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Effectiveness and Cost of Implementing Evidence-Based Interventions to Increase Colorectal Cancer Screening Among an Underserved Population in Chicago

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Abstract

With funding from the Centers for Disease Control and Prevention's Colorectal Cancer Control Program, The University of Chicago Center for Asian Health Equity partnered with a federally qualified health center (FQHC) to implement multiple evidence-based interventions (EBIs) in order to improve colorectal cancer (CRC) screening uptake. The purpose of this study is to determine the effectiveness and cost of implementing a provider reminder system entered manually and supplemented with patient reminders and provider assessment and feedback. The FQHC collected demographic characteristics of the FQHC and outcome data from January 2015 through December 2015 (preimplementation period) and cost from January 2016 through September 2017 (implementation period). Cost data were collected for the implementation period. We report on the demographics of the eligible population, CRC screening order, completion rates by sociodemographic characteristics, and, overall, the effectiveness and cost of implementation. From the preimplementation phase to the implementation phase, there was a 21.2 percentage point increase in CRC screens completed. The total cost of implementing EBIs was $40908.97. We estimated that an additional 283 screens were completed because of the interventions, and the implementation cost of the interventions was $144.65 per additional screen. With the interventions, CRC screening uptake in Chicago increased for all race/ethnicity and demographic backgrounds at the FQHC, particularly for patients aged 50 to 64 years and for Asian, Hispanic, and uninsured patients.

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Keywords

colorectal cancer; Chicago; cancer screening; economic evaluation; cancer disparities; federally qualified health centers

BACKGROUND

Despite evidence that screening for colorectal cancer (CRC) reduces the incidence of and mortality from the disease, only 69.7% of the eligible population in the United States is up-to-date with CRC screening (National Cancer Institute & Centers for Disease Control and Prevention, n.d.). Studies have consistently shown that provider recommendation to be screened, an evidence-based intervention (EBI) recommended by *The Community Guide*, is strongly associated with screening completion (Brawarsky et al., 2004; Honein-AbouHaidar et al., 2016; Lobchuk et al., 2012; Wee et al., 2005). Because providers may not recommend CRC screening during an office visit, provider reminder systems have been developed that prompt providers to offer screening to eligible adults. Patients may also not schedule or complete their ordered CRC screening test. Patient reminder systems encourage patients to complete the test and may contain additional educational information about the importance of being tested.

Through its Colorectal Cancer Control Program (CRCCP), the Centers for Disease Control and Prevention has funded awardees to implement interventions to increase CRC screening uptake, particularly among underserved and uninsured populations. (Additional detail on the CRCCP is provided in a companion article in this journal by Tangka et al.). Since January 2016, The University of Chicago Center for Asian Health Equity, a CRCCP awardee, has worked with a designated federally qualified health center (FQHC), Heartland Health Centers, to implement multiple EBIs. Multilevel interventions to increase CRC screening have been shown effective, and there is some evidence to indicate that they are cost-effective (Community Preventive Services Task Force, 2016). The intention of this article is to further contribute to the limited literature on the cost of CRC interventions by determining the effectiveness and cost of implementing a provider reminder system, the key EBI at Heartland, supplemented with patient reminders and provider assessment and feedback (PAF).

METHOD

Health System and Readiness Assessment

Heartland Health Centers (Heartland) provides comprehensive primary care services to a diverse underserved urban patient population. The health system had seven clinic sites when implementation began in 2016 and added a site in late 2016. All are located within Chicago.

Using a participatory implementation approach, a pre-implementation assessment was conducted to assess readiness for implementation of EBIs in order to increase CRC screening uptake. The assessment tools were guided by the Consolidated Framework for Implementation Research (Damschroder et al., 2009). Three key features to support the implementation of EBIs were identified: a highly capable electronic medical record (EMR)

system with data reporting capacity through a population management tool, care coordinators within Heartland to help facilitate the implementation of reminders, and a provider champion to promote the program.

EBI Implementation

The University of Chicago Center for Asian Health Equity (the Center) and Heartland performed a systematic evaluation for the 18 months between January 2016 and September 2017 (the implementation period). The Center and Heartland (at the health system level) implemented provider reminders and patient reminders in January 2016 and conducted the PAF intervention in June 2016, with subsequent assessments in October 2016, January 2017, and May 2017.

As part of the EBI implementation process, the Center and Heartland identified a care coordinator as the internal champion (steward) to lead the implementation efforts for provider and patient reminders. For implementing provider reminders, the steward and her team used their EMR's population health management tool to develop a report on patients visiting the clinic each week. The care coordinators then identified those patients who might be due for CRC screening (fecal immunochemical test [FIT], fecal occult blood test [FOBT], or colonoscopy), after which EMR alerts (flags) were placed manually into their charts and would pop up when the provider was with the patient. A copy of the flag was sent to the care coordination team's desktop for follow-up to determine whether the patient had an order placed for FIT or colonoscopy. The care coordination team removed EMR flags once the screen had been completed.

To initiate patient reminders, the care coordination team reviewed their desktop to determine whether the patient had an order placed for FIT/FOBT test or colonoscopy. If an order had been placed for a FIT/FOBT test 90 days ago, but the test was not yet completed, the care coordinators initiated up to two follow-up calls to request return of FIT/FOBT tests. If positive FITs/FOBTs were returned, the care coordination team phoned patients to encourage them to schedule a colonoscopy. For patients who could not be reached by phone, care coordinators sent a mailed letter to the patient's listed home address. If a patient did not schedule a colonoscopy during the study period, the provider took an active role in initiating a conversation with the patient by sending a letter and/or addressing it during the next visit.

For the PAF, the University of Chicago data manager and health system leadership analyzed all CRC screening data each quarter. During quarterly health system meetings, each provider received their CRC screening rate in reference to other providers.

Implementation Evaluation

The evaluation team collected outcome measures, such as the number of individuals not up-to-date with CRC screening who had CRC screening ordered and who completed the screen during the study time period. These data were collected for two timeframes: pre-implementation (January 2015 through December 2015) and implementation (January 2016 through September 2017) periods. Cost data were also collected for the implementation phase from January 2016 to September 2017 to estimate costs of implementing the EBIs. To calculate the costs of activities, we tailored an existing cost data collection tool, which we

have used in previous cost assessments, to reflect the activities being performed by Heartland (Dacus et al., 2018; Hoover et al., 2019; Kemper et al., 2018; Kim et al., 2018; Subramanian et al., 2018). Activities included contacting patients and monitoring and tracking their CRC screening status. For these activities, we collected the time spent on each activity as well as the salary of staff performing the activity. We also collected nonlabor costs pertaining to each activity, such as postage, computer software, and hardware. Using these data, we then calculated the cost per activity.

Data Analysis

The unit of analysis was an active, age-eligible patient who visited the health clinic during the pre-implementation period or implementation period at least once. If a patient visited more than once in the specified period, only the last visit record was kept. The CRC order rate (defined as the proportion of the FQHC's age-eligible population who were not up-to-date with FIT/FOBT or colonoscopy and received an order during the specified time period to those who were not up-to-date) and the overall screening completion rates (defined as the proportion of the FQHC's age-eligible population who received an order to be screened with FIT/FOBT or colonoscopy and completed the screening during the specified time period to those who were not up-to-date and received an order) were reported to compare the pre-implementation and implementation periods. The CRC screen completion rate by sociodemographic characteristics was also compared to conduct pre–post implementation assessments. Significance testing comparing pre-implementation and implementation periods was conducted using *t* tests, and only results that were statistically significant ($p < .05$) were reported. The average cost for each activity (patient and provider reminders, and PAF) and the EBI implementation cost per patient successfully screened were also reported.

RESULTS

During the pre-implementation phase (January 2015–December 2015), 75.8% ($N = 2,453$) of the eligible population was not up to date with CRC screenings (Table 1). Of those not up-to-date at the time of the visit, 18.8% ($N = 460$) received a CRC screening order—50.6% ($N = 233$) of these were for FITs and FOBTs—from their physician, and 2.4% ($N = 11$) completed the order. During the implementation phase (January 2016–September 2017), 69.6% ($N = 3,610$) of the age-eligible population was not up-to-date with their CRC screening; 37.0% ($N = 1,334$) received an order—77.4% ($N = 1,033$) of these were for FITs or FOBTs—and 23.6% ($N = 315$) completed the screening, representing an overall increase in orders completed of 21.2 percentage points.

Table 2 displays the characteristics of patients who received a CRC screening order and completed it. The table shows both the pre-implementation (January 2015–December 2015) and implementation (January 2016–September 2017) periods. Screening orders and screenings completed increased across all sociodemographic categories. The percentage of male patients who received orders and completed screens increased by 19.1 percentage points each, while the percentage points for female patients who received orders and completed screens increased by 17.4 and 23.3 percentage points, respectively. By race and ethnicity, percentage point increases were highest among Hispanic and Asian patients: CRC

screening tests ordered for Hispanic patients increased by 23.4 percentage points, and screens completed increased by 24.2 percentage points, while screens ordered for Asian patients increased by 21.1 percentage points, and screens completed increased by 28.2 percentage points. By age, the largest percentage point increases for screens completed were among older patients: patients 65 to 69 years of age increased by 28.0 percentage points, and patients 70 to 75 years of age increased by 29.8 percentage points. By insurance group, the largest percentage point increases of screens completed were 31.3 for uninsured patients and 19.8 for patients with Medicare.

From January 2016 through September 2017, the costs to implement each of the EBIs were as follows: provider reminders, $23,649; PAF, $9,336; and patient reminders, $7924.08 (Table 3). Components of provider reminders included identifying age-eligible patients and manually inputting flags for CRC screening ($21,597), and monitoring and tracking patient CRC screening status ($2,052). Overall, we estimated that an additional 283 screens were conducted (based on 21.2% increase in screening and 1,334 orders during the implementation period) as a result of EBI implementation at an implementation cost of $145 per screen completed.

DISCUSSION

This study has important implications for the implementation of EBIs to increase CRC screening among a large urban FQHC with a diverse population. First, the pre-implementation process allowed the awardee to determine the infrastructure needs and their capacity to implement EBIs. Second, each EBI was modified to fit the needs and staffing model for this health system, which may have improved efficiency and impact. Third, the effectiveness of these EBIs on CRC order and screening uptake was significant across all populations served and independent of insurance status. Furthermore, this study adds to the growing body of literature on the cost of implementing multicomponent interventions for increasing CRC screening uptake in an FQHC setting (Community Preventive Services Task Force, 2016; Kemper et al., 2018; Lara et al., 2018). While *The Community Guide* (Community Preventive Services Task Force, 2016) found the median incremental cost per additional person screened to be $582.44 for various multilevel, multicomponent interventions, Kemper et al. (2018) found the cost per FIT kit returned to be $39.81 and Lara et al. (2018) found the incremental cost per person screened for multiple EBIs implemented to be in the range of $23.78 to $29.16 in two FQHCs.

In this study, CRC screening completion was facilitated by using EBIs recommended by *The Community Guide* for provider reminders, patient reminders, and PAF (Sabatino et al., 2012). CRC screening uptake increased for patients of all races/ethnicities and demographic backgrounds at the FQHC. On national surveys, uptake of CRC screening tests is much lower among people 50 to 64 years of age compared with those 65 to 75 years of age, and among people who are Hispanic or Asian compared with other race/ethnicity groups (National Cancer Institute, n.d.). In this study, CRC screening tests ordered and completed increased substantially among patients 50 t 64 years of age, indicating that this was an effective intervention to increase screening in this population. Similarly, Hispanic and Asian patients had significant increases in CRC screening uptake (24.2 and 28.2 percentage point

increases, respectively) such that by the end of the implementation period, these groups had the highest percentage of screens ordered and completed compared with other race/ethnicity groups.

This study contributes to the sparse literature around EBI influence on screens ordered for CRC screening. Specifically, the study demonstrates that both screens ordered and screens completed increased with these interventions. Screens ordered is an important measure to evaluate provider recommendations and engagement in the CRC screening process. The combination of all three EBIs might have led to an increase in CRC screening uptake, where screens ordered increased from 18.8% to 37.0%, and screens completed increased from 2.4% to 23.6% among those not up to date with screening. This study demonstrates that EBIs to increase CRC screening may be effective in clinics with fewer resources that serve populations who have poor access to or under-utilize health care services. Tailoring the EBIs to the needs and capacity of participating clinics may have been key to their effectiveness.

The total implementation cost for all EBIs was calculated to be $40908.97, and the cost per additional screen was $144.65. Although the incremental cost is higher for this health system than for some other FQHCs that implemented multicomponent interventions (Lara et al., 2018; Tangka et al., 2019), we believe that this is in part caused by manual entry of provider and patient reminders into the EMR. As this health system moves toward a more automated system of reminders, we expect that this incremental cost will decrease.

This study has several limitations. Although we would have liked to implement and measure the effect of each EBI separately, the goal of the health system was to see an increase in CRC screening uptake; therefore, we initiated a multicomponent approach to EBI implementation. Tracking process data that might isolate each EBI could help future implementation analyses. Second, our study population is a diverse urban, underserved population that may not represent a typical clinic population in another FQHC. However, this study does demonstrate that CRC screening rates increased in an underserved population when interventions were implemented effectively and with appropriate support. Third, this study presents the results on changes in screening coverage, but we may have underreported screenings performed and we were unable to collect and report data on diagnostic colonoscopy follow-up for those with positive FITs, a necessary step before screening can be considered complete (Nadel et al., 2019). Last, the cost data were collected retrospectively, which may have introduced recall bias. Future efforts will attempt to collect time and cost data contemporaneously as the interventions are being planned and implemented.

IMPLICATIONS FOR PRACTICE AND/OR POLICY AND RESEARCH

This study reports on the effectiveness of EBI implementation on both screens ordered as well as CRC screens completed across a health system of safety net primary care clinics. The introduction of a provider reminder system entered manually and supplemented with patient reminders, and PAF, increased CRC screening. Lessons learned from the Heartland Health Center’s demonstrated that effectiveness in increasing screening among Hispanic, Asian, and uninsured patients may inform other clinic systems working to eliminate cancer

screening disparities among priority populations. As provider reminders become more automated in EMRs, the cost of labor for manually entering reminders may decrease and improve cost-effectiveness of the multicomponent interventions.

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TABLE 1

Order Rate and Colorectal Cancer (CRC) Screen Completion Rates at Heartland Health Centers, Chicago: Preimplementation, Implementation, and Change

	Preimplementation (January-December 2015)		*Implementation (January 2016-September 2017)*			
CRC status	**n**	***%***	**n**	***%***	***Change in percentage points***	**p**[c]
Age-eligible	3,235	100	5,190	100	n/a	n/a
Individuals not up to date with screening at the time of visit	2,453	75.8	3,610	69.6	6.3	<.001
Individuals who received CRC screening order[a]	460	18.8	1,334	37.0	18.2	<.001
Individuals who received order for CRC screen and completed it[b]	11	2.4	315	23.6	21.2	<.001

Note. FIT = fecal immunochemical test; FOBT = fecal occult blood test; n/a = not applicable.

[a]Age-eligible who were not up to date and got an order in time period. Out of the 460 orders placed, 233 (50.6%) received orders for FITs or FOBTs in the baseline period. In the implementation period, 1,033 (77.4%) received orders for FITs or FOBTs.

[b]Age-eligible who were not up to date, got an order, and completed the test in the time period.

[c]The *p* values are based on *t* tests.

TABLE 2

Patient Characteristics of Those With Order Completion and Colorectal Cancer Screen Completion Rates at Heartland Health Centers, Chicago: Preimplementation, Implementation, and Change

	Preimplementation (January-December 2015)		*Implementation (January 2016-September 2017)*		*Percentage point change*			
Patient characteristics	***Screens ordered, % (N = 460)***	***Screens completed, % (N = 460)***	***Screens ordered, % (N = 1,334)***	***Screens completed, % (N = 1,334)***	***Screens ordered***	**p**	***Screens completed***	**p**[a]
Gender								
Male	17.8	2.0	36.9	21.1	19.1	0.000	19.1	<.001
Female	19.6	2.7	37.0	26.0	17.4	0.000	23.3	<.001
Race/ethnicity								
White	17.0	1.7	34.7	18.9	17.7	0.000	17.2	<.001
Black or African American	22.2	1.3	34.9	22.3	12.7	0.000	21.0	<.001
Hispanic	17.8	4.6	41.2	28.8	23.4	0.000	24.2	<.001
Asian	18.6	0.0	39.7	28.2	21.1	0.000	28.2	<.001
Unknown/other	14.5	1.7	33.6	13.0	19.1	0.001	11.3	.024
Age range (years)								
50–54	19.4	3.1	39.0	23.9	19.6	0.000	20.8	<.001
55–59	20.9	2.8	36.0	20.5	15.1	0.000	17.7	<.001
60–64	18.1	2.1	39.5	23.7	21.4	0.000	21.6	<.001
65–69	17.0	0.0	35.4	28.0	18.4	0.000	28.0	<.001
70–75	9.4	0.0	25.2	29.8	15.8	0.000	29.8	.033
Insurance								
Private	19.6	5.1	45.2	20.7	25.6	0.000	15.6	.023
Medicaid	20.6	2.7	37.4	19.3	16.8	0.000	16.6	<.001
Medicare	11.7	0.0	32.6	19.8	20.9	0.000	19.8	.002
Uninsured	19.1	1.9	35.7	33.2	16.6	0.000	31.3	<.001

Note. White = non-Hispanic White; Black or African American = non-Hispanic Black or African American; unknown/other = other, unknown, American Indian/Alaska Native, Native Hawaiian, or other Pacific Islander.

[a]The *p* values are based on *t* tests.

TABLE 3

Costs and Effectiveness of Evidence-Based Interventions (EBIs) at Heartland Health Centers, Chicago

Implementation cost of EBI	**$**
Provider reminder	23648.93
Identify age-eligible patients and manually input flags	21597.21
Monitor and track patients related to screening	2051.72
Patient reminder	7924.08
Provider assessment and feedback	9335.96
Total cost for multicomponent EBI	40908.97
Cost per additional screen	**$**
Number of additional screens	283
Implementation cost per additional screen	144.65[a]

[a]144.65 = 40908.97/282.81.

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