



The Association of a Colorectal Cancer Screening Patient Navigation Program With Adherence to Timely Surveillance Colonoscopies

The Harvard community has made this article openly available. [Please share](#) how this access benefits you. Your story matters

Citation	Enogieru, Imarhia. 2018. The Association of a Colorectal Cancer Screening Patient Navigation Program With Adherence to Timely Surveillance Colonoscopies. Doctoral dissertation, Harvard Medical School.
Citable link	http://nrs.harvard.edu/urn-3:HUL.InstRepos:41973510
Terms of Use	This article was downloaded from Harvard University's DASH repository, and is made available under the terms and conditions applicable to Other Posted Material, as set forth at http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-of-use#LAA

Scholarly Report submitted in partial fulfillment of the MD Degree at Harvard Medical School

Date: 4 March 2018

Student Name: Imarhia Enogieru, BA

Scholarly Report Title: The Association of a Colorectal Cancer Screening Patient Navigation Program with Timely Surveillance Colonoscopies

Mentor Name(s) and Affiliations: Dr. Sanja Percac-Lima, MD, PhD, MPH, Department of General Internal Medicine, Massachusetts General Hospital, Harvard Medical School, Boston, MA, United States

Collaborators, with Affiliations:

1. Julian Mitton, MD, MPH, Division of General Internal Medicine, Massachusetts General Hospital, Boston, MA United States
2. Janet J. Ho MD, MPH, Division of Palliative Care, Department of Medicine, Massachusetts General Hospital/Harvard Medical School, Boston, MA United States
3. Jeffrey M. Ashburner PhD, MPH, Division of General Internal Medicine, Massachusetts General Hospital, Harvard Medical School, Boston, MA United States
4. Wei He MS, Division of General Internal Medicine, Massachusetts General Hospital, Boston, MA United States

Table of Contents

Abstract.....	3
Glossary of abbreviations	5
Introduction	6
Student Role.....	7
Methods.....	8
Creation of Cohort	8
Patient measures	8
Colorectal Cancer Risk Score.....	8
Chart abstraction.....	9
Outcomes.....	9
Statistical Analysis	9
Results.....	10
Timely follow-up surveillance colonoscopy	10
Reasons for non-adherence with recommended follow-up colonoscopy.....	10
Discussion	12
Acknowledgments	14
References	15
Tables and Figures	19
Table 1: Baseline patients' characteristics N=216.....	19
Table 2: Proportion of patients with timely completion of follow-up surveillance colonoscopy in navigated vs. non-navigated patients for initial screening colonoscopy	19
Table 3: Odds of timely completion of follow-up screening colonoscopy among patients who receive patient navigation compared to those who do not ¹	20
Table 4: Reasons for Nonadherence with timely FSC in Navigated (PN=29) and Non-navigated (No-PN =90) patients.....	20

Abstract

Title: The Association of a Colorectal Cancer Screening Patient Navigation Program with Adherence to Timely Surveillance Colonoscopies

Imarhia Enogieru BA, Julian Mitton MD, Janet J. Ho MD, Jeffrey M. Ashburner PhD, MPH, Wei He MS, Sanja Percac-Lima MD, PhD

Purpose: Reduction in incidence and mortality of colorectal cancer (CRC) has been attributed to colonoscopy for detection and removal of precursor lesions/polyps. Post-polypectomy patients are often at higher risk of developing cancer and require follow-up surveillance colonoscopy (FSC). Patient navigation (PN) has been effective in improving screening in low income and minority populations; however, the literature is scarce on its effect on timely FSC. Our objectives were to compare the proportions of timely FSCs in patients who had received PN for initial colonoscopy to patients without PN and to identify reasons for non-adherence with FSC in underserved populations.

Methods: In this retrospective, matched cohort study, we reviewed the charts of Massachusetts General Hospital (MGH) Chelsea health center primary care patients who received PN at their initial colonoscopy between 2010-2011 and had abnormal finding requiring surveillance. These patients were matched in a 1:3 ratio by age, gender, race, language and CRC risk category to patients with an abnormal colonoscopy during the same period who required FSC, but were not navigated. The primary outcome was proportion of timely FSC, defined as colonoscopy completed within six months of the recommended date based on the CRC risk score, in navigated vs. non-navigated group. We used a chi-square test for unadjusted comparison and multivariable logistic regression with adjustment for health insurance, education and prior number of annual visits. Our secondary outcome were reasons for non-adherence to timely completion of FSC.

Results: Among 216 patients, 34 (55%) who received PN, completed a timely FSC compared to 82 (53%) in the control group ($p=0.881$). After adjusting for insurance, education, language and number of annual primary care visits, patients who received PN had similar odds (AOR=1.209, 95% CI 0.622-2.349) of completing a timely surveillance when compared to those who did not

receive PN. The reasons for non-adherence with timely FSC were related to patients' issues: declined, moved/traveled, co-morbidities and death. System and provider barriers included: patient referred but scheduling issues, provider miscommunication and delayed referral.

Conclusions: Navigation in underserved patients for initial colonoscopy did not improve odds of timely FSC. Understanding the multiple reasons for non-adherence could guide future initiatives to improve FSC rates in this population.

Glossary of abbreviations

Colorectal cancer (CRC)

Patient navigation (PN)

Massachusetts General Hospital (MGH)

Follow-up Surveillance Colonoscopy (FSC)

Introduction

Colorectal cancer (CRC) is the second leading cause of cancer-related deaths in the United States. ⁽¹⁻²⁾ Reduction in incidence and mortality of CRC has been attributed to the use of screening, ⁽³⁻⁴⁾ particularly colonoscopy to detect invasive disease early and remove precursor lesions and polyps. ⁽⁵⁻⁸⁾

Patients who are post-polypectomy are at higher risk of developing cancer and require follow-up surveillance colonoscopy (FSC). ^(4,9-10) Recommended surveillance interval is determined by risk stratification based on number, size and histology of polyps and determines surveillance intervals. ^(4,9-10) Non-adherence to recommended surveillance contributes to metachronous cancer development and interval colorectal cancer. ^(11,31) Additionally, in patients with fair or poor bowel preparation for colonoscopy, rates of missed adenomas and advanced adenomas are 42% and 27%, respectively. ⁽¹²⁾ Inadequate bowel preparation is a risk factor of recurrent high-risk polyps and interval cancers. ^(13-14, 17) Depending on preparation quality and initial colonoscopy results, current guidelines recommend repeat colonoscopy in 1 to 5 years. ⁽⁴⁾

Despite the effectiveness of screening, there is a disproportionate burden of CRC incidence and mortality in minority and low-income populations. ^(3, 7, 18-19) Patient navigation (PN), one of the effective interventions to improve screening in underserved populations, ^(20-23, 32-35) might reduce these inequalities. Navigators explore patients' barriers to CRC screening and provide solutions including patient education, instruction about bowel preparation, scheduling and reminding patients about appointments, interpreting and sometimes accompanying patients to have a colonoscopy. ^(20-26,32-35) These strategies have improved rates of screening colonoscopies in minority and low-income populations. ^(20-23, 32-35) However, there is scarce data in the literature about adherence and timeliness of recommended FSC after inadequate preparation or abnormal finding in patients who were navigated for initial colonoscopy. ⁽²⁷⁻²⁸⁾

The objective of this study is to compare the rates of timely follow-up surveillance colonoscopy between patients who received patient navigation for initial colonoscopy and those who did not receive patient navigation. Our secondary objective is to identify reasons for non-adherence with FSC in this population.

Student Role

With my mentor Dr. Percac-Lima, I designed the abstraction tool for chart review for both quantitative and qualitative part of the study. Wei He provided the list of patients from the navigation program and matched these patients to patients without navigation at initial colonoscopy. I completed the chart review for all 216 patients included in this study and provided a dataset for statistical analysis that was completed by Drs. Mitton, Ho and Ashburner. I also performed additional in-depth review of 100 patients who did not have timely FSC to understand the reasons for non-adherence. With Dr. Percac-Lima and Ashburner, I did the qualitative data analyses.

I completed the literature review, and designed our poster titled “Reasons for Non-Adherence with Recommended Surveillance Colonoscopy in Community Health Center Patients.” I presented this poster at:

1. New England Regional Society General Internal Medicine Conference, Boston, MA
March 10, 2017
2. 102nd Annual American Medical Women’s Association Annual Meeting, San Francisco, CA April 1, 2017
3. Annual Soma Weiss Medical and Dental Student Research, Boston, MA March 16, 2017
4. Massachusetts General Hospital Chelsea Health Center Community Research Day, Chelsea, MA October 13, 2017

I drafted the whole manuscript, except part of Methods/Results section related to quantitative analyses. The manuscript was reviewed and edited by Drs. Mitton, Ho, Ashburner and Percac-Lima.

Methods

This retrospective, matched cohort study was conducted in the Massachusetts General Hospital (MGH) academic primary care network. The MGH/Partners Institutional Review Board approved this study and waived the need for informed consent.

Creation of Cohort

Using the MGH Chelsea health center CRC screening patient navigation database, we identified patients 50 to 74 years old who received PN at time of an initial colonoscopy between January 1, 2010 and December 31, 2011, and had abnormal findings requiring FSC. We matched these patients in a 1:3 ratio by age, gender, race (white or non-white), CRC risk category (low, moderate, high/incomplete), and language (non-English or English) with patients at other MGH practices or healthcare centers who had an abnormal initial colonoscopy requiring a FSC during the same period but did not receive PN. Patients who had history of inflammatory bowel disease and colorectal cancer were excluded from the study. Duration of patient follow-up for this cohort continued through July 1, 2017 with chart abstraction completed August 22, 2017 to allow for capture of a 5-year follow-up period.

Patient measures

Patient demographics were collected from administrative databases and included age, gender, race (white or non-white), primary language (English or non-English), health insurance (Medicaid/ self-pay or other), education (high school completion or not), and number of primary care clinic visits per year. We also recorded a patient's date of initial colonoscopy and date of FSC.

Colorectal Cancer Risk Score

Colorectal cancer risk was scored using a tool based on risk factors identified by the American College of Gastroenterology guidelines⁴ through review of electronic medical records including progress notes, colonoscopy reports, and gastroenterology consult letters. Factors included: adequacy of bowel preparation, number, type and size of polyps detected, and gastroenterology recommendations for follow-up time interval. These factors were combined into a single CRC risk score with three categories correlating to an appropriate time for follow-

up ('high' = 1 year, 'moderate' = 3 years, 'low' = 5 years). Patients with inadequate bowel preparation were classified as high risk, requiring a 1-year follow-up.

Chart abstraction

Two authors separately performed additional in-depth review of medical records of all patients who did not receive timely FSC, to explore possible reasons for non-adherence with recommended FSC. The authors met weekly to compare the data and reach the consensus. Chart abstraction ended August 22, 2017 to allow for >5-year follow-up.

Outcomes

Our primary outcome is timely FSC, defined as surveillance colonoscopy completed within six months of the recommended date based on the CRC risk score. Our secondary outcome includes reasons for non-adherence to timely completion of FSC.

Statistical Analysis

We compared demographic characteristics by patient navigation (PN) using parametric and non-parametric tests based on variable distribution. We used a chi-square test to compare unadjusted differences in rates of timely completion of FSC between patients who received PN for initial colonoscopy and matched patients who did not receive PN.

To analyze the relationship between PN and timely FSC, we developed a multivariable logistic regression model adjusting for additional clinically relevant socio-demographic factors defined a priori and not accounted for by matching, including health insurance, education, and number of annual clinic visits. We additionally adjusted for language in the final model, given a statistically significant difference ($p < 0.05$) between groups despite matching. All analyses were conducted with SAS version 9.4 (SAS Institute Inc., Cary, NC).

Results

As presented in Table 1, there were 62 patients enrolled in CRC screening PN at time of initial colonoscopy with 154 matched unexposed patients at other primary care practices. Following the initial colonoscopy, 23 patients (11%) received a high CRC risk score requiring 1-year FSC, 99 (46%) patients received a moderate CRC risk score requiring 3-year FSC, and 94 (43%) patient received a low CRC risk score requiring 5-year FSC. There was no significant difference in risk score stratification between the study groups (p-value=0.74). As expected due to matching, there were no significant differences in age, gender, race, or risk category between the two groups. There was no notable difference in annual number of primary care clinic visits by study group (p= 0.99). Patients who received PN at time of initial colonoscopy were less likely to have completed a high school education (42% versus 17%, p-value <0.001), more likely to be insured by Medicaid (64% versus 36%, p <0.001), and were more likely to be non-English speaking (56% versus 25%, p <0.001), when compared to matched patients who did not receive PN.

Timely follow-up surveillance colonoscopy

During the study period among patients who received PN, 55% (n=34/62) completed a timely FSC compared to 53% (n=82/154) in the control group who did not receive PN at time of initial colonoscopy (p=0.88), as seen in Table 2. After fully adjusting for insurance, education, language and number of annual primary care visits, patients who received PN at time of initial colonoscopy had similar odds (AOR=1.209, 95% CI 0.622-2.349) of completing a timely FSC when compared to those who did not receive PN (Table 3).

Reasons for non-adherence with recommended follow-up colonoscopy

We present reasons for non-adherence with timely FSC among 100 patients (28 navigated and 72 non-navigated) by CRC risk category (Table 4). Individual patients had several reasons for non-adherence, total of 119 reasons, 29 in the navigated group and 90 in the non-navigated group.

Seven key themes emerged from our analysis. Four themes were directly related to patients: 1) patient declined the colonoscopy, 2) multiple co-morbidities and contraindications

to colonoscopy, 3) patient died and 4) patient moved/traveled. Three themes were related to system and provider issues: 1) patient referred but scheduling issues, 2) provider miscommunication, and 3) delayed referral. Circumstances classified as the “patient moved” includes patients moved to another practice, patient traveled during follow-up time or colonoscopy was completed at an outside hospital. Circumstances classified as “patient referred but scheduling issues” includes patient referred but appointment never scheduled, appointment was scheduled but it was cancelled or patient did not show up. Examples of “provider miscommunication” includes lack of follow-up date in primary care notes, lack of gastroenterology recommendation for follow-up in the record, discrepancy between primary care and gastroenterology notes regarding needed follow-up, and no documentation of referral or order for colonoscopy. “Delayed referral” is defined as a referral placed six-months after the surveillance colonoscopy due-date.

The reasons for non-adherence with FSC were similar in navigated and non-navigated patients. The most common reasons for non-adherence in the navigated group were patient moved/traveled (20.7%, n=6), patient referred but scheduling issues (17.2%, n=5), provider miscommunication (10.3%, n=3) and delayed referral (10.3%, n=3). The most common reasons in the non-navigated groups were provider miscommunication (15.6%, n=14), comorbidities (13.3%, n=12) and delayed referral (12.2%, n=11). We noted some difference in reasons for non-adherence by CRC risk. Patient who had incomplete colonoscopy and needed FSC within one year often declined, had scheduling issues or provider miscommunication. Patients at low risk who needed to complete FSC at five years had more overall reasons for non-adherence. They often had co-morbidities, moved/traveled or died. System/provider issues such as scheduling, delayed referral and providers’ miscommunication were most common in the moderate risk group.

Discussion

Our study showed that there was no significant difference in rates of timely FSC between patients who received and did not receive patient navigation for initial colonoscopy. It is possible that the comparable rates are due to the current design of the patient navigation program, which is limited to engagement only at the time of initial colonoscopy. Murphy et al. found non-attenders of surveillance colonoscopies have multiple perceived barriers including concerns for cost, transportation, and fears about medical complications and repeating the bowel prep.³⁰ These are exactly the barriers that patient navigators are trained to intervene when helping underserved populations.²⁵ Patient navigators re-engagement closer to the time of scheduled FSC could help address these logistical issues as well as providing education around better preparation for colonoscopy to improve timeliness of surveillance colonoscopies.

Our in-depth chart review revealed the reasons why patients did not complete surveillance colonoscopies were often systems barriers such as provider miscommunication regarding the follow-up time interval, difficulties scheduling after the patient was referred and patient declining or cancelling the follow-up colonoscopy. These results may have implications for primary care practices seeking to improve access and adherence to surveillance. To prevent provider miscommunications, primary care physicians can coordinate with gastroenterologists to standardize the method of communicating recommendations to minimize confusion about follow-up. Several possibly beneficial efforts to address systems barriers have been described: Adding “adenoma” to the electronic medical record (EMR) problem-list has been identified as a predictor of adherence to surveillance,⁽²⁹⁾ creating a SmartLetter in the electronic records to standardize communication between providers, reminder letters about follow-up and add alert messages in patient charts.^(38,40) For patients who decline follow-up after an incomplete colonoscopy, other surveillance options could be effective such as CT colonography, fecal occult blood testing and colon capsule endoscopy.⁽³⁶⁻³⁷⁾

The major limitation of our study is inherent to the retrospective design. The type and number of reasons collected is limited to available documentation in the electronic medical record. Due to the matched design of the study, the results may not be generalizable to the overall population. However, we wanted to be able to draw conclusions on minority and low-

income populations while improving study validity. Another limitation in our study was a small percentage of cases where the gastroenterologist recommended surveillance intervals which were discordant with the risk classification based on pathology. For example, a patient with an incomplete colonoscopy could be recommended for three-year follow-up. This does not impact our results because both follow-up intervals were used in classifying patients as adherent or non-adherent to FSC. Finally, we were not able to obtain data about colonoscopies performed outside our institution.

Almost half of our underserved patients who had abnormal or incomplete initial colonoscopy did not receive timely follow-up surveillance colonoscopy. This rate of timely surveillance colonoscopy is comparable to the rate of other community practices, which have ranged from 46-58% study by Schoen et al. published eight years ago.³⁹ During this time, the CRC screening rates in the United States have significantly increased.⁴¹ However, if underserved populations who were navigated to receive screening are not guided to follow-up after abnormal findings, it might be difficult to achieve equity in CRC mortality reduction.

In conclusion, our study did not show an association between timely follow-up surveillance colonoscopy and patient navigation for initial screening colonoscopy in underserved populations. Multiple patient, provider and system barriers to timely FSC were identified. Future research should seek to better understand if implementing patient navigation not only for initial but also at the time of recommended follow-up surveillance colonoscopy would improve adherence to follow-up and equity in colorectal cancer outcomes.

Acknowledgments

I would like to thank my research mentor and the principle investigator of this project, Dr. Sanja Percac-Lima for her guidance, time and hard work from design to the completion of this project. Also, I am very grateful to Drs. Julian Mitton, Janet Ho, Jeffrey Ashburner and Wei He for their hard work with the data analysis, reviewing the manuscript and guidance with shaping the project and writing the project. I want to thank my family and friends for their support during my research year and throughout my medical school experience. I could not have done this without your support!

References

1. Center for Disease Control and Prevention, Division of Cancer Prevention and Control. *Colorectal Cancer Statistics*. Atlanta: Center for Disease Control and Prevention. Last updated June 7, 2017.
2. American Cancer Society. *Cancer Facts & Figures 2017*. Estimated Number of Deaths for the Four Major Cancers by Sex and Age Group. 2017. Atlanta, GA: American Cancer Society; 2017.
3. Bibbins-Domingo K, Grossman DC, Curry SJ, et al. Screening for Colorectal Cancer: US Preventive Services Task Force Recommendation Statement. *JAMA*. 2016;315(23):2564-2575. doi:10.1001/jama.2016.5989.
4. 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 | American College of Gastroenterology. 2012 <http://gi.org/guideline/guidelines-for-colonoscopy-surveillance-after-screening-and-polypectomy-a-consensus-update-by-the-us-multi-society-task-force-on-colorectal-cancer/>. Accessed February 4, 2017.
5. Zauber AG, Winawer SJ, O'Brien MJ, et al. Colonoscopic polypectomy and long-term prevention of colorectal-cancer deaths. *N Engl J Med*. 2012;366(8):687-696. doi:10.1056/NEJMoa1100370.
6. Morois S, Cottet V, Racine A, et al. Colonoscopy reduced distal colorectal cancer risk and excess cancer risk associated with family history. *Cancer Causes Control*. 2014;25(10):1329-1336. doi:10.1007/s10552-014-0438-7.
7. Yang DX, Gross CP, Soulos PR, Yu JB. Estimating the magnitude of colorectal cancers prevented during the era of screening: 1976 to 2009. *Cancer*. 2014;120(18):2893-2901. doi:10.1002/cncr.28794.
8. Nishihara R, Wu K, Lochhead P, et al. Long-term colorectal-cancer incidence and mortality after lower endoscopy. *N Engl J Med*. 2013;369(12):1095-1105. doi:10.1056/NEJMoa1301969.
9. Cottet V, Jooste V, Fournel I, Bouvier A-M, Faivre J, Bonithon-Kopp C. Long-term risk of colorectal cancer after adenoma removal: a population-based cohort study. *Gut*. 2012;61(8):1180-1186. doi:10.1136/gutjnl-2011-300295.
10. Good NM, Macrae FA, Young GP, et al. Ideal colonoscopic surveillance intervals to reduce incidence of advanced adenoma and colorectal cancer. *J Gastroenterol Hepatol*. 2015;30(7):1147-1154. doi:10.1111/jgh.12904.
11. le Clercq CMC, Winkens B, Bakker CM, et al. Metachronous colorectal cancers result

from missed lesions and non-compliance with surveillance. *Gastrointest Endosc.* 2015;82(2):325-333.e2. doi:10.1016/j.gie.2014.12.052.

12. Lebwohl B, Kastrinos F, Glick M, Rosenbaum AJ, Wang T, Neugut AI. The impact of suboptimal bowel preparation on adenoma miss rates and the factors associated with early repeat colonoscopy. *Gastrointest Endosc.* 2011;73(6):1207-1214. doi:10.1016/j.gie.2011.01.051.
13. Britton EJ, Sidhu S, Geraghty J, Psarelli E, Sarkar S. The 5-year outcome of patients having incomplete colonoscopy. *Colorectal Dis.* 2015;17(4):298-303. doi:10.1111/codi.12901.
14. Jang ES, Kim JW, Jung YJ, et al. Clinical and endoscopic predictors of colorectal adenoma recurrence after colon polypectomy. *Turk J Gastroenterol.* 2013;24(6):476-482.
15. Jang HW, Park SJ, Hong SP, Cheon JH, Kim WH, Kim TI. Risk Factors for Recurrent High-Risk Polyps after the Removal of High-Risk Polyps at Initial Colonoscopy. *Yonsei Med J.* 2015;56(6):1559-1565. doi:10.3349/ymj.2015.56.6.1559.
16. de Jonge V, Sint Nicolaas J, van Leerdam ME, Kuipers EJ, Veldhuyzen van Zanten SJO. Systematic literature review and pooled analyses of risk factors for finding adenomas at surveillance colonoscopy. *Endoscopy.* 2011;43(7):560-572. doi:10.1055/s-0030-1256306.
17. 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. *Gastroenterology.* 2014;147(4):903-924. doi:10.1053/j.gastro.2014.07.002.
18. American Cancer Society. *Colorectal Cancer Facts & Figures 2017-2019.* Atlanta: American Cancer Society; 2017.
19. Jackson CS, Oman M, Patel AM, Vega KJ. Health disparities in colorectal cancer among racial and ethnic minorities in the United States. *J Gastrointest Oncol.* 2016;7(Suppl 1):S32-43. doi:10.3978/j.issn.2078-6891.2015.039.
20. Percac-Lima S, López L, Ashburner JM, Green AR, Atlas SJ. The longitudinal impact of patient navigation on equity in colorectal cancer screening in a large primary care network. *Cancer.* 2014;120(13):2025-2031. doi:10.1002/cncr.28682.
21. Braschi CD, Sly JR, Singh S, Villagra C, Jandorf L. Increasing colonoscopy screening for Latino Americans through a patient navigation model: a randomized clinical trial. *J Immigr Minor Health.* 2014;16(5):934-940. doi:10.1007/s10903-013-9848-y.
22. Honeycutt S, Green R, Ballard D, et al. Evaluation of a patient navigation program to promote colorectal cancer screening in rural Georgia, USA. *Cancer.* 2013;119(16):3059-3066. doi:10.1002/cncr.28033.

23. Naylor K, Ward J, Polite BN. Interventions to improve care related to colorectal cancer among racial and ethnic minorities: a systematic review. *J Gen Intern Med*. 2012;27(8):1033-1046. doi:10.1007/s11606-012-2044-2.
24. Jandorf L, Stossel LM, Cooperman JL, et al. Cost analysis of a patient navigation system to increase screening colonoscopy adherence among urban minorities. *Cancer*. 2013;119(3):612-620. doi:10.1002/cncr.27759.
25. Freeman HP. The origin, evolution, and principles of patient navigation. *Cancer Epidemiol Biomarkers Prev*. 2012;21(10):1614-1617. doi:10.1158/1055-9965.EPI-12-0982.
26. Fritz C, Naylor K, Kim K. Knowledge of Polyp History and Recommended Follow-Up Among a Predominately African American Patient Population and the Impact of Patient Navigation. *J Racial Ethn Health Disparities*. 2016;3(3):403-412. doi:10.1007/s40615-015-0152-5.
27. Lee J-H, Fulp W, Wells KJ, Meade CD, Calcano E, Roetzheim R. Effect of patient navigation on time to diagnostic resolution among patients with colorectal cancer-related abnormalities. *J Cancer Educ*. 2014;29(1):144-150. doi:10.1007/s13187-013-0561-2.
28. Green BB, Anderson ML, Wang C-Y, 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. doi:10.3122/jabfm.2014.06.140125.
29. Calderwood AH, Schroy PC, Kluge MA, Cabral HJ, Burgess JF. Predictors of Adherence to Post-Polypectomy Surveillance Colonoscopy. *J Health Care Poor Underserved*. 2016;27(1):261-279. doi:10.1353/hpu.2016.0028.
30. Murphy CC, Lewis CL, Golin CE, Sandler RS. Underuse of Surveillance Colonoscopy in Patients at Increased Risk of Colorectal Cancer. *Am J Gastroenterol*. 2015;110(5):633-641. doi:10.1038/ajg.2014.344.
31. Naylor J, Saltzman JR, Campbell EJ, Perencevich ML, Jajoo K, Richter JM. Impact of physician compliance with colonoscopy surveillance guidelines on interval colorectal cancer. *Gastrointestinal Endoscopy*. 2017;85(6): 1263-1270. ISSN 0016-5107.
32. Sunny A, Rustveld L. The Role of Patient Navigation on Colorectal Cancer Screening Completion and Education: a Review of the Literature. *Journal of Cancer Education*. 2016; p 1-9. DOI 10.1007/s13187-016-1140-0.
33. DeGross A, Schroy PC, Morrissey KG, Slotman B, Rohan EA, Bethel J, Murillo J, Ren W, Niwa S, Leadbetter S, Joseph D. Patient Navigation for Colonoscopy Completion: Results of an RCT. *American Journal of Preventive Medicine*. 2017; 53(3): 363-372. ISSN 0749-3797.

34. Reuland DS, Brenner AT, Hoffman R, McWilliams A, Rhyne RL, Getrich C, Tapp H, Weaver MA, Callan D, Cubillos L, Urquieta de Hernandez B, Pignone MP. Effect of Combined Patient Decision Aid and Patient Navigation vs Usual Care for Colorectal Cancer Screening in a Vulnerable Patient Population A Randomized Clinical Trial. *JAMA Internal Medicine*. 2017;177(7):967–974. doi:10.1001/jamainternmed.2017.1294
35. Rice K, Gressard L, DeGroff A, Gersten J, Robie J, Leadbetter S, Glover-Kudon R, Butterly L. Increasing colonoscopy screening in disparate populations: Results from an evaluation of patient navigation in the New Hampshire Colorectal Cancer Screening Program. *Cancer*. 2017; 123(17): 3356–3366.
36. Triantafyllou K, Viazis N, Tsibouris P, et al. Colon capsule endoscopy is feasible to perform after incomplete colonoscopy and guides further workup in clinical practice. *Gastrointestinal Endoscopy*. 2014;79(2):307-316.
37. Spada C, Hassan C, Barbaro B, et al. Colon capsule versus CT colonography in patients with incomplete colonoscopy: a prospective, comparative trial. *Gut* 2015; 64:272-281.
38. Atreja A, Patel SS, Boules M, Putka B, Rizk M. Automated recall system for colonoscopy: a generalizable informatics solution for procedures requiring timely follow-up. *Gastrointestinal Endoscopy*. 2014;80(4):684-688. doi:10.1016/j.gie.2014.03.022.
39. Schoen, R. E., Pinsky, P. F., Weissfeld, J. L., Yokochi, L. A., Reding, D. J., Hayes, R.B. et al. Utilization of Surveillance Colonoscopy in Community Practice. *Gastroenterology*. 2010; 138(1): 73–81. <https://doi.org/10.1053/j.gastro.2009.09.062>
40. Rapuri, S., Spencer, J., & Eckels, D. Importance of postpolypectomy surveillance and postpolypectomy compliance to follow-up screening—review of literature. *International Journal of Colorectal Disease*. 2008; 23(5): 453–459. <https://doi.org/10.1007/s00384-007-0430-8>
41. National Center for Health Statistics. Health, United States, 2016: With Chartbook on Long-term Trends in Health. Hyattsville, MD. 2017.

Tables and Figures

Table 1: Baseline patients' characteristics N=216

Characteristics	Patients with navigation N=62	Patients without navigation N=154	p-value
Age, mean (SD), y ¹	61 (7.3)	61 (7.2)	0.985
Female, N (%) ¹	25 (40)	58 (38)	0.758
Non-Latino White, N (%) ¹	34 (56)	96 (62)	0.440
Colorectal Cancer Risk Score², N (%)¹			0.735
High (1 year)	5 (8)	18 (12)	
Moderate (3 years)	29 (47)	70 (45)	
Low (5 years)	28 (45)	66 (43)	
Primary language, N (%)¹			<0.001
English	27 (44)	116 (75)	
Non-English	35 (56)	38 (25)	
Education, N (%)			<0.001
Non-high school graduate	25 (42)	25 (17)	
High school graduate or beyond	34 (58)	124 (83)	
Insurance, N (%)			<0.001
Medicaid or Dual eligibility	39 (64)	56 (36)	
Other (Private, Medicare, etc.)	22 (36)	98 (64)	
Annual No. primary care visits, mean (SD)	3.3 (2.0)	3.3 (2.7)	0.993

¹ Matched patient factors

² Recommended time for follow-up surveillance colonoscopy correlating with risk score

Table 2: Proportion of patients with timely completion of follow-up surveillance colonoscopy in navigated vs. non-navigated patients for initial screening colonoscopy

	Patients with navigation N=62	Patients without navigation N=154	p-value
Timely FSC ³ , N (%)			
Timely completion	34 (55 %)	82 (53 %)	p=0.881

³ FSC (follow-up surveillance colonoscopy) is considered timely when completed within 6-months of timeframe recommended per colorectal cancer risk score

Table 3: Odds of timely completion of follow-up screening colonoscopy among patients who receive patient navigation compared to those who do not¹

	Odds Ratio (95% CI)
Unadjusted ² (95% CI)	1.066 (0.590, 1.927)
Adjusted ^{2,3} (95% CI)	1.209 (0.622, 2.349)

¹ Follow-up surveillance colonoscopy is considered timely when completed within 6-months of timeframe recommended per colorectal cancer risk score

² Matched patient factors: age, sex, race, colorectal cancer risk score, primary language

³ Adjusted for education, insurance, # annual clinic visits, language

Table 4: Reasons for Nonadherence with timely FSC in Navigated (PN=29) and Non-navigated (No-PN =90) patients

Reasons	High risk		Moderate Risk		Low risk	
	PN ¹ (n=3)	No-PN (n=10)	PN (n=12)	No-PN (n=46)	PN (n=14)	No-PN (n=34)
Patient declined	3.4%	4.4%	3.4%	3.3%	-	3.3%
Patient referred but scheduling issues	3.4%	-	17.2%	12.2%	6.9%	4.4%
Provider Miscommunication	3.4%	3.3%	-	15.6%	10.3%	6.6%
Co-morbidities	-	3.3%	3.4%	4.4%	-	8.9%
Delayed Referral	-	-	10.3%	13.3%	6.9%	8.9%
Patient died	-	-	-	-	3.4%	1.1%
Patient moved/traveled	-	-	6.9%	2.2%	20.7%	4.4%

¹PN – patient navigation at initial screening colonoscopy