Analysis of Human DNA in Stool Samples as a Technique for Colorectal Cancer Screening

Effective: October 1, 2022

Next Review: August 2023
Last Review: August 2022

IMPORTANT REMINDER

Medical Policies are developed to provide guidance for members and providers regarding coverage in accordance with contract terms. Benefit determinations are based in all cases on the applicable contract language. To the extent there may be any conflict between the Medical Policy and contract language, the contract language takes precedence.

PLEASE NOTE: Contracts exclude from coverage, among other things, services or procedures that are considered investigational or cosmetic. Providers may bill members for services or procedures that are considered investigational or cosmetic. Providers are encouraged to inform members before rendering such services that the members are likely to be financially responsible for the cost of these services.

DESCRIPTION

Tumor-associated gene variants and epigenetic markers can be detected in exfoliated intestinal cells in stool specimens. Since cancer cells are shed into stool, screening tests have been developed that detect these genetic alterations in the DNA from shed colorectal cancer cells isolated from stool samples.

MEDICAL POLICY CRITERIA

Note: This policy does not address fecal DNA testing with Cologuard®, which may be considered medically necessary.

Fecal DNA testing using any test other than Cologuard® is considered investigational for all indications.

NOTE: A summary of the supporting rationale for the policy criteria is at the end of the policy.

CROSS REFERENCES

1. Genetic Testing for Lynch Syndrome and APC-associated and MUTYH-associated Polyposis Syndromes,
BACKGROUND

Numerous cellular genetic alterations have been associated with colorectal cancer. In the proposed multistep model of carcinogenesis, the tumor suppressor gene p53 (TP53) and the proto-oncogene KRAS are most frequently altered. Variants in APC (adenomatous polyposis coli) genes and epigenetic markers (e.g., hypermethylation of specific genes) have also been detected. Colorectal cancer is also associated with deoxyribonucleic acid (DNA) replication errors in microsatellite sequences (termed microsatellite instability or MSI) in patients with Lynch syndrome (formerly known as hereditary nonpolyposis colorectal cancer or HNPCC) and in a subgroup of patients with sporadic colon carcinoma.

Several tests have been marketed, including the PreGen-Plus™ test (LabCorp) which includes testing for 21 different variants in the p53, APC, and KRAS genes, along with the BAT-26 MSI marker and a marker called the DNA Integrity Assay (DIA®). PreGen-Plus has not been cleared by the U.S. Food and Drug Administration (FDA). Another test, ColoSure™, was developed by OncoMethylome and detects aberrant methylation of the vimentin (VIM) gene. This test is offered as a laboratory-developed test, not subject to FDA regulation.

EVIDENCE SUMMARY

The important outcome of interest in cancer screening is a reduction in the mortality and morbidity due to cancer. This is ideally determined with randomized clinical trials. However, for colon cancer screening, many of the recommended tests have not been evaluated with clinical trials. The efficacy of these tests is supported by numerous studies evaluating the diagnostic characteristics of the test for detecting cancer and cancer precursors along with a well-developed body of knowledge regarding the natural history of the progression of cancer precursors to cancer. Modelling studies have evaluated the robustness and quantity of health benefit of various screening tests when clinical trial evidence is lacking.

Lacking direct evidence of screening in reducing cancer mortality, the critical parameters in the evaluation of a screening test are the diagnostic performance characteristics (i.e., sensitivity, specificity, positive and negative predictive value) compared with a criterion standard, the proposed frequency of screening, and the follow-up management of test results. The diagnostic performance characteristics of the currently accepted screening options (i.e., fecal occult blood testing [FOBT], fecal immunochemical testing [FIT], flexible sigmoidoscopy, double contrast barium enema) have been established using colonoscopy as the criterion standard. Modelling studies and clinical trial evidence on some of the screening modalities have allowed some confidence on the effectiveness of currently recommended cancer screening modalities.

For patients at average to moderate risk for colorectal cancer (CRC), organizations such as the U.S Preventive Services Task Force recommend several options for colon cancer screening. Advocates of DNA testing of stool samples have hypothesized that the relative simplicity of collecting a stool sample might increase the overall compliance with screening.
recommendations, and the detection of cancer-associated DNA may be superior to current stool tests for the detection of cancer and cancer precursors.

Currently, there are no studies of stool DNA testing for screening of individuals at high risk of colorectal cancer.

SYSTEMATIC REVIEWS

A systematic review conducted by Lin (2021) (used to inform the U.S. Preventive Services Task Force 2021 CRC screening recommendation statement) pooled data from one good- and three fair-quality studies assessing the accuracy of CRC screening with FIT-DNA testing.[1] The studies all used colonoscopy as the reference standard. When pooled, FIT-DNA had a sensitivity of 93% (95% confidence interval [CI], 87.0% to 100%; I²=0%) and a specificity of 85% (95% CI, 84.0% to 86.0%; I²=37.3%) for detection of CRC, based on 3 studies. For advanced neoplasia, sensitivity was 47% (95% CI, 44.0% to 55.0%; I²=0%) and specificity was 89% (95% CI, 87.0% to 92.0%; I²=88.8%) based on 4 studies. Pooled sensitivity and specificity for detection of advanced adenoma, based on 3 studies, was 43% (95% CI, 40.0% to 46.0%; I²=0%) and 89% (95% CI, 86.0% to 92.0%; I²=87.8%).

Gachabayov (2021) reported a systematic review and meta-analysis of the accuracy of stool DNA methylation testing for the detection of CRC.[2] A total of 46 studies with 16,149 patients met inclusion criteria. Combinations of genes provided higher sensitivity compared to single genes (80.8% vs. 57.8%) with no significant decrease in specificity (87.8% vs. 92.1%). The most accurate single gene was SDC2, which had a sensitivity of 83.1% and a specificity of 91.2%.

A systematic review conducted by Niedermaier (2016) evaluated FITs in combination with stool tests compared to FIT alone. The systematic review included 18 total studies.[3] Only one of the prospective studies was conducted in an asymptomatic screening population. A variety of stool-based tests were used in combination with FIT including fecal DNA or RNA, stool proteins other than hemoglobin (Hb), haptoglobin (Hp), or the HbHp complex, or tissue from the colonic mucosa. Many of the studies had methodological limitations with risk of bias including selective reporting. The authors concluded that the addition of stool-based tests to FIT may improve performance compared to FIT alone. However, no definitive conclusions can be drawn, and additional research is needed in true screening settings to evaluate performance of FIT in combination with other stool tests.

Raut (2020) published a systematic review of fecal DNA methylation markers for the detection of colorectal cancer, which included 27 studies reporting stage-specific associations or performances of these markers for detecting colorectal neoplasms.[4] Stage-specific associations or sensitivities were only reported for two markers, hypermethylation of GATA4 and VIM, and the authors noted that “most studies were underpowered and limited by their case-control design.”

NONRANDOMIZED STUDIES

Following FDA approval for use of FIT-DNA (Cologuard) in asymptomatic adults aged 45 to 49 years, Imperiale (2021) published results from a screening study that included 983 adults aged 45 to 49 years (mean age, 48 years) at average risk of CRC.[5] Among 816 participants who had evaluable FIT-DNA and colonoscopy results, 49 participants (6%) were found to have advanced precancerous lesions; no cases of CRC were detected. Sensitivity of FIT-DNA was
32.7% (95% CI, 19.9% to 47.5%) for detection of advanced precancerous lesions and 7.1% (95% CI, 4.3% to 11.0%) for detection of nonadvanced adenoma. When analyzed according to lesion type, FIT-DNA was most sensitive for villous growth pattern adenomas (60%; 95% CI, 26.2% to 87.8%). Specificity was 96.3% (95% CI, 94.3% to 97.8%) in participants with a negative colonoscopy, and 95.2% (95% CI, 93.4% to 96.6%) in those with non-advanced adenomas, non-neoplastic findings, and negative results on colonoscopy. FIT testing without DNA analysis was not included in the study.

Mo (2021) reported results of a multidimensional analysis of stool samples from patients with CRC (n=108), colorectal adenoma (n=18), or no cancer (n=36).[6] The analysis of stool samples included FIT, stool DNA tests for methylation of three genes (Septin9, NDRG4, BMP3), variants in three genes (KRAS, BRAF, PI3KCA) using next generation sequencing, and detection of stool bacteria level of Fusobacterium nucleatum and Parvimonas micra using qPCR. The FIT and sDNA tests together had a sensitivity of 81.5% for CRC (AUC 0.93, higher than FIT alone, p=0.017) and 27.8% for adenoma with 94.4% specificity. Sensitivity of the multidimensional test to detect CRC was 84.6% for stage II 91.9% for stage III CRC, which was relatively higher (88.2%) than that of patients with stage I (60.0%) and stage IV (75.0%) (p=0.024).

Other, smaller studies have assessed the accuracy of FIT-DNA in special populations. Cooper (2018) compared the sensitivity of FIT-DNA and FIT using colonoscopy as the reference standard in 265 Black and 495 White participants.[7] FIT-DNA was associated with sensitivities of 50% in Black participants and 39% in White participants for identifying advanced lesions; corresponding sensitivities for FIT were 35% and 33%. Redwood (2016) included 661 asymptomatic, Alaska natives undergoing screening or surveillance colonoscopy, using colonoscopy as a reference standard.[8] Sensitivity for CRC was 100% for FIT-DNA, and 85% for FIT. For screening-relevant neoplasms (defined as adenoma or sessile serrated adenoma or polyp ≥1 cm, any adenoma with ≥25% villous component, or cancer), sensitivity was 49% for FIT-DNA and 28% for FIT.

A study by Imperiale (2004) prospectively evaluated the PreGen-Plus™ test, which is no longer available but was used to support prior practice recommendations regarding fecal DNA cancer screening.[9] Another previously marketed test, ColoSure™, has not been evaluated in a large screening study.

Two studies allow calculation of the performance characteristics of the assay for the hypermethylated vimentin (hV) gene. In a study by Itzkowitz (2007), separately assembled groups of patients with colorectal cancer (n=40) and patients with normal colonoscopy (n=122) were tested with hV.[10] Sensitivity was 72% and specificity was 87%. In a second study by Itzkowitz (2008), separately assembled groups of patients with CRC (n=82) and patients with normal colonoscopy (n=363) were tested with hV and a two-site DNA integrity assay.[11] The purpose of the study was to calculate diagnostic performance characteristics of this combined test, but the results are also presented for hV alone. Using data-derived cutoff values, the sensitivity for cancer was 77% and the specificity was 83%. Other studies of hypermethylated vimentin using different assays have shown sensitivities of 38% and 41% for detecting colorectal cancer.[12, 13]

Additional studies have been published that evaluate the performance of various other types of fecal DNA tests, however there is a lack of evidence regarding the clinical utility of such tests.[14, 15]
U.S. PREVENTIVE SERVICES TASK FORCE

The U.S. Preventive Services Task Force (USPSTF) guidelines for colorectal cancer screening were updated in 2021.[16] The USPSTF recommends screening for colorectal cancer for adults age 45 to 49 years (Grade B) and adults age 50 to 75 years (Grade A). The guidelines also recommend selectively screening adults aged 76 to 85 years, dependent on the patient’s overall health, prior screening history, and preferences (Grade C). The recommendation statement reviews seven different screening strategies including FIT-DNA. Regarding comparisons or preferences between the seven different methods mentioned: “Recommendations regarding which screening tests to use, or if there is a hierarchy of preferred screening tests, will depend on the decisionmaker’s criteria for sufficiency of evidence and weighing the net benefit.” In addition, the USPSTF further states that the risks and benefits of different screening methods vary and references a table outlining different screening strategies.

NATIONAL COMPREHENSIVE CANCER NETWORK

The National Comprehensive Cancer Network (NCCN) guidelines for colorectal cancer screening discuss FIT-DNA-based testing as a potential screening option for average-risk individuals.[17] These guidelines specifically reference Cologuard® and do not mention other tests.

THE U.S. MULTI-SOCIETY TASK FORCE ON COLORECTAL CANCER

In 2021, the U.S. Preventive Services Task Force (USPSTF) published updated recommendations for CRC screening in asymptomatic, average risk adults defined as no prior diagnosis of CRC, adenomatous polyps, or inflammatory bowel disease; no personal diagnosis or family history of known genetic disorders that predispose them to a high lifetime risk of CRC (such as Lynch syndrome or familial adenomatous polyposis).[18] The USPSTF recommended universal screening for average risk adults aged 45 to 49 years (B recommendation) and for adults aged 50 to 75 years (A recommendation). For adults aged 76 to 85 years, the USPSTF recommends selective screening due to the small magnitude of net benefit (C Recommendation). The USPSTF reviewed evidence for 6 screening strategies, including FIT-DNA. They do not recommend one screening strategy over another and noted the lack of direct evidence on clinical outcomes when comparing screening strategies. These recommendations list fecal DNA testing every three years as a second-tier testing option.[19] Cologuard® is the only specific test referenced.

AMERICAN CANCER SOCIETY

In 2018, the American Cancer Society updated its guidelines for CRC screening for average-risk adults.[20] Regular screening with either a structural examination (i.e. colonoscopy) or high-sensitivity stool-based test is recommended to start in adults who are 45 years and older (qualified recommendation) or who are 50 years and older (strong recommendation). Recommendations for screening with stool-based tests include FIT repeated every year, high-sensitivity guaiac-based fecal occult blood test repeated every year, or multitarget stool DNA test repeated every three years.
SUMMARY

There is not enough research to show that stool DNA testing with any test other than Cologuard® is an effective way to screen for colon cancer and can improve health outcomes for patients. Therefore, stool DNA testing using any test other than Cologuard® is considered investigational.

REFERENCES


**CODES**

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*Date of Origin: October 2012*