ECONOMIC CONSEQUENCES OF INCREASING MT-SDNA UTILIZATION AMONG COLORECTAL CANCER SCREENING STRATEGIES FROM A PAYER PERSPECTIVE

EXACT SCIENCES

Hathway JM, MPH[1], Miller-Wilson LA, PhD, MBA[2], Jensen IS, MBA[1], Ozbay B, PhD, MBA[2], Regan C, BA[1], Yao W, MS[1], Jena AB, MD, PhD[3], Weinstein MC, PhD[4], Parks, P, MD, MPH[2]

PRECISION HEOR — PART OF PRECISION VALUE & HEALTH

[1]Precision Health Economics and Outcomes Research, Boston, MA; [2]Exact Sciences Corporation, Madison, WI; [3]Harvard Medical School, Boston, MA; [4]Harvard T. H. Chan School of Public Health Boston, MA

BACKGROUND

Colorectal cancer (CRC) is the second leading cause of cancer death in the United States (US) [1]. While the US Preventive Services Task Force (USPSTF) recommends screening individuals ages 50-75 at average risk for CRC [2], the American Cancer Society (ACS) recommends screening individuals ages 45-75 [3]. The utilization of screening modalities (FIT, Cologuard® (mt-sDNA), colonoscopy) for individuals at average risk for CRC remains largely dominated by the use of colonoscopy and this has economic and health implications. Because eligibility for Medicare (and therefore commercial and Medicaid) is often dependent on age, it is also important to evaluate the implications of defining CRC screening eligibility based on different age groups for different payer types.

OBJECTIVE

To evaluate the health and economic outcomes of increasing mt-sDNA uptake among screening strategies for individuals eligible for screening according to the USPSTF and ACS guidelines among commercial, Medicare, and Medicaid beneficiaries.

METHODS

- A Markov model based on CRC screening guidelines and literature-based cross-sectional compliance was developed in order to simulate the clinical and economic outcomes of increasing mt-sDNA screening from 6% (status quo) to 28% over 10 years among the following screening modalities: colonoscopy, FIT, mt-sDNA.
- It was assumed that some patients (24%) [4] would remain screening naïve throughout the 10-year time horizon, and that the rest may adhere incompletely to scheduled screenings (i.e., potential screeners).
- Cross-sectional compliance for potential screeners was 64% [4], 64.7% [5], and 67.5% [6] for colonoscopy, FIT, and mt-sDNA. Longitudinal screening compliance for stool-based modalities and follow-up diagnostic colonoscopy were 81.6% [7] and 78.4% [7] for FIT; mt-sDNA estimates were assumed to be the same as FIT.

Figure 1. Eligible screener breakdown

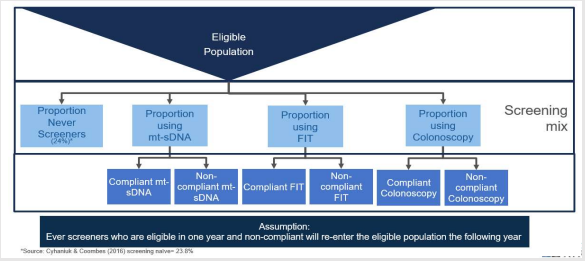


Figure 1 displays how eligible patients are divided among screening modalities and cross-sectional compliance status (i.e., screening during an eligible cycle). Note that each year, non-compliant patients remain eligible the following year and are redistributed based on the new screening mix.

Figure 2. Conceptual model framework

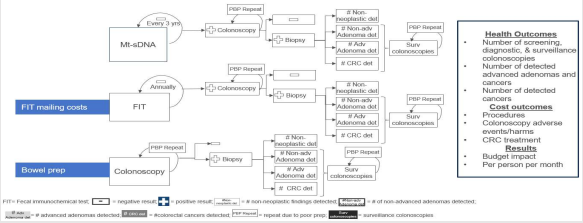


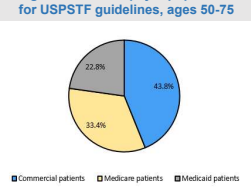
Figure 2 displays the patient pathways for eligible and compliant CRC screeners per modality.

- The population was divided into 5-year age bands based on US Census data [8] and assigned age-specific risk profiles for adenoma type prevalence and cancer [9,10].
- It was assumed that beneficiaries ages 65-75 were on Medicare. Of eligible persons ages <65, 34.2% were assumed to be on Medicaid [11] and the remaining 65.8% were assumed to be commercially insured. The uninsured population was not modeled.
- Costs included direct medical costs (stool-based screening [12], colonoscopy [13], sedation [14], adverse events [11], and CRC treatment [15]).
- Cost indices were calculated in order to convert Medicare to Commercial [16] and Medicaid costs [17], and from Commercial costs to Medicare and Medicaid costs. The cost indices were 1.27 and 0.79 for converting Medicare to commercial costs and Medicare to Medicaid costs.
- All costs were either extracted from 2019 data or were updated to 2019 USD based on medical CPI [18].
- A deterministic sensitivity analysis (DSA) was conducted in order to determine the parameters to which the budget impact result was most sensitive.
- In order to account for uncertainty in the model, a probabilistic sensitivity analysis (PSA) was run using a Monte Carlo simulation, during which all parameters as well as costs and resource could vary across a predetermined range, as established by draws from beta and gamma distributions.

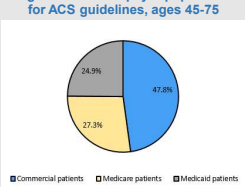
RESULTS

- With the USPSTF age range, there were ~302K eligible with ~73K screening naive and ~229K potential screeners whereas for the ACS age range, there were ~368K eligible screeners with ~88K screening naïve and ~280K potential screeners in the first year of the time horizon.
- With the USPSTF guidelines (Figure 3), 33.4% of all eligible screeners were on Medicare (i.e., age 65-75), whereas 27.3% of them were on Medicare with the ACS guidelines (Figure 4) due to an expanded non-Medicare population.

Figures 3. Year 1 payer population for USPSTF guidelines, ages 50-75

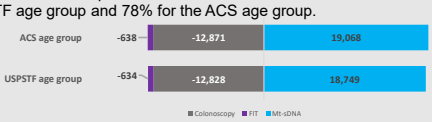


Figures 4. Year 1 payer population for ACS guidelines, ages 45-75



- Overall adherence for the status quo and increased mt-sDNA scenarios remained the same; 80% for the USPSTF age group and 78% for the ACS age group.

Figures 5. Incremental number of screenings per modality (Increased mt-sDNA – status quo)



Within both USPSTF and ACS age groups, increased use of mt-sDNA yielded increases in detected CRC cases and diagnostic colonoscopies in addition to decreases in screening and surveillance colonoscopies compared to the status quo.

Figure 6. Number of colorectal cancers detected over 10 years

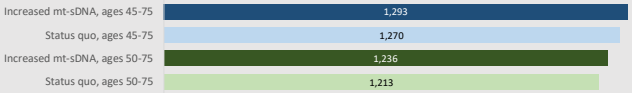


Figure 7. Number of non-cancer findings during screening, diagnostic, and surveillance colonoscopy over 10 years

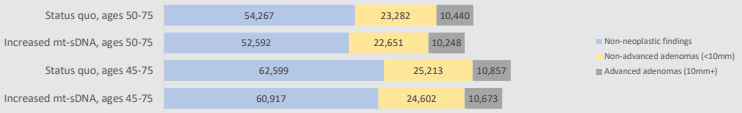


Table 1. Incremental (increased mt-sDNA- status quo scenario) number of colonoscopies by type over 10 years

Number of colonoscopy by type	Incremental results (Increased mt-sDNA – status quo)	
	Ages 50-75	Ages 45-75
Screening colonoscopies	-12,828	-12,871
Surveillance colonoscopies	-395	-391
Diagnostic colonoscopies	2,155	2,171

The cost savings can be explained primarily by the reduction in colonoscopies, which results in savings due to fewer procedures and associated sedation and adverse events.

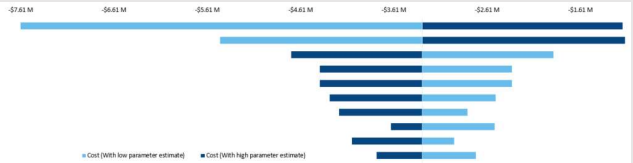
Table 2. Economic outcomes

Parameter	Status quo (6% mt-sDNA, 11% FIT, 83% colonoscopy)		Increased Cologuard (28% mt-sDNA, 9% FIT, 63% colonoscopy)		Incremental costs (increased mt-sDNA- status quo)	
	Ages 50-75	Ages 45-75	Ages 50-75	Ages 45-75	Ages 50-75	Ages 45-75
CRC screening*	$408,426,082	$462,939,265	$403,664,322	$458,327,223	-$4,761,760	-$4,612,042
Surveillance colonoscopies	$66,209,914	$82,205,102	$63,865,518	$79,883,093	-$2,344,396	-$2,322,009
Diagnostic colonoscopies	$6,207,748	$7,008,487	$9,442,107	$10,252,628	$3,234,359	$3,244,141
Adverse events	$68,048,950	$76,828,422	$65,915,207	$74,700,028	-$2,133,743	-$2,128,394
CRC treatment	$170,417,377	$180,403,685	$173,117,195	$183,130,843	$2,699,818	$2,727,158
Total cost	**$719,310,071**	**$809,384,960**	**$716,004,350**	**$806,293,815**	**-$3,305,721**	**-$3,091,146**
PMPM	$5.99	$6.74	$5.97	$6.72	-$0.03	-$0.03

*CRC screening includes the costs of screening colonoscopies and stool-based screenings.

The DSA indicated that the model is most sensitive to the number of covered lives, proportion of covered lives at average risk, sensitivity and specificity of screening colonoscopies, and the cost of sedation (Figure 8). Out of 10,000 iterations of the model, the PSA indicated that the model demonstrates cost savings for the payer in 96% of the model iterations.

Figure 8. Top 10 results of the Deterministic sensitivity analysis (DSA) for ages 50-75



Rank	Parameter	Low estimate	High estimate	Result with low estimate	Result with high estimate
1	Specificity of screening (sc) colonoscopy	69%	100%	-$7,613,084	-$1,163,874
2	mt-sDNA cost	$407	$611	-$5,474,703	-$1,136,739
3	Cost of sedation	$471	$707	-$1,900,593	-$4,710,849
4	Number of payer lives	800,000	1,200,000	-$2,349,910	-$4,408,866
5	Proportion of lives at average CRC risk	64%	96%	-$2,349,910	-$4,408,866
6	Sensitivity of sc colonoscopy for non-advanced adenomas	64%	96%	-$2,521,566	-$4,298,374
7	Proportion of ages 55-59 that were previously screened	40%	60%	-$2,821,143	-$4,201,334
8	Proportion of ages 65-69 that were previously screened	74%	100%	-$2,532,970	-$3,645,406
9	Mt-sDNA specificity for 65-69 yr. olds	40%	60%	-$2,966,323	-$4,059,881
10	Mt-sDNA specificity for 60-64 yr. olds	69%	100%	-$2,733,618	-$3,795,950

CONCLUSION

Increased mt-sDNA utilization may lead to overall cost savings for payers, when considering both the USPSTF and ACS guidelines for screening individuals at average risk for CRC, including initiation of screening at age 45. Increases in diagnostic colonoscopy costs were offset by reductions in colonoscopy screening and surveillance colonoscopies in addition to a reduction in adverse events associated with colonoscopy. Compared to the status quo, the increased mt-sDNA scenarios yielded fewer non-neoplastic findings, the majority of which would not have developed into pre-cancer or cancer. Small non-neoplastic polyps are not known to progress to either pre-cancer or cancer in average risk individuals.

REFERENCES

1. American Cancer Society. Cancer Facts & Figures 2020.Table 1. Estimated Number of New Cancer Cases and Deaths by Sex, US, 2020. Retrieved from https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/annual-cancer-facts-and-figures/2020/estimated-number-of-new-cancer-cases-and-deaths-by-sex-2020.pdf.
2. Bibbins-Domingo et al.JAMA, 2016. 315(23); p. 2564-2575.
3. Wolf, A.M.D., et al. CA: A Cancer Journal for Clinicians, 2018. 68(4): p. 250-281.
4. Cyhaniuk and Coombes, Am J Manag Care. 2016 Feb;22(2):105-11.
5. van Roon et al, Gut. 2013 Mar;62(3):409-15.
6. Manufacturer data on file. 2019. Cologuard's compliance rate represents the cumulative completed tests from kits shipped to patients during the six-month period ending 12 months prior to the end of the Q3 2019, excluding program orders.
7. Jensen CD et al. Annals of Internal Medicine. 2016;164(7):456-463.
8. U.S. Census Bureau. Population Estimates by Age, Sex, Race and Hispanic Origin: United States Census Bureau; 2018 [December 1, 2018]. Available from: https://www.census.gov/newsroom/press-kits/2018/estimates-characteristics.html
9. Rutter et al., Stat Med. 2007 Jan 15;26(1):98-109
10. Knudsen et al., JAMA. 2016 Jun 21;315(23):2595-609
11. Healthcare Cost and Utilization Project (HCUP). HCUP CCS - Services and Procedures Rockville, MD. Retrieved on 1 December 2018 from: https://www.hcup-us.ahrq.gov/toolssoftware/ccs_svcsproc/ccssvcproc.jsp
12. Centers for Medicare & Medicaid Services. Clinical Laboratory Fee Schedule Baltimore, MD. Retrieved on 1 June 2019 from: https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/ClinicalLabFeeSched/Clinical-Laboratory-Fee-Schedule-Files.html
13. Centers for Medicare & Medicaid Services. Physician Fee Schedule cms.gov. Retrieved on 1 May 2019 from: https://www.cms.gov/apps/physician-fee-schedule/overview.aspx
14. Healthcare Bluebook. Binding Price Estimate for Anesthesia for Colonoscopy (with biopsy). Retrieved on 20 January 2019 from: https://www.healthcarebluebook.com/
15. Goede, S.L., et al. Med Care, 2015. **53**(7): p. 630-8.
16. Calculation based on MEDPAC March 2015 Report to the Congress Medicare Payment Policy, Retrieved on 30 JUL 2019 from http://www.medpac.gov/docs/default-source/reports/mar2015_entirereport_revised.pdf
17. The Henry J. Kaiser Family Foundation; Retrieved from: https://www.kff.org/medicaid/state-indicator/medicaid-to-medicare-fee-index/?currentTimeframe=0&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D
18. Federal Reserve Bank of St. Louis. Federal Reserve Economic Data St. Louis, MO. Retrieved on 1 June from: https://fred.stlouisfed.org/series/CPIAUCSL#0.

Disclosures

This project was funded by Exact Sciences Corporation. The content and results was approved by all authors and has not been subject to sponsor censorship. Joanne Hathway, Ivar Jensen, Catherine Reagan, and Weiyu Yao are an employees of Precision Health Economics and Outcomes Research, which provides consulting services to the life sciences industry, including Exact Sciences. Dr. Lesley-Ann Miller-Wilson and Dr. Burak Ozbay are Senior Directors, Health Economics and Outcomes Research at Exact Sciences Corporation. Dr. Philip Parks is Senior Director, Healthcare Transformation at Exact Sciences Corporation. Dr. Bapu Jena and Dr. Milton Weinstein are advisors to Precision Health Economics and Outcomes Research and consult for Exact Sciences Corporation.