



Return on Investment of Free Colorectal Cancer Screening Tests in a Primarily Rural Uninsured or Underinsured Population in Northeast Texas

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Abstract

Background Colorectal cancer (CRC) is the third most common cancer in the USA. Its economic impact is extensive, and preventive screening services are warranted to help prevent it.

Objective We sought to examine the return on investment, in terms of reduced costs attributed to cancer prevention, of a CRC screening outreach program providing education and screening in a primarily rural region targeting the uninsured and underinsured.

Methods The expenditures of the Northeast Texas CRC screening program were calculated for the years of 2016 and 2017. Prices (\$US) were adjusted for inflation and converted to year 2017 values. The costs saved were calculated using the estimated costs of CRC care present in the literature.

Results For fiscal years 2016 and 2017, the program provided an average return of \$US1.46–2.06 for every tax dollar spent. Estimated cost avoidance was \$US165,080 per avoided case and estimated cost avoidance of \$US245,601 among early-stage cancer cases detected, resulting in potential savings ranging from \$US3,893,676 to \$US4,837,923.

Conclusion A CRC outreach program providing education and screening operating in less densely populated regions yields a positive return on investment.

Key Points for Decision Makers

Funding preventive screening programs for colorectal cancer is a long-term cost-saving strategy.

Even in rural areas with uninsured patients, educational and screening programs can be cost effective.

1 Background

Colorectal cancer (CRC) is the third most common cancer among men and women in the USA [1]. Its economic impact is extensive, totaling \$US7.49 billion in 2000, and is estimated to increase to \$US14.03 billion by 2020 in the USA [2]. However, the number of patients diagnosed and/or succumbing to CRC and its subsequent economic burden can be lessened through the use of colonoscopy and/or fecal immunochemical testing (FIT). Colonoscopy and FIT testing provide clinicians the opportunity to detect and subsequently remove precancerous polyps, thus preventing CRC [3]. Specifically, the majority of cases of CRC develop from adenomatous polyps, with a small percentage developing from hyperplastic polyps [4]. Currently, colonoscopy is considered the gold standard for CRC screening, as colonoscopies are the only CRC screening test that prevents CRC and evaluates the entire large bowel [5]. However, many individuals opt not to undergo colonoscopies because of several factors, such as cost, distance, need for proper bowel preparation and fear/avoidance. Specifically,

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many patients have a fear of and avoid the procedure [6–8]. The procedure also requires proper bowel preparation to be effective. Finally, many (especially in rural areas such as Northeast Texas) have to travel long distances for specialty care (i.e., seeing a gastroenterologist to undergo a colonoscopy) and require help from a family member to drive them home after the procedure. This is especially true for the uninsured or underinsured, who do not get a choice on where free services may be provided. Alternatively, a stool test, such as the FIT, provides a less invasive and inexpensive alternative to colonoscopies. Individuals who elect FIT can collect a sample in the convenience of their own home, without the need for bowel preparation, and mail the sample to be examined. If the sample is returned as abnormal, individuals can then proceed to colonoscopy. FIT testing is a more cost-effective method for public health programs to provide more widespread testing for those who are underinsured or uninsured [9].

A large proportion of the population is left unscreened and at risk for CRC [10]. Although the Patient Protection and Affordable Care Act improved access to screening colonoscopies, an estimated 28.1 million Americans are uninsured [11]. Northeast Texas is a primarily rural, medically underserved region of Texas approximately the size of West Virginia. The region is largely unhealthy, with poor health outcomes for the five leading causes of death (heart disease, cancer, stroke, chronic respiratory diseases, and unintentional injury) and with many health disparities, including a substantial uninsured population and high smoking and adult obesity rates [12–14].

While the age-adjusted incidence of CRC for the state of Texas (38.1 per 100,000) [15] is similar to the national rate (38.27 per 100,000) [16], the CRC incidence is higher in the primarily rural region of Northeast Texas (43.3 per 100,000) [15]. This follows a similar trend of CRC mortality, where rates in Northeast Texas (15.8–16.9 per 100,000) [17] exceed the state (14.4 per 100,000) [17] and national (14.1 per 100,000) [18] averages. The reason behind these incidence rates may be multifaceted. For example, Northeast Texas reports one of the highest smoking rates in the state and has the highest obesity rate in the state [12–14]. In addition, non-adherence to cancer screening recommendations, diagnosis of cancer at a later stage, and higher cancer mortality is more likely among rural residents [19–21]. Another barrier to care includes distance. Residents often have to travel long distances to seek care, and the number of specialists in the area is often limited. This problem intensifies for older adults (who are the target population for CRC screening) or for those who are uninsured, especially since public transportation is lacking. Therefore, seeking CRC preventive services may not be a priority for individuals in these communities.

Currently, the Healthy People 2020 initiative set by the US Department of Health and Human Services aims to achieve a 70.5% CRC screening rate [22]. However, even with the availability of multiple screening methods, CRC screening rates remain suboptimal in the general public, (62.4%) [10] and in rural communities (58.2%) [22], with rates being even lower in Northeast Texas (44.63%) [23] and among the uninsured (25.1%) [23]. The high CRC prevalence yet low screening rates in the Northeast Texas region are a growing concern.

Cancer can cause a significant financial burden on those who have insurance, with an even greater burden placed on the uninsured [24]. Patients with cancer are 2.5 times more likely to file for bankruptcy than those without cancer. Patients with CRC who file for bankruptcy have a 2.5 times higher mortality rate than those who do not file for bankruptcy [25]. Socioeconomic status also impacts medical treatment decisions, with lower-income patients with cancer focusing on avoiding costly treatment as opposed to higher-income patients with cancer, who focus on survival [26]. Colonoscopies are also independently associated with fewer deaths from CRC [27].

Therefore, the current CRC project aimed to provide screening services to the underinsured and uninsured in the form of free colonoscopies and/or FIT testing in a 19-county region in Northeast Texas. Furthermore, we aimed to assess the economic impact of this program. Specifically, we hypothesized that the program would yield a positive return on investment (ROI) from a programmatic perspective.

2 Methods

2.1 Community Outreach Program

The program was funded by the Cancer Prevention and Research Institute of Texas (CPRIT). Screening was conducted in a 19-county catchment area during the fiscal years (September 1–August 31) of 2016 and 2017. In total, 3002 individuals were screened through this program. Table 1 displays the medical and demographic variables of participants. The catchment area was primarily rural, with the exception of some small metropolitan statistical areas. Study participants were recruited either by referrals from clinics or through community outreach events targeting underinsured and uninsured individuals. The program was an education and screening program. Potential participants were educated on the importance of CRC screening, different methods of CRC screening, and the current program providing these screening services free of charge. Study participants seen at clinics deemed eligible were recommended/referred for colonoscopy and/or FIT test based on their preference and/or provider recommendation. Screenings were provided free

Table 1 Medical and demographic variables of participants ($n = 3002$)

Variable	
Sex	
Female	2047 (68.2)
Male	955 (31.8)
Race/ethnicity	
African American	482 (16.1)
Asian	23 (0.8)
Hispanic	1058 (35.2)
Non-Hispanic White	1434 (47.8)
Unknown/prefer not to say	5 (0.2)
Age, years	56.96 \pm 5.1
Previous screening for CRC	
Yes	611 (20.4)
No	1994 (66.4)
Missing/unknown	397 (13.2)
Family history of CRC	
Yes	219 (7.3)
No	2363 (78.7)
Missing/unknown	420 (14.0)

Data are presented as n (%) or mean \pm standard deviation unless otherwise indicated

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of charge. An additional \$US20 gift card for transportation was provided upon completion of a colonoscopy. Participants who elected to take the FIT test were scheduled for colonoscopy if they had an abnormal FIT result (and subsequently received the same \$US20 gift card for transportation upon completion of colonoscopy). The team consisted of a Program Director, Co-Program Director, Program Manager, an Outreach Education Coordinator, Program Specialist, Nurse Navigator, and three Health Education Coordinators. The Program Manager, Outreach Education Coordinator, Program Specialist, Nurse Navigator, and Health Education Coordinators had completed the Texas Community Health Worker (CHW) certification training and maintained their certification by completing CHW continuing education requirements. They were also trained in motivational interviewing.

Recruitment had both a community-based and a clinical focus. Our strategy involved reaching out to individuals to make them aware of the need to undergo CRC screening, educating them about their screening options, performing the screening methodology of choice (FIT or colonoscopy), providing access to treatment for CRC, and providing follow-up. Individuals were recruited from clinics at The University of Texas Health Science Center at Tyler, health fairs, charity clinics, local health departments and districts, and federally qualified health centers. The primarily rural

19-county region known as Northeast Texas has an area of about 14,762 square miles [28] with a total population of 2,167,769 [29] in 2017. Eligibility for colonoscopy/FIT was determined after education outreach and/or physician recommendation.

To determine eligibility, US Preventive Services Task Force guidelines, which recommend screening all races/ethnicities between the ages of 50 and 75 years [30], were followed. Individuals were eligible to participate if they were aged 50–75 years, spoke English or Spanish, were uninsured or underinsured, did not have a medical exclusion for the procedure(s) (e.g., taking blood thinners), and had not been previously diagnosed with CRC. Individuals also could not have had a colonoscopy in the last 10 years, a sigmoidoscopy in the last 5 years, or a stool test in the last year before becoming eligible for the CPRIT screening program. A breakdown of the budget can be seen in Table 2.

2.2 Return on Investment

To calculate the ROI, several transformations and assumptions were utilized. All dollars were converted into quarter 3, year 2017 values, as this was the end of fiscal year 2. Converting all dollar values spent to a single month allowed meaningful discussion of expenditures across time. The original and converted budgets are provided in Table 3. The CMS Medicare Economic Index [31, 32] for quarter 3 of 2016 and 2017 were assumed for the budgets of year 1 and year 2, respectively, as they were the midpoints of

Table 2 Budgetary breakdown of the CPRIT screening program (\$US)

Category	Year 2 budgeted	Year 3 budgeted
Personnel	209,069.20	209,069.20
Fringe	53,739.38	53,739.38
Travel	5000.00	5800.00
Supplies	3272.00	3272.00
Contractual	43,200.00	51,200.00
Other	449,017.00	449,017.00
Total	763,297.58	772,097.58

CPRIT Cancer Prevention and Research Institute of Texas

Table 3 Inflationary adjustment of yearly budgets (\$US)

	Nominal budget	Inflation-adjusted budget
Year 1	763,297	791,692
Year 2	772,097	786,844
Total	1,535,394	1,578,536

those fiscal years. As with other ROIs on cancer-screening programs, only direct costs related to the program were included [33]. Costs for polyp removal were included in ROI calculations.

During the course of this program, 433 people had adenomas (precancerous polyps) removed, and 12 people had suspected malignancies removed, although one turned out to be an adenoma. No records were kept of how many polyps were removed from each patient, so we conservatively assumed only one polyp per patient. Although this is unlikely given that the mean number of polyps per colonoscopy patient is > 1 [34], we decided to err on the side of a conservative economic analysis. A review of the literature showed that approximately 5% of CRC adenomas become cancerous [35]. Accordingly, we assumed that 5% ($n = 22$) of these individuals would have eventually developed malignant polyps, rounding to the closest whole-person number; meaning that we assumed a total of 22 people avoided requiring treatment for CRC. We also added the cost savings of the documented malignancies, as they constitute costs avoided. These 7 of 11 individuals who had cancer removed had early-stage CRC and therefore avoided the costs incurred for a stage IV CRC treatment, estimated in other literature to be \$US361,197 in year 2010 values [36] (\$US410,681 in 2017 values).

2.3 Sensitivity Analysis

A sensitivity analysis was conducted (Table 4) to factor in uncertainty in the analysis. It assumed different years to cancer development as well as different discount rates. The standard medical discount rate recommended by the Second Panel on Cost-Effectiveness in Health and Medicine was utilized as it is the standard medical discount rate in the literature [37]. An alternative discount rate of 5% was used for comparison [38]. For patients who avoided cancer altogether, the estimated cost saving was \$US165,080 utilized [39]. During analysis, we used a conservative assumption that it would take 10 years to develop CRC, because this is an estimate for people with no polyps in their colonoscopies [40]. Other literature indicates that CRC can occur as early as 5 years after a colonoscopy [41].

Table 4 Costs avoided for 22 patients who had polyps removed (\$US)

	3% discount rate	5% discount rate
10 years to development of cancer after colonoscopy	2,678,147	2,174,469
5 years to development of cancer after colonoscopy	3,118,716	2,810,187

The seven patients who avoided late-stage CRC were included in the analysis as costs avoided. We assumed that these seven individuals avoided the difference between the late stage (\$US410,681) and average CRC treatment costs (\$US165,080), which is \$US245,601. This amounts to a cost avoidance of \$US1,719,207 with these patients.

3 Results

Utilizing the estimated cost of CRC cancer care provided by the Milliman Research Report [39], we assumed that the avoided cost of CRC treatment was \$US165,080 per avoided case for the 22 patients who avoided cancer. Factoring in the range of cancerous cases that were likely to have developed, along with those who avoided late-stage cancer, the potential savings, in year 2017 values, ranged from \$US3,893,676 (assuming 10 years to development of cancer and a 5% discount rate) to \$US4,837,923 (assuming 5 years to development of cancer and a 3% discount rate). With an equation of $(\text{cost saved} - \text{investment}) / \text{investment} = \text{ROI}$, the range for the ROI was 146% (\$US1.46) to 206% (\$US2.06) return in savings per tax dollar spent.

4 Discussion

The present study sought to examine the ROI of a CRC outreach program in a primarily rural population in Northeast Texas with high incidence of CRC and CRC mortality. As hypothesized, the program yielded a positive ROI despite additional costs not typical for other programs conducted in urban settings. These include costs accrued by the outreach program to reach rural residents living long distances from the screening site and having a smaller pool of potentially eligible individuals for screening due to regional rurality. For fiscal years 2016 and 2017, the program provided an average return of \$US1.46–2.06 for every dollar invested in the program. Estimated cost saved was \$US165,080 per avoided case and estimated potential savings ranged from \$US3,893,676 to \$US4,837,923.

Past research has focused on the cost effectiveness of CRC screenings [42–44]. However, the literature examining the economic impact of a CRC outreach program targeting the underinsured and uninsured in rural settings while utilizing colonoscopy and/or FIT testing is limited. The current study found that such a program could yield a positive ROI. This indicates that providing free CRC screening programs to the uninsured and underinsured is an efficient allocation of resources for state governments. As proposed in the literature, targeting CRC screening in rural areas could further help close the urban–rural health disparity gap [45].

The program had several advantages, including screening patients who would have normally not been screened due to lack of insurance or those who were underinsured, and therefore saving taxpayer dollars via saved future Medicaid/Medicare expenditures or indigent care costs to the region. Other advantages included the utilization of FIT testing, a more cost-effective method for public health programs, enabling wider test dissemination for those who are underinsured and uninsured.

While technology for stool tests such as the FIT continue to improve in terms of detecting cancer, other technological advances can continue to shape the way CRC screening services are provided. Examples of technical change could include “virtual colonoscopies,” a method in which an individual swallows a camera and a doctor uses that to examine the colon, may become more popular. Future studies assessing CRC screening programs may also evaluate methods such as these [46]. Another approach may be the use of toilets to detect disease [47]. While this technology seems promising for conditions such as diabetes, additional research is warranted for CRC [47].

The current study had several limitations. First, because there were no records of how many polyps were removed from each patient, we conservatively assumed only one polyp per patient. Although this is unlikely, given that the mean number of polyps per colonoscopy patient is > 1 [34], we decided to err on the side of a conservative economic analysis. Each polyp has a chance for developing into cancer. It is entirely possible for a single patient to account for more than one avoided case of cancer, given that each polyp has a statistical chance of turning into a malignancy. This suggests that the ROI would have yielded a higher number if this information had been collected. Therefore, our calculations regarding the avoided cancer cases are potentially underestimated. The authors also did not have information regarding the size or type of the polyps, which further helps predict the likelihood of cancerous growth. This would have helped refine the amount saved by detecting the growth at a given state.

5 Conclusions

In the current study, we address the real-world ROI of a CRC outreach program in a primarily rural setting, demonstrating the practicality and fiscal savings of such a program among the underinsured and uninsured. This finding is an important consideration for public health programs and to consider instituting such programs in less densely populated areas as our program demonstrated a positive ROI in such an environment. In densely populated urban areas, people participating in outreach programs do not have to travel such long distances for screening. Such factors contribute to higher costs and reduce the ratio of ROIs in screening programs in rural regions.

However, providing such a program in rural areas is warranted, as rates of CRC in the Northeast Texas region are high and the program yielded a considerable positive programmatic ROI. In conclusion, a CRC outreach program of this design is a cost-effective option to reach the underinsured and uninsured.

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Compliance with Ethical Standards

Conflicts of interest GO, AM, CMA, KPS, and PM have no conflicts of interest that are directly relevant to the content of this article.

Data availability The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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