

8-28-2022

Exploring the Association of Physician Characteristics to Patient Requests for Genetic Testing

Vanessa B. Crowther

Florida Agricultural & Mechanical University, vanessa.crowther@famu.edu

Sandra G. Suther

Florida Agricultural and Mechanical University, sandra.suther@famu.edu

Jullet Davis Weaver

Queens University of Charlotte, weaverj@queens.edu

Clement K. Gwede

Moffitt Cancer Center, clement.gwede@moffit.org

Matthew T. Dutton

Florida Agricultural and Mechanical University, matthew.dutton@famu.edu

Follow this and additional works at: <https://digitalcommons.unf.edu/fphr>

 [next page for additional authors](#)
Part of the [Community Health and Preventive Medicine Commons](#)

Recommended Citation

Crowther, Vanessa B.; Suther, Sandra G.; Davis Weaver, Jullet; Gwede, Clement K.; Dutton, Matthew T.; Cui, Dongming; and López, Ivette A. (2022) "Exploring the Association of Physician Characteristics to Patient Requests for Genetic Testing," *Florida Public Health Review*: Vol. 19, Article 5.

Available at: <https://digitalcommons.unf.edu/fphr/vol19/iss1/5>

This Article is brought to you for free and open access by the Brooks College of Health at UNF Digital Commons. It has been accepted for inclusion in Florida Public Health Review by an authorized administrator of UNF Digital Commons. For more information, please contact [Digital Projects](#).

© 8-28-2022 Protected by original copyright, with some rights reserved.

Exploring the Association of Physician Characteristics to Patient Requests for Genetic Testing

Authors

Vanessa B. Crowther, Sandra G. Suther, Juliet Davis Weaver, Clement K. Gwede, Matthew T. Dutton, Dongming Cui, and Ivette A. López

EXPLORING THE ASSOCIATION OF PHYSICIAN CHARACTERISTICS TO PATIENT REQUESTS FOR GENETIC TESTING

Vanessa B. Crowther
Sandra G. Suther
Juliet Davis Weaver
Clement K. Gwede
Matthew T. Dutton

Florida Public Health Review
Volume 19
Published August 23, 2022

Background: Cancer genomic testing improves health outcomes for individuals at risk, drives cost-efficiency, and facilitates healthcare equity; however, little is known about how physician demographic and practice characteristics influence patient requests for genetic testing. **Purpose:** To explore whether (and to what extent) physician demographic and practice characteristics are associated with patient requests for cancer genetic testing. **Methods:** A cross-sectional quantitative design survey was distributed to 1240 primary care physicians registered with the state health department who had active licenses and main practices in Florida. Primary care physicians were defined as those who practice family medicine, internal medicine, obstetrics, and gynecology. The survey tool was developed from a search of the literature and two previously validated surveys. It was administered using a modified Dillman strategy. The study sample size was 317 physicians, with an 85% response rate based upon a targeted sample of 372. Statistical calculations were performed using SPSS version 27 and STATA release 17. **Results:** Logistic regression model found significant associations between patient requests and physicians' race and professional practice size. Physicians identified as White were 1.840 times as likely to have patient requests for genetic testing ($p=.036$) than physicians whose race was other than White. Physicians whose professional practices were solo or small groups were 2.39 times as likely to have patient requests ($p=.001$) than physicians affiliated with larger practices. **Discussion:** Patient requests may be leveraged by physicians, other healthcare providers, and public health professionals; patient requests present a significant opportunity for increasing genetic testing and thus promoting better health outcomes for patients with Lynch syndrome-related colorectal cancer.

Background | Genomics plays a role in nine of the ten leading causes of death in the United States,¹ including hereditary cancers such as Lynch syndrome-related colorectal cancer (LS-CRC). Financial market research experts predict worldwide growth in the genetic testing market. The projected rise is due to the increase in cancer prevalence and genetic disorders, advancements in genetic testing techniques, and the surge in awareness of personalized medicine.² A joint study by the University of Pittsburgh Medical Center and Healthcare Information and Management Systems Society (HIMSS) Media found that almost 90% of healthcare organizations currently provide or plan to provide genetic or genomic testing.³ This represents an increasing movement among healthcare organizations towards genomic innovation. Healthcare experts agree that genomics can propel prevention, outcomes, cost-efficiency, and healthcare equity further than would have been achieved otherwise.³

Similarly, cancer genetic testing has advantages over other means in predicting risk, diagnosis, delivering

preventive interventions, improving outcomes, cost-savings, and enabling a systematic process of providing care that does not vary in quality because of personal characteristics.^{1,3} Cancer genetic testing allows physicians to proactively implement preventive surveillance for those at high risk for hereditary cancers who have not yet been diagnosed. It also enables surveillance in the care of patients diagnosed with their first genetics-related tumor and the monitoring of biological relatives.^{4,5} Cancer genetic testing guides physicians on patient management, surgical options, and treatment choices, such as selecting chemotherapy agents.^{4,5} Early detection and treatment facilitate better patient outcomes, lower treatment costs, and promote fair and impartial healthcare.^{4,5}

Despite these benefits, the literature demonstrates that only a small percentage of adult patients at higher risk for hereditary breast or ovarian cancer, who know their risk is higher than that of relatives without hereditary cancer,⁶ request or discuss genetic testing with their

physicians or apply for testing. Furthermore, data indicate a declining trend in genetic testing in families affected by LS-CRC.^{7,8} Using national cancer survey data, Baer et al⁷ explored the perceived risk, knowledge, and use of genetic testing among respondents. They found that 40.2% of respondents indicated they were familiar with genetic testing for cancer risk, and 5.6% had discussed it with their physician. Among study participants stratified at the highest risk, those with two or more first-degree relatives with breast, ovarian, or Lynch syndrome-associated cancer, 49.5% had heard of genetic testing; and only 14.8% had discussed it with their physician,⁷ suggesting underutilization of physicians' expertise. Patient barriers to requesting genetic testing range from the psychological to the practical. There is the psychological incentive to avoid information, even when it is valid, the complexity of disclosure, associated costs, if not covered by insurance, and concerns with the loss of confidentiality.^{9,10,11,12}

Patient request is also influenced by perceived risk, the communication process within the family environment, and perceived emotional support.⁶ When patients do request genetic testing, it is influenced by several factors: having had a previous illness, the presence of symptoms, perceived vulnerability because a genetic condition exists in the family, being part of a population with an increased incidence of a particular disease, the influence of their education and training, a news story, social media, or product advertising.^{13,14}

Lynch syndrome is an inherited gene variant that increases the risk for several cancers: breast, endometrial, ovarian, prostate, urinary tract, bile-duct, brain, stomach, small bowel, and colorectal cancer, the most common Lynch syndrome-related cancer.^{15,16,17} People with Lynch syndrome have a significantly increased risk of developing colorectal cancer at a younger age (average age of 45 years) than the general population (average age of 72). Lynch syndrome accounts for four to 16% of early-onset CRC.^{18,19,20,21,22} Additionally, 15% of sporadic cancers (cancers with no known cause) among adults younger than 50 have Mismatch Repair deficiency, a characteristic feature of Lynch syndrome.²³ Persons with Lynch syndrome have a 50%-80% lifetime risk of developing CRC compared to a 2% risk among the general population. First- and second-degree biological relatives each have elevated risks for Lynch syndrome.^{16,24}

In a prior study,²⁵ patient requests for genetic testing were the single most significant factor associated with adopting genetic testing by primary care physicians (PCPs). Given that cancer genomic technology has the potential to reduce disparities, increase access to

quality care and improve health outcomes, it is essential to consider the role of patients in the utilization of genetic testing for LS-CRC. This study explores the association of physician demographic and practice characteristics with patient requests for Lynch syndrome-related cancer genetic testing.

Physician demographics. The literature establishes that patient-physician racial/ethnic concordance influences the patient experience. Concordance positively affects communication and clinical decision-making, while differences moderate communication and decision-making.²⁶ Other studies have found that physicians consistently received higher scores in racial/ethnic concordant patient-physician dyads. In contrast, discordant dyads were associated with a lower likelihood of physicians receiving the maximum patient satisfaction score on a national outpatient health care survey.^{26,27} Cooper et al,²⁸ Garcia et al,²⁹ and Johnson et al³⁰ have also established that patients reported race-concordant visits as being longer, were more satisfied with their physicians, and rated them as more participatory and trustworthy. Discordant social characteristics such as race affected patient-physician communication patterns and patients' perception of care.^{28,29,30} In light of these findings in the literature, we anticipated that physicians' demographic characteristics would have a differential effect on patient requests for genetic testing.

Physician practice size. Scholarly research suggests that organizational size affects primary care delivery. Large institutions were more likely to have established genetic programs staffed with genetic experts who support physicians with patient counseling and interpreting test results.³¹ Because of this support system, we anticipated that patients whose physicians were affiliated with large groups would be more likely to request genetic testing.

Methodology | We used a cross-sectional quantitative survey design to answer our research question: which, if any, physician or practice characteristic is associated with patient requests for LS-CRC genetic testing?

Sample. The study population consisted of 11,572 physicians. A list of physicians was acquired from the state health department. The list was randomized and used to select the sample frame. A targeted study sample size of 372 was determined using the Raosoft sample size calculator³² for a 95% confidence interval (CI) and a 5% sampling error. The study sample size was 317 physicians, with an 85% response rate based upon a targeted sample of 372. PCPs were defined as those who practice family medicine, internal medicine, obstetrics, and gynecology. Those with

active licenses and main practice sites in Florida were eligible for this study.

Procedure. The surveys were distributed over two periods, August 2017 to October 2017 and November 2017 to April 2018, through mail and email, using a modified Dillman³³ strategy.

Survey Instrument. We developed the survey tool from a literature review and two previously validated surveys.^{34,35} Factor analysis and Cronbach alpha established survey reliability. We anticipated the survey would take approximately 10 minutes to complete. The survey questionnaire consisted of 43 questions answerable on a five-point Likert scale and nine questions related to physicians' personal and professional characteristics. The findings from the 43 questions were the content of a previous publication.³⁶

Dependent Variable. The dependent variable, patient requests, was operationalized as physicians who reported patient requests for cancer genetic testing in the previous two years.

Independent Variables. Six demographic and professional characteristics measures were the independent variables: physician age, gender, race, ethnicity, practice affiliation, and source of advice.

Variable Coding. The dependent variable "*Have you had patient requests for cancer genetic testing in the previous two years?*" was constructed by physician responses "Yes" or "No." Respondents were coded as 1 for the dependent variable if they answered "Yes" and 0 if they did not. We coded the independent variables as follows: Age Range, 0 for 60 years or older, 1 for 20-59 years; Gender, 0 for female, 1 for male; Race, 0 for non-White, 1 for White; Ethnicity, 0 for non-Hispanic, 1 for Hispanic; Professional Practice Size, 0 for large group/hospital affiliation, 1 for solo/small group affiliation; Source of Advice, 0 for non-internet, 1 for the internet.

Data Analysis. Descriptive analysis provided sample summaries and assessed frequencies, chi-square examined differences between categorical variables among the sample, while binary logistic regression analysis produced odds ratios to determine which, if any, of the variables were significantly associated with patient requests for cancer genetic testing (with alpha set at 0.05). Statistical calculations were performed using SPSS version 27³⁷ and STATA release 17.³⁸

Results | The study included 317 PCP respondents. The majority (63.62%) of PCPs were in the 20-59 age range, 199 (65.7%) were males, 218 were White (72.7%), and 89.9% were non-Hispanic or Latino (Table 1). Approximately 46% of respondents had patient requests for cancer genetic testing. Forty-four

percent of PCPs reported practicing in solo or small groups with five or fewer physicians³⁹ and were classified as independently affiliated. Most physicians in this study sample, 55.8%, were affiliated with large practices defined as large groups, hospitals, academic research universities, federally qualified health centers, health departments, and similar affiliations.

Chi-square tests of independence were performed to examine associations between various physician factors and patient requests for genetic testing. Significance was found between professional practice and patient requests for genetic testing. Fifty-six percent of physicians in solo or small group practices reported receiving patient requests for cancer genetic testing, compared to 39% of physicians who practiced in large groups. Chi-square tests of independence showed no significant associations between patient requests and physician age, gender, race, ethnicity, or source of advice.

We conducted a binary regression (Table 3) to compare patient requests for cancer genetic testing and physician characteristics. The final model demonstrated that physician race and professional practice size were significantly correlated with the dependent variable, patient requests.

Adjusted odds ratios indicated that physicians who identified as White were 1.840 times as likely to have patient requests for genetic testing ($p=.036$) than physicians whose race was other than White in our sample. Physicians whose professional practices were solo or in small groups were 2.39 times as likely to have patient requests ($p=.001$) than PCPs in large groups. Other independent variables: age, gender, ethnicity, or source of advice were not significant.

Discussion | Studies have found that physicians are more likely to order genetic testing at the patient's request.^{25,40} This study was conducted using a randomized survey method of PCPs in Florida. It examined physician demographic and professional characteristics and their association to patient requests for genetic testing related to LS-CRC. We found that patient requests varied by physician demographics and practice characteristics.

Physician demographics. Our research demonstrated that physician race was associated with patient requests. Several factors may explain this finding. The body of literature corroborates that patient-physician race and ethnicity are positively associated with communication, patient satisfaction, and physician clinical decision-making.^{26,27} Furthermore, patients of the same race as their physicians reported that their visits lasted longer, had more engaging visits and perceived a higher level of care.^{28,29,30} Thus, they viewed their physicians as more trustworthy, which is

critical to reducing health care disparities and improving healthcare outcomes.

The socioeconomic status (SES) of the physicians' patient mix may also explain our finding of higher patient requests among physicians identified as White. Research studies have shown that SES influences utilization and access to medical services. For example, in a study consisting of only female patients, physicians were more likely to order comprehensive BRCA testing for non-Hispanic White women, women who were college-educated, married, and had higher incomes. Studies have also shown that SES factors are associated with higher health literacy, self-efficacy, and seeking and obtaining information.^{41,42,43}

Conversely, studies have found that physicians who serve a high proportion of minority, Medicaid, uninsured patients, and patients whose primary language is one other than English "were significantly less likely than their peers who serve fewer minority patients to have ever ordered a genetic test for breast cancer, colon cancer, and Huntington disease."^{44,45}

Patient cynicism may offer additional insight into the findings in this study related to physician race.⁴⁶ There is a long history of distrust of the medical system in the United States due to racial discrimination, eugenics, and unethical medical research practiced in the past. This lack of confidence may influence the relationship and communication between patients and physicians, impacting requests for medical care related to genetics. Consequently, it is essential to acknowledge the legacy of patient mistrust of the healthcare system, especially as it pertains to genetics.

Physician practice size. In this study, physician practice size was significantly associated with patient requests. The researchers in this study anticipated that

Table 1. Sample Descriptives

Variable	Percentage %
Dependent Variable	
Patient Requests Genetic Testing (n=312)	
Yes	46.2%
Demographic Characteristics	
Age Range (n=305)	
20-59	63.6%
Gender (n=303)	
Male	65.7%
Race (n=300)	
White	72.7%
Ethnicity (n=298)	
Hispanic or Latino	10.1%
Professional Characteristics	
Professional Practice Size (n=313)	
Solo or Small Group (5 or fewer)	44.1%
Source of Advice (n=306)	
Internet	39.50%

physicians affiliated with large institutions such as teaching hospitals and academic institutions would receive more patient requests for cancer genetic testing. The literature suggests that large institutions were more likely to have established genetic programs and a cadre of genetic experts to support physicians with interpreting test results.³¹ However, our analysis found that physicians practicing in solo or small groups had more patient requests for cancer genetic testing than physicians in large group practices. Ng and Ng⁴⁷ found that physician practice size was negatively associated with patient satisfaction. Van de Ven⁴⁸ found a negative correlation between patient satisfaction and clinic size. One possible reason for this outcome may be that the complexity of an organization's structure increases with size.⁴⁹ Physicians in private practice have higher practice autonomy, which may allow for greater freedom when ordering tests.^{31,50}

Study Limitations. The study response rate was just under the level required to generalize study findings (372 surveys for 95% confidence interval and a 5% sampling error) (<http://www.raosoft.com/samplesize.html>) and therefore presents the possibility of non-response bias. However, non-response bias in physician surveys may be less of an issue than in surveys of the general public, given the similarity in knowledge, training, attitude, and behaviors compared to the general public.^{51,52} A second limitation is that this study did not include patients themselves, who may have different perspectives than those provided by physicians. Finally, the increase in familywise error rate across the reported binary logistic regression analysis for physician race and patient requests was not controlled. Overall, we consider this research relatively preliminary and encourage replication.

Table 2. Cross Tabulations with Chi-Square between Patient Requests for Cancer Genetic Testing and Physician Characteristics

		PCP had Patient Requests for Cancer Genetic Testing		
PCP Professional Practice is Solo or Small Group		No	Yes	Total
No		61.1%	38.9%	100.0%
Yes		44.5%	55.5%	100.0%
Total	Count	168	144	312
$\chi^2 = 8.538$ $p = 0.003$				
PCP Source of Advice is the Internet		No	Yes	Total
No		50.3%	49.7%	100.0%
Yes		59.5%	40.5%	100.0%
Total	Count	163	139	302
$\chi^2 = 2.486$ $p = 0.115$				
PCP Age is 20-59		No	Yes	Total
No		53.7%	46.3%	100.0%
Yes		53.4%	46.6%	100.0%
Total	Count	161	140	301
$\chi^2 = .003$ $p = 0.950$				
PCP Race is White		No	Yes	Total
No		61.0%	39.0%	100.0%
Yes		50.5%	49.5%	100.0%
Total	Count	158	138	296
$\chi^2 = 2.631$ $p = 0.105$				
PCP Ethnicity is Hispanic or Latino		No	Yes	Total
No		53.4%	46.6%	100.0%
Yes		56.7%	43.3%	100.0%
Total	Count	158	136	294
$\chi^2 = 115$ $p = 0.735$				
PCP Gender is Male		No	Yes	Total
No		48.1%	51.9%	100.0%
Yes		56.9%	43.1%	100.0%
Total	Count	161	138	299
$\chi^2 = 2.136$ $p = 0.144$				

Table 3. Binary Logistic Regression for Association between Patient Requests for Cancer Genetic Testing and Physician Characteristics

Variables	Odds Ratio	LCI	UCI	p-value
Age				
20-59	1.159	.668	2.010	.601
60+	1.000			
Gender				
Male	.616	.359	1.056	.078
Female	1.000			
Race				
White	1.840	1.041	3.250	.036
Non-White	1.000			
Ethnicity				
Hispanic	.857	.373	1.968	.716
Non-Hispanic	1.000			
Practice Size				
Solo or Small Group (5 or fewer)	2.390	1.452	3.934	.001
Large Group or Hospital	1.000			
Source of Advice				
Internet	.664	.405	1.089	.105
Non-Internet	1.000			

Implications for Public Health Practice | Genomic Medicine is increasingly incorporated into diagnostic practices and patient care to guide preventive medicine, improve health care equity, improve clinical outcomes, and realize cost efficiencies. Consistent adoption of genetic testing protocols for patients newly diagnosed with colorectal cancer will help achieve the anticipated benefits of genomic technology for patients with LS-CRC. The extant body of literature reveals that patient requests are highly associated with physician adoption of genetic testing for hereditary diseases such as LS-CRC. This study examined PCPs' demographic and professional characteristics and their association with patient requests for LS-CRC. Our findings indicate that physician race and practice size are associated with patient requests for LS-CRC genetic testing. These findings point to the need for increased awareness and targeted education among physicians on the impact of race and practice size on patient requests for medical services. It also raises the need for patient-focused education that explores and addresses self-efficacy, regardless of physician race and practice size. To better understand the implications of these results, future studies could address patient knowledge about genetic testing for inherited cancer and patient self-efficacy to navigate their medical care options once diagnosed with colorectal cancer.

References |

1. Genomics. HealthyPeople.gov. Office of Disease Prevention and Health Promotion, US Department of Health and Human Services. Updated October 14, 2021. www.healthypeople.gov/2020/topics-objectives/topic/genomics#5. Accessed May 2, 2022.
2. Genetic testing market to hit \$21.26 billion by 2027: AMR: Rise in prevalence of cancer & genetic disorders, advancements in genetic testing techniques, and surge in awareness about personalized medicines drive the growth of the global genetic testing market. Allied Market Research NASDAQ OMX's News Release Distribution Channel. Published October 26, 2020. <https://go.openathens.net/redirector/famu.edu?url=https://www.proquest.com/wire-feeds/genetic-testing-market-hit-21-26-billion-2027-amr/docview/2454094543/se-2?accountid=10913>. Accessed May 2, 2022.
3. Birk S. The power of genomics: A population health strategy. *Healthcare Executive*, 2021;36(N4):8.
4. Hamilton SR. Status of testing for high-level microsatellite instability/deficient mismatch repair in colorectal carcinoma. *Journal of the American Medical Association, Oncology*. 2018;4(2) doi: 10.1001/jamaoncol.2017.3574.
5. Stupart DA, Goldberg PA, Algar U, et al. Surveillance colonoscopy improves survival in a cohort of subjects with a single mismatch repair gene mutation. *Colorectal Disease*, 2009;11(2):126-30.
6. Katapodi MC, Northouse L, Pierce P, et al. Differences between women who pursued genetic testing for hereditary breast and ovarian cancer and their at-risk relatives who did not. *Oncology Nursing Forum*. 2011;38(5):572-581. <https://doi.org/10.1188/11.ONF.572-581>.
7. Baer HJ, Brawarsky P, Murray MF, et al. Familial risk of cancer and knowledge and use of genetic testing. *J Gen Intern Med*. 2010;25(7):717-724. doi:10.1007/s11606-010-1334-39.
8. Ramsoekh D, van Leerdam ME, Tops CJ, et al. The use of genetic testing in hereditary colorectal cancer syndromes: Genetic testing in HNPCC, (A)FAP and MAP. *Clinical Genetics*. 2007;72(6):562-567.
9. Denbo SM. What your genes know affects them: Should patient confidentiality prevent disclosure of genetic test results to a patient's biological relatives? *American Business Law Journal*. 2006;43(3):561-607.
10. Gail GW. Patients' rights: Who should know what? *Medical Economics*. 2002;79(19):97-100,103-4.
11. Golman R, Hagmann D, Loewenstein G. Information avoidance. *Journal of Economic Literature*. 2017;55(1):96-135. doi:http://dx.doi.org/10.1257/jel.20151245.
12. Parker-Pope, T. Health mailbox. *Wall Street Journal* 2005 Feb 15.
13. Farndon P, Bishop M. Genetic testing in primary care. *Gp*. 2010;38.
14. The nature of patients' expectations and requests. Kravitz RL & Street RL, Jr. eds. *Understanding Clinical Negotiation*. McGraw Hill, 2021.
15. Vasen HFA, Watson P, Mecklin JP, et al. New clinical criteria for hereditary nonpolyposis colorectal cancer (HNPCC, Lynch syndrome) proposed by the International Collaborative Group on HNPCC. *Gastroenterology*. 1999;116:1453-1456. doi: [http://dx.doi.org/10.1016/S0016-5085\(99\)70510-X](http://dx.doi.org/10.1016/S0016-5085(99)70510-X).
16. Have you or a family member had colorectal(colon) cancer? Centers for Disease Control and Prevention, Office of Public Health Genomics [CDC-OPHG]. <https://www.cdc.gov/features/lynchsyndrom>

- [e/index.html](#). 2020. Updated February 24, 2020. Accessed May 2, 2022.
17. Cancer.net Lynch syndrome. Published January 2020. <http://www.cancer.net/cancer-types/lynch-syndrome>. Accessed May 2, 2022.
 18. Barnetson RA, Tenesa A, Farrington SM, et al. Identification and survival of carriers of mutations in DNA mismatch-repair genes in colon cancer. *N Engl J Med*. 2006;354(26):2751-2763. doi: 10.1056/NEJMoa053493.
 19. Evaluation of Genomic Applications in Practice and Prevention (EGAPP) Working Group. Recommendations from the EGAPP Working Group: Genetic testing strategies in newly diagnosed individuals with colorectal cancer aimed at reducing morbidity and mortality from Lynch syndrome in relatives. *Genet Med*. 2009;11(1):35-41. doi: 10.1097/GIM.0b013e31818fa2ff.
 20. Hampel H, Frankel WL, Martin E, et al. Feasibility of screening for Lynch syndrome among patients with colorectal cancer. *J Clin Oncol*. 2008;26(35):5783-5788.
 21. Mork ME, You YN, Ying J, et al. High prevalence of hereditary cancer syndromes in adolescents and young adults with colorectal cancer. *J Clin Oncol*. 2015;33(31):3544-3549.
 22. Yurgelun MB, Allen B, Kaldate RR, et al. Identification of a variety of mutations in cancer predisposition genes in patients with suspected Lynch syndrome. *Gastroenterology*. 2015;149(3):604-13.e20. doi: 10.1053/j.gastro.2015.05.006.
 23. Shaikh T, Handorf EA, Meyer JE, et al. Mismatch repair deficiency testing in patients with colorectal cancer and nonadherence to testing guidelines in young adults. *JAMA Oncol*. 2018;4(2):e173580. doi: 10.1001/jamaoncol.2017.3580.
 24. Genomics application toolkit: More detailed information on key tier 1 applications – Lynch syndrome. Centers for Disease Control and Prevention, Public Health Genomics [CDC-PHG], Atlanta, GA. 2014 https://www.cdc.gov/genomics/implementation/toolkit/lynch_1.htm#lynch
 25. Crowther VB. *The utilization of genetic testing for Lynch syndrome-related colorectal cancer among primary care physicians in Florida: A multilevel analysis*. [dissertation]. Tallahassee: Florida Agricultural & Mechanical University, 2018.
 26. Betancourt JR, Green AR. Racial and ethnic disparities in health care. In Jameson J, Fauci AS, Kasper DL, Hauser SL, Longo DL, Loscalzo J eds. *Harrison's Principles of Internal Medicine*, 20e. McGraw Hill. 2018.
 27. Takeshita J, Wang S, Loren AW, et al. Association of racial/ethnic and gender concordance between patients and physicians with patient experience ratings. *JAMA Network Open*. 2020;3(11), e2024583. <https://doi.org/10.1001/jamanetworkopen.2020.24583>.
 28. Cooper LA, Roter DL, Johnson RL, et al. Patient-centered communication, ratings of care, and concordance of patient and physician race. *Annals of Internal Medicine*. 2003; 139(11):907-915. doi:10.7326/0003-4819-139-11-200312020-00009.
 29. Garcia JA, Paterniti DA, Romano PS et al. Patient preferences for physician characteristics in university-based primary care clinics. *Ethnicity and Disease* 2003;12(2):259-267.
 30. Johnson RL, Powe NR, Roter D, et al. Patient-physician social concordance, medical visit communication, and patients' perceptions of health care quality. *Patient Education and Counseling*, 2011;85(3): e202-e208. <https://doi.org/10.1016/j.pec.2011.07.015>.
 31. Fok RW, Ong, CS, Lie D et al. How practice setting affects family physicians' views on genetic screening: A qualitative study. *BMC Family Practice*. 2021;22:1-10. doi:http://dx.doi.org/10.1186/s12875-021-01492-y.
 32. Raosoft Sample Size Calculator. Raosoft. Published 2004. <http://www.raosoft.com/samplesize.html>.
 33. Dillman DA. Mail and internet surveys: The tailored design method. New York: John Wiley and Sons Publishing, 2006.
 34. Suther S, Goodson P. Texas physicians' perceptions of genomic Medicine as an innovation. *Clin Genet*, 2004;65:368-377.
 35. Marzuillo C, De Vito C, Boccia S, et al. Knowledge, attitudes, and behavior of physicians regarding predictive genetic tests for breast and colorectal cancer. *Preventive Medicine*, 2013;57:477-482.
 36. Crowther VB, Suther SG, Weaver JA, et al. An exploratory study of the likelihood of adopting genetic counseling and testing for Lynch Syndrome-related colorectal cancer among primary care physicians in Florida. *Journal of Health Disparities Research and Practice*, 2020;13(3):118-128.
 37. IBM Statistical package for the social sciences (SPSS) version 27. Published 2020.

- <https://www.ibm.com/analytics/spss-statistics-software>.
38. StataCorp. *Stata Statistical Software: Release 17*. College Station, TX: StataCorp LLC. Published, 2021. <https://www.stata.com/>.
 39. Casalino LP, Devers KJ, Lake TK, Reed M, Stoddard JJ. Benefits of and barriers to large medical group practice in the United States. *Arch Intern Med*. 2003;163(16):1958–1964. doi:10.1001/archinte.163.16.1958.
 40. Wideroff L, Freedman AN, Olson L, et al. Physician use of genetic testing for cancer susceptibility: results of a national survey. *Cancer Epidemiol Biomarkers Prev*. 2003;12(4):295-303.
 41. Sarkar U, Fisher L, Schillinger D. Is self-efficacy associated with diabetes self-management across race/ethnicity and health literacy? *Diabetes care* 2006;29(4): 823-829. doi:10.2337/diacare.29.04.06.dc05-1615.
 42. Armstrong J, Toscano M, Kotchko N, et al. Utilization and Outcomes of *BRCA* Genetic Testing and Counseling in a National Commercially Insured Population: The ABOUT Study. *JAMA Oncol*. 2015;1(9):1251–1260. doi:10.1001/jamaoncol.2015.3048.
 43. McGarragle KM, Aronson M, Semotiuk K, et al. Patient-physician relationships, health self-efficacy, and gynecologic cancer screening among women with Lynch syndrome. *Hereditary cancer in clinical practice*. 2019;17:24. doi:10.1186/s13053-019-0123-7.
 44. Moy E, Bartman BA. Physician race and care of minority and medically indigent patients. *JAMA*. 1995;273(19):1515–1520. doi:10.1001/jama.1995.03520430051038.
 45. Shields AE, Burke W, Levy DE. Differential use of available genetic tests among primary care physicians in the United States: Results of a national survey. *Genet Med*. 2008;10(6):404-14. DOI: 10.1097/GIM.0b013e3181770184.
 46. Sullivan LS. Trust, risk, and race in American Medicine. *Hastings Center Report* 2020; 50(1):18-26. <https://doi.org/10.1002/hast.1080>.
 47. Ng CW, Ng KP. Does practice size matter? Review of effects on quality of care in primary care. *Br J Gen Pract*. 2013;63(614):e604-e610. doi:10.3399/bjgp13X671588.
 48. Van de Ven AH. What matters most to patients? Participative provider care and staff courtesy. *Patient Experience Journal*. 2014;1(1):131-139. doi:10.35680/2372-0247.1016.
 49. Hamilton JG, Abdiwahab E, Edwards, HM et al. Primary care providers' cancer genetic testing-related knowledge, attitudes, and communication behaviors: A systematic review and research agenda." *Journal of General Internal Medicine*. 2017;32(3):315-324. doi:http://dx.doi.org/10.1007/s11606-016-3943-4.
 50. Aarons G, Sommerfeld DH, Walrath-Greene CM. Evidence-based practice implementation: the impact of public versus private sector organization type on organizational support, provider attitudes, and adoption of evidence-based practice. *Implementation science*. 2009 Dec 31;4(83):1-13. doi:10.1186/1748-5908-4-83
 51. Kellerman SE, Herold J. Physician response to surveys. A review of the literature. *American Journal of Preventive Medicine*, 2001;20(1), 61–67. [https://doi.org/10.1016/s0749-3797\(00\)00258-0](https://doi.org/10.1016/s0749-3797(00)00258-0).
 52. Noll A, J Parekh P, Zhou M, et al. Barriers to Lynch syndrome testing and preoperative result availability in early-onset colorectal cancer: A national physician survey study. *Clin Transl Gastroenterol*. 2018;9(9):185. doi:10.1038/s41424-018-0047-y.