

The cost case for colorectal cancer screening, with an applied model for Hidalgo County, Texas

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Abstract

Background. Colorectal cancer is the second leading cause of cancer death in the United States and is one of the few cancers for which screening removes the precursor lesion rather than only finding disease earlier. This analysis asks whether screening is a net expense or a net saving, what a programme costs to deliver at 2026 prices, and what either answer means for a county in which incidence is rising 4.7 percent a year and 45.9 percent of adults aged 45 to 75 are unscreened.

Methods. Published microsimulation, claims, trial and primary government data were assembled without inflation adjustment or interpolation, and combined in a single transparent break-even model for Hidalgo County, Texas. The perspective is that of a county health department, the time horizon of the applied model is one year of billed treatment charges, and lifetime model results are reported at the source's 3 percent discount rate. Reporting follows the CHEERS 2022 statement.

Results. Annual fecal immunochemical testing between ages 45 and 75 costs less over a lifetime than no screening at all in every model used to set national policy, while gaining 125 to 163 quality-adjusted life years and averting 24 to 28 colorectal cancer deaths per 1,000 people [1,2]. In commercial claims, first-year medical charges rise by \$353,255 after a metastatic diagnosis against \$182,000 after a non-metastatic one, a difference of \$171,255 per patient [3]. Mailed outreach in a Hispanic-majority safety-net network costs \$10.48 per patient contacted [4]. In Hidalgo County, 113,504 adults aged 45 to 74 are unscreened; a single mailing to all of them costs \$1,189,525, which equals the first-year charges of 3.4 metastatic patients, and which is recovered in charges if the programme shifts seven patients from late-stage to early-stage diagnosis, 3.7 percent of the 188 late-stage cases the county records annually. One-way sensitivity analysis using published bounds for each input places the break-even between 6.3 and 14.1 stage shifts. Because the claims figures are billed charges rather than amounts paid, the break-even was recomputed using Medicare paid amounts by stage and phase of care [21]: the first-year paid cost of a stage IV colon cancer exceeds that of a stage I cancer by \$64,229 in 2019 dollars, giving a break-even of 18.5 stage shifts, 9.9 percent of the annual late-stage caseload.

Conclusions. At published unit costs the programme recovers its cost within a single year at a stage shift of under 4 percent measured in billed charges, or under 10 percent measured in Medicare paid amounts, before counting any health gain. Every figure is a published or primary-source value; no cost was assumed, interpolated or inflated.

Keywords. *colorectal cancer screening; cost-effectiveness; fecal immunochemical test; stage at diagnosis; safety-net population; mailed outreach; Hidalgo County, Texas*

1. Background

Colorectal cancer screening differs from most screening in one respect relevant to its economics. Colonoscopy, and any test that leads to colonoscopy, permits removal of adenomatous polyps, so a proportion of the cancers that would otherwise have occurred in a screened cohort are prevented rather than detected earlier. In the three CISNET microsimulation models used to set the current national recommendation, the lifetime cost per person of annual fecal immunochemical testing, \$3,811 to \$5,384, is below the lifetime cost of no screening, \$5,268 to \$5,845 [1]. The mechanism is that the 77 to 88 colorectal cancers per 1,000 people that occur without screening fall to 20 to 46 with

annual testing [1,2], and the cost of treating the cancers avoided exceeds the cost of the tests and follow-up colonoscopies performed. Screening is therefore reported as cost saving, meaning lower total cost and greater health benefit than the comparator, rather than cost effective, meaning greater benefit purchased at an acceptable additional cost.

The question addressed here is whether early detection of colorectal cancer produces a net financial saving, and what a screening programme would cost in this setting. Answering it requires five quantities that are usually reported in different literatures and different dollar years: the lifetime cost of screening against not screening, the cost of treating advanced disease, the unit cost of delivering tests and outreach, the savings that accrue to a payer or a population block, and the health gain expressed in life years. A sixth quantity, local epidemiology, determines whether national values for incidence, screening uptake and insurance coverage can be applied to this county without adjustment. This paper reports each quantity in turn and then combines them in a break-even model specified by six equations in section 3.7.

2. Methods

2.1 Evidence selection

Figures were drawn only from four classes of source: microsimulation analyses commissioned to set national policy, peer-reviewed cost analyses of claims data, randomised trial evidence, and primary government data files. Where a secondary summary and a primary file both existed, the primary file was downloaded and read directly. Medicare payment rates were taken from the CMS fee schedule files themselves rather than from lookup websites or published summaries, with the single exception of the 2026 conversion factor, which is noted in the text as a secondary source [5,6,7,8,9]. No figure was estimated, interpolated between reported values, or inflated forward from an older dollar year. Values that could not be verified against the source document were excluded.

2.2 Dollar years and perspective

Costs in this paper carry four dollar years, 2020, 2021, 2023 and 2026, and three perspectives, and no figure from one may be added to or subtracted from a figure from another without an inflation adjustment and a perspective adjustment, neither of which is made here. Lifetime model costs are 2021 dollars from a health system perspective at a 3 percent discount rate [1]. Treatment figures from commercial claims are billed charges in 2023 dollars, not amounts paid, and are reported from the perspective of the claims record rather than of any single payer [3]. Medicare payment rates are 2026 dollars and represent what one payer pays, not what care costs to produce. Outreach costs are as published in 2023 with no stated inflation year [4]. No conversion between dollar years was performed, since any such conversion would introduce an inflation index that is itself an assumption. Every table states its dollar year in its own column. The only arithmetic performed across sources is in section 3.7, which multiplies the 2023 outreach cost [4] by a population count and divides the product by the 2023 difference in treatment charges [3]; both figures were published in the same year.

2.3 Notation

The applied model in section 3.7 uses the following symbols. All are either read from a cited source or derived by the equation shown.

Symbol	Meaning	Value and source
N	Adults aged 45 to 74 resident in the county	247,286; Census Vintage 2024 [10]
s	Share of adults aged 45 to 75 currently screened	0.541; CDC PLACES 2024 release [11]
m	Median screening share across 254 Texas counties	0.592; CDC PLACES [11]
s_lo, s_hi	95 percent confidence limits of s	0.497, 0.584; CDC PLACES [11]

Symbol	Meaning	Value and source
U	Unscreened adults, $U = N(1 - s)$	113,504; derived
G	Adults needed to reach the state median, $G = N(m - s)$	12,612; derived
c	Cost to mail one test with reminders and processing	\$10.48; Coronado 2023 Table 5 [4]
C_met	Increase in first-year medical charges, metastatic disease	\$353,255; Nguyen 2025 [3]
C_non	Increase in first-year medical charges, non-metastatic disease	\$182,000; Nguyen 2025 [3]
D	Charges avoided per stage shift, $D = C_{\text{met}} - C_{\text{non}}$	\$171,255; derived
L	Late-stage cases diagnosed per year in the county	188; NCI State Cancer Profiles [12]
D_paid	Paid amounts avoided per stage shift, stage IV to stage I colon, year one	\$64,229; derived from Tramontano 2020 Table 6 [21]

Table 1. Notation used in the applied model. Derived quantities are computed in the accompanying workbook as live formulas, not as typed constants.

2.4 Verification

Every derived quantity is implemented as a formula in the accompanying workbook rather than as a fixed value, so that the effect of altering any input can be observed directly. The workbook was recalculated in full before release and reports 37 formulas and zero errors. Each data tab records the source, population, dollar year and retrieval location for every figure, together with a note stating what the figure does not cover.

3. Results

3.1 The cost of screening against the cost of not screening

Three independent microsimulation models, SimCRC, CRC-SPIN and MISCAN, were used to set the current national screening recommendation. Their reported lifetime costs and health gains are given in Table 2. The first two rows report the principal economic finding: annual stool testing costs less per person over a lifetime than no screening, while also producing a health gain. Within each individual model the screened strategy was the less costly one; the overlap visible in the ranges below arises from reporting low and high values across three models rather than within a single model [1].

Strategy, ages 45 to 75	No screening	Annual FIT	Colonoscopy, 10-yearly
Lifetime cost per person	\$5,268 to \$5,845	\$3,811 to \$5,384	\$5,375 to \$7,031
QALYs gained per 1,000	0	125 to 163	132 to 177
Colorectal cancers per 1,000	77 to 88	20 to 46	12 to 34
Colorectal cancer deaths per 1,000	32 to 36	6 to 10	3 to 8
Net monetary benefit per person	reference	\$12,763 to \$18,128	\$11,773 to \$18,126

Table 2. Lifetime cost and benefit per person, 2021 dollars, 3 percent discount rate, ranges across the three CISNET models. Net monetary benefit is calculated at a \$100,000 per QALY threshold. Source: Nascimento de Lima et al., JNCI 2024, Table 1 [1]; outcome counts corroborated by Knudsen et al., AHRQ decision analysis for the USPSTF, 2021, Appendix Tables 9.1 and 9.2 [2].

The published tables report outcomes rather than events averted. Averted figures used in this paper are computed as the no-screening value minus the strategy value within each model, and then reported as a range across models. For deaths averted per 1,000 by annual FIT this gives 34 minus 6 in SimCRC, 32 minus 6 in CRC-SPIN and 34 minus 10 in MISCAN, reported as 24 to 28 [2]. Subtracting across models rather than within them would give 22 to 28, a wider range that pairs values from different model structures.

3.2 What advanced disease costs to treat

The most recent estimate derives from commercial claims for 25,169 patients aged 45 and over diagnosed between 2017 and 2023. It is reported as the mean increase in billed medical charges from the year before diagnosis to the year after, split by whether disease was metastatic at diagnosis: \$353,255 (standard deviation \$285,923) for metastatic and \$182,000 (standard deviation \$211,845) for non-metastatic disease, with medians of \$285,826 and \$124,390 [3]. These are charges submitted on claims, not amounts allowed or paid; the source authors state that billed charges may overestimate system costs and call for reimbursement data [3]. A second estimate in paid dollars is therefore taken from SEER-Medicare, which records Medicare reimbursements plus patient co-insurance, co-payments and deductibles for 90,023 colon cancer patients aged 66 and over diagnosed 2000 to 2013, reported as mean monthly cost by stage and phase of care in 2019 dollars [21]. In the surgery month, the six-month initial phase and the continuing phase, a stage I colon cancer costs \$32,782, \$2,046 per month and \$1,688 per month; a stage IV colon cancer costs \$41,818, \$8,034 per month and \$5,541 per month. A first year composed of one surgery month, six initial months and five continuing months, which is the phase structure the source defines, therefore costs \$53,498 at stage I and \$117,727 at stage IV, a difference of \$64,229. For a stage IV patient not treated surgically, the one-month staging phase at \$13,605 replaces the surgery month and the first-year cost is \$89,514, a difference of \$36,016 against stage I. Both figures exclude the terminal phase at \$15,537 per month, which many stage IV patients enter within the first year, and so understate the stage IV cost. Medicare-based phase-of-care costs from SEER-Medicare are shown alongside it. The two sources differ in population, commercially insured adults aged 45 and over against Medicare beneficiaries aged 65 and over; in dollar year, 2023 against 2020; and in cost definition, all-cause first-year cost against cancer-attributable cost by phase of care. Adding them would count first-year care twice.

Measure	Amount	Population and dollar year
Metastatic, first-year increase in medical charges, mean	\$353,255	Commercial claims, 2023 USD [3]
Metastatic, first-year increase in medical charges, median	\$285,826	Commercial claims, 2023 USD [3]
Metastatic, first-year increase in prescription charges	\$5,745	Commercial claims, 2023 USD [3]
Non-metastatic, first-year increase in medical charges, mean	\$182,000	Commercial claims, 2023 USD [3]
Non-metastatic, first-year increase in medical charges, median	\$124,390	Commercial claims, 2023 USD [3]
Difference in mean charges attributable to stage	\$171,255	Derived, $D = C_{\text{met}} - C_{\text{non}}$
Difference in median charges attributable to stage	\$161,436	Derived from the medians above
Stage I colon, first-year paid amount (surgery month, 6 initial, 5 continuing)	\$53,498	SEER-Medicare, age 66+, 2019 USD, derived from monthly means [21]
Stage IV colon, first-year paid amount, surgical	\$117,727	SEER-Medicare, age 66+, 2019 USD, derived [21]
Stage IV colon, first-year paid amount, non-surgical	\$89,514	SEER-Medicare, age 66+, 2019 USD, derived [21]
Difference in paid amounts, stage IV surgical minus stage I, D_{paid}	\$64,229	Derived [21]
Patient out-of-pocket, metastatic, first year	\$4,032	Commercial claims, 2023 USD [3]

Measure	Amount	Population and dollar year
Initial care, first 12 months	\$66,524	SEER-Medicare, age 65+, 2020 USD [13]
Continuing care, per year	\$6,246	SEER-Medicare, age 65+, 2020 USD [13]
Last year of life	\$110,144	SEER-Medicare, age 65+, 2020 USD [13]
National colorectal cancer expenditure	\$24.3 billion	All payers, 2020 USD [13]

Table 3. Treatment charges and paid amounts by stage, and treatment costs by phase of care. The commercial figures [3] are billed charges. The SEER-Medicare stage figures [21] are Medicare reimbursements plus patient liability, summed over the first year from the source's monthly means and phase lengths. The SEER-Medicare phase figures [13] are cancer-attributable costs. The three sets describe different populations, dollar years and cost definitions and are not additive. Independent modeled estimates of lifetime metastatic cost, \$370,465 for standard of care, fall in the same order of magnitude [14].

3.3 What a programme costs to deliver

Delivery cost comprises two components: the payment for the test itself, and the operational cost of reaching a person who is not currently seeking screening. The first is set by fee schedule and is shown in Table 4 at 2026 rates read directly from the CMS data files. The second is not a billable service and has no fee schedule; its only source is programme evaluations that report their own cost accounting, of which one is used here [4].

Code	Test or service	2026 payment	Payment system and file
82274	Fecal immunochemical test, diagnostic	\$15.92	Clinical Lab Fee Schedule, 26CLABQ1 [5]
G0328	Fecal immunochemical test, screening	\$18.05	Clinical Lab Fee Schedule, 26CLABQ1 [5]
81528	Multi-target stool DNA	\$508.87	Clinical Lab Fee Schedule, 26CLABQ1 [5]
0464U	Blood-based DNA marker screen	\$591.92	Clinical Lab Fee Schedule, 26CLABQ1 [5]
G0121	Screening colonoscopy, facility	\$510.49	ASC Addendum AA, July 2026 [8]
G0121	Screening colonoscopy, facility	\$950.10	OPPS Addendum B, APC 5311 [7]
45380	Colonoscopy with biopsy, facility	\$1,222.56	OPPS Addendum B, APC 5312 [7]
G0121	Physician work, facility setting	\$164.98	4.94 RVU x \$33.4009 [6,9]
G0121	Physician work, office setting	\$378.43	11.33 RVU x \$33.4009 [6,9]

Table 4. Medicare payment rates, read from the CMS source files rather than from a lookup tool. Professional payment is computed as total relative value units multiplied by the 2026 conversion factor of \$33.4009. A complete screening colonoscopy is therefore \$675.49 in a surgery centre and \$1,115.10 in a hospital outpatient department, being the facility payment plus the facility-setting professional payment.

Outreach cost comes from a stepped-wedge trial in a 15-clinic federally qualified health centre network serving 27,585 patients, 82 percent of whom were Hispanic and 68 percent of whom preferred Spanish. This network was selected because, like Hidalgo County, it serves a Hispanic-majority, Spanish-preferred population through safety-net clinics, and because no outreach cost has been published for Hidalgo County itself. The standard mailed arm cost \$10.48 per patient, comprising \$5.23 for the kit and mailing, \$4.31 for laboratory processing, \$0.74 for live reminder calls, \$0.17 for project management and \$0.04 for patient identification [4]. Adding text and automated voice

reminders raised the cost to \$11.14. Adding a live advance call raised it to \$21.30. The abstract of the same paper reports \$10.84 where Table 5 reports \$10.48; the Table 5 value is used here and the discrepancy is recorded.

3.4 Savings at the level of a covered population

The evidence on payer-level savings is weaker than that presented in the preceding sections. It derives from two modeled analyses rather than from observed expenditure, and describes a change in the mix of screening tests used rather than a change from no screening to screening [15,16]. A payer covering one million lives that raises the stool DNA share of its screening mix from 6 to 28 percent is modeled to save \$4.4 million over ten years, or \$0.04 per member per month. An integrated delivery network, which captures both the premium and the care, is modeled to save \$19.6 million over the same period, or \$0.16 per member per month. A self-insured employer with 100,000 employees is modeled to save \$214,000 over five years once absenteeism is included. Savings expressed per covered member are therefore \$0.04 to \$0.16 per month accruing over ten years, whereas the charges avoided by a single stage shift are \$171,255 in the first year of care (Table 3). A county health department does not collect premiums and so cannot realise a per-member saving; it bears the treatment cost of uninsured patients directly, and so realises the per-patient figure.

3.5 Health outcomes

Sections 3.1 to 3.4 report cost. Table 5 reports the health gain produced by the same strategies, in life years, quality-adjusted life years, cancers averted and deaths averted per 1,000 people screened.

Outcome per 1,000 people	Annual FIT	Colonoscopy	Source
Life years gained	291 to 348	301 to 369	[2]
Quality-adjusted life years gained	125 to 163	132 to 177	[1]
Colorectal cancer cases averted	35 to 59	47 to 71	[2]
Colorectal cancer deaths averted	24 to 28	26 to 31	[2]
Days of life gained per person	106 to 127	110 to 135	[2]

Table 5. Health gain per 1,000 people screened from age 45 to 75, relative to no screening, computed within each model and reported as a range across models.

These modeled results may be compared with the one large randomised trial of screening colonoscopy. In NordICC, 28,220 adults were invited to a single colonoscopy and 42 percent attended. At ten years, invitation reduced colorectal cancer risk from 1.20 to 0.98 percent, a risk ratio of 0.82 with a confidence interval of 0.70 to 0.93, with 455 people needing to be invited to prevent one cancer. The reduction in death was not statistically significant at ten years, with a risk ratio of 0.90 and an interval from 0.64 to 1.16 [17]. This is an intention-to-screen estimate attenuated by 58 percent non-attendance. The two bodies of evidence therefore answer different questions: the models estimate the effect of screening among those screened, while the trial estimates the effect of an invitation in a population in which a majority did not attend. The models assume full adherence to the screening schedule; NordICC observed 42 percent attendance at a single invitation. The gap between the modeled 24 to 31 deaths averted per 1,000 and the trial's non-significant mortality effect is therefore attributable in part to the 58 percent who did not attend, and that non-attending population is the one that outreach expenditure is designed to reach.

3.6 Local epidemiology

The applicability of national estimates to this setting depends on whether the local population resembles the national one. The comparisons in Table 6 indicate that it does not in three respects: incidence trend, screening uptake and insurance coverage.

Measure	Hidalgo	McAllen	Texas	United States
Incidence per 100,000, age-adjusted	38.8	n/a	38.6	36.9
New cases per year	311	n/a	11,856	148,127
Trend in incidence	rising 4.7% a year	n/a	stable	stable
Late-stage cases per year	188	n/a	7,286	89,163
Share diagnosed at late stage	60.5%	n/a	61.5%	60.2%
Deaths per year	96	n/a	4,283	n/a
Screened, ages 45 to 75	54.1%	55.7%	59.2% median county	n/a
Uninsured, ages 18 to 64	40.1%	34.0%	n/a	n/a

Table 6. Incidence, mortality and late-stage figures are 2019 to 2023 and 2020 to 2024 averages from the NCI State Cancer Profiles, drawing on the Texas Cancer Registry and NPCR/SEER [12]. Screening and insurance prevalence are 2022 model-based estimates from CDC PLACES [11]. The incidence trend confidence interval is 3.2 to 6.6 percent a year.

Two of these measures bear most directly on the analysis. County incidence is rising at 4.7 percent a year while state and national rates are stable, and the confidence interval for this trend excludes zero, which is consistent with a genuine local increase rather than sampling variation. Separately, 40.1 percent of adults aged 18 to 64 are uninsured. The treatment figure used in section 3.7, C_{met} , is a commercial-claims charge; for an uninsured patient the equivalent charge is borne by the treating hospital, the county and the patient rather than by an insurer, so the saving from a stage shift accrues to public and local funds in a larger share here than in a population with national insurance coverage. Hidalgo County ranks 46th lowest of 254 Texas counties for screening uptake.

3.7 Applied model for Hidalgo County

This section is the only one in which figures drawn from different sources are combined. Each step is presented as an equation so that individual assumptions can be examined separately from the overall result.

$$U = N(1 - s) = 247,286 \times (1 - 0.541) = 113,504 \text{ unscreened adults aged 45 to 74}$$

$$\text{Cost of one mailing to all of them} = U \times c = 113,504 \times \$10.48 = \$1,189,525$$

$$\text{Equivalent number of metastatic first-year charge increases} = U \times c / C_{met} = \$1,189,525 / \$353,255 = 3.4 \text{ patients}$$

$$\text{Stage shifts needed to break even, in charges} = U \times c / D = \$1,189,525 / \$171,255 = 6.9, \text{ so 7 patients}$$

$$\text{Stage shifts needed to break even, in paid amounts} = U \times c / D_{paid} = \$1,189,525 / \$64,229 = 18.5, \text{ so 19 patients}$$

$$\text{Cost of reaching only the state median} = G \times c = 12,612 \times \$10.48 = \$132,174$$

$$\text{First-year charges of this year's late-stage cases} = L \times C_{met} = 188 \times \$353,255 = \$66,411,940$$

The county-wide mailing therefore costs less than the first-year charge increase of four metastatic patients, and is recovered in first-year charges alone if it shifts seven patients from late-stage to early-stage diagnosis, against the 188 late-stage cases recorded annually. This corresponds to a 3.7 percent change in stage distribution. The calculation excludes life years gained, continuing care avoided, and last-year-of-life costs not incurred. Measured in Medicare paid amounts rather than commercial charges, the break-even is 18.5 stage shifts, or 9.9 percent of the 188 annual late-stage cases; with the non-surgical stage IV figure it is 33.0, or 17.6 percent.

3.8 Sensitivity analysis

The break-even result depends on three inputs, each of which was varied across a published range while the others were held at base case. The unit cost of outreach, c , takes the values \$10.48, \$11.14 and \$21.30 reported for the three

arms of the source trial [4]. The charges avoided per stage shift, D , takes the base-case mean difference of \$171,255, the mean difference including prescription charges of \$174,594, and the median difference of \$161,436, all from the same source [3]. The screening rate, s , takes its point estimate of 54.1 percent and its published 95 percent confidence limits of 49.7 and 58.4 percent [11], which through $U = N(1 - s)$ give unscreened populations of 124,385 and 102,871. The charge-based D was additionally replaced by the three paid-amount differences derived in section 3.2 from SEER-Medicare, \$64,229, \$54,380 (stage IV against stage II) and \$36,016, which are shown as the three lightest bars. No input was varied across a range that is not published. Probabilistic analysis was not performed, since the inputs are point estimates drawn from separate literatures rather than a fitted joint distribution, and any imposed distribution would not be empirically derived.

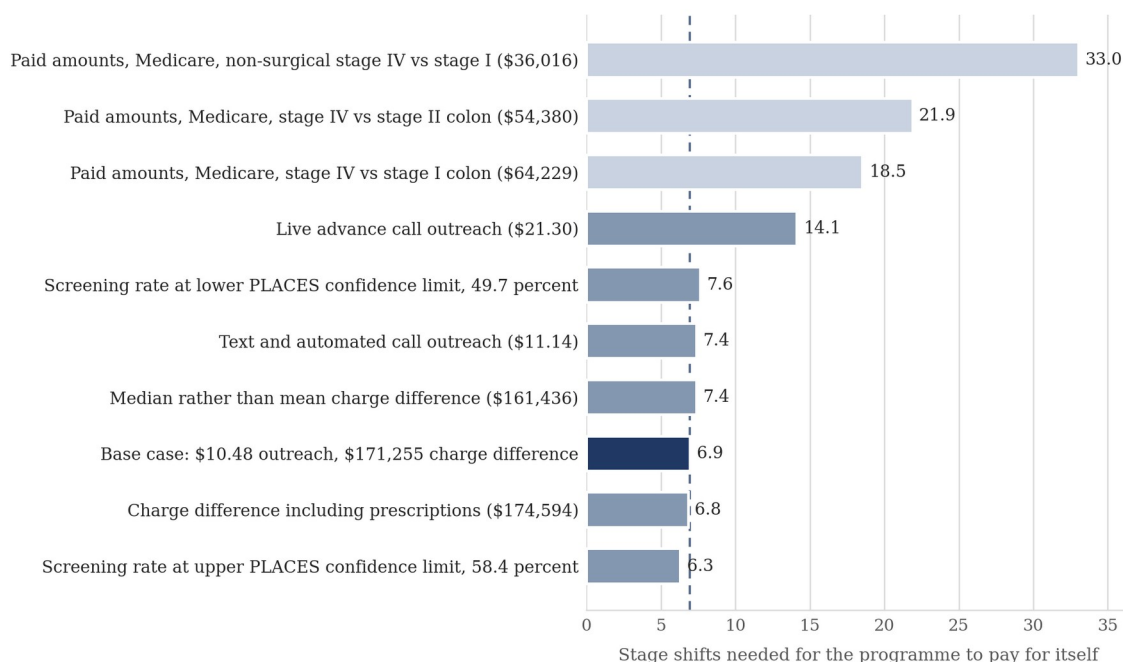


Figure 1. One-way sensitivity of the break-even point. Bars show the number of patients who must be shifted from late-stage to early-stage diagnosis for the programme to recover its cost in first-year treatment dollars avoided. The dashed line marks the base case of 6.9. Mid-blue bars vary one input of the charge-based model: outreach costs from the three arms of Coronado et al. [4], charge differences from the means and medians of Nguyen et al. [3], and screening rates from the point estimate and 95 percent confidence limits of CDC PLACES [11]. The three light bars replace the charge difference with first-year paid-amount differences derived from SEER-Medicare monthly costs by stage [21]. Hidalgo County records 188 late-stage cases a year, so the base case corresponds to a 3.7 percent shift in stage distribution, the paid-amount base case of 18.5 to 9.9 percent, and the highest value shown to 17.6 percent.

Within the charge-based model the break-even point lies between 6.3 and 14.1 stage shifts, or 3.4 to 7.5 percent of the county's annual late-stage caseload, across every published bound tested. Replacing charges with Medicare paid amounts raises it to 18.5 for a surgically treated stage IV cancer against stage I, 21.9 against stage II, and 33.0 for a non-surgical stage IV cancer, or 9.9 to 17.6 percent of the annual caseload. The paid-amount figures are the more conservative measure of what any payer would actually avoid, and they exclude the terminal phase that many stage IV patients enter within the first year. Within the charge-based model the largest effect comes from outreach design: substituting the live-call arm at \$21.30 per patient for the standard mailed arm at \$10.48 raises the break-even to 14.1, and the text and automated call arm at \$11.14 raises it to 7.4. Using the median rather than the mean charge difference raises it to 7.4; including prescription charges lowers it to 6.8. Moving the screening rate to either confidence limit changes the result by 0.7 in each direction. Across all bars, the choice between charges and paid amounts is the input on which the result most depends; within either measure, the outreach unit cost is the next largest and is the input over which a programme has the most control.

A further source of uncertainty is not shown in Figure 1, since it affects the effort required to reach the break-even point rather than the break-even point itself. A mailed kit does not correspond to a completed test. If the kit return rate is 15 percent, the cost per completed screen is \$69.87 rather than \$10.48; at 25 percent it is \$41.92, and at 40 percent it is \$26.20. Programme cost, and therefore the break-even point, are unchanged, since the mailing is paid for irrespective of whether a kit is returned; the probability of achieving seven stage shifts, however, increases with the return rate. Raising the return rate from 15 to 25 percent lowers the cost per completed screen by \$27.95, whereas the difference between the two CMS payment rates for a fecal immunochemical test in Table 4 is \$2.13; the return rate is therefore the larger of the two levers by an order of magnitude.

4. Discussion

Three findings follow from the evidence presented. First, in the three CISNET models the lifetime cost per person of annual FIT, \$3,811 to \$5,384, is below the lifetime cost of no screening, \$5,268 to \$5,845, while annual FIT also gains 125 to 163 QALYs per 1,000 people (Table 2). The incremental cost-effectiveness ratio, defined as the cost of screening minus the cost of no screening, divided by the QALYs with screening minus the QALYs without, therefore has a negative numerator and a positive denominator. Annual FIT is dominant: it costs less and produces more benefit than the comparator, so no willingness-to-pay threshold is required to justify it. The net monetary benefit at \$100,000 per QALY, \$12,763 to \$18,128 per person, is positive in every model for the same reason.

Second, the quantity with the greatest influence on the economic result is the difference in first-year treatment dollars associated with stage at diagnosis rather than the price of any test. That difference is \$171,255 in commercial billed charges [3] and \$64,229 in Medicare paid amounts [21], equivalent to 16,340 and 6,129 mailed outreach contacts at \$10.48 each. Decisions about programme design, such as whether to add live reminder calls at \$21.30 rather than \$10.48 per patient, are therefore better evaluated against their effect on the number of completed tests than against their unit price.

Third, each of the three local parameters that differ from national values moves the break-even result in the same direction. Incidence rising at 4.7 percent a year increases L , the annual number of late-stage cases from which stage shifts can be drawn, and so lowers the share of that caseload that seven shifts represent. Screening uptake of 54.1 percent against a state county median of 59.2 percent increases U , the reachable population. An uninsured share of 40.1 percent means that a larger fraction of C_{met} is borne by public and local funds rather than by a commercial payer. A calculation using national values for these three parameters would therefore yield a smaller local benefit than the one reported in section 3.7.

5. Limitations

- A mailed kit does not constitute a completed screen. In the trial from which the \$10.48 unit cost is drawn, only a proportion of those mailed returned a kit. A complete model would apply a return rate, which would raise the cost per completed screen and raise the number of stage shifts required to break even proportionally. The break-even figure of seven patients should be read as seven stage shifts, not as seven mailings.
- The two treatment sources measure different things in different populations. The commercial figures [3] are billed charges for adults aged 45 and over in 2023 dollars, and overstate what any payer would avoid. The Medicare figures [21] are paid amounts, but for patients aged 66 and over, in 2019 dollars, for colon cancer only, and summed to a first year using the source's phase lengths rather than reported directly as an annual figure. The true first-year paid difference for a 45-to-74 year old in Hidalgo County lies between neither bound with certainty; the paper reports both and treats the paid-amount figure as the conservative case. Separately, with 40 percent of working-age adults here uninsured, the avoided dollars fall on hospitals, the county and patients rather than on an insurer, and no local payer-mix cost figure is published.
- The applied model counts first-year treatment charges only. Continuing care at \$6,246 a year and last-year-of-life care at \$110,144 are excluded, as are the lifetime costs and QALYs reported in Table 2. Every excluded term is a cost avoided or a benefit gained, so the model understates the saving.

- The outreach unit cost comes from a Hispanic-majority safety-net network elsewhere in the country, not from a local pilot. It is the closest published analogue available, not a local measurement.
- Payer-level savings in section 3.4 are modeled rather than observed and describe a change in test mix rather than a move from no screening to screening. They do not enter the applied model in section 3.7.
- Costs in this paper are stated in 2020, 2021, 2023 and 2026 dollars and were deliberately not converted to a common year, because any conversion would introduce an inflation assumption not present in the sources. The only arithmetic performed across sources is in section 3.7, which combines two figures published in 2023.

6. Conclusion

This analysis supports funding for a mailed stool-test outreach programme directed at unscreened adults within the existing catchment. At published unit costs, reaching all 113,504 of them once costs \$1,189,525, and reaching the Texas county median costs \$132,174. Seven patients diagnosed early rather than late offset the cost of reaching all of them in first-year billed charges, and nineteen do so in Medicare paid amounts, before accounting for the 125 to 163 quality-adjusted life years gained per 1,000 screened, the continuing care avoided, or the end-of-life costs not incurred. The accompanying workbook holds every figure above as a live formula with its source, so that any input can be changed and the conclusion retested.

Declarations

Funding. This analysis received no external funding. It was conducted using publicly available data and departmental staff time. No funder had any role in the design, conduct, analysis or reporting of the work.

Competing interests. The authors declare no financial or non-financial competing interests. No author has a relationship with any manufacturer of a screening test, laboratory service or therapeutic named in this paper.

Ethics approval. This analysis used only publicly available, aggregate, de-identified data and published summary statistics. It involved no human subjects, no individually identifiable health information and no primary data collection, and therefore did not constitute human subjects research requiring institutional review board approval or a waiver.

Data availability. Every input is publicly available at the location cited in the references. The derived calculations, including all intermediate quantities, are supplied in full as live formulas in the accompanying workbook CRC_Screening_Cost_Case.xlsx, which is available from the authors on request. No data were generated that are not reported here.

Reporting guideline. This paper is reported in accordance with the Consolidated Health Economic Evaluation Reporting Standards 2022 statement [20]. A completed item-by-item checklist is given in Appendix B.

Author contributions. Contributions are described using the CRediT taxonomy. A. Katz: conceptualization, methodology, software, formal analysis, data curation, validation, visualization, writing of the original draft, and project administration. C. Patel, M. Mousa, K. Mohanraj and S. M. Taori: investigation and data curation, and writing through review and editing. All authors reviewed the analysis, contributed to revision of the manuscript, and approved the final version. A. Katz is guarantor.

Health economic analysis plan. No health economic analysis plan was registered or published in advance of this analysis. The analytic approach was specified before the county-level figures were assembled but was not deposited.

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time. Neither party reviewed or approved the conclusions presented here, which remain the responsibility of the authors.

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Appendix A. Structure of the accompanying workbook

CRC_Screening_Cost_Case.xlsx contains ten tabs. Read Me states the rules under which figures were admitted. Summary answers twelve questions in one line each and names the tab holding the evidence for each answer. Tabs 1 through 6 hold the underlying figures for each research task: screening against late-stage diagnosis, treatment charges and costs, programme cost, savings per population, life years and lives, and local numbers. Hidalgo Model is the only tab that combines sources, with yellow input cells that a reader may change; every cell below them recalculates. Sources lists every source used and what was taken from it. Blue cells are inputs, black cells are formulas, and every figure carries its source, population, dollar year and retrieval location in adjacent columns.

Appendix B. CHEERS 2022 reporting checklist

Item names are those of the CHEERS 2022 statement [20]. Items are marked not applicable only where the study design genuinely does not admit them, and items not done are stated as not done rather than omitted.

No.	CHEERS 2022 item	Where reported, or why not
1	Title	Title identifies the study as an economic analysis and names the strategies compared.
2	Abstract	Structured abstract, page 1: background, methods, results, conclusions and sensitivity analysis.
3	Background and objectives	Section 1.
4	Health economic analysis plan	Not done. Stated in Declarations: no plan was registered or deposited in advance.
5	Study population	Section 3.6 and Table 6: adults aged 45 to 74 resident in Hidalgo County, Texas. Source populations for each borrowed parameter are given in Tables 2 to 5.
6	Setting and location	Section 3.6: Hidalgo County, Texas, a Hispanic-majority border county with 40 percent of working-age adults uninsured.
7	Comparators	Section 3.1: no screening, annual fecal immunochemical testing ages 45 to 75, and colonoscopy every 10 years. Section 3.7 compares mailed outreach against current practice.
8	Perspective	Section 2.2: county health department for the applied model; health system for the borrowed lifetime models; payer for the claims-based treatment costs. Each table states its own perspective.
9	Time horizon	Lifetime for the borrowed models; one year of treatment cost for the applied model. Stated in section 2.2 and flagged as a limitation in section 5.

No.	CHEERS 2022 item	Where reported, or why not
10	Discount rate	3 percent for the borrowed lifetime models, as reported by the source [1]. The applied model is undiscounted because its horizon is one year.
11	Selection of outcomes	Sections 3.1 and 3.5: quality-adjusted life years, life years, cancers averted, deaths averted, and cost.
12	Measurement of outcomes	Outcomes were not measured de novo. They are taken from the CISNET microsimulation models and from the NordICC randomised trial, each cited at the point of use.
13	Valuation of outcomes	Quality-adjusted life years as valued by the source models. Net monetary benefit is reported at the source's \$100,000 per QALY threshold, Table 2.
14	Measurement and valuation of resources and costs	Sections 3.2 and 3.3. Treatment charges from commercial claims and treatment paid amounts and costs from SEER-Medicare, distinguished in Table 3; test payments read directly from CMS fee schedule files; outreach cost from a published programme evaluation.
15	Currency, price date, and conversion	Section 2.2. All figures are US dollars. Dollar years are 2020, 2021, 2023 and 2026 and were deliberately not converted to a common year; every table states its own.
16	Rationale and description of model	Section 3.7 and Table 1. The applied model is a deterministic break-even calculation, fully specified by six equations. It is publicly inspectable as live formulas in the accompanying workbook.
17	Analytics and assumptions	Sections 2.1, 2.4 and 3.7. No extrapolation or statistical transformation was performed. Validation consisted of full recalculation and source-by-source checking of every input.
18	Characterizing heterogeneity	Not done. The analysis reports a single county-level population and does not estimate results by age band, sex, insurance status or clinic.
19	Characterizing distributional effects	Partially. Section 3.6 documents that the burden falls on an uninsured, Hispanic-majority population, and section 5 notes that avoided cost accrues to hospitals, the county and patients rather than to a commercial payer. No formal distributional cost-effectiveness analysis was conducted.
20	Characterizing uncertainty	Section 3.8 and Figure 1: one-way sensitivity analysis across published bounds for each input, with no assumed ranges. Probabilistic analysis was not performed, for the reason given in section 3.8.
21	Approach to engagement with patients and others affected	Not done. No patients, members of the public or community organisations were involved in the design of this analysis.
22	Study parameters	Tables 1 to 6 report every analytic input with its value, population, dollar year and source. Ranges are given wherever the source reports them.
23	Summary of main results	Sections 3.7 and 6, and the Summary tab of the accompanying workbook.
24	Effect of uncertainty	Section 3.8, including the effect of measuring treatment in charges against paid amounts. Discount rate and time horizon effects are addressed qualitatively in section 5: the one-year horizon of the applied model understates the saving.
25	Effect of engagement with patients and others affected	Not applicable, since no such engagement took place.
26	Study findings, limitations, generalizability, and current knowledge	Sections 4 and 5. Six limitations are stated, including the transfer of an outreach unit cost from a non-local network and the omission of a kit return rate.

No.	CHEERS 2022 item	Where reported, or why not
27	Source of funding	Declarations: no external funding.
28	Conflicts of interest	Declarations: none declared.