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Utilizing Decision Tree Implementation and Provider Education to Improve Colorectal Cancer

Screening Orders: A Quality Improvement Project

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Abstract

Background and Significance: Colorectal cancer (CRC) is the third most common cancer and the second leading cause of cancer-related deaths (Jain, et al., 2022). Healthy People 2030 objectives include reducing the CRC death rate and increasing the proportion of adults who get screened (Healthy People 2030, n.d.). According to 2021 data, only 58.7% of adults are screened with a Healthy People target of 68.3%. Healthy People states that there are effective screening tools to detect colorectal cancer early, and people are more likely to survive it (Healthy People 2030, n.d.). **Purpose:** This quality improvement (QI) project aims to implement an evidence-based colorectal cancer screening decision tree at two primary care offices in Central Pennsylvania (PA). The goal of the implementation is to increase colorectal cancer screening orders for patients who are eligible for screening. **Methods:** This project utilized the Plan, Do, Study, Act (PDSA) approach to implement a decision tree to increase CRC screening orders at two primary care offices in Central PA. Providers and ancillary staff members were educated on using the decision tree and screening order data was collected. **Results:** There was an average weekly increase of 13.35% in screening orders compared to the previous year's screening data. The average number of screenings increased by 2.12 screening orders placed per week. An increase in screening orders placed will hopefully improve the number of screening tests completed, which will contribute to the goal of increasing screenings and reducing the colorectal cancer death rate.

Keywords: colorectal cancer screening, screening colonoscopy, colorectal cancer screening rates, colorectal cancer screening tools

Utilizing Decision Tree Implementation and Provider Education to Improve Colorectal

Cancer Screening Orders: A Quality Improvement Project

In 2019, there were 51,896 colorectal cancer-related deaths and 142,462 new colorectal cancer (CRC) cases in the United States. Colorectal Cancer is the third most common cancer and the second leading cause of cancer-related deaths (Jain et al., 2022). Since the 1990s, there has been an increase in CRC incidence in individuals younger than 50 (Jain et al, 2022). In May 2021, the United States Preventative Task Force (USPTF) updated its guidelines to recommend that adults aged 45 years and older of average risk be screened for Colorectal Cancer (Jain et al., 2022). Patient outcomes are greatly improved if CRC is detected early, which contributed to the decision to recommend screening in people aged 45 years and older who are at average risk (Wilson et al, 2023). Predictions from MD Anderson Center indicate that one in four CRC diagnoses will be in those younger than 50 years old. Adults born in the 1990s have twice the risk of colon cancer than those born in the 1950s (Mannucci et al, 2019).

CRC is largely preventable with evidence-based screening tools (Jain et al., 2022). The national goal for CRC screening is 80% or better (National Colorectal Cancer Roundtable, 2023). Prior to COVID-19 and the addition of the 45-49-year-old population, the screening rate for CRC in Centre County, Pennsylvania was below the standard at 68.3% (CDC, 2022). As of 2020, the national screening rate for colorectal cancer was 69.7% (National Colorectal Cancer Roundtable, 2022).

As stated by Jain et al. (2022) "CRC screening is primarily opportunistic and only achieved if a primary care provider actively recommends it" (p. 488). Health systems with higher screening rates have evidence-based and programmatic screening approaches (Jain et al., 2022). The most effective evidence-based strategies include mailed patient outreach, patient education,

provider education, and hiring patient navigators who can help patients with the screening process (Jain et al., 2022). CRC screening options include fecal immunochemical test (FIT), high-sensitivity guaiac fecal occult blood test (HSgFOBT), multi-target stool DNA (mt-sDNA), computer tomographic (CT) colonography, flexible sigmoidoscopy, flexible sigmoidoscopy with FIT, or colonoscopy (Jain et al., 2022).

Healthcare Problem

The impact of the COVID-19 pandemic on colorectal cancer screenings and the updated screening guidelines will require additional attention from healthcare providers. Screening for CRC continues to remain below the Healthy People 2020 goals (Mohan & Chattopadhyay, 2020). According to Mazidimoradi et al. (2021), the COVID-19 pandemic caused a reduction in CRC screenings due to restrictions and a lack of referrals for fear of developing COVID-19. Combined with other common barriers to CRC screening such as screening cost, lack of knowledge, and lack of physician recommendation, effective practice interventions must be implemented to compensate for the decline and improve screening rates (Mazidimoradi et al., 2021). With the potential for future waves of COVID-19, or other potential pandemics, there is an imperative need to reorganize efforts against high-impact diseases such as CRC (Ricciardiello et al, 2021). As of 2018, 68.3% of the population aged 50-75 reported being up to date on their colorectal cancer screening in Centre County, Pennsylvania compared to 69.5% of the United States (Centers for Disease Control and Prevention, 2021).

Tools utilized by organizations to improve their CRC screening rate include provider education, offering a range of CRC screening options, and active outreach to patients reaching screening age (National Colorectal Roundtable, 2022). Studies have shown that a recommendation from the provider is the most influential factor in patient screening (National

Colorectal Roundtable, 2022). Interventions to increase screening rates can include reminders for healthcare providers to address screenings using pop-up warnings or dashboards embedded in the electronic health record (Inadomi et al, 2021). Increased screening rates are associated with earlier diagnosis and treatment and improved health outcomes with quality-adjusted life-years (QALYs). This enhances both health equity and economic efficiency (Mohan & Chattopadhyay, 2020).

<div style="text-align:center">Literature Review</div>

The Johns Hopkins Evidence-Based Practice model is a problem-solving approach to clinical decision-making (Johns Hopkins Medicine, 2023). The model is user-friendly and can be used as a guide to navigate the evidence-based practice (EBP) process (Johns Hopkins Medicine, 2023). The quality of evidence reviewed was done by utilizing this appraisal tool.

The databases utilized for this literature review included PubMed, Cumulative Index of Nursing and Allied Health Literature (CINAHL), MEDLINE, and Cochrane Library. The articles reviewed were published between 2016-2023. The following search terms were included: colorectal cancer, colorectal cancer screenings, colorectal cancer screening increase, barriers to colorectal cancer screening, and colorectal cancer screening guidelines. Nineteen articles were determined to be relevant. Articles included quantitative and qualitative studies, case-control studies, meta-analyses, and systematic reviews. Information was gathered from national organizations including the U.S. Preventative Services Task Force (USPSTF), the American Cancer Society (ACS), and the National Comprehensive Cancer Network.

Recommendations for Screening

The ACS and USPSTF recommend screening for colorectal cancer in average-risk adults starting at age 45. The increase in earlier-onset CRC incidence and mortality demonstrates an

obligation to take action to increase screening rates (Mannucci et al, 2019). Screenings reduce the risk of CRC by detecting and removing adenomas and increase survival and cure rates by earlier diagnosis (Mannucci et al, 2019). The type of screening performed and the results of the test will determine the frequency of retesting. For adults aged 75 years and older, it is recommended that clinicians selectively offer screenings due to the net benefit of screening being small in this age group. In collaboration with the patient, it is recommended the provider consider the patient's prior screening history, overall health status, and personal screening preferences when deciding whether continued screening is necessary. There is no single correct approach to increasing CRC screening; however, projects aiming to increase screenings can reduce CRC mortality and improve health disparities (Leach et al, 2021).

Barriers to Screening

Common barriers to CRC screening with colonoscopy include loss of time or income from work for patients and caregivers, transportation, reluctance to complete the bowel prep, complications such as perforation, access to screening colonoscopies, and anesthesia risks (Wilson et al, 2023). Understanding the barriers, which can often be discovered through patient-provider discussions, can assist in working toward solutions. To maximize CRC screening, patients and providers should engage in an informed decision-making discussion about the benefits, options, and limitations of screening to determine the most appropriate test (Jain et al., 2022). Topics that should be discussed regarding screening include invasiveness of the test, test performance, screening interval, and accessibility (Jain et al., 2022).

<center>**Description of Project**</center>

This quality improvement (QI) project seeks to promote CRC education, improve CRC screening awareness, and increase referral/order rates for average-risk patients through the

implementation of a decision tree at two primary care offices in Central PA. The project aims to improve screening referrals/orders, particularly in the 45-49-year-old age group. The decision tree will assist providers and staff in identifying patients who are eligible for screening as well as placing orders during the visit. Stakeholders engaged with the project have communicated a need for an increase in CRC screening orders. They have expressed optimism regarding implementing a decision tree in the primary care offices.

Methodology/Theoretical Framework

This quality improvement (QI) project will utilize the Plan, Do, Study, Act (PDSA) model from the Institute of Healthcare Improvement (IHI) to test the effectiveness of implementing a decision tree to increase colorectal cancer screening orders at two primary care offices in Central PA. This model is used to test a change (plan), implement the change (do), evaluate the change (study), and determine if any modifications are needed (act) (Institute for Healthcare Improvement, 2017). This model will help gauge the success of the decision tree implementation and help guide future interventions for improvement.

DNP Project Aims & Objectives

Aim 1 (Plan): Establish the current colorectal cancer screening (FIT, HSgFOBT), multi-target stool DNA (mt-sDNA), computer tomographic (CT) colonography, flexible sigmoidoscopy, flexible sigmoidoscopy with FIT, or colonoscopy) order/referral rate at two primary care offices in Central PA.

Objective 1.1: Complete a review of the primary care office colorectal cancer screening referrals/orders over the past 12 months to present to stakeholders to develop a plan to increase referrals/orders by Fall 2023.

Aim 2 (Plan): Develop a colorectal cancer screening decision tree based on the United States Preventative Services Task Force (USPSTF) screening guidelines.

Objective 2.1: Collaborate with stakeholders including the chief nursing officer, director of primary care services, providers and primary care office staff to establish a decision tree that can be utilized in each patient room for reference during visits.

Aim 3 (Do): Implement a colorectal cancer screening decision tree at two primary care offices in Central PA.

Objective 3.1: Provide guidance and education for providers regarding the project and its goals.

Objective 3.2: Have providers utilize the decision tree for patients to determine if they are screen-eligible and if so, place the order/referral to increase orders by at least 5% by Fall 2023.

Objective 3.3: Administer a post-implementation questionnaire to assess decision tree ease of use, barriers encountered by providers, and subjective determination of whether screening referrals/orders have increased or not.

Aim 4 (Study): Evaluate the effectiveness of colorectal cancer screening decision tree implemented at the primary care offices.

Objective 4.1: Measure screening referral orders and compare them to pre-implementation data to determine whether there has been an increase, decrease, or no change.

Objective 4.2: Utilize post-implementation provider questionnaire findings to categorize common barriers reported to be utilized in future practices.

Aim 5 (Act): Analyze the data obtained during the project to identify strengths, weaknesses, and barriers to the decision tree implementation.

Objective 5.1: Identify the project's strengths and weaknesses through provider questionnaire feedback and data analysis to identify alterations that may benefit the program.

Objective 5.2: Present the health system providers, staff, and stakeholders with the results of the program and discuss how findings can be utilized in future practice.

Objective 5.3: Inform the health system providers of the commonly identified barriers that can be utilized for the development of future practice.

Setting

The project was implemented at two of the primary care offices in a rural health system in Central Pennsylvania. There are a total of fifteen primary providers between the combined offices. There are a total of 20 exam rooms between the two locations. The nursing assistants for each provider helped assist with the identification of screen-eligible patients. They can place pending orders for the provider to review with the patient during the appointment.

Implementation

A CRC average-risk screening decision tree was developed utilizing guidelines from the USPSTF in August 2023 (Figure 1). The most current guidelines developed by the USPSTF were utilized as the foundation for the quality improvement project. The decision tree was implemented after the internal review board (IRB) approval of two primary care offices in Central PA in September 2023. Decision trees were placed on the cupboards in the exam rooms in areas of high visibility. The timeline of these activities is noted in Figure 2. Prior to the start of the project, pre-implementation questionnaires were distributed to explore subjective data regarding barriers to ordering CRC screening and barriers to patient completion of the screening. Providers and rooming staff were educated on the use of the decision tree. Decision trees were placed in each exam room where providers and rooming staff could clearly visualize. The

decision tree aided as both a reminder for screening and a decision matrix for whether patients were screen-eligible and which screening tests were available/recommended. After implementation, questionnaire data was gathered by providers to re-evaluate barriers and determine whether the decision tree was subjectively helpful.

Data Management Plan

Data was collected through the health system's electronic medical record (EMR). The data collected included: screening order type, age, gender, practice location, provider name, marital status, order date, and patient ethnicity. The data collected was de-identified. Prior to, and following decision tree implementation, providers completed CRC screening-focused questionnaires (see Questionnaire 1 and Questionnaire 2).

Benefits and Cost

According to the CDC (2021), CRC has the second highest cost of any cancer in the United States and an estimated $14.1 billion is spent annually on treatment. Implementation of strategies to increase screening rates will help to prevent cancer, reduce deaths, increase the 5-year survival rate, and reduce healthcare spending (CDC, 2021). Costs of screening tests vary based on insurance coverage and which test is performed. For self-pay patients, Cologuard costs approximately $650 per test, while colonoscopies can cost $2000-$2500 plus additional costs for any pathology testing that may be complete (Eidem, 2019). Preventing or diagnosing CRC early can provide significant cost savings for the healthcare system. The difference between the cost of CRC treatment when diagnosed with stage I vs. stage IV cancer is $360,000 (Green, B.B. & Meenan, R.T., 2020). When CRC is prevented or detected early it is not only a cost savings, but it increases cancer prevention, reduces death rates, increases 5-year survival rates, improves

community health, reduces late-stage CRC diagnoses, and reduces mental stress (Green, B. B., &

Meenan, R. T., 2020).

Development and implementation of the decision tree and ongoing education will provide

staff with the confidence to order screening tests when applicable and help patients navigate

through the screening options. Many variables will affect the potential cost savings of

implementing a program to increase CRC screening in the community. Given the

recommendations and the increasing incidence of CRC, the implementation of a decision tree

and screening education is fiscally beneficial considering the potential outcomes. This will

benefit patients, providers, families, the community, and the healthcare system.

DNP Project Findings

Aim 1

Colorectal cancer screening order data was evaluated for one year prior to the start of the

project (September 27, 2022 to September 26, 2023). That data showed that there was an average

of 15.88 colorectal cancer screening orders placed per week for adults aged 45 years and older.

These orders were comprised of both screening colonoscopies and Cologuard. Notably, the age

with the highest number of screening orders was for those age 45, accounting for 44 out of a total

of 826 orders. Orders placed for those aged 45 accounted for 5.3% of the total orders for the

year.

Aim 3

An objective of aim 3 was to obtain a post-decision tree implementation questionnaire,

completed by the providers to determine whether they felt that the decision tree was subjectively

helpful. Both pre and post-implementation questionnaires were obtained, and six providers

completed each questionnaire anonymously. When questioned about the ease of ordering

screening tests, providers attributed difficulties to time limitations, computer issues, and patient resistance to screening. Barriers when discussing colorectal cancer screenings were attributed to time, patient interest, and patients having difficulties with prepping for colonoscopy or transportation availability. When they chose a screening test to recommend to their patients, they chose ones that were easy for patients, patient-preferred, and followed current guidelines. The most common barriers identified by providers to having their patients complete the screening are transportation and scheduling. Other than following up with their patient at the next visit, there are no procedures in place to ensure that patient screening has been completed.

Of the providers that completed the post-implementation questionnaire, only one of them found the decision tree to be helpful. One provider felt that they noticed an increase in their order rate. Other providers that participated did not find it helpful and did not feel that it had an impact on the number of screening tests ordered. However, feedback received from the practice manager was that the rooming staff utilized the decision tree to determine whether an order should be placed on hold for the provider to review when they were completing their visit.

Aim 4

Between two primary care locations, there were 144 screening colonoscopy or Cologuard orders (Figure 4) placed during the 8-week project implementation period. Screening ages ranged from 45 to 84. The data showed an average of 18 colorectal cancer screening orders placed per week for adults aged 45 years and older during the 8-week project. Notably, the age with the highest number of screening orders was 45 (Figure 3) and accounted for 7.6% of orders placed. Screening Colonoscopy orders accounted for 71% of orders and Cologuard orders were the remaining 29%. There were more orders placed for male patients (56%) than female patients (44%). Most of the orders were placed for non-Hispanic white patients. Most patients were

married. On average, there was an increase of 2.12 screening tests ordered per week with the decision tree in place. Over a year, this can potentially increase total orders by 110 additional screening tests. When evaluating the past year, the Green Tech location had ordered more screening tests than the Blue Course location. However, during the project, the Blue Course location ordered more screening tests. This may have been secondary to one of the main providers at the Green Tech location going on leave during the project.

Aim 5

Strengths

Overall, there was an increase noted in screening tests ordered. Continued decision tree use and data collection could be obtained to further support the data. Although some providers did not find the decision tree helpful, feedback received was that ancillary staff members utilized it to help assist the provider in completing screening orders. In the future, continued education could be provided to both providers and ancillary staff.

Weaknesses

Providers may have felt it more beneficial to have the decision tree implemented in the electronic medical record (EMR). With the potential conversion to a new EMR soon, this decision tree can be added for ease of use. Providers identified that computer issues with the EMR can be a barrier to finding previous testing results and determining whether their patient is screen-eligible. Implementation of the decision tree into the EMR may help with ease of information finding.

Barriers

Common barriers to ordering screening tests noted in the decision tree questionnaires included difficulty ordering screening tests, time limitations, and lack of patient

interest/resistance to screening (Questionnaire Results 1 & 2). With the implementation of a new EMR and an integrated decision tree, the providers may find it easier to determine if their patient is screen-eligible and order the testing. Barriers to completion of the screening tests included patient discomfort with performing the test, scheduling issues, cost, and transportation issues (Questionnaire Results 1 & 2). This information can be used to develop interventions to improve the provider workflow, improve patient interest in screening, and increase the number of completed screening tests. The development of strategies to overcome barriers could be the focus of future projects in the practices. Transportation was noted as a common theme for why patients do not complete their screening. Focusing on this barrier and providing options such as transportation services to patients may result in improved completion of screening tests.

Interpretation/Sustainability

The DNP project implemented a colorectal cancer decision tree in two primary care offices in Central PA and found an average increase in weekly screening orders. The plan will be to expand the decision tree to other primary care offices within the organization and potentially integrate the decision tree into the electronic medical record. On-going stakeholder meetings will occur. Increasing provider and staff engagement is a strategy to continue to improve the use of the decision tree. The identification of patient screening barriers can be used to implement strategies to help overcome those barriers so screenings can be completed. Continued use of the decision tree can lead to an increase in order placement, which could potentially lead to an increase in screenings completed. Intermittent data collection would occur to monitor screening rates. Monitoring for patient completion of the screening tests would be the next step. Once verification of screening completion can be established, appropriate follow-up could occur.

Ongoing exploration for reasons why patients do not complete their screening tests can ensue, with the formulation of strategies to improve completion rates based on feedback obtained.

Limitations

The course of the implementation was short, therefore with continued use of the decision tree, data can continue to be evaluated and help support the findings of the study. Not all providers completed the pre and post-implementation questionnaire, and of those completed, not all providers provided answers to every question on the questionnaire. Subjective provider data collection was limited due to the limited number of questionnaires completed.

Ethical Considerations

Ethical considerations of this project include promoting patient autonomy by encouraging patients to make educated medical decisions regarding their health. The project promoted equity by ensuring all patients have the same information and are educated to make informed decisions. Some screening methods, such as colonoscopies, have risks associated with the procedure, so risks and benefits could be weighed and discussed with each patient to ensure no unnecessary harm. The project promoted voluntary participation with the providers. Despite being educated and encouraged to use the decision tree, the providers were able to voluntarily utilize it. It is also a voluntary decision for the patients to complete the ordered screening test.

Conclusion

Utilizing evidence-based guidelines, Primary Care Providers are committed to improving health outcomes for their patients. Colorectal Cancer is the third most common cancer and the second leading cause of cancer-related deaths, making it extremely important to improve completed patient screenings (Jain et al., 2022). There are many different screening options for patients to complete, including screening colonoscopy as the primary screening tool. Improving

awareness regarding current recommendations and guidelines is imperative to patient health. This quality improvement (QI) project focused on implementing an evidence-based decision tree that outlined the appropriate path for screening recommendations for patients aged 45 years and older. The decision tree was developed utilizing recommendations provided by the United States Preventative Services Task Force. With the implementation of the decision tree, there was an average weekly increase of screening orders by 2.12. This is an average increase of 13.35% per week. It was found that rooming staff at the primary care locations utilized the decision tree to help place screening orders as a reminder for the provider, which was beneficial support throughout the project. Common barriers to screening completion, such as transportation, time, and patient interest were identified and can be used in the future to identify strategies to overcome these barriers. Collectively, this can increase screening orders not only being placed but also completed which will result in better health outcomes for patients. This would also contribute to the reduction of overall healthcare costs.

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Table 1

Quality Improvement Project Data Collection Timeline

When	What	How	People Involved in Data Collection
Fall 2023	Initial data collection prior to program implementation	Questionnaires, Focus Groups with primary care providers, EMR	The project manager, primary care office staff, Dr. Dustin Case, and Information Services (I.S.) will assist with the initial findings.
Fall 2023	Data collection during program implementation	Questionnaires at project end, EMR	The project manager and I.S.
Spring 2024	Post-program implementation data collection	Questionnaires and focus groups with primary care providers. Final data collection of CRC screening rates (Final Data Analysis) from EMR and presentation of data.	The project manager, primary care office staff, I.S., and Dr. Dustin Case.

Figure 1

Average Risk Colorectal Cancer Decision Tree

Expires 7/2024

Average Risk Colorectal Cancer (CRC) Screening Decision Tree
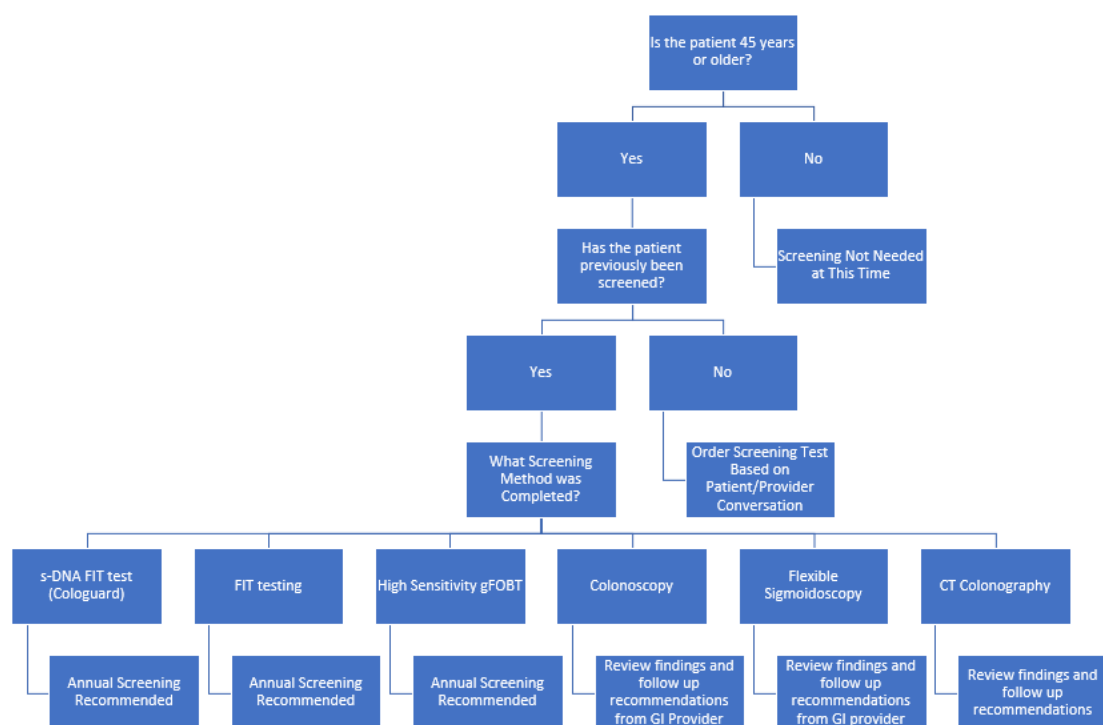
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Figure 2

Quality Improvement Project Timeline

- **Summer/Fall 2023**
  - Literature review completed, aims and objectives identified, project development, discussed project with stakeholders

- **Fall 2023**
  - Pre-Implementation Questionnaire completed by providers
  - Implement decision tree in primary care offices and educate staff & providers on current guidelines/recommendations

PLAN   DO

ACT   STUDY

- **Spring 2024**
  - Provide Recommendations for furture projects and workflows

- **Fall 2023/Spring 2024**
  - Post-Implementation Questionnaire completed by providers
  - Review post-decision tree implementation referral/order data

Questionnaire 1

Pre-Implementation Questionnaire

Pre-Decision Tree Implementation Questionnaire

1. Practice Site:

2. How easy is it to order colorectal cancer screenings for your patients? What are the barriers to ordering? Circle all that apply.
    a. Time
    b. Knowledge
    c. Computer Issues
    d. Scheduling Difficulties
    e. Other (please explain):

3. Approximately how many screening orders do you place weekly?

4. What barriers do you encounter when discussing colorectal cancer screenings you're your patients? Circle all that apply.
    a. Time
    b. Patient Interest
    c. Openness/Rapport with the Patient
    d. Patient discomfort when discussing the issue?
    e. Other (please explain):

5. What factors influence what screening modality you chose? Circle all that apply.
    a. Cost
    b. Ease of Screening Test
    c. Insurance Requirements
    d. Convenience for the Patient
    e. Test Recommendations (such as colonoscopy since it is the "gold standard")
    f. Other (please explain):

6. Once the order is placed, what are the most common barriers to screening for your patients that cause them not to get screened? Circle all that apply.
    a. Cost
    b. Scheduling Issues
    c. Ride Issues
    d. Patient Discomfort with performing the test
    e. Other (please explain):

7. If the CRC screening test is ordered in the system, what is the follow-up to ensure the test has been completed?

8. Are there any barriers specific to your office/location?

9. Other Comments:

Questionnaire 2

Post-Implementation Questionnaire

Post-Decision Tree Questionnaire

1. Practice Site:

2. How easy is it to order colorectal cancer screenings for your patients? What are the barriers to ordering? Circle all that apply.
    a. Time
    b. Knowledge
    c. Computer Issues
    d. Scheduling Difficulties
    e. Other (please explain):

3. Approximately how many screening orders do you place weekly?

4. What barriers do you encounter when discussing colorectal cancer screenings you're your patients? Circle all that apply.
    a. Time
    b. Patient Interest
    c. Openness/Rapport with the Patient
    d. Patient discomfort when discussing the issue?
    e. Other (please explain):

5. What factors influence what screening modality you chose? Circle all that apply.
    a. Cost
    b. Ease of Screening Test
    c. Insurance Requirements
    d. Convenience for the Patient
    e. Test Recommendations (such as colonoscopy since it is the "gold standard")
    f. Other (please explain):

6. Once the order is placed, what are the most common barriers to screening for your patients that cause them not to get screened? Circle all that apply.
    a. Cost
    b. Scheduling Issues
    c. Ride Issues
    d. Patient Discomfort with performing the test
    e. Other (please explain):

7. If the CRC screening test is ordered in the system, what is the follow-up to ensure the test has been completed?

8. Are there any barriers specific to your office/location?

9. Was the decision tree helpful in reminding you about colorectal cancer screenings?

10. Were you able to utilize the data from the decision tree to guide your decision-making?

11. Did you notice an increase in patients' questions regarding colorectal cancer screening after the decision tree was posted?

12. Other Comments:

Questionnaire Results 1

Pre-Decision Tree Questionnaire Results	Number of Responses
Practice Site	
Green Tech	2
Blue Course	4
Barriers to Ordering CRC Screening	-
Time	1
Knowledge	0
Computer Issues	3
Scheduling Difficulties	0
Other (Patient Agreeable)	2
How Many Screening Orders Placed Per Week	
0-5	4
6-10	1
11-15	0
16-20	0
Other: Many	1
Patient Barriers	
Time	2
Patient Interest	4
Openness/Rapport with the Patient	0
Patient Discomfort with Discussing the Issue	0
Other: Time Off for Prep/Anesthesia	1
Other: Transportation	1
Factors that Influence Screening Modality	
Cost	0
Ease of Screening Test	2
Insurance Requirements	0

Convenience for the Patient	1
Test Recommendations	3
Other: Patient Preference	1

Common Barriers to Screening Completion

Cost	1
Scheduling Issues	1
Transportation Issues	5
Patient Discomfort with Performing the Test	1
Other: Patient Time	1
Other: Loss of Work for Patient and/or Spouse	1

Follow Up Provided

None	1
Next Visit Follow Up	3

Barriers Specific to the Office

No Follow Through on Completed Orders/Cancelled Tests	1
None	5

Questionnaire Results 2

Post Decision Tree Questionnaire Results	Number of Responses
Practice Site	
Green Tech	2
Blue Course	4
Barriers to Ordering CRC Screening	
Time	0
Knowledge	0
Computer Issues	1
Scheduling Difficulties	0
Other: Confusion on whether to code as Diagnostic vs. Screening	1
Other: Patient Interest	1
How Many Screening Orders Placed Per Week	
0-5	3
6-10	1
11-15	0
16-20	0
Other: Several	1
Patient Barriers	
Time	0
Patient Interest	5
Openness/Rapport with the Patient	0
Patient Discomfort with Discussing the Issue	1
Other: Time Off for Prep/Anesthesia	1
Other: Transportation	0
Factors that Influence Screening Modality	
Cost	3

Ease of Screening Test	2
Insurance Requirements	2
Conveience for the Patient	5
Test Recommendations	2
Other: Patient Preference	0

Common Barriers to Screening Completion

Cost	1
Scheduling Issues	3
Transportation Issues	3
Patient Discomfort with Performing the Test	4
Other: Patient Time	0
Other: Loss of Work for Patient and/or Spouse	0

Follow Up Provided

None	1
Next Visit Follow Up	4
Follow Up Phone Call	1

Barriers Specific to the Office

No Follow Through on Completed Orders/Cancelled Tests	0
None	5

Was The Decision Tree Helpful

Yes	1
No	2

Was Data from the Decision Tree Used to Guide Decision Making

Yes	1
No	2

Was an Increase in Patient Questions Post-Decision Tree Implementation	
Yes	1
No	2

Figure 3

Number of Colorectal Cancer Screening Orders by Age During 8 Week Project Implementation n = 144

Figure 4

Order Quantity by Week During Project Implementation
n = 144

Figure 5

Colorectal Cancer Screening Orders During 8 Week Project by Gender

Figure 6

Colorectal Cancer Screening Order during 8 Week Project by Ethnicity
n = 144

Figure 7

Colorectal Cancer Screening Orders
During 8 Week Project by Order Type
n = 144
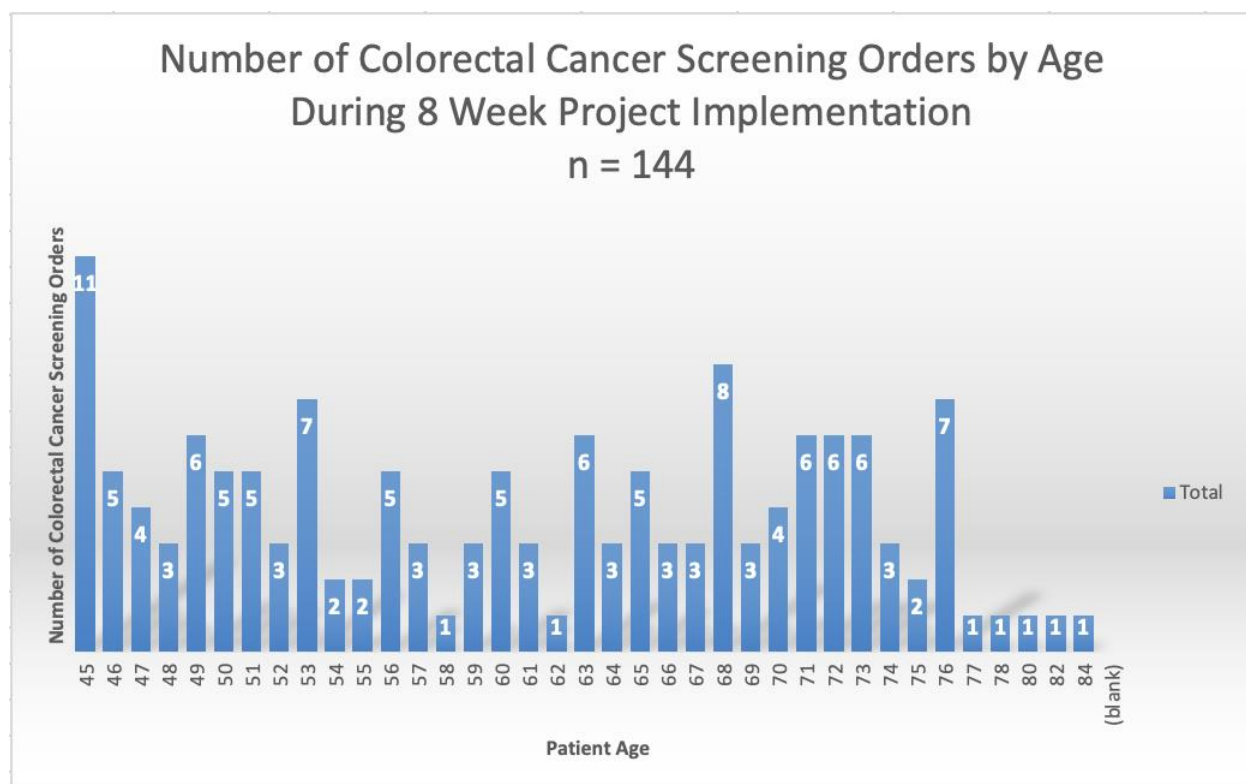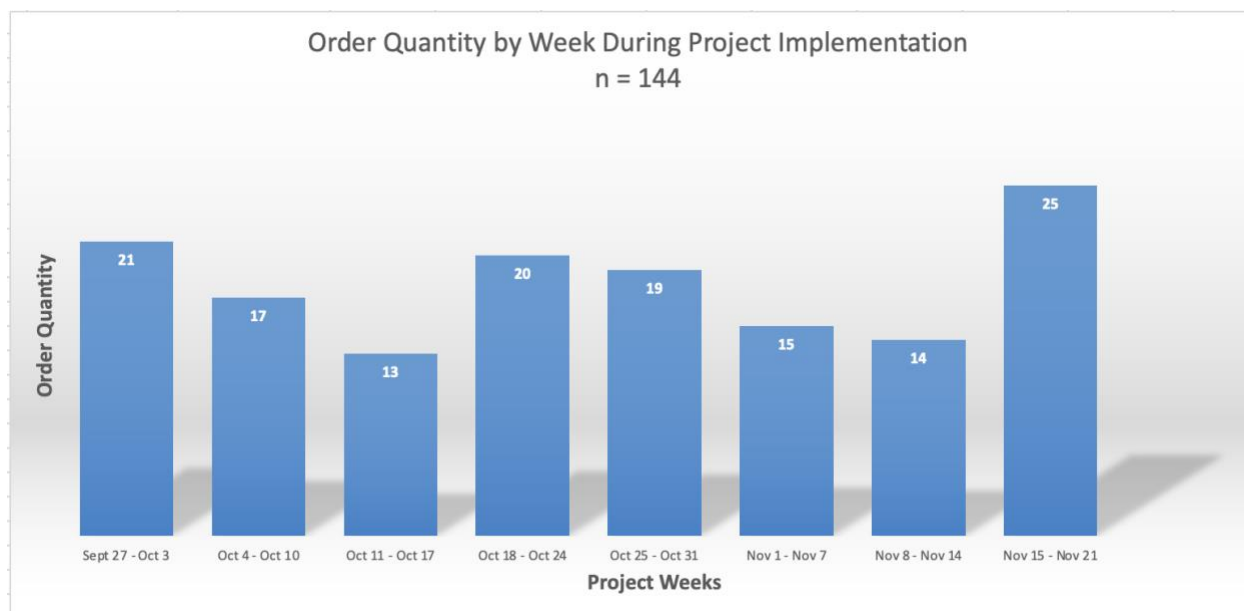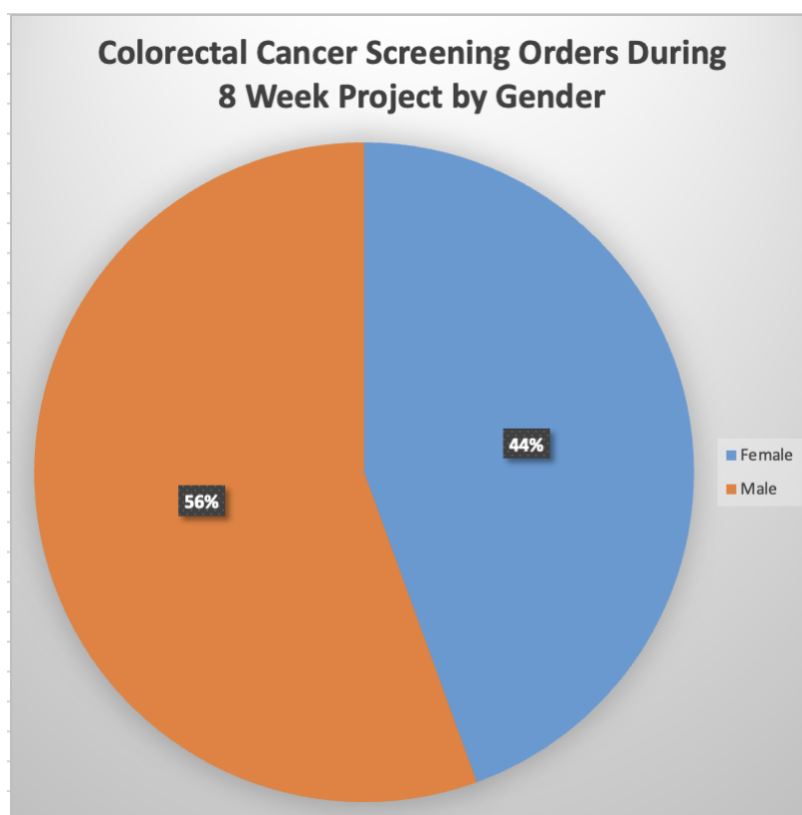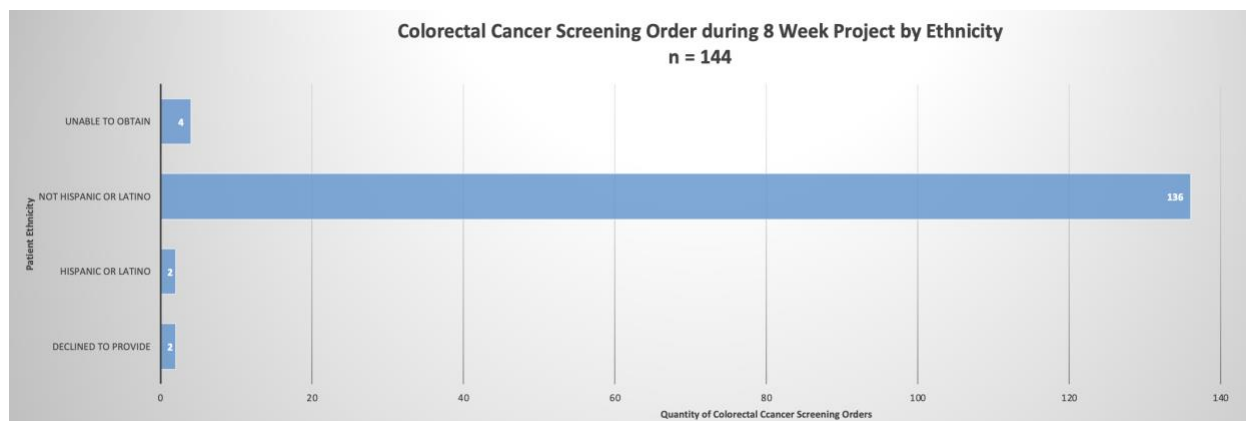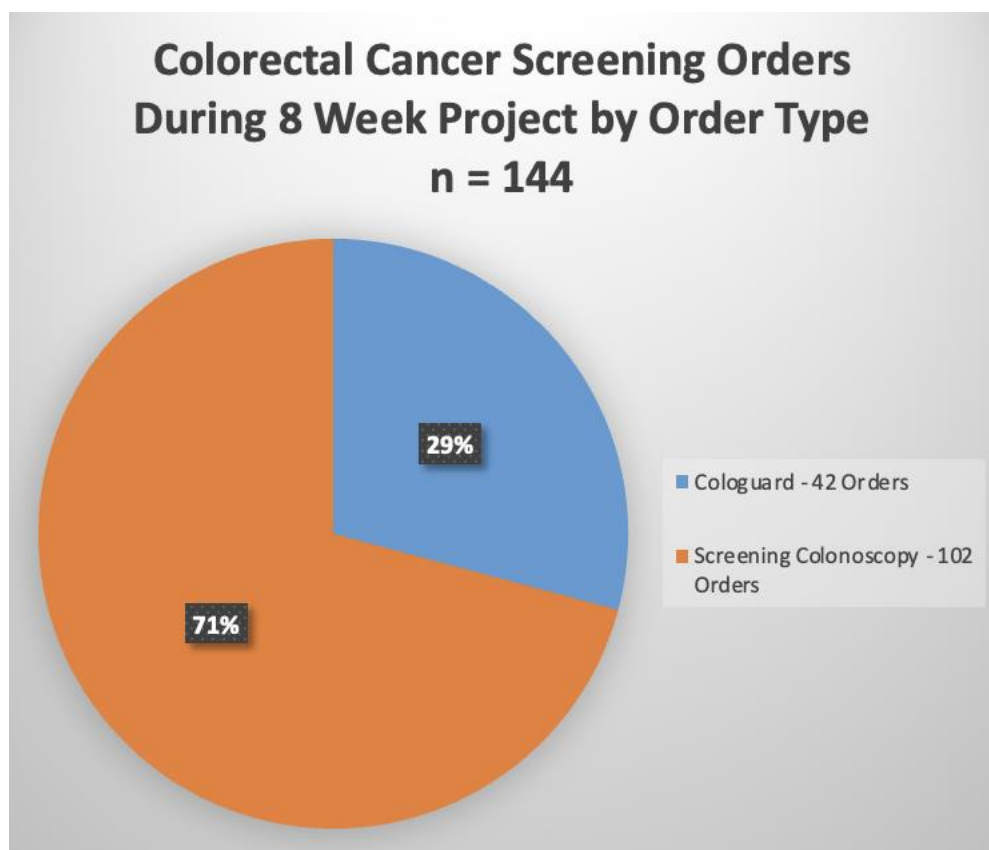
Figure 8
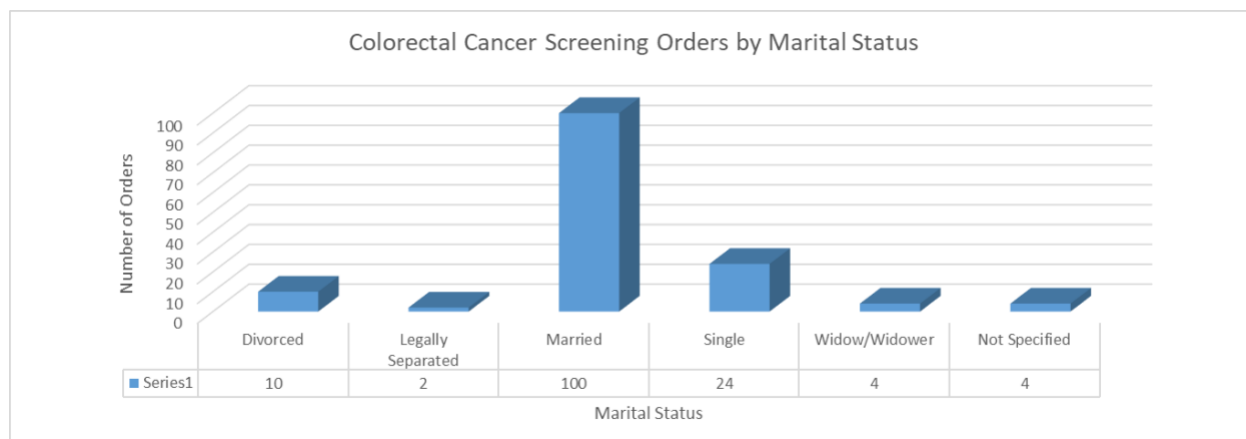
Table 2

Tangible and Intangible Benefits

Benefits	Value	Detail
Tangible	Average cost savings of treatment for stage I CRC vs. stage IV CRC in the first year of treatment for individuals aged 45 and older in Centre County, Pennsylvania.	Difference between cost of CRC cancer treatment when diagnosed stage I vs. stage IV = $36,000 (Green, B. B., & Meenan, R. T., 2020). Average incidence of CRC applied to Centre County, PA = 23.1 per 59,984 people (U.S. Department of Commerce, 2021). $36,000 x 23.1 = $877,800
Intangible	Priceless	Increased cancer prevention, reduction in death rates, increased 5-year survival rate, improved community health, reduction in late-stage CRC diagnosis, avoidance of mental stress when cancer is prevented or detected early.
Total		$877,800

Table 3

Colorectal Cancer Screening Decision Tree Integration and Training

Categories	Amount ($)	Participants	Expense	Total Expense
Training of Physicians and Nurses	$104.90/hr – physician (Salary.com, n.d.) $22.00/hr - medical assistant staff members (Indeed.com, n.d)	15 physicians 30 ancillary staff	$209.80/physician 2 hours training = $3,147.00 $44.00/medical assistant 2 hour training = $1,320	$4,467.00
Education Materials	$ 0 Electronic Health Record	15 physicians + 30 ancillary staff members	$0.00	$0.00
Advertising	$0.70 per flyer	100 flyers	$70	$70.00
Training/IT	Conference Room	Multiple Sessions	$0.00	$0.00
Refreshments	Pizza @ $13.00 each Soda @ $8 each case Paper Products Water @ $6 each case Chips @ $4 each bag	45 participants	$143.00 $64.00 $40.00 $18.00 $24.00	$289.00
Total Cost				$4,826.00

Table 4

Cost Benefit Analysis

Cost Benefit Analysis	Expenses	Benefit	Total
Total Costs	$4,826.00		
Benefits		$877,800	
Intangible	Unable to quantify		
Undetermined Costs (Cost of Screening)	Unable to quantify due to varying factors such as type of test, insurance coverage, screening intervals, and yearly percentage of the population due for screening		
Discount Rates/Net Present Value (NPV)	3% for 4 years	1st Year: $877,800-$4,826 = $872,974/(1+3%)= NPV of $899,163.22	$899,163.22
		2nd Year: $877,800-$4,826 = $872,974/(1+3%)^2 or 1.0609 = NPV of $827,410.69	$827,410.69
		3rd Year: $877,800-$4,826 = $872,974/(1+3%)^3 or 1.0927 = NPV of $803,331.20	$803,331.20
		4th Year: $877,800-$4,826 = $872,974/(1+3%)^4 or 1.1255 = NPV of $775,632.16	$775,632.16
Benefit to Cost Ratio		$877,800/$4826	181.89
Return on Investment		ROI= $877,800-$4,826.00/$4,826 x 100	18,089%