
A Critical Look at Prevention

Colorectal Cancer Screening

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Abstract: This case—colorectal cancer screening—is one of a series of teaching cases in the Case-Based Series in Population-Oriented Prevention (C-POP). It has been developed for use in medical school and residency prevention curricula. The complete set of cases is presented in this supplement to the *American Journal of Preventive Medicine*.

This preventive medicine teaching case discusses the concepts of diagnostic test evaluation, prevention, and screening using the example of colorectal cancer screening. Features of the case include a health policy exercise concerning community screening programs and an exercise in clinical prevention decision making. (*Am J Prev Med* 2003;24(4S):139–142)
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Recommended Reading:

- Chapter(s) in your epidemiology text on diagnostic tests and screening programs.
- Ransohoff DF, Sandler RS. Screening for colorectal cancer. *N Engl J Med* 2002;346(1):40–4.
- U.S. Preventive Services Task Force. Screening for colorectal cancer: recommendations and rationale. *Ann Int Med* 2002;137:129–31.

Objectives: At the end of the case, the student will be able to:

- calculate the characteristics of diagnostic tests: sensitivity, specificity, and positive and negative predictive values;
- evaluate screening tests in terms of their validity, results, and generalizability;
- use the concepts of primary and secondary prevention as they relate to common clinical preventive services;
- describe the appropriate conditions for screening in terms of characteristics of the disease, the patient, and the screening test;
- describe the appropriate study design to evaluate the effectiveness of a screening program and discuss the common biases encountered in screening program research; and
- evaluate locally obtained survey data about screening rates and attitudes and devise a community response to increase colorectal cancer screening.

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Section A

Diagnostic Test Characteristics

Teaching Note: This section is to be completed before class.

Screening programs use diagnostic tests to screen for disease. These tests should first be evaluated by their ability to diagnose the target disease. This evaluation is accomplished by studying the performance of the test in a clinical population.

You are asked to evaluate the performance of a fecal occult blood test (FOBT) to screen for colorectal cancer (CRC). The test consists of taking two samples of stool from each of three consecutive stools and smearing the samples onto cards (one sample per slide, two slides per card). The stool samples are then tested for the presence of occult blood. The results of the stool test are reported as either positive (one or more slides positive) or negative (no positive slides). If the screening test is positive, the patient is referred for a definitive test to diagnose CRC.

Question 1. What is a “reference standard” test for the diagnosis of CRC? (i.e., what is a definitive diagnostic test for the disease?)

You have the following table of data from this hypothetical study of FOBT:

	<u>CRC present</u>	<u>CRC absent</u>
FOBT positive	40	26
FOBT negative	80	854

Question 2. Calculate the following characteristics from the data in the table:

- Prevalence of CRC: _____
- Sensitivity of FOBT: _____
- Specificity of FOBT: _____
- Positive predictive value of FOBT: _____
- Negative predictive value of FOBT: _____

Question 3. How would these numbers change if the prevalence of the disease were halved?

Teaching Note: For advanced learners, a discussion of likelihood ratios, as well as pretest and posttest probability would be appropriate here.

Question 4. What are the relative strengths and weaknesses of this test for use in a screening program?

Question 5. This test has a dichotomous (positive–negative) result. How would you calculate these characteristics for tests with continuous outcomes (i.e., blood pressure, cholesterol)?

Section B

Evaluation of Diagnostic Test Studies

Studies of diagnostic tests should be evaluated according to their validity, results, and generalizability. You are now given more details about the hypothetical study introduced in Section A.

All 1000 study participants (selected from gastroenterologists' offices in 20 sites across the country) were asked to perform the FOBT. After that, those participants who had a positive test (defined as one or more slides positive for occult blood) underwent a colonoscopy. Those participants who had a negative test were sent a survey each year for the next 3 years to determine whether or not they had been diagnosed with CRC.

Question 1. What are some criteria used to assess the validity of a study of a diagnostic test? Was this study valid?

Question 2. Do the results of the study (and the test characteristics derived from them) show that this test (FOBT) can accurately diagnose CRC? How precise are the results (are there confidence intervals given for sensitivity, specificity, etc.)?

Question 3. Generalizability: How well would the information from this study apply to the same diagnostic test performed in a primary care physician's office (where most screening would likely take place)?

Section C

Concepts of Prevention

CRC is a major contributor to morbidity and mortality. Screening programs for this disease have been shown to significantly reduce its effect on health. To fully appreciate the importance of screening tests, clinicians need to have an understanding of the concepts of prevention.

Question 1. Define and explain the differences between the following terms:

- Primary prevention—
- Secondary prevention—
- Screening—

Teaching Note: For the following question, allow for discussion, as there are reasonable arguments for both answers in some of the situations presented.

Question 2. The notions of primary and secondary prevention can be challenging. To further explore the nuances of these types of prevention, categorize the following tests and interventions in terms of primary and secondary prevention:

- Counseling about smoking cessation in a healthy 40-year-old male to prevent lung cancer.
Primary or secondary prevention?
- Vaccination of a healthy infant with injectable polio vaccine to prevent polio.
Primary or secondary prevention?
- Cholesterol testing in a healthy 45-year-old male to prevent coronary artery disease.
Primary or secondary prevention?
- Prostate-specific antigen testing in healthy 50-year-old males to prevent prostate cancer morbidity and mortality.
Primary or secondary prevention?

The next questions are a little more controversial.

- Papanicolaou smear in a healthy 28-year-old female to prevent cervical cancer.
Primary or secondary prevention?
- Colonoscopy in a healthy 35-year-old male whose father died of CRC at age 42 to prevent CRC.
Primary or secondary prevention?
- Glucose challenge testing in pregnant females to prevent gestational diabetes–related complications of pregnancy.
Primary or secondary prevention?

Section D

Screening Programs

A screening program consists of the screening test, definitive diagnostic testing, and treatment for the disease. In medical practice, physicians may choose to screen a patient for a disease based on a variety of factors, such as their training, numerous (and sometimes conflicting) guidelines, patient preferences, and common local practice. These factors can influence not only the decision to screen but also the method of screening.

Question. What are some criteria that would classify any one screening program as desirable and necessary for your practice? Consider factors concerning the test itself, the disease, and the patients to be screened.

Teaching Note: After students have developed a list of criteria, distribute Handout 1.

Section E Evaluation of Screening Programs

Although a diagnostic test can accurately screen for a disease, it is still important to examine whether the adoption of the screening program leads to better outcomes for the patients screened.

Question 1. What is the best study design to evaluate the overall effectiveness of a screening program?

Question 2. There are five important biases found in evaluations of screening tests and programs: lead-time bias, length-time bias, over-diagnosis bias, selection bias, and referral bias. Explain each of these (with examples) and describe ways to reduce each one.

Teaching Note: This section can be performed in smaller groups with each group responsible for explaining one bias to the larger group.

Section F Health Policy Exercise: Colorectal Cancer Screening

Teaching Note: This section can be taught with the students divided into three or four groups. The students should examine the tables of data in Handout 2 and answer the questions below. Once the groups have answered the questions separately, the class can reconvene and discuss the answers.

The knowledge that you have gained in this session has made you a local expert in screening and prevention. You have been notified by an outside health policy agency of an alarmingly low CRC screening rate in your county. Your group has been commissioned by the health commissioner to confirm this data and to explore reasons why this rate might be lower. You work with an epidemiologist to conduct a telephone survey of the population about rates of CRC screening, the results of which are presented in Handout 2. This study was a random telephone survey of residents of Onondaga County, New York, conducted in October 2000. Analysis of the demographic data revealed an underrepresentation of minorities in the sample.

Examine this data for “opportunities to improve,” then answer the following questions in your groups.

Question 1. What is the most important reason people do not undergo the recommended CRC screening in Onondaga County?

Question 2. What patient-related factors may contribute to the lack of recommended screening?

Question 3. What could physicians do to increase the overall screening rates in the county?

Question 4. What could the health department do for both physicians and patients to increase screening rates?

Question 5. What do you think is the best diagnostic test for a community screening program for CRC: colonoscopy, sigmoidoscopy, or FOBT?

Section G Optional Clinical Correlation Exercise

Teaching Note: Use the case presentations in Handout 3 to discuss the finer points of screening and clinical prevention, such as life expectancy, special populations, and the difference between screening and diagnosis.

The Case-Based Series in Population-Oriented Prevention (C-POP) is funded by grants from the Josiah Macy, Jr. Foundation and the Health Resources and Services Administration, U.S. Department of Health and Human Services.

Handout 1

Screening Program Evaluation Criteria

Teaching Note: This can be given as a handout for the students after they have completed Section C.

In the 1970s and 1980s, Paul Frame, MD, and others began to evaluate the research evidence behind the “complete physical,” or as he termed it, “Adult Health Maintenance” and published his findings in multiple articles in the *Journal of Family Practice*. From this research, a set of criteria was developed that could be used to evaluate clinical preventive services. This set of criteria, with modifications, was used by the U.S. Preventive Services Task Force (USPSTF) in 1996 to develop their report on clinical preventive services.^a

Listed below, adapted from Frame’s original work and the 1996 USPSTF report, are some criteria for evaluating a screening test for its usefulness in clinical prevention.

- A. Considerations about the disease for which to be screened
 1. The disease must have an asymptomatic state and progress to a symptomatic state.
 2. The disease must be sufficiently prevalent in the population.
 3. The disease must cause significant morbidity and mortality.
 4. Treatments must be available that will beneficially affect morbidity and mortality.
- B. Considerations about the tests for the disease
 1. The screening test must be a good test (e.g., sensitivity and specificity, positive and negative predictive value).
 2. The evaluation of the screening program must avoid the common significant biases.
 3. The screening test must be cost-effective.
- C. Considerations about the patient(s) to be screened
 1. The screening test must be acceptable to the patient.
 2. The patient must have sufficient life expectancy to derive benefit from the potential life gained by the screening program.

^aU.S. Preventive Services Task Force. Guide to clinical preventive services, 2nd ed. Baltimore MD: Wilkins & Wilkins, 1996.

Handout 2 Health Policy Exercise Data

Highlighted results of the Colorectal Cancer Screening Survey, Onondaga County Health Department, Syracuse, New York, October 2000.

Study Participants:

For this telephone survey, out of 4318 calls made, 2331 calls were completed. From this group, 800 people were determined eligible for the survey and 410 people consented to participate.

Table 1. Respondents screened for colon cancer

Screened?	%
Yes	64
No	32
No information	4

FOBT <2 years OR flexible sigmoidoscopy <5 years ago OR colonoscopy <10 years ago.

Table 2. Reasons given for no recent (<2 years ago) FOBT

Reason	n
Don't know	21
Fear of embarrassment	3
Fear of bad news	4
No access to doctors' offices	5
No convenient appointments	0
Doctor or nurse said screening not needed	18
No regular doctor	5
No insurance, can't afford	3
Too busy	5
Didn't think of it	23
No one told me	40
No reason/no problems	90

N=164, more than one response per person accepted.

Table 3. Effect of physician recommendation for screening on screening rates

	Screened as recommended?*		Total
	Yes	No	
Physician advised screening? Yes	61	151	212
Physician advised screening? No	6	165	171
Total	67	316	383

*Recommended screening—FOBT annually plus flexible sigmoidoscopy every 5 years OR FOBT annually OR flexible sigmoidoscopy every 5 years.

FOBT, fecal occult blood test.

Table 4. Respondents' reported source(s) of information about colorectal cancer screening

Source	%
At work	1.5
Radio	4.3
Brochures, billboards	5.0
Other	12.4
Relative, friend, co-worker	13.9
Magazine, newspaper	25.4
Television	28.8
Physician or nurse	56.7

Handout 3 Clinical Correlation Exercise

Teaching Note: These questions are meant to encourage discussion; there are not necessarily any correct answers.

Pretend you are an adult primary care physician. Would you offer screening for CRC to the following patients? Why or why not? What screening test would you use?

Mr. Adams is a 45-year-old male in your office for a health maintenance visit. Apart from occasional nocturia and a one pack-per-day smoking habit, his history is remarkable only for a family history of CRC in his uncle at age 70. He complains of no abdominal or bowel-related symptoms, and his physical examination is normal except for a mildly enlarged prostate.

Ms. Baker is a 60-year-old female who came to you at the recommendation of her gynecologist. During her most recent well-woman examination she complained of some constipation symptoms that were new for her. On the advice of her gynecologist, she has increased her fiber intake somewhat, but that modification has only helped a little. She has no family history of CRC, and her physical examination, including a recto-vaginal examination, is normal.

Mr. Carlton, a 38-year-old male whose father contracted CRC at age 45 and died at age 46 presents for a visit at which he asks specifically to be screened. He notes no changes in his bowel habits and no history of rectal bleeding. His physical examination is normal.

Mr. Davis, a 75-year-old male with emphysema on long-term steroid therapy and home oxygen asks during a recent visit when he should get his next flexible sigmoidoscopy. He has had some diarrhea, which he attributes to the almost monthly courses of antibiotics he requires for exacerbations of his emphysema. He notes no other abdominal complaints.

Ms. Edwards is a 53-year-old female who is one of your patients in a group care home for a history of mental retardation. She is somewhat interactive but requires sedation during procedures such as dental cleanings. Neither she nor the health aide accompanying her notes any abdominal symptoms recently, and she has no other significant medical history.