRC.[17] Revenue generated for colonoscopy with and without polypectomy was calculated for each payer, as shown in Supplementary Table 2.

Colonoscopy Use and Capacity Estimation

Based on published commercial claim and encounter databases, it was estimated there are approximately 15 million

Table. Model Inputs and Sources

Parameter	Value	Source
US population eligible for screening	58,338,480	Ebner et al, 2024[11]
Total annual colonoscopy capacity	15,000,000 (ranged from 18,000,000 to 30,000,000 in sensitivity analysis)	Joseph et al, 2016[12]
Annual colonoscopy capacity available for screening	6,300,000	Joseph et al, 2016[12]
Annual colonoscopy capacity available for nonscreening	8,700,000	
Eligible population undergoing initial screening	100% (ranged from 40% to 100% in sensitivity analysis)	Assumption
Real-world initial screening modality distribution		
Colonoscopy	60%	Stieber et al, 2024[13]
FIT	20%	
mt-sDNA	20%	
Precancerous lesion prevalence	36.5%	Imperiale et al, 2014[14]
APL	7.6%	
NAPL	29.0%	
CRC prevalence	0.65%	
Test performance: ng mt-sDNA		
Sensitivity: CRC stage I	88.0%	FDA 2024[9]
Sensitivity: CRC stage II	92.9%	
Sensitivity: CRC stage III	100.0%	
Sensitivity: CRC stage IV	100.0%	
Sensitivity: APL	43.3%	
Sensitivity: NAPL	12.5%	
Specificity: non-neoplastic findings	91.1%	
Specificity: negative colonoscopy	93.4%	
Test performance: FIT		
Sensitivity: CRC stage I	56.0%	FDA 2024[9]
Sensitivity: CRC stage II	78.6%	
Sensitivity: CRC stage III	73.3%	
Sensitivity: CRC stage IV	83.3%	
Sensitivity: APL	23.3%	
Sensitivity: NAPL	6.7%	
Specificity: non-neoplastic findings or negative colonoscopy	95.2%	
Specificity: negative colonoscopy	96.0%	
Test performance: colonoscopy		
Sensitivity: CRC	95.0%	Knudsen et al, 2021[15]
Sensitivity: APL	94.0%[a]	Imperiale et al, 2014[14]
Sensitivity: NAPL	78.3%[b]	
Real-world follow-up colonoscopy adherence		
After positive FIT	46.0%	Austin et al, 2023[16]
After positive mt-sDNA	72.1%	

Distribution of detected CRC	Local	Regional	Distant	
Undetected CRC - distribution of detected symptomatic CRC	37%	40%	23%	SEER 1975–1999[17]
Transition of APL to CRC	8% of adenoma >10 mm transition to CRC at 10 y			Stryker et al, 1987[18]
Screening cost				
Colonoscopy without polypectomy[c]	$1392			Komodo health data[d]
Colonoscopy with polypectomy[c]	$2802			

Table. Continued

Parameter			Value	Source
FIT			$18.05	CMS 2022[19]
ng mt-sDNA			$591.92	CMS 2025[20]
CRC costs[e]	Local	Regional	CRC costs[e]	
0–12 mo from diagnosis	$50,273	$151,276	$193,592	Fitch et al, 2015[21]
13–24 mo from diagnosis	$23,808	$55,652	$155,551	
25–36 mo from diagnosis	$24,869	$52,640	$134,562	
37–48 mo from diagnosis	$33,440	$35,255	$134,562	

APL, advanced precancerous lesions; CMS, Centers for Medicare and Medicaid Services; FDA, Food and Drug Administration; NAPL, non-advanced precancerous lesions; ng mt-sDNA, next-generation mt-sDNA; SEER, Surveillance, Epidemiology, and End Results Program.
[a]Weighted average based on APL prevalence by size and reported performance of colonoscopy: 1.3% lesions <6 mm (75.0%); 7.4% lesions 6 to <10 mm (85.0%); 91.3% lesions ≥10 mm (95.0%).[14,15]
[b]Weighted average based on APL prevalence by size and reported performance of colonoscopy: 66.9% lesions <6 mm (75.0%); 33.1% lesions 6 to <10 mm (85.0%).[14,15]
[c]The cost of colonoscopy consists of the procedure, pathology, and anesthesia costs.
[d]See Supplementary Appendix 1 for details of cost calculations.
[e]Reported costs before adjustment for survival and inflation to July 2025 USD.

colonoscopies available in the United States every year.[12] At baseline, 6.3 million (42% of 15 million) of these colonoscopies are performed as part of the CRC screening process (4.9 million [33% of 15 million] for initial screening and 1.4 million [9% of 15 million] for follow-up after a positive stool test; Figure 1).[12] As documented in prior research, the remaining 58% of colonoscopies are allocated for surveillance, diagnostic, and therapeutic indications (Figure 1).

Screening—Current Screening Modality Distribution Scenario

The US average-risk population eligible for CRC screening was assumed to be 58,338,480 individuals.[11] The eligible average-risk population are those who are not up to date with screening and who are without CRC or a family history of CRC, inflammatory bowel disease, or Lynch syndrome.[11] The current real-world initial CRC screening modality distribution in the United States was based on administrative claims data: colonoscopy (60%), FIT (20%), and mt-sDNA (20%).[13]

Optimal Screening Modality Distribution Estimation

Keeping the same relative proportion of initial CRC screening with FIT and mt-sDNA constant as in the current screening modality distribution scenario (ie, 50%/50% ratio of the stool-based tests), scenarios were modeled that shifted

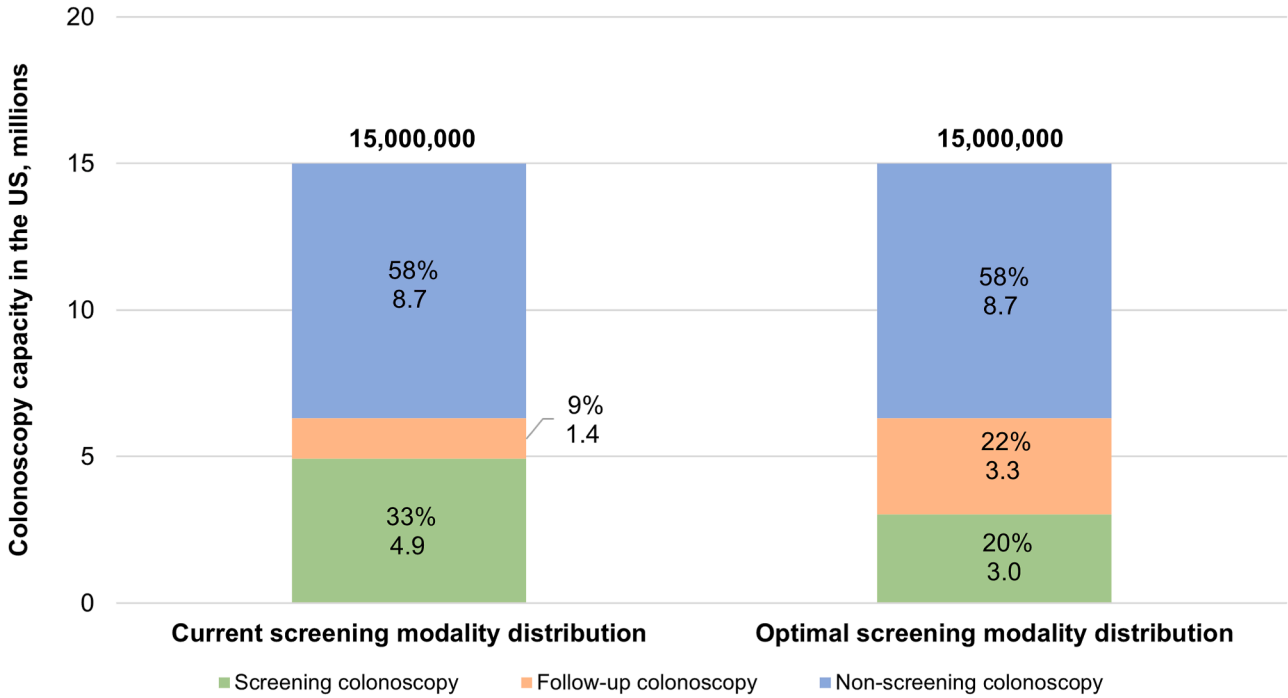


Figure 1. Current and optimal use of colonoscopy capacity in the United States.

initial screening colonoscopies to stool-based tests in 1% increments, and the subsequent resultant proportion of colonoscopies for screening and follow-up to maintain full capacity was estimated. To better understand the effectiveness of the analysis, the model is assumed to be a single snapshot in time, focusing on a one-time screening event with either colonoscopy or a stool-based test. Outcomes were estimated for each scenario seeking to identify a distribution of CRC screening modalities that maximized the clinical and economic outcomes.

Sensitivity Analyses

Leveraging the flexibility of the model, multiple sensitivity analyses were conducted. First, National Health Interview Survey and claims data show an upward increased trend over time for mt-sDNA use and a decreasing trend for FIT use.[7,23,24] Thus, the first sensitivity scenario evaluated changing the proportion of increases for FIT and next-generation mt-sDNA to a 25%/75% ratio, and in the second sensitivity analysis, to a 0%/100% ratio (eg, FIT use remains constant and only next-generation mt-sDNA increases). Next, in the baseline analysis, it was simplistically assumed that the time to perform screening and follow-up colonoscopy (ie, withdrawal time) was the same. Given the possibility that the performance of colonoscopies in individuals with a positive stool test would take longer than screening, sensitivity analyses were conducted to determine the impact on outcomes of longer follow-up colonoscopy withdrawal times (ie, relatively longer by 10%, 20%, 30%, 40%, and 50%). It was assumed that as the follow-up procedures took x% longer to perform, the total number of hours available for screening colonoscopies was reduced. This reduction in available time was reflected in the overall screening capacity.

In addition, given some uncertainty about colonoscopy capacity, we performed sensitivity analyses that increased the total colonoscopy capacity ranging from 18 million to 30 million. Another sensitivity analysis was conducted in which the uptake of initial screening by the screening-eligible population ranges from 40% to 100%. Finally, a sensitivity analysis was conducted to understand the importance and the benefits of the follow-up colonoscopy rate after a positive stool test compared with the status quo (FIT, 46%; and mt-sDNA, 72.1%), in which the adherence to follow-up colonoscopy was assumed to be uniform at a 50% or 60% rate, irrespective of the initial screening test used.

Results

Colonoscopy Capacity Current Distribution and Optimal Distribution Estimates

With the current screening modality distribution, 33% (4.9 million of the 15 million) of colonoscopies available annually in the United States can be performed for initial screening, 9% for follow-up after a positive stool test, and 58% for surveillance (Figure 1, left column). Given the fixed number of colonoscopy procedures, only 28.3 million individuals per year may receive initial screening, leaving 30.0 million eligible individuals remaining unscreened (Figure 2, left column). In order for all of the nearly 60 million average-risk individuals to be screened in the optimal screening modality distribution scenario—that utilizes the entire colonoscopy capacity—the number of individuals initially screened by stool-based tests would need to increase 2.4-fold from current use (Figure 2, right column). To allow for the newly screened patients with positive stool-based test results (1.9 million) to undergo follow-up procedures (using published follow-up rates), the

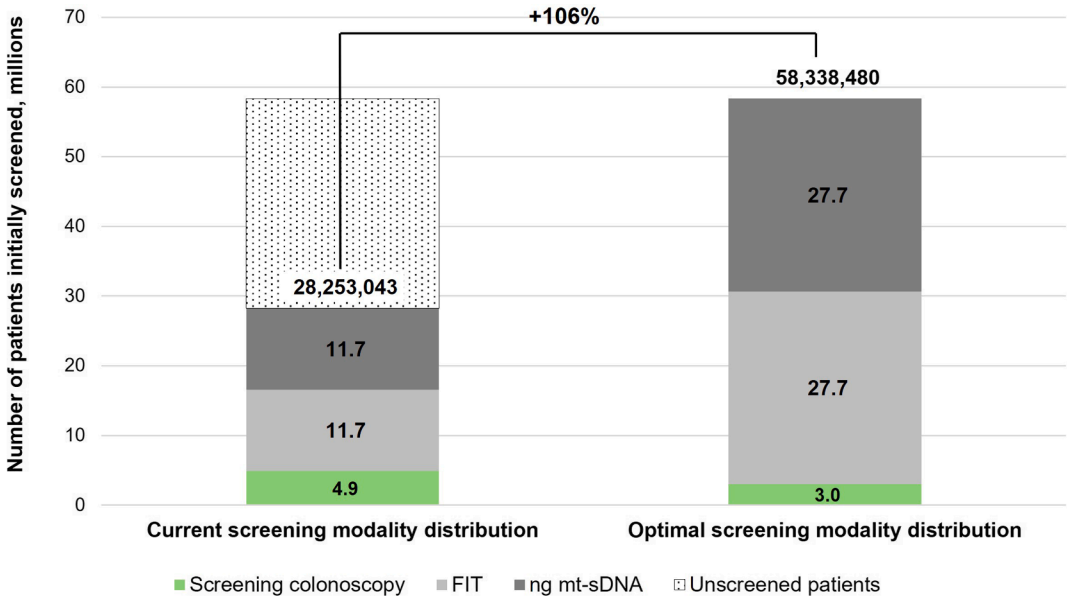


Figure 2. Number of individuals initially screened by each test with current and optimal screening modality distributions in the United States.

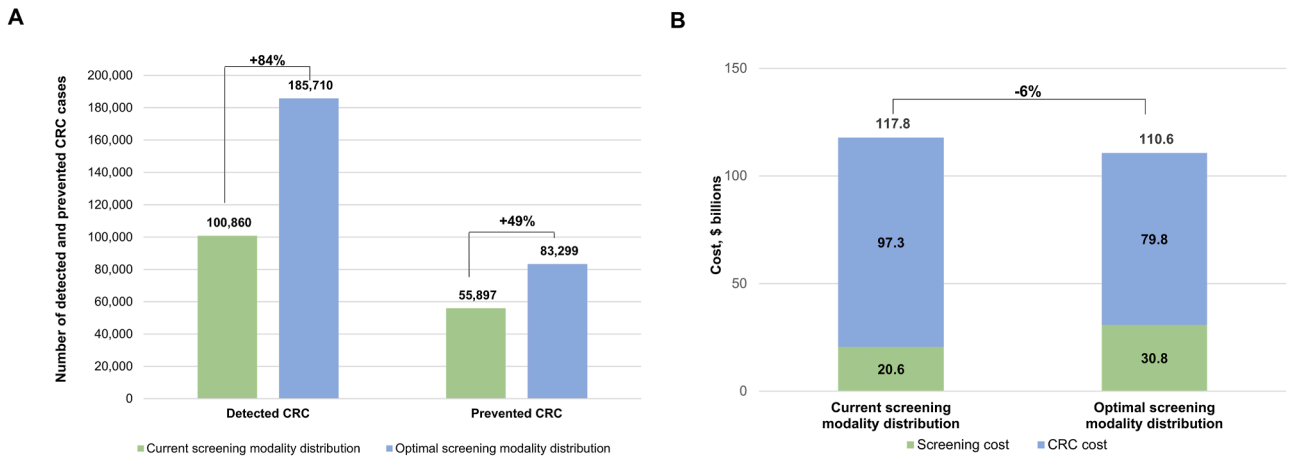


Figure 3. (A) Clinical (CRC cases detected and prevented) and (B) economic outcomes (screening and treatment cost) with current and optimal screening modality distributions. Screening costs include the cost of initial screening and of a follow-up colonoscopy after a positive stool test. Treatment costs are CRC treatment costs minus the costs saved by CRC prevention.

percentage of follow-up colonoscopies performed after positive stool tests would need to increase from the current 9% of the colonoscopy capacity to 22% (3.3 million/15 million). Given fixed capacity, the number of colonoscopies performed for initial screening would need to decrease by the same amount, from the current 33% of the colonoscopy capacity to 20% (3.0 million/15 million; Figure 1, right column).

Clinical Outcomes

In the optimal screening modality distribution scenario where the entire eligible population is screened and the full colonoscopy capacity is allocated most efficiently (ie, 13% fewer screening colonoscopies and 13% more follow-up colonoscopies), the model estimates that the number of detected CRC cases would increase by 84% (185,710 vs 100,860, respectively) and 49% more CRC cases would be prevented (83,299 vs 55,897, respectively; Figure 3A) compared to the current distribution of colonoscopy and stool-based screening.

Economic Outcomes

In the optimal screening modality distribution scenario where all eligible patients initiate screening, the model estimated that the total costs associated with CRC screening, treatment, and CRC prevented would decrease by 6% compared with the current distribution (includes unscreened individuals) of colonoscopy and stool-based screening ($110.6 billion vs $117.8 billion, respectively; Figure 3B). Screening costs (including costs for follow-up colonoscopy after a positive stool test) are estimated to increase by 50% ($30.8 billion vs $20.6 billion, respectively), driven by 30 million more people screened. While the *total* cost of screening would increase, the cost of screening per individual—including follow-up colonoscopy—would decrease from $728 per patient screening in the current distribution to $528 in the optimal distribution scenario. Reduced CRC treatment costs and savings from prevented CRC (from 16% more polypectomies) and earlier stage of CRC diagnosis would reduce the total CRC costs by 18% in the optimal distribution scenario from the current distribution ($79.8 billion vs $97.3 billion, respectively), even though more patients are treated in the optimal distribution scenario (Figure 3B).

Colonoscopy Revenue

In the optimal screening modality distribution scenario, revenue for all colonoscopy indications was estimated to increase from $13.4 billion for current distribution to $13.9 billion, due to the 16% increase in the number of polypectomies, including non-neoplastic lesions (3,656,568 vs 3,313,183, respectively). The model projected that any level of increase in current reimbursement up to $4529 for a follow-up colonoscopy would not result in additional cost for all screening and treatment that was observed in the optimal distribution scenario.

Sensitivity Analyses

When the proportion of initial CRC screening performed using FIT and next-generation mt-sDNA was assumed to increase at a 25%/75% ratio, the optimal distribution scenario occurs when 17% of the capacity is used for screening colonoscopy, driven by the increased performance of follow-up colonoscopy. When FIT use remains constant and only next-generation mt-sDNA increases (0%/100% ratio increase), the optimal distribution scenario occurs when 14% of the capacity is used for screening colonoscopy (Supplementary Table 3). Both the 25%/75% and 0%/100% proportional increase optimal distribution scenarios would result in more CRC detected and prevented, as well as total cost savings and greater colonoscopy revenue, compared with the current distribution (Supplementary Table 3).

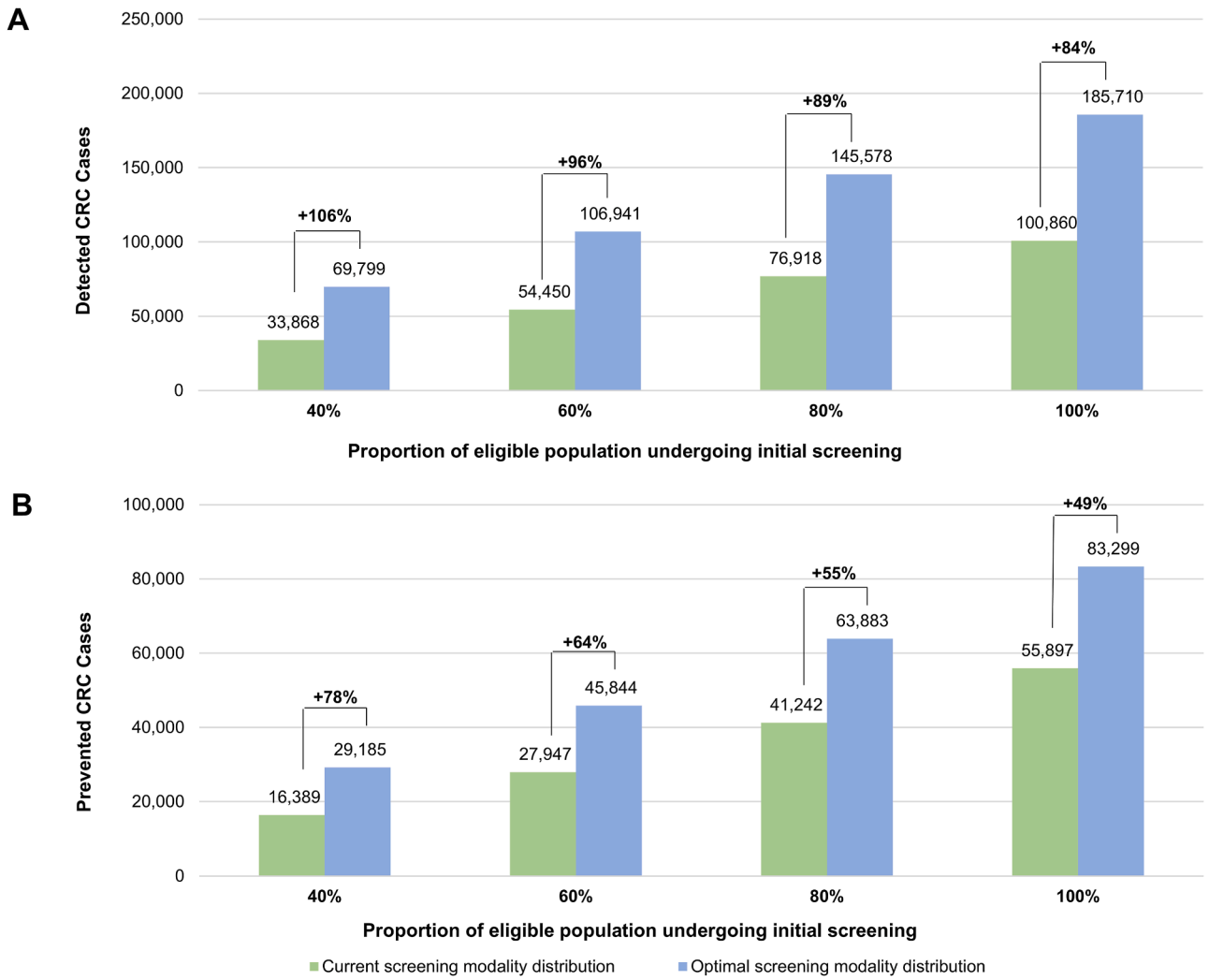


Figure 4. (A) Number of detected CRC cases and (B) number of prevented CRC cases with current and optimal screening modality distributions by the proportion of the eligible screening population undergoing initial screening. If the initial screening test is a stool-based test, the follow-up colonoscopy adherence is based on real-world rates.

If scheduled time devoted to follow-up colonoscopy is 10% longer than for screening, the shift away from screening colonoscopy to complete screening for the entire eligible population would be the same as for the base-case optimal distribution scenario (shift to 20%). If withdrawal time is 50% longer, 17% of colonoscopy capacity could be dedicated to screening colonoscopy to ensure that all follow-up examinations could be completed (Supplementary Figure 1).

When the assumed colonoscopy capacity is increased, the percentage of initial screening colonoscopies necessary to achieve the optimal distribution also increases. In the case that the total capacity is 20% higher (18 million), the optimal distribution scenario occurs when 35% of the capacity is used for screening colonoscopy (compared to 20% with the base-case optimal distribution scenario). When the capacity is doubled to 30 million, the optimal distribution of screening colonoscopy would be 63% (Supplementary Figure 2).

The sensitivity analysis of initial screening adherence indicated that at 40% uptake, the number of detected CRC cases would increase by 106% with the optimal distribution scenario compared with current distribution (69,799 vs 33,868, respectively; Figure 4A) and the number of prevented CRC cases would increase by 78% (29,185 vs 16,389, respectively; Figure 4B). The number of CRC cases detected with only 60% uptake is greater with the optimal distribution scenario than with 100% uptake of the current distribution scenario (Figure 4A).

In the sensitivity analysis of 50% adherence to follow-up colonoscopy for both the stool tests, the optimal distribution scenario occurs when 25% of the capacity is used for screening colonoscopy. At 60% follow-up adherence, the optimal distribution scenario occurs when 21% of the capacity is used for screening colonoscopy. At 50% or 60% adherence to follow-up colonoscopy after a positive stool test, clinical and economic outcomes are improved compared with current distribution (Supplementary Table 4).

Discussion

Suboptimal CRC screening rates, driven partially by constraints on colonoscopy capacity in the United States, are a public health issue as delays or lack of screening potentially increase the number of CRC cases and related deaths.[25,26] Although colonoscopy is considered the "gold standard" for CRC screening, current capacity does not allow all eligible individuals to be screened by this modality. Thus, the availability of guideline-recommended screening modalities that do not face similar capacity constraints warranted an assessment of allocation strategy scenarios that substituted initial colonoscopy screening with stool-based tests, such that the number of follow-up colonoscopies maintained the full colonoscopy capacity. Follow-up colonoscopies produce superior clinical outcomes (compared with screening colonoscopy),[27] cost-savings (compared to those with a positive stool-based screening test who do not undergo follow-up colonoscopy),[28] and increased revenue.

Since the current colonoscopy capacity is likely fixed for at least the short term, the advantages derived from shifting the proportional mix of screening and follow-up colonoscopy indications include: (1) increasing the number of individuals screened to include all eligible average risk individuals; (2) increasing the number of individuals who complete the screening process (ie, undergo follow-up colonoscopy when the stool test is positive); (3) substantially improving the population benefits of screening (more estimated CRC cases detected and prevented compared with current use); (4) reducing total spending on CRC costs; and (5) increasing colonoscopy revenue.

Implementing the shift to the optimal screening modality distribution scenario would require a cultural change in clinical practice, moving away from a "colonoscopy-first" mindset for average-risk screening. Colonoscopy is the preferred modality for average-risk CRC screening in terms of its high single-test cancer sensitivity (~95%) and the ability to detect and remove precancerous lesions during the procedure. The data are clear that in the unattainable scenario where everyone eligible was screened with colonoscopy, then more CRC would be detected and prevented compared with the stool-based tests. However, this research was motivated by the question of *how to screen all eligible individuals using the current fixed colonoscopy capacity*. Compared with the current status quo where 30 million eligible individuals in the US remain unscreened for CRC, resulting in an estimated nearly 200,000 missed cases, our optimization strategy (more stool-based testing, utilizing full colonoscopy capacity) led to 84% more CRC detected than current screening utilization patterns. This emphasizes the popular sentiment that "…the best test is the one that gets done."[29]

Communicating to endoscopists that the optimal shift preserves procedural volume and increases revenue through a different case mix will be crucial for adoption. Based on a nationally representative claims analysis, a meaningful shift in clinical practice towards more efficient use of the current colonoscopy capacity has already recently occurred in response to policy changes that eliminated cost-sharing for follow-up colonoscopy for insured individuals.[30] The analysis found that the proportion of all colonoscopies conducted as a follow-up after a positive stool-based test increased by a relative 41% after implementation of the policy, without an overall increase in colonoscopy volume.[30]

A shift toward more stool-based tests for average-risk screening may also be challenging for the minority of patients that prefer colonoscopy. We recently reported the results of a discrete choice experiment survey of adults aged 45–75 years at average risk for CRC and physicians who recommend CRC screening.[31] The survey revealed that mt-sDNA was most preferred by the majority of patients (39.4%), followed by colonoscopy (24.8%), while colonoscopy was overwhelmingly preferred by clinicians (95.0%), regardless of specialty (primary care vs gastroenterology).[31] Since patient preference should play an increasingly important role in the mix of stool-based tests and colonoscopy, it is noteworthy that under the optimal allocation strategy, a substantial number of screening colonoscopies are performed annually (3 million), allowing those who choose that modality to receive it.

The challenges of the insufficient colonoscopy capacity have been recognized by others, and various strategies to increase capacity have been proposed or evaluated in non-US populations.[32–36] These strategies include using a higher threshold or multiple stool tests to decrease follow-up colonoscopies[32,35] and increasing the screening interval.[32] Data are emerging that people might be willing to accept alterations in screening behavior that prioritizes higher risk individuals when colonoscopy capacity was limited. In a survey of 1054 US veterans, 94% responded a willingness to delay their next screening colonoscopy for at least 6 months so their higher-risk peers could be prioritized for colonoscopy.[37] Our evidence-based solution differs from these other strategies as it remains aligned with those endorsed by the US Preventive Services Task Force, while utilizing the full colonoscopy capacity.

One study estimated that, assuming real-world adherence rates to stool-based tests and follow-up colonoscopies after a positive stool test result, transitioning all eligible individuals to stool-based tests would result in the number of follow-up colonoscopies after a positive stool test being less than 50% of current colonoscopy capacity.[10] However, utilizing only half of the colonoscopy capacity for the most efficient screening modality suggests suboptimal analysis. Instead of shifting all screening colonoscopies to follow-up colonoscopies, the current study suggests that there is an opportunity for an optimal combination of colonoscopy use that offers screening for all eligible individuals and improves outcomes.

Shifting initial screening colonoscopies to follow-up colonoscopy after positive stool-based testing could not only benefit the population health outcomes but also is

cost-saving for payers and revenue generating for providers. Our analysis shows that while screening costs increase with expanded uptake, this increase in cost is offset by fewer cancer cases and lower treatment costs of individuals with earlier cancer stage. Furthermore, even though the total number of colonoscopies remains the same, the optimal distribution scenario produces higher total colonoscopy revenue compared with current allocation due to a higher proportion of therapeutic procedures with polypectomy (based on 2025 Medicare physician fee schedule rules).

Using a base-case analysis that models a single, point-in-time screening episode with no repeated rounds is a limitation. We hypothesize that the reported favorable outcomes of the single screening episode are likely an underestimate compared with a long-term analysis with repeated rounds of screening. After repeated rounds of screening with the optimal screening modality distribution scenario, the number of screening-eligible individuals and number needing a follow-up colonoscopy after a positive stool test would decrease over time. As the number of follow-up colonoscopies decreases, the number of colonoscopies available for initial screening would increase, and clinical outcomes would likely improve. Thus, it will be of interest in future analyses to estimate the clinical and economic outcomes of the optimal screening modality distribution over a long-term period with repeated rounds of screening.

Another limitation of the analysis is that some of the input variables used in the model are fluid and change over time. Therefore, the base-case scenario inputs may differ at different points in time. For example, the market share of stool-based tests and colonoscopy may fluctuate, and some studies have shown an increase in the uptake of mt-sDNA.[7,23] The sensitivity analyses using ratios reflecting greater increases for mt-sDNA than FIT showed better clinical outcomes, total cost savings, and more generated revenue with the optimal distribution of colonoscopy compared with current distribution. The dollar amount of colonoscopy reimbursement is also a fluid variable. The current analysis was based on 2025 Medicare physician fee schedule rules, and any changes to these rules could impact colonoscopy reimbursement and associated revenue. An additional limitation is that the model did not consider any changes in surveillance colonoscopy; as more individuals are screened in the optimal distribution scenario, more individuals will have precancerous lesions detected that require polypectomy and surveillance. Individuals with low-risk polyps may need infrequent surveillance, but the 5%–10% of individuals who will have high-risk polyps on screening colonoscopy, and likely the 10%–15% of individuals with positive stool-based tests, may need more frequent surveillance. As an alternative to increasing surveillance colonoscopies, there has been some observational research that surveillance using stool-based tests in individuals who have undergone a polypectomy can be safe and cost-effective.[38]

Adherence to both initial screening and a follow-up colonoscopy after a positive stool-based test is a critical driver of estimated outcomes in CRC screening modeling analyses.[39–41] Real-world adherence for follow-up colonoscopy evaluations was incorporated in the base case of the current analysis. However, the assumption of 100% uptake of initial screening as modeled in the base case scenario is unrealistic; hence, we performed the sensitivity analysis ranging the uptake. By using the entire screening-eligible population for the base case analysis, we showed that should all 58.3 million eligible candidates choose to be screened, then it is possible even with the current limited colonoscopy capacity. Moreover, there is a substantial relative clinical impact when shifting from current colonoscopy use to the optimal distribution scenario at each level of uptake. In fact, implementing the optimal distribution of colonoscopy has a greater impact than increasing uptake at the current distribution of screening modalities. When both uptake and the screening modality distribution are optimized, over 150,000 more CRC cases are detected compared to the current stool-based test and colonoscopy screening distribution patterns.

Conclusions

An unacceptably high percentage of average-risk, screening-eligible individuals remain unscreened for CRC in the United States, partially driven by patient preference, COVID-19–related backlog, and constraints on colonoscopy capacity. Our population-based model estimated that reallocating clinical indications for colonoscopies by substituting some screening colonoscopies with follow-up colonoscopies, along with a shift in initial CRC screening modalities to more stool-based testing, can provide more favorable relevant clinical and economic outcomes, while maintaining total colonoscopy procedure volumes (albeit with a different mix of indications). The proposed shift would produce a rare “win-win-win” for patients, endoscopists, and payers through enhanced screening uptake leading to increased health benefits, maximized colonoscopy efficiency and revenue, and reduced total expenditures.

Supplementary Materials

Material associated with this article can be found in the online version at https://doi.org/10.1016/j.gastha.2026.100930.

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A. Mark. Fendrick: Conceptualization, writing, review, and editing. Vahab Vahdat: Methodology, data curation, formal analysis, investigation, software, and visualization of the study, writing, review, and editing. Chris Estes: Methodology, data curation, formal analysis, investigation, software, and visualization of the study, writing, review, and editing. Shrey Gohil: Data curation, formal analysis, investigation, software, and writing, review, and editing. Paul J. Limburg: Conceptualization, methodology, writing, review, and editing. Jacob E. Kurlander: Conceptualization, writing, review, and editing. David A. Lieberman: Conceptualization, writing, review, and editing. All authors approved the final draft for submission.

Conflicts of Interest:
These authors disclose the following: A. Mark. Fendrick has been a consultant for AbbVie, Amgen, Centivo, Community Oncology Association, Covered California, EmblemHealth, Exact Sciences, Freedman Health, GRAIL, Harvard University, Health & Wellness Innovations, Health at Scale Technologies, MedZed, Penguin Pay, Risalto, Sempre Health, the State of Minnesota, US Department of Defense, Virginia Center for Health Innovation, Wellthy, and Zansors; has received research support from the Agency for Healthcare Research and Quality, Gary and Mary West Health Policy Center, Arnold Ventures, National Pharmaceutical Council, Patient-Centered Outcomes Research Institute, Pharmaceutical Research and Manufacturers of America, the Robert Wood Johnson Foundation, the State of Michigan, and the Centers for Medicare and Medicaid Services. David A. Lieberman has served as a consultant for Geneoscopy, Universal Diagnostics, and ColoWrap. Chris Estes, Vahab Vahdat, Shrey Gohil, and Paul J. Limburg are employees of Exact Sciences Corporation and hold stock in the company. The remaining author discloses no conflicts.

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