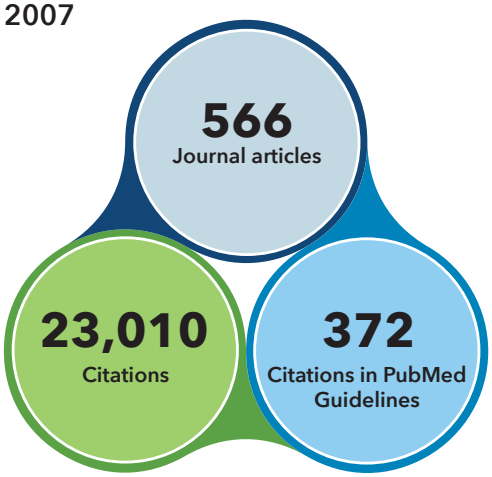
Kaiser Permanente Research Brief

Colorectal cancer

This brief summarizes the contributions of Kaiser Permanente Research since 2007 on the topic of colorectal cancer.

Colorectal cancer refers to cancers that start in the colon or rectum, the lower parts of the digestive system.[1] The incidence of these cancers in the United States has declined over the past several decades, due to improved uptake of screening through endoscopic methods or stool tests.[1] Nevertheless, colorectal cancer is the fourth most common cancer and the second-leading cause of cancer death in the United States.[2] Colorectal cancer is caused by a mix of avoidable risk factors (such as smoking) and factors that cannot be avoided (such as genetics), but individuals can decrease their chances of getting colorectal cancer through a variety of actions, including regular screening.[1] The National Cancer Institute estimates that more than 1 in 25 U.S. men and women will be diagnosed with colorectal cancer in their lifetime.[2] In 2017, there were an estimated 135,430 new cases of colorectal cancer and more than 50,000 deaths.[2]

Kaiser Permanente publications related to colorectal cancer since 2007



Source: Kaiser Permanente Publications Library and Scite metrics, as of December 8, 2021.

Colorectal cancer is an active area of study for Kaiser Permanente Research. Scientists across the program have used our rich and comprehensive longitudinal data to advance knowledge in the areas of understanding risk, improving patient outcomes, and translating research findings into policy and practice. We have published more than 560 articles related to colorectal cancer since 2007.[3] Together, these articles have been cited over 23,000 times.

These articles are the product of observational studies, randomized controlled trials, meta-analyses, and other studies led by Kaiser Permanente scientists. Our unique environment – a fully integrated care and coverage model in which our research scientists, clinicians, medical groups, and health plan leaders collaborate – lets us contribute generalizable knowledge on colorectal cancer, and many other research topics.

This brief summarizes a selection of the publications contained within the Kaiser Permanente Publications Library, which indexes journal articles and other publications authored by individuals affiliated with Kaiser Permanente. The work described in this brief originated from across Kaiser Permanente's 8 regions and was supported by a wide range of funding sources including internal research support as well as both governmental and nongovernmental extramural funding.

Understanding Risk

Who is at risk for developing colorectal cancer?

National statistics show that men experience an overall higher risk than women, and risk increases with age. Specific risk factors for developing colorectal cancer that have been studied by our researchers include age and race;[4] lifestyle factors such as diet,[5-11] metabolic phenotype,[12,13] muscle abnormalities,[14] weight,[15] and use of tobacco [16-19] or alcohol;[20] hyperinsulinemia (abnormally high insulin);[21] polyp characteristics;[22] and hereditary cancer-syndrome-related risks.[23-27] However, the evidence for some of these risk factors is inconsistent.[5,18,28] There is evidence that the risk of colorectal cancer may be linked to select genetic traits,[29-46] some of which may interact with lifestyle factors.[6] We have also studied protective factors that may reduce colorectal cancer risk, such as levels of plasma vitamin B6[47] and flavonoids,[48] and long-term use of metformin[49] and daily low-dose aspirin.[50-52]

There are well-documented disparities in colorectal cancer risk by race, ethnicity, and socioeconomic status.[2,53] Kaiser Permanente researchers have characterized differences in prevalence of colorectal tumors by age, sex, and race, and found demographic differences that have implications for both screening programs (such as what type of screening is optimal for different demographic groups) and for more refined interpretations of quality measures related to colonoscopy performance.[4] Disparities in colorectal cancer risk are linked to differences in underlying risk factors (such as diet or tobacco use), and also reflect differences in screening uptake[54-61] and the timeliness of diagnostic workup following positive results on screening tests.[60,62,63] Our researchers have found that the interpersonal relationships and quality of communication between doctors and patients are factors that partially explain the differences observed in colorectal cancer screening participation.[54] Other work has studied socioeconomic disparities[64,65] and patient factors[66-68] in relation to screening participation.

Increased risks of colorectal cancer associated with other risk factors

Meat eating	Smoking	Obesity
41%	**95%**	**116%**
People in the highest quartile of meat eating compared to the lowest[5]	Current smokers compared to never smokers in the Women's Health Initiative[18]	BMI ≥ 30 at time of colonoscopy compared to normal weight people[15]

Our researchers have published several studies characterizing colorectal cancer risk for people with specific risk profiles. A recent analysis evaluated the performance of a colorectal cancer risk prediction model that incorporated lifestyle and environmental factors, and genetic variants. Models incorporating a broader set of risk factors appear to outperform family history models based on the current screening guideline, suggesting that individualized colorectal cancer screening algorithms may be appropriate.[69,70] More recent work has explored different thresholds for defining a positive FIT (fecal immunochemical test) result as a strategy for personalizing screening.[71]

What other health risks do people with colorectal cancer face?

The primary health risk for people with colorectal cancer is death. Our research has estimated that more than half of colorectal cancer deaths are attributable to patients not being screened,[72] and that many failures in the screening process are preventable, such as fewer visits to primary care physicians and failure to follow up abnormal screening results.[60] Among people with colorectal cancer, prognosis is linked to characteristics of the tumor (such as tumor type and tumor stage), and to patient characteristics (such as age, race, sex, and comorbidities)[73-75] and health behaviors.[76] Those who are obese, those

with low muscle mass or density, and those who have metabolic syndrome have a higher risk of colorectal cancer death.[77-82]

Survivors of colorectal cancer also face health and quality-of-life challenges related to cancer treatments. Patients who need surgical treatment for colorectal cancer may lose portions of their intestine and receive a temporary or permanent ostomy (a surgically-created opening in the abdomen for passage of bodily waste), which frequently leads to bowel dysfunction and other issues. Our researchers have studied quality of life and psychosocial adjustment for patients with ostomies after colorectal cancer.[83] They found that people who have a permanent ostomy have worse social well-being than colorectal cancer patients who do not have an ostomy, and that women suffer more in terms of both physical and psychosocial well-being after ostomy than men.[84-87] These persistent concerns among those who have survived more than 5 years after diagnosis highlight the challenges of long-term survivorship.[84,88] Our researchers have also studied long-term quality of life for rectal cancer survivors, noting the impact of cancer and cancer treatment on many aspects of survivors' lives.[89-94]

Improving Patient Outcomes

What strategies are effective in preventing colorectal cancer?

Lifestyle modifications to mitigate risk, combined with regular screening (via endoscopic methods or stool tests) are the primary approaches to preventing colorectal cancer.

Guidelines recommend regular colorectal cancer screening, although timing and frequency varies depending on screening type, family history, and other factors. New guidance from the U.S. Preventive Services Task Force recommends that average-risk adults begin regular screening at age 45.[95-97] Approximately 80% of Kaiser Permanente members between the ages of 50 and 75 are screened for colorectal cancer,[98,99] which far exceeds the national average screening rate of 67%.[100,101] Our researchers have studied the factors associated with nonuse of FIT kits, leading to suggested changes in FIT kit contents to improve uptake of this screening method.[102] In our research, the implementation of more than one choice for screening, combined with direct patient outreach, was associated with increased screening rates in all racial and ethnic groups.[103-121]

Screening colonoscopy can offer preventive benefit because it allows for identification of precancerous polyps, which can be removed before they progress to cancer.[122] One Kaiser Permanente study estimated that screening colonoscopy (versus no endoscopic screening) was associated with a 65% reduction in risk of death for right-sided colon cancers and a 75% reduction for left-sided colon and rectal cancers among average-risk adults,[123] while another estimated that organized screening efforts within Kaiser Permanente were associated with large reductions in cancer-related mortality over a 15-year period.[99] Other research contributed to the evidence base for ongoing enhancements in screening quality by establishing associations between increased polyp detection and both a decreased risk of colorectal cancer death[124,125] and higher rates of colorectal cancers detected between screening visits.[126] Screening programs that leverage multiple screening methods[127-130] and age-specific screening intervals[131] have been shown in our research to be cost-effective, as has the removal of cost sharing for low-income persons eligible for screening.[132]

How does early identification of colorectal cancer affect outcomes?

Organized screening programs can result in early detection of colorectal cancer,[133] thereby offering substantial survival benefits (because cancers are less likely to have advanced or spread). Colorectal cancer cases that are identified early also may be treatable with less invasive approaches that have fewer associated risks; our researchers have described some of these minimally invasive treatment options.[134-136]

Disparities in colorectal cancer outcomes are complex. Our research has shown that survival disparities are related both to screening uptake (and therefore early identification of precancerous and cancerous lesions) and to treatment pathway choices after diagnosis.[57,137]

Primary care importance in colorectal cancer screening[141]

Patients with >1 primary care provider (PCP) visit had:

88%
higher odds of completing screening
versus those with no PCP visits
OR = 1.88
(95% CI: 1.86-1.89)

30%
higher odds of following up a positive FIT
versus those with no PCP visits
OR = 1.30
(95% CI: 1.22-1.40)

What are the key factors in effective treatment of people with colorectal cancer?

Follow-up of positive screenings – When a patient receives a positive result from a colorectal cancer screening test, such as FIT or fecal occult blood tests (FOBT), appropriate follow-up, including timely colonoscopy,[138] is an essential component of effective care.[139,140] Our research has shown that primary care physicians play a critical role in achieving appropriate follow-up after positive FIT or FOBT.[141] However, some patients do not receive appropriate follow-up; in one study about 20% of patients with a positive result did not complete follow-up within the recommended 3 months,[141] while another study found that only about half of patients completed a follow-up colonoscopy within a year of an abnormal screening result.[142] Reasons for not receiving follow-up are complex. In 2014, our researchers reported that one barrier to follow-up of positive results was patient cost sharing under the Affordable Care Act, which did not mandate coverage of follow-up colonoscopies (examination of the whole large bowel) after positive screening FOBT or sigmoidoscopy (examination of only the sigmoid or distal part of the colon).[143] Other commonly cited barriers to timely follow-up colonoscopy include inadequate transportation, fear of the procedure, not being aware of screening test results, and insufficient explanation of its importance.[144,145]

Person- centered treatment – Patients with colorectal cancer should receive whole-person treatment that varies depending on the stage of the cancer at the time of diagnosis, and is driven by patient-centered decision-making that weighs the risks and benefits of the available treatment options. Our researchers have evaluated patients' experiences with cancer care using telephone surveys in the first year after diagnosis. They found that race, language, and health status were all associated with patients' ratings of care, and that Asian and Pacific Islander patients reported the poorest care experience.[146] Another survey found that half of colorectal cancer survivors have unmet needs following treatment; these needs are particularly pronounced among younger survivors, those with lower levels of education, and those with racial or ethnic minority backgrounds.[147]

Personalized medicine, a growing trend in cancer care, is relevant to colorectal cancer treatment and is the subject of much interest.[147,148] Some hereditary cancers have specific mutations that can be identified with tumor marker testing. Our studies have analyzed genetic associations with exposures (such as alcohol consumption or smoking) and found a series of significant relationships, but the researchers caution that their results require additional replication and validation.[149,150] Personalized medicine and the link between genetic, lifestyle, and environmental factors is an area that requires further study.

Ongoing surveillance – Ongoing colonoscopy surveillance is recommended after polypectomy,[151] and among survivors of colon cancer, to detect new or recurrent cancers, though there is uncertainty as to the optimal timing for surveillance.[152,153] There is evidence that surveillance is underutilized by some patients and overutilized by others.[154] Our scientists have explored factors such as financial hardship, which may affect patients' compliance with surveillance,[155] and have informed new, refined guidelines through estimation of post-colonoscopy risks for different polyp types.[22,156]

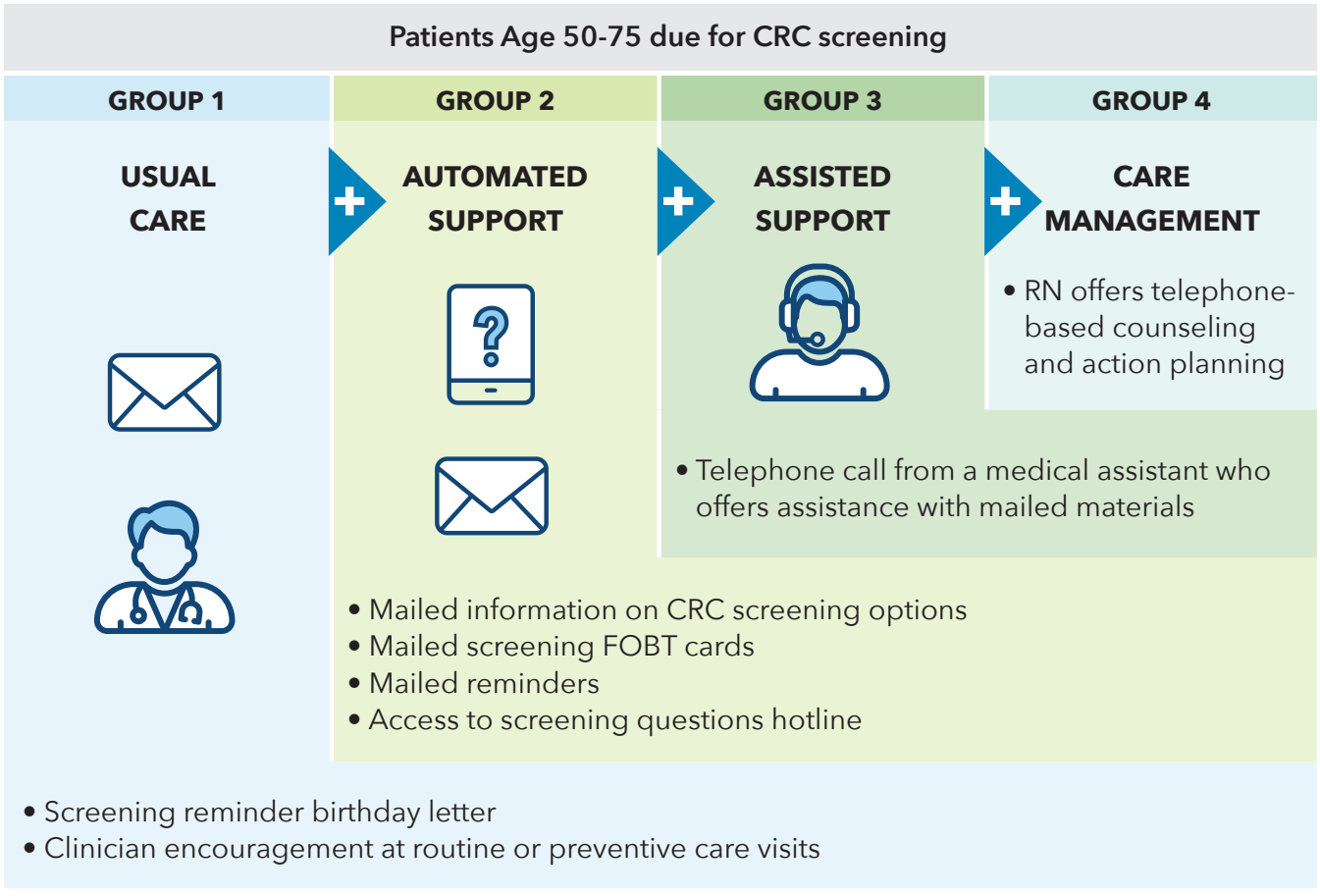
Translating Research into Policy and Practice

Kaiser Permanente is a learning health care organization that works to systematically use research to inform policy and improve practice. Research, clinical, and operational partners within Kaiser Permanente have tested a range of interventions to reduce the risk of colorectal cancer and improve outcomes for patients with colorectal cancer.

Screening for colorectal cancer has been a key area in which our researchers have partnered closely with operational and clinical leaders both to measure effectiveness of screening strategies and to improve those programs based on the evidence. Our studies have evaluated how best to engage patients in screening that meets guideline recommendations,[157-167] the effectiveness of different screening methods,[168-171] best practices for screening follow-up,[172] and organizational factors that may promote effective implementation of screening efforts.[167,173,174] Several recent studies have examined the performance of our mail-based FIT screening programs. In a 5-year randomized controlled trial, our researchers found a high rate of screening participation over several years, demonstrating both the feasibility and effectiveness of this approach.[175-178]

Our researchers have also reported on the effects of focused efforts to improve screening among underserved populations.[179-184] A community-based intervention using family health histories to modify patients' risk perception was tested by our researchers, who concluded it had promise for decreasing disparities in colorectal cancer risk.[185]

Study design: A centralized mailed program with stepped increases of support for colorectal cancer screening[178]



The way in which screening results are communicated to patients has also been studied by our researchers. In the context of Kaiser Permanente's integrated and team-based care model, an intervention that added a nurse navigator to the post-screening bundle did not have any added benefit.[172]

Kaiser Permanente research contributes to policy and practice change not only within our own care delivery organization, but also has advanced national understanding of colorectal cancer. Our research on colorectal cancer since 2007 has been cited more than 370 times in recent consensus statements and clinical practice guidelines. For example, an article establishing quality thresholds for colonoscopy-based cancer screening contributed to modifications of national screening quality guidelines.[186] Kaiser Permanente researchers and clinicians have also directly contributed to many consensus statements and practice guidelines. These include 6 consensus statements from the U.S. Multi-Society Task Force on Colorectal Cancer,[187-193] an additional 4 statements from the U.S. Preventive Services Task Force,[50,95,97,194-196] and a guideline issued by the World Endoscopy Organization.[197] Our scientists have also participated in Fight Colorectal Cancer, a national work group that discussed trends and research priorities in colorectal cancer diagnosis and prevention,[198] and in a Centers for Disease Control and Prevention summit on FIT outreach strategies.[199] Finally, Kaiser Permanente researchers are involved in ongoing work studying patterns of screening and follow-up during the COVID-19 pandemic, as well as adherence to newly available blood tests for colorectal cancer.

Kaiser Permanente's 185 research scientists and 1,530 support staff are based at 9 research centers. There are currently 2,355 studies underway, including clinical trials. Since 2007, our research scientists and clinicians have published nearly 19,000 articles. Kaiser Permanente currently serves approximately 12.5 million members in 8 states and the District of Columbia.

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References

1. National Cancer Institute. Colorectal Cancer—Patient Version - National Cancer Institute. 2018; https://www.cancer.gov/types/colorectal. Accessed April 4, 2018.
2. National Cancer Institute. Cancer Stat Facts: Colorectal Cancer. 2018; https://seer.cancer.gov/statfacts/html/colorect.html. Accessed April 4, 2018.
3. KPPL Search, conducted on December 8, 2021: ((title:(fecal OR faecal OR stool) AND (test or screen or exam or analysis or evaluation)) OR (abstract:(fecal OR faecal OR stool) AND (test or screen or exam or analysis or evaluation)) OR abstract:Colonoscop* OR title:Colonoscop* OR title:Sigmoidoscop* OR title:"colorectal screening"~4 OR title:"rectal cancer"~4 OR title:"colorectal cancer"~4 OR title:"colon cancer"~4 OR (title:rectal AND title:(tumor OR tumors)) OR abstract:CRC OR abstract:"fecal immunochemical test" OR subject:"colorectal neoplasms" OR subject:"colonic neoplasms" OR subject:"rectal neoplasms" OR subject:colonscopy OR subject:"Sigmoid Neoplasms") AND dc.type:"Journal Article" AND dc.date.issued:[2007 2022].
4. Corley DA, Jensen CD, Marks AR, et al. Variation of Adenoma Prevalence by Age, Sex, Race, and Colon Location in a Large Population: Implications for Screening and Quality Programs. *Clin Gastroenterol Hepatol.* 2013;11(2):172-180.
5. Ananthakrishnan AN, Du M, Berndt SI, et al. Red Meat Intake, NAT2, and Risk of Colorectal Cancer: A Pooled Analysis of 11 Studies. *Cancer Epidemiol Biomarkers Prev.* 2015;24(1):198-205.
6. Slattery ML, Lundgreen A, Herrick JS, et al. Diet and Colorectal Cancer: Analysis of a Candidate Pathway Using SNPS, Haplotypes, and Multi-Gene Assessment. *Nutr Cancer.* 2011;63(8):1226-1234.
7. Slattery ML, Curtin K, Sweeney C, et al. Diet and lifestyle factor associations with CpG island methylator phenotype and BRAF mutations in colon cancer. *Int J Cancer.* 2007;120(3):656-663.
8. Bull CJ, Bell JA, Murphy N, et al. Adiposity, metabolites, and colorectal cancer risk: Mendelian randomization study. *BMC Med.* 2020;18(1):396.
9. Khankari NK, Banbury BL, Borges MC, et al. Mendelian randomization of circulating polyunsaturated fatty acids and colorectal cancer risk. *Cancer Epidemiol Biomarkers Prev.* 2020;29(4):860-870.
10. Hidaka A, Harrison TA, Cao Y, et al. Intake of dietary fruit, vegetables, and fiber and risk of colorectal cancer according to molecular subtypes: A pooled analysis of 9 studies. *Cancer Res.* 2020;80(20):4578-4590.
11. Archambault AN, Lin Y, Jeon J, et al. Nongenetic Determinants of Risk for Early-Onset Colorectal Cancer. *JNCI Cancer Spectr.* 2021;5(3):pkab029.
12. Liang X, Margolis KL, Hendryx M, et al. Metabolic Phenotype and Risk of Colorectal Cancer in Normal-Weight Postmenopausal Women. *Cancer Epidemiol Biomarkers Prev.* 2017;26(2):155-161.
13. Murphy N, Carreras-Torres R, Song M, et al. Circulating Levels of Insulin-like Growth Factor 1 and Insulin-like Growth Factor Binding Protein 3 Associate With Risk of Colorectal Cancer Based on Serologic and Mendelian Randomization Analyses. *Gastroenterology.* 2020;158(5):1300-1312.e1320.
14. Xiao J, Caan BJ, Weltzien E, et al. Associations of pre-existing co-morbidities with skeletal muscle mass and radiodensity in patients with non-metastatic colorectal cancer. *J Cachexia Sarcopenia Muscle.* 2018;9(4):654-663.
15. Sedjo RL, Byers T, Levin TR, et al. Change in body size and the risk of colorectal adenomas. *Cancer Epidemiol Biomarkers Prev.* 2007;16(3):526-531.
16. Curtin K, Samowitz WS, Wolff RK, et al. Somatic Alterations, Metabolizing Genes and Smoking in Rectal Cancer. *Int J Cancer.* 2009;125(1):158-164.
17. Voutsinas J, Wilkens LR, Franke A, et al. Heterocyclic amine intake, smoking, cytochrome P450 1A2 and N-acetylation phenotypes, and risk of colorectal adenoma in a multiethnic population. *Gut.* 2013;62(3):416-422.
18. Paskett ED, Reeves KW, Rohan TE, et al. Association between cigarette smoking and colorectal cancer in the Women's Health Initiative. *J Natl Cancer Inst.* 2007;99(22):1729-1735.
19. Wang X, Amitay E, Harrison TA, et al. Association Between Smoking and Molecular Subtypes of Colorectal Cancer. *JNCI Cancer Spectr.* 2021;5(4):pkab056.
20. McNabb S, Harrison TA, Albanes D, et al. Meta-analysis of 16 studies of the association of alcohol with colorectal cancer. *Int J Cancer.* 2020;146(3):861-873.
21. Le Marchand L, Wang H, Rinaldi S, et al. Associations of plasma C-peptide and IGFBP-1 levels with risk of colorectal adenoma in a multiethnic population. *Cancer Epidemiol Biomarkers Prev.* 2010;19(6):1471-1477.
22. Lee JK, Jensen CD, Levin TR, et al. Long-term Risk of Colorectal Cancer and Related Death After Adenoma Removal in a Large, Community-based Population. *Gastroenterology.* 2020;158(4):884.e885-894.e885.
23. Giardiello FM, Allen JI, Axilbund JE, et al. Guidelines on Genetic Evaluation and Management of Lynch Syndrome: A Consensus Statement by the US Multi-Society Task Force on Colorectal Cancer. *Gastroenterology.* 2014;147(2):502-526.

24. Deverka PA, Schully SD, Ishibe N, et al. Stakeholder Assessment of the Evidence for Cancer Genomic Tests: Insights from Three Case Studies. *Genet Med.* 2012;14(7):656-662.
25. Cross DS, Rahm AK, Kauffman TL, et al. Underutilization of Lynch syndrome screening in a multisite study of patients with colorectal cancer. *Genet Med.* 2013;15(12):933-940.
26. Hunter JE, Arnold KA, Cook JE, et al. Universal screening for Lynch syndrome among patients with colorectal cancer: patient perspectives on screening and sharing results with at-risk relatives. *Fam Cancer.* 2017;16(3):377-387.
27. Hunter JE, Zepp JM, Gilmore MJ, et al. Universal tumor screening for Lynch syndrome: Assessment of the perspectives of patients with colorectal cancer regarding benefits and barriers. *Cancer.* 2015;121(18):3281-3289.
28. Slattery ML, Curtin K, Wolff RK, et al. Diet, physical activity, and body size associations with rectal tumor mutations and epigenetic changes. *Cancer Causes Control.* 2010;21(8):1237-1245.
29. Slattery ML, Herrick J, Curtin K, et al. Increased risk of colon cancer associated with a genetic polymorphism of SMAD7. *Cancer Res.* 2010;70(4):1479-1485.
30. Slattery ML, Lundgreen A, Herrick JS, et al. Associations between genetic variation in RUNX1, RUNX2, RUNX3, MAPK1 and eIF4E and riskof colon and rectal cancer: additional support for a TGF-beta-signaling pathway. *Carcinogenesis.* 2011;32(3):318-326.
31. Slattery ML, Lundgreen A, Herrick JS, et al. Genetic variation in bone morphogenetic protein and colon and rectal cancer. *Int J Cancer.* 2011;130(3):653-664.
32. Slattery ML, Curtin K, Poole EM, et al. Genetic variation in C-reactive protein in relation to colon and rectal cancer risk and survival. *Int J Cancer.* 2011;128(11):2726-2734.
33. Slattery ML, Lundgreen A, Herrick JS, et al. Genetic variation in the transforming growth factor-beta signaling pathway and survival after diagnosis with colon and rectal cancer. *Cancer.* 2011;117(18):4175-4183.
34. Slattery ML, Lundgreen A, Herrick JS, et al. Variation in the CYP19A1 gene and risk of colon and rectal cancer. *Cancer Causes Control.* 2011;22(7):955-963.
35. Slattery ML, Lundgreen A, Wolff RK, et al. Genetic Variation in the Transforming Growth Factor-beta-Signaling Pathway, Lifestyle Factors, and Risk of Colon or Rectal Cancer. *Dis Colon Rectum.* 2012;55(5):532-540.
36. Slattery ML, Herrick JS, Mullany LE, et al. The co-regulatory networks of tumor suppressor genes, oncogenes, and miRNAs in colorectal cancer. *Genes Chromosomes Cancer.* 2017;56(11):769-787.
37. Huyghe JR, Bien SA, Harrison TA, et al. Discovery of common and rare genetic risk variants for colorectal cancer. *Nat Genet.* 2019;51(1):76-87.
38. Schmit SL, Edlund CK, Schumacher FR, et al. Novel Common Genetic Susceptibility Loci for Colorectal Cancer. *J Natl Cancer Inst.* 2019;111(2):146-157.
39. Slattery ML, Mullany LE, Sakoda LC, et al. The PI3K/AKT Signaling Pathway: associations of miRNAs with dysregulated gene expression in colorectal cancer. *Mol Carcinog.* 2018;57(2):243-261.
40. Slattery ML, Mullany LE, Sakoda L, et al. The NF-κB signalling pathway in colorectal cancer: associations between dysregulated gene and miRNA expression. *J Cancer Res Clin Oncol.* 2018;144(2):269-283.
41. Wolff RK, Hoffman MD, Wolff EC, et al. Mutation analysis of adenomas and carcinomas of the colon: early and late drivers. *Genes Chromosomes Cancer.* 2018;57(7):366-376.
42. Slattery ML, Mullany LE, Sakoda LC, et al. The MAPK-Signaling Pathway in Colorectal Cancer: Dysregulated Genes and Their Association With MicroRNAs. *Cancer Inform.* 2018;17:1176935118766522.
43. Archambault AN, Su YR, Jeon J, et al. Cumulative Burden of Colorectal Cancer-Associated Genetic Variants is More Strongly Associated With Early-onset vs Late-onset Cancer. *Gastroenterology.* 2020;158(5):1274-1286.e1272.
44. Bien SA, Su YR, Conti DV, et al. Genetic variant predictors of gene expression provide new insight into risk of colorectal cancer. *Hum Genet.* 2019;138(4):307-326.
45. Thomas M, Sakoda LC, Hoffmeister M, et al. Genome-wide Modeling of Polygenic Risk Score in Colorectal Cancer Risk. *Am J Hum Genet.* 2020;107(3):432-444.
46. Guo X, Lin W, Wen W, et al. Identifying novel susceptibility genes for colorectal cancer risk from a transcriptome-wide association study of 125,478 subjects. *Gastroenterology.* 2021;160(4):1164-1178.e1166.
47. Le Marchand L, Wang H, Selhub J, et al. Association of plasma vitamin B6 with risk of colorectal adenoma in a multiethnic case-control study. *Cancer Causes Control.* 2011;22(6):929-936.
48. Bobe G, Sansbury LB, Albert PS, et al. Dietary Flavonoids and Colorectal Adenoma Recurrence in the Polyp Prevention Trial. *Cancer Epidemiol Biomarkers Prev.* 2008;17(6):1344-1353.
49. Bradley MC, Ferrara A, Achacoso N, et al. A Cohort Study of Metformin and Colorectal Cancer Risk among Patients with Diabetes Mellitus. *Cancer Epidemiol Biomarkers Prev.* 2018;27(5):525-530.
50. Chubak J, Whitlock EP, Williams SB, et al. Aspirin for the Prevention of Cancer Incidence and Mortality: Systematic Evidence Reviews for the U.S. Preventive Services Task Force. *Ann Intern Med.* 2016;164(12):814-825.
51. Nan H, Hutter CM, Lin Y, et al. Association of aspirin and NSAID use with risk of colorectal cancer according to genetic variants. *JAMA.* 2015;313(11):1133-1142.

52. Wang X, Chan AT, Slattery ML, et al. Influence of Smoking, Body Mass Index, and Other Factors on the Preventive Effect of Nonsteroidal Anti-Inflammatory Drugs on Colorectal Cancer Risk. *Cancer Res*. 2018;78(16):4790-4799.
53. Mojica CM, Bradley SM, Lind BK, et al. Initiation of Colorectal Cancer Screening Among Medicaid Enrollees. *Am J Prev Med*. 2020;58(2):224-231.
54. Ge G, Burke N, Somkin CP, Pasick R. Considering Culture in Physician-Patient Communication During Colorectal Cancer Screening. *Qual Health Res*. 2009;19(6):778-789.
55. Jerant AF, Arellanes RE, Franks P. Factors associated with Hispanic/non-Hispanic white colorectal cancer screening disparities. *J Gen Intern Med*. 2008;23(8):1241-1245.
56. Burnett-Hartman AN, Mehta SJ, Zheng Y, et al. Racial/Ethnic Disparities in Colorectal Cancer Screening Across Healthcare Systems. *Am J Prev Med*. 2016;51(4):e107-115.
57. Doubeni CA, Field TS, Buist DS, et al. Racial Differences in Tumor Stage and Survival for Colorectal Cancer in an Insured Population. *Cancer*. 2007;109(3):612-620.
58. Doubeni CA, Jambaulikar GD, Fouayzi H, et al. Neighborhood Socioeconomic Status and Use of Colonoscopy in an Insured Population - A Retrospective Cohort Study. *PLoS One*. 2012;7(5):e36392.
59. Green BB, Bogart A, Chubak J, et al. Nonparticipation in a Population-Based Trial to Increase Colorectal Cancer Screening. *Am J Prev Med*. 2012;42(4):390-397.
60. Doubeni CA, Fedewa SA, Levin TR, et al. Modifiable Failures in the Colorectal Cancer Screening Process and Their Association With Risk of Death. *Gastroenterology*. 2019;156(1):63-74.e66.
61. Rutter CM, Knudsen AB, Lin JS, Bouskill KE. Black and White Differences in Colorectal Cancer Screening and Screening Outcomes: A Narrative Review. *Cancer Epidemiol Biomarkers Prev*. 2021;30(1):3-12.
62. Corley DA, Jensen CD, Quinn VP, et al. Association Between Time to Colonoscopy After a Positive Fecal Test Result and Risk of Colorectal Cancer and Cancer Stage at Diagnosis. *JAMA*. 2017;317(16):1631-1641.
63. Rutter CM, Kim JJ, Meester RGS, et al. Effect of Time to Diagnostic Testing for Breast, Cervical, and Colorectal Cancer Screening Abnormalities on Screening Efficacy: A Modeling Study. *Cancer Epidemiol Biomarkers Prev*. 2018;27(2):158-164.
64. Davis MM, Renfro S, Pham R, et al. Geographic and population-level disparities in colorectal cancer testing: A multilevel analysis of Medicaid and commercial claims data. *Prev Med*. 2017;101:44-52.
65. Green BB, Anderson ML, Cook AJ, et al. Financial Incentives to Increase Colorectal Cancer Screening Uptake and Decrease Disparities: A Randomized Clinical Trial. *JAMA Netw Open*. 2019;2(7):e196570.
66. Green BB, BlueSpruce J, Tuzzio L, et al. Reasons for never and intermittent completion of colorectal cancer screening after receiving multiple rounds of mailed fecal tests. *BMC Public Health*. 2017;17(1):531.
67. Petrik AF, Le T, Keast E, et al. Predictors of Colorectal Cancer Screening Prior to Implementation of a Large Pragmatic Trial in Federally Qualified Health Centers. *J Community Health*. 2018;43(1):128-136.
68. Nielson CM, Vollmer WM, Petrik AF, et al. Factors Affecting Adherence in a Pragmatic Trial of Annual Fecal Immunochemical Testing for Colorectal Cancer. *J Gen Intern Med*. 2019;34(6):978-985.
69. Jeon J, Du M, Schoen RE, et al. Determining Risk of Colorectal Cancer and Starting Age of Screening Based on Lifestyle, Environmental, and Genetic Factors. *Gastroenterology*. 2018;154(8):2152-2164.
70. Hornbrook MC, Goshen R, Choman E, et al. Early Colorectal Cancer Detected by Machine Learning Model Using Gender, Age, and Complete Blood Count Data. *Dig Dis Sci*. 2017;62(10):2719-2727.
71. Selby K, Jensen CD, Lee JK, et al. Influence of Varying Quantitative Fecal Immunochemical Test Positivity Thresholds on Colorectal Cancer Detection: A Community-Based Cohort Study. *Ann Intern Med*. 2018;169(7):439-447.
72. Meester RG, Doubeni CA, Lansdorp-Vogelaar I, et al. Colorectal cancer deaths attributable to nonuse of screening in the United States. *Ann Epidemiol*. 2015;25(3):208-213.
73. Feuer EJ, Rabin BA, Zou Z, et al. The Surveillance, Epidemiology, and End Results Cancer Survival Calculator SEER*CSC: Validation in a Managed Care Setting. *J Natl Cancer Inst Monographs*. 2014;2014(49):265-274.
74. Feliciano EMC, Kroenke CH, Meyerhardt JA, et al. Association of Systemic Inflammation and Sarcopenia With Survival in Nonmetastatic Colorectal Cancer: Results From the C SCANS Study. *JAMA Oncol*. 2017;3(12):e172319.
75. Kroenke CH, Prado CM, Meyerhardt JA, et al. Muscle radiodensity and mortality in patients with colorectal cancer. *Cancer*. 2018;124(14):3008-3015.
76. Hua X, Phipps AI, Burnett-Hartman AN, et al. Timing of Aspirin and Other Nonsteroidal Anti-Inflammatory Drug Use Among Patients With Colorectal Cancer in Relation to Tumor Markers and Survival. *J Clin Oncol*. 2017;35(24):2806-2813.
77. Cespedes Feliciano EM, Kroenke CH, Meyerhardt JA, et al. Metabolic Dysfunction, Obesity, and Survival Among Patients With Early-Stage Colorectal Cancer. *J Clin Oncol*. 2016;34(30):3664-3671.

78. Caan BJ, Meyerhardt JA, Kroenke CH, et al. Explaining the Obesity Paradox: The Association between Body Composition and Colorectal Cancer Survival (C-SCANS Study). *Cancer Epidemiol Biomarkers Prev.* 2017;26(7):1008-1015.

79. Kroenke CH, Neugebauer R, Meyerhardt J, et al. Analysis of Body Mass Index and Mortality in Patients With Colorectal Cancer Using Causal Diagrams. *JAMA Oncol.* 2016;2(9):1137-1145.

80. Kocarnik JM, Chan AT, Slattery ML, et al. Relationship of pre-diagnostic body mass index with survival after colorectal cancer: Stage-specific associations. *Int J Cancer.* 2016;139(5):1065-1072.

81. Brown JC, Caan BJ, Meyerhardt JA, et al. The deterioration of muscle mass and radiodensity is prognostic of poor survival in stage I-III colorectal cancer: a population-based cohort study (C-SCANS). *J Cachexia Sarcopenia Muscle.* 2018;9(4):664-672.

82. Brown JC, Caan BJ, Prado CM, et al. The Association of Abdominal Adiposity with Mortality in Patients with Stage I-III Colorectal Cancer. *J Natl Cancer Inst.* 2020;112(4):377-383.

83. Mohler MJ, Coons SJ, Hornbrook MC, et al. The health-related quality of life in long-term colorectal cancer survivors study: objectives, methods and patient sample. *Curr Med Res Opin.* 2008;24(7):2059-2070.

84. Krouse RS, Herrinton LJ, Grant M, et al. Health-related quality of life among long-term rectal cancer survivors with an ostomy: manifestations by sex. *J Clin Oncol.* 2009;27(28):4664-4670.

85. Krouse RS, Wendel CS, Garcia DO, et al. Physical activity, bowel function, and quality of life among rectal cancer survivors. *Qual Life Res.* 2017;26(11):3131-3142.

86. Altschuler A, Ramirez M, Grant M, et al. The Influence of Husbands' or Male Partners' Support on Women's Psychosocial Adjustment to Having an Ostomy Resulting from Colorectal Cancer. *J Wound Ostomy Continence Nurs.* 2009;36(3):299-305.

87. Altschuler A, Liljestrand P, Grant M, et al. Caregiving and mutuality among long-term colorectal cancer survivors with ostomies: qualitative study. *Support Care Cancer.* 2018;26(2):529-537.

88. Sun V, Grant M, McMullen CK, et al. Surviving Colorectal Cancer: Long-term, Persistent Ostomy-Specific Concerns and Adaptations. *J Wound Ostomy Continence Nurs.* 2013;40(1):61-72.

89. Hornbrook MC, Wendel CS, Coons SJ, et al. Complications among colorectal cancer survivors: SF-6D preference-weighted quality of life scores. *Med Care.* 2011;49(3):321-326.

90. Hornbrook MC, Grant M, Wendel C, et al. Rectal Cancer Survivors' Participation in Productive Activities. *Perm J.* 2018;22:17-022.

91. Herrinton LJ, Altschuler A, McMullen CK, et al. Conversations for providers caring for patients with rectal cancer: Comparison of long-term patient-centered outcomes for patients with low rectal cancer facing ostomy or sphincter-sparing surgery. *CA Cancer J Clin.* 2016;66(5):387-397.

92. McMullen C, Liu L, Bulkley JE, et al. Participation in Activities Associated With Quality of Life for Long-Term Survivors of Rectal Cancer. *Perm J.* 2017;21:16-011.

93. McMullen CK, Bulkley JE, Altschuler A, et al. Greatest Challenges of Rectal Cancer Survivors: Results of a Population-Based Survey. *Dis Colon Rectum.* 2016;59(11):1019-1027.

94. McMullen CK, Hornbrook MC, Grant M, et al. The greatest challenges reported by long-term colorectal cancer survivors with stomas. *J Support Oncol.* 2008;6(4):175-182.

95. Knudsen AB, Rutter CM, Peterse EFP, et al. Colorectal Cancer Screening: An Updated Modeling Study for the US Preventive Services Task Force. *JAMA.* 2021;325(19):1998-2011.

96. Levin TR, Jensen CD, Chawla NM, et al. Early Screening of African Americans (45-50 Years Old) in a Fecal Immunochemical Test-based Colorectal Cancer Screening Program. *Gastroenterology.* 2020;159(5):1695-1704. e1691.

97. Lin JS, Perdue LA, Henrikson NB, et al. Screening for Colorectal Cancer: Updated Evidence Report and Systematic Review for the US Preventive Services Task Force. *JAMA.* 2021;325(19):1978-1997.

98. Byron J. Kaiser Permanente Successfully Screens for Colorectal Cancer. *Look InsideKP NCAL.* 2016-02-03, 2016.

99. Levin TR, Corley DA, Jensen CD, et al. Effects of Organized Colorectal Cancer Screening on Cancer Incidence and Mortality in a Large Community-Based Population. *Gastroenterology.* 2018;155(5):1383-1391.e1385.

100. American Cancer Society. *Colorectal Cancer Facts & Figures 2020-2022.* Atlanta 2022.

101. Singal AG, Corley DA, Kamineni A, et al. Patterns and predictors or repeat fecal immunochemical and occult blood test screening in four large health care systems in the United States. *Am J Gastroenterol.* 2018;113(5):746-754.

102. Gordon NP, Green BB. Factors Associated with Use and Non-Use of the Fecal Immunochemical Test (FIT) Kit for Colorectal Cancer Screening in Response to a 2012 Outreach Screening Program: A Survey Study. *BMC Public Health.* 2015;15:546.

103. Fedewa SA, Corley DA, Jensen CD, et al. Colorectal Cancer Screening Initiation After Age 50 Years in an Organized Program. *Am J Prev Med.* 2017;53(3):335-344.

104. Mehta SJ, Jensen CD, Quinn VP, et al. Race/Ethnicity and Adoption of a Population Health Management Approach to Colorectal Cancer Screening in a Community-Based Healthcare System. *J Gen Intern Med.* 2016;31(11):1323-1330.

105. Davis MM, Freeman M, Shannon J, et al. A systematic review of clinic and community intervention to increase fecal testing for colorectal cancer in rural and low-income populations in the United States - How, what and when? *BMC Cancer.* 2018;18(1):40.

106. Coronado GD, Rivelli JS, Fuoco MJ, et al. Effect of Reminding Patients to Complete Fecal Immunochemical Testing: A Comparative Effectiveness Study of Automated and Live Approaches. *J Gen Intern Med.* 2018;33(1):72-78.

107. Coury J, Schneider JL, Rivelli JS, et al. Applying the Plan-Do-Study-Act (PDSA) approach to a large pragmatic study involving safety net clinics. *BMC Health Serv Res.* 2017;17(1):411.

108. Coronado GD, Schneider JL, Petrik A, et al. Implementation successes and challenges in participating in a pragmatic study to improve colon cancer screening: perspectives of health center leaders. *Transl Behav Med.* 2017;7(3):557-566.

109. Coronado GD, Petrik AF, Vollmer WM, et al. Effectiveness of a Mailed Colorectal Cancer Screening Outreach Program in Community Health Clinics: The STOP CRC Cluster Randomized Clinical Trial. *JAMA Intern Med.* 2018;178(9):1174-1181.

110. Selby K, Bartlett-Esquilant G, Cornuz J. Personalized cancer screening: helping primary care rise to the challenge. *Public Health Rev.* 2018;39:4.

111. Meester RGS, Doubeni CA, Zauber AG, et al. Impact of adenoma detection on the benefit of faecal testing vs. colonoscopy for colorectal cancer. *Int J Cancer.* 2017;141(11):2359-2367.

112. Jager M, Demb J, Asghar A, et al. Mailed Outreach Is Superior to Usual Care Alone for Colorectal Cancer Screening in the USA: A Systematic Review and Meta-analysis. *Dig Dis Sci.* 2019;64(9):2489-2496.

113. Coronado GD, Thompson JH, Petrik AF, et al. Patient-Refined Messaging for a Mailed Colorectal Cancer Screening Program: Findings from the PROMPT Study. *J Am Board Fam Med.* 2019;32(3):318-328.

114. Coronado GD, Green BB, West, II, et al. Direct-to-member mailed colorectal cancer screening outreach for Medicaid and Medicare enrollees: Implementation and effectiveness outcomes from the BeneFIT study. *Cancer.* 2020;126(3):540-548.

115. Selby K, Jensen CD, Levin TR, et al. Program components and results from an organized colorectal cancer screening program using annual fecal immunochemical testing. *Clin Gastroenterol Hepatol.* 2020;S1542-3565(20):31372-31370.

116. Inadomi JM, Issaka RB, Green BB. What Multi-Level Interventions Do We Need to Increase the Colorectal Cancer Screening Rate to 80%? *Clin Gastroenterol Hepatol.* 2021;19(4):633-645.

117. Coury J, Miech EJ, Styer P, et al. What's the "secret sauce"? How implementation variation affects the success of colorectal cancer screening outreach. *Implement Sci Commun.* 2021;2(1):5.

118. Green BB, Anderson ML, Cook AJ, et al. A Centralized Program with Stepped Support Increases Adherence to Colorectal Cancer Screening Over 9 Years: a Randomized Trial. *J Gen Intern Med.* 2021:1-8.

119. Rozario MA, Walton A, Kang M, Padilla BI. Colorectal Cancer Screening: A Quality Improvement Initiative Using a Bilingual Patient Navigator, Mobile Technology, and Fecal Immunochemical Testing to Engage Hispanic Adults. *Clin J Oncol Nurs.* 2021;25(4):423-429.

120. Coronado GD, Nyongesa DB, Petrik AF, et al. Randomized Controlled Trial of Advance Notification Phone Calls vs Text Messages Prior to Mailed Fecal Test Outreach. *Clin Gastroenterol Hepatol.* 2021;19(11):2353-2360.e2352.

121. Coronado GD, Rawlings AM, Petrik AF, et al. Precision patient navigation to improve rates of follow-up colonoscopy, an individual randomized effectiveness trial. *Cancer Epidemiol Biomarkers Prev.* 2021;30(12):2327-2333.

122. Lee JK, Jensen CD, Levin TR, et al. Long-term Risk of Colorectal Cancer and Related Deaths After a Colonoscopy With Normal Findings. *JAMA Intern Med.* 2019;179(2):153-160.

123. Doubeni CA, Corley DA, Quinn VP, et al. Effectiveness of Screening Colonoscopy in Reducing the Risk of Death from Right and Left Colon Cancer: A Large Community-Based Study. *Gut.* 2018;67(2):291-298.

124. Corley DA, Jensen CD, Marks AR, et al. Adenoma Detection Rate and Risk of Colorectal Cancer and Death. *N Engl J Med.* 2014;370(14):1298-1306.

125. Meester RG, Doubeni CA, Lansdorp-Vogelaar I, et al. Variation in Adenoma Detection Rate and the Lifetime Benefits and Cost of Colorectal Cancer Screening: A Microsimulation Model. *JAMA.* 2015;313(23):2349-2358.

126. Lam AY, Li Y, Gregory DL, et al. Association between improved adenoma detection rate and interval colorectal cancer rates after a quality improvement program. *Gastrointest Endosc.* 2020;92(2):355-364.e355.

127. Dinh T, Ladabaum U, Alperin P, et al. Health Benefits and Cost-Effectiveness of a Hybrid Screening Strategy for Colorectal Cancer. *Clin Gastroenterol Hepatol.* 2013;11(9):1158-1166.

128. Meenan RT, Coronado GD, Petrik A, Green BB. A cost-effectiveness analysis of a colorectal cancer screening program in safety net clinics. *Prev Med.* 2019;120:119-125.

129. Smith DH, O'Keeffe Rosetti M, Mosen DM, et al. Balancing Adherence and Expense: The Cost-Effectiveness of Two-Sample vs One-Sample Fecal Immunochemical Test. *Popul Health Manag.* 2019;22(1):83-89.

130. Meenan RT, Baldwin LM, Coronado GD, et al. Costs of Two Health Insurance Plan Programs to Mail Fecal Immunochemical Tests to Medicare and Medicaid Plan Members. *Popul Health Manag.* 2021;24(2):255-265.

131. Naber SK, Kuntz KM, Henrikson NB, et al. Cost Effectiveness of Age-specific Screening Intervals for People with Family Histories of Colorectal Cancer. *Gastroenterology.* 2018;154(1):105-116.

132. Peterse EFP, Meester RGS, Gini A, et al. Value Of Waiving Coinsurance For Colorectal Cancer Screening In Medicare Beneficiaries. *Health Aff (Millwood).* 2017;36(12):2151-2159.

133. Levin TR, Jamieson L, Burley DA, et al. Organized colorectal cancer screening in integrated health care systems. *Epidemiol Rev.* 2011;33(1):101-110.

134. Kunitake H, Abbas MA. Transanal endoscopic microsurgery for rectal tumors: a review. *Perm J.* 2012;16(2):45-50.

135. Tomassi MJ, Taller J, Yuhan R, et al. Robotic Transanal Minimally Invasive Surgery for the Excision of Rectal Neoplasia: Clinical Experience With 58 Consecutive Patients. *Dis Colon Rectum.* 2019;62(3):279-285.

136. Yu JX, Lin JL, Oliver M, et al. Trends in Endoscopic Mucosal Resection for Nonmalignant Colorectal Polyps in the United States. *Gastrointest Endosc.* 2020;91(1):124-131.

137. Lee DY, Teng A, Pedersen RC, et al. Racial and Socioeconomic Treatment Disparities in Adolescents and Young Adults with Stage II-III Rectal Cancer. *Ann Surg Oncol.* 2017;24(2):311-318.

138. Selby K, Jensen CD, Zhao WK, et al. Strategies to Improve Follow-up After Positive Fecal Immunochemical Tests in a Community-Based Setting: A Mixed-Methods Study. *Clin Transl Gastroenterol.* 2019;10(2):e00010.

139. Meester RG, Zauber AG, Doubeni CA, et al. Consequences of Increasing Time to Colonoscopy Examination Following Positive Result From Fecal Colorectal Cancer Screening Test. *Clin Gastroenterol Hepatol.* 2016;14(10):1445-1451.

140. Selby K, Baumgartner C, Levin TR, et al. Interventions to Improve Follow-up of Positive Results on Fecal Blood Tests: A Systematic Review. *Ann Intern Med.* 2017;167(8):565-575.

141. Halm EA, Beaber EF, McLerran D, et al. Association Between Primary Care Visits and Colorectal Cancer Screening Outcomes in the Era of Population Health Outreach. *J Gen Intern Med.* 2016;31(10):1190-1197.

142. O'Connor EA, Nielson CM, Petrik AF, et al. Prospective Cohort study of Predictors of Follow-Up Diagnostic Colonoscopy from a Pragmatic Trial of FIT Screening. *Sci Rep.* 2020;10(1):2441.

143. Green BB, Coronado GD, Devoe JE, Allison J. Navigating the Murky Waters of Colorectal Cancer Screening and Health Reform. *Am J Public Health.* 2014;104(6):982-986.

144. Schneider JL, Rivelli JS, Gruss I, et al. Barriers and Facilitators to Timely Colonoscopy Completion for Safety Net Clinic Patients. *Am J Health Behav.* 2020;44(4):460-472.

145. Cusumano VT, Corona E, Partida D, et al. Patients without colonoscopic follow-up after abnormal fecal immunochemical tests are often unaware of the abnormal result and report several barriers to colonoscopy. *BMC Gastroenterol.* 2020;20(1):115.

146. Ayanian JZ, Zaslavsky AM, Arora NK, et al. Patients' Experiences with Care for Lung Cancer and Colorectal Cancer: Findings from the Cancer Care Outcomes Research and Surveillance Consortium. *J Clin Oncol.* 2010;28(27):4154-4161.

147. McMullen C, Bulkley J, Corley DA, et al. Health care improvement and survivorship priorities of colorectal cancer survivors: findings from the PORTAL colorectal cancer cohort survey. *Support Care Cancer.* 2019;27(1):147-156.

148. Simonds NI, Khoury MJ, Schully SD, et al. Comparative Effectiveness Research in Cancer Genomics and Precision Medicine: Current Landscape and Future Prospects. *J Natl Cancer Inst.* 2013;105(13):929-936.

149. Sharafeldin N, Slattery ML, Liu Q, et al. A Candidate-Pathway Approach to Identify Gene-Environment Interactions: Analyses of Colon Cancer Risk and Survival. *J Natl Cancer Inst.* 2015;107(9):djv160.

150. Sharafeldin N, Slattery ML, Liu Q, et al. Multiple Gene-Environment Interactions on the Angiogenesis Gene-Pathway Impact Rectal Cancer Risk and Survival. *Int J Environ Res Public Health.* 2017;14(10):e1146.

151. Laiyemo AO, Murphy G, Albert PS, et al. Postpolypectomy colonoscopy surveillance guidelines: predictive accuracy for advanced adenoma at 4 years. *Ann Intern Med.* 2008;148(6):419-426.

152. Salloum RG, Hornbrook MC, Fishman PA, et al. Adherence to surveillance care guidelines after breast and colorectal cancer treatment with curative intent. *Cancer.* 2012;118(22):5644-5651.

153. Kunitake H, Zheng P, Yothers G, et al. Routine preventive care and cancer surveillance in long-term survivors of colorectal cancer: results from National Surgical Adjuvant Breast and Bowel Project Protocol LTS-01. *J Clin Oncol.* 2010;28(36):5274-5279.

154. Chubak J, McLerran D, Zheng Y, et al. Receipt of Colonoscopy Following Diagnosis of Advanced Adenomas: An Analysis within Integrated Healthcare Delivery Systems. *Cancer Epidemiol Biomarkers Prev.* 2019;28(1):91-98.

155. McDougall JA, Banegas MP, Wiggins CL, et al. Rural Disparities in Treatment-Related Financial Hardship and Adherence to Surveillance Colonoscopy in Diverse Colorectal Cancer Survivors. *Cancer Epidemiol Biomarkers Prev.* 2018;27(11):1275-1282.

156. Li D, Liu L, Fevrier HB, et al. Increased Risk of Colorectal Cancer in Individuals With a History of Serrated Polyps. *Gastroenterology.* 2020;159(2):502-511.e502.

157. Albright K, Richardson T, Kempe KL, Wallace K. Toward a Trustworthy Voice: Increasing the Effectiveness of Automated Outreach Calls to Promote Colorectal Cancer Screening among African Americans. *Perm J.* 2014;18(2):33-37.

158. Kempe KL, Shetterly SM, France EK, Levin TR. Automated phone and mail population outreach to promote colorectal cancer screening. *Am J Manag Care.* 2012;18(7):370-378.

159. Muller D, Logan J, Dorr D, Mosen D. The effectiveness of a secure email reminder system for colorectal cancer screening. *AMIA Annu Symp Proc.* 2009;2009:457-461.

160. Walsh JM, Karliner L, Burke N, et al. Physicians' approaches to recommending colorectal cancer screening: a qualitative study. *J Cancer Educ.* 2010;25(3):385-390.

161. Mosen DM, Feldstein AC, Perrin NA, et al. More comprehensive discussion of CRC screening associated with higher screening. *Am J Manag Care.* 2013;19(4):265-271.

162. Potter MB, Somkin CP, Ackerson LM, et al. The FLU-FIT program: an effective colorectal cancer screening program for high volume flu shot clinics. *Am J Manag Care.* 2011;17(8):577-583.

163. Potter MB, Ackerson LM, Gomez V, et al. Effectiveness and Reach of the FLU-FIT Program in an Integrated Health Care System: A Multisite Randomized Trial. *Am J Public Health.* 2013;103(6):1128-1133.

164. Green BB, Wang CY, Anderson ML, et al. An Automated Intervention with Stepped Increases in Support to Increase Uptake of Colorectal Cancer Screening: A Randomized Trial. *Ann Intern Med.* 2013;158(5 Pt 1):301-311.

165. Allison JE, Fraser CG, Halloran SP, Young GP. Population Screening for Colorectal Cancer Means Getting FIT: The Past, Present, and Future of Colorectal Cancer Screening Using the Fecal Immunochemical Test for Hemoglobin (FIT). *Gut Liver.* 2014;8(2):117-130.

166. Green BB, Fuller S, Anderson ML, et al. A Quality Improvement Initiative to Increase Colorectal Cancer (CRC) Screening: Collaboration between a Primary Care Clinic and Research Team. *J Fam Med.* 2017;4(3):04.

167. Petrik AF, Green B, Schneider J, et al. Factors Influencing Implementation of a Colorectal Cancer Screening Improvement Program in Community Health Centers: an Applied Use of Configurational Comparative Methods. *J Gen Intern Med.* 2020;35(Suppl 2):815-822.

168. Allison JE, Sakoda LC, Levin TR, et al. Screening for Colorectal Neoplasms with New Fecal Occult Blood Tests: Update on Performance Characteristics. *J Natl Cancer Inst.* 2007;99(19):1462-1470.

169. Dominitz JA, Robertson DJ, Ahnen DJ, et al. Colonoscopy vs. Fecal Immunochemical Test in Reducing Mortality From Colorectal Cancer (CONFIRM): Rationale for Study Design. *Am J Gastroenterol.* 2017;112(11):1736-1746.

170. Young GP, Senore C, Mandel JS, et al. Recommendations for a step-wise comparative approach to the evaluation of new screening tests for colorectal cancer. *Cancer.* 2016;122(6):826-839.

171. Imperiale TF, Ransohoff DF, Itzkowitz SH, et al. Multitarget Stool DNA Testing for Colorectal-Cancer Screening. *N Engl J Med.* 2014;370(14):1287-1297.

172. Green BB, Anderson ML, Wang CY, et al. Results of Nurse Navigator Follow-up After Positive Colorectal Cancer Screening Test: A Randomized Trial. *J Am Board Fam Med.* 2014;27(6):789-795.

173. Baldwin LM, Schneider JL, Schwartz M, et al. First-year implementation of mailed FIT colorectal cancer screening programs in two Medicaid/Medicare health insurance plans: qualitative learnings from health plan quality improvement staff and leaders. *BMC Health Serv Res.* 2020;20(1):132.

174. Coronado GD, Kihn-Stang A, Slaughter MT, et al. Follow-up colonoscopy after an abnormal stool-based colorectal cancer screening result: analysis of steps in the colonoscopy completion process. *BMC Gastroenterol.* 2021;21(1):356.

175. Jensen CD, Corley DA, Quinn VP, et al. Fecal Immunochemical Test Program Performance Over 4 Rounds of Annual Screening: A Retrospective Cohort Study. *Ann Intern Med.* 2016;164(7):456-463.

176. Green BB, Anderson ML, Chubak J, et al. Impact of Continued Mailed Fecal Tests in the Patient-Centered Medical Home: Year 3 of the Systems of Support to Increase Colon Cancer Screening and Follow-Up Randomized Trial. *Cancer.* 2016;122(2):312-321.

177. Green BB, Anderson ML, Cook AJ, et al. A centralized mailed program with stepped increases of support increases time in compliance with colorectal cancer screening guidelines over 5 years: A randomized trial. *Cancer.* 2017;123(22):4472-4480.

178. Green BB, Wang CY, Horner K, et al. Systems of Support to Increase Colorectal Cancer Screening and Follow-Up Rates (SOS): Design, Challenges, and Baseline Characteristics of Trial Participants. *Contemp Clin Trials.* 2010;31(6):589-603.

179. Gupta S, Tong L, Allison JE, et al. Screening for colorectal cancer in a safety-net health care system: access to care is critical and has implications for screening policy. *Cancer Epidemiol Biomarkers Prev.* 2009;18(9):2373-2379.

180. Gupta S, Sussman DA, Doubeni CA, et al. Challenges and Possible Solutions to Colorectal Cancer Screening for the Underserved. *J Natl Cancer Inst.* 2014;106(4):dju032.

181. Berkowitz SA, Percac-Lima S, Ashburner JM, et al. Building Equity Improvement into Quality Improvement: Reducing Socioeconomic Disparities in Colorectal Cancer Screening as Part of Population Health Management. *J Gen Intern Med.* 2015;30(7):942-949.

182. Coronado GD, Vollmer WM, Petrik A, et al. Strategies and Opportunities to STOP Colon Cancer in Priority Populations: Design of a Cluster-Randomized Pragmatic Trial. *Contemp Clin Trials.* 2014;38(2):344-349.

183. Coronado GD, Vollmer WM, Petrik A, et al. Strategies and Opportunities to STOP Colon Cancer in Priority Populations: Pragmatic Pilot Study Design and Outcomes. *BMC Cancer*. 2014;14:55.

184. Coronado GD, Sanchez J, Petrik A, et al. Advantages of Wordless Instructions on How to Complete a Fecal Immunochemical Test: Lessons from Patient Advisory Council Members of a Federally Qualified Health Center. *J Cancer Educ*. 2014;29(1):86-90.

185. Murthy VS, Garza MA, Almario DA, et al. Using a Family History Intervention to Improve Cancer Risk Perception in a Black Community. *J Genet Couns*. 2011;20(6):639-649.

186. Rex DK, Schoenfeld PS, Cohen J, et al. Quality indicators for colonoscopy. *Gastrointest Endosc*. 2015;81(1):31-53.

187. Durno C, Boland CR, Cohen S, et al. Recommendations on Surveillance and Management of Biallelic Mismatch Repair Deficiency (BMMRD) Syndrome: A Consensus Statement by the US Multi-Society Task Force on Colorectal Cancer. *Gastroenterology*. 2017;152(6):1605-1614.

188. Giardiello FM, Allen JI, Axilbund JE, et al. Guidelines on Genetic Evaluation and Management of Lynch Syndrome: A Consensus Statement by the US Multi-Society Task Force on Colorectal Cancer. *Am J Gastroenterol*. 2014;109(8):1159-1179.

189. Johnson DA, Barkun AN, Cohen LB, et al. Optimizing Adequacy of Bowel Cleansing for Colonoscopy: Recommendations From the US Multi-Society Task Force on Colorectal Cancer. *Am J Gastroenterol*. 2014;109(10):1528-1545.

190. Kahi CJ, Boland CR, Dominitz JA, et al. Colonoscopy Surveillance After Colorectal Cancer Resection: Recommendations of the US Multi-Society Task Force on Colorectal Cancer. *Gastroenterology*. 2016;150(3):758-768.

191. Lieberman DA, Rex DK, Winawer SJ, et al. Guidelines for Colonoscopy Surveillance After Screening and Polypectomy: A Consensus Update by the US Multi-Society Task Force on Colorectal Cancer. *Gastroenterology*. 2012;143(3):844-857.

192. Rex DK, Boland CR, Dominitz JA, et al. Colorectal Cancer Screening: Recommendations for Physicians and Patients From the U.S. Multi-Society Task Force on Colorectal Cancer. *Gastroenterology*. 2017;153(1):307-323.

193. Robertson DJ, Lee JK, Boland CR, et al. Recommendations on Fecal Immunochemical Testing to Screen for Colorectal Neoplasia: A Consensus Statement by the US Multi-Society Task Force on Colorectal Cancer. *Gastroenterology*. 2017;152(5):1217-1237.

194. Dehmer SP, Maciosek MV, Flottemesch TJ, et al. Aspirin for the Primary Prevention of Cardiovascular Disease and Colorectal Cancer: A Decision Analysis for the U.S. Preventive Services Task Force. *Ann Intern Med*. 2016;164(12):777-786.

195. Lin JS, Piper MA, Perdue LA, et al. Screening for Colorectal Cancer: Updated Evidence Report and Systematic Review for the US Preventive Services Task Force. *JAMA*. 2016;315(23):2576-2594.

196. Whitlock EP, Lin JS, Liles E, et al. Screening for colorectal cancer: a targeted, updated systematic review for the U.S. Preventive Services Task Force. *Ann Intern Med*. 2008;149(9):638-658.

197. Rutter MD, Beintaris I, Valori R, et al. World Endoscopy Organization Consensus Statements on Post-Colonoscopy and Post-Imaging Colorectal Cancer. *Gastroenterology*. 2018;155(3):909-925.e903.

198. Dwyer AJ, Murphy CC, Boland CR, et al. A summary of the Fight Colorectal Cancer working meeting: exploring risk factors and etiology of sporadic early-age onset colorectal cancer. *Gastroenterology*. 2019;157(2):280-288.

199. Gupta S, Coronado GD, Argenbright K, et al. Mailed fecal immunochemical test outreach for colorectal cancer screening: Summary of a Centers for Disease Control and Prevention-sponsored summit. *CA Cancer J Clin*. 2020;70(4):283-298.