

---

# AJPM FOCUS

---

INCLUSIVITY IN PEOPLE, METHODS, AND OUTCOMES

RESEARCH ARTICLE

## An Estimate of Preventable Harms Associated With Screening Colonoscopy Overuse in the U.S.



Shannon Brownlee, MSc,<sup>1</sup> Alison N. Huffstetler, MD,<sup>2</sup> Joseph Fraiman, MD,<sup>3</sup>  
Kenneth W. Lin, MD, MPH<sup>4</sup>

**Introduction:** Screening colonoscopy is often performed on patients who are younger or older than the ages specified in national guidelines or at shorter intervals than recommended. The annual incidence of harms associated with overuse of screening colonoscopy in the U.S. is not known. This study estimated the incidence of low-value screening colonoscopies annually in the U.S. and the number of preventable harms associated with them.

**Methods:** The 2018 National Health Interview Survey was used to estimate the number of annual screening colonoscopies. Rates of colonoscopy overuse and serious (bleeding and bowel perforation) and minor harms were drawn from 3 recent systematic reviews.

**Results:** Approximately 12.4 million screening colonoscopies were completed in the U.S. in 2018. Given the credible range of overuse rates of screening colonoscopy, between 2.1 and 3.2 million low-value colonoscopies occur per year. Applying the credible ranges identified for serious and minor harms secondary to screening colonoscopy resulted in an estimated annual incidence of serious harm from unnecessary colonoscopies ranging from 9,055 to 11,874. The estimate for minor harms ranged from 359,5790 to 1,566,846.

**Conclusions:** In the U.S., screening colonoscopies are often completed at intervals and in populations that are inconsistent with national recommendations, resulting in unnecessary serious and minor harm. Although individual risk is relatively low, the large number of nonindicated screening colonoscopies results in large numbers of adverse events that are preventable with better adherence to recommendations.

*AJPM Focus 2025;4(1):100296. © 2024 The Author(s). Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).*

---

## INTRODUCTION

Screening colonoscopy is often performed on patients who are younger or older than the ages specified in national guidelines<sup>1–3</sup> or at shorter intervals than recommended. Nonindicated use of the procedure is considered low-value care or overuse.<sup>4–7</sup> When screening colonoscopy is performed in accordance with guidelines, the potential benefits of this procedure exceed the risk of harm. Conversely, when not indicated, the risk of harm generally outweighs the potential benefits. Harms include rare but serious complications such as bowel

perforation and gastrointestinal bleeding as well as infection, cardiovascular events, and death.<sup>8,9</sup> Less serious

---

From the <sup>1</sup>Milken School of Public Health, The George Washington University, Washington, District of Columbia; <sup>2</sup>Robert Graham Center for Policy Studies in Family Medicine and Primary Care, Washington, District of Columbia; <sup>3</sup>Baromedical Research Institute, New Orleans, Louisiana; and <sup>4</sup>Penn Medicine Lancaster General Health, Lancaster, Pennsylvania

Address correspondence to: Kenneth W. Lin, MD, MPH, Department of Family Medicine, Lancaster General Hospital, 540 North Duke Street, Lancaster PA 17602. E-mail: [Kenneth.Lin@georgetown.edu](mailto:Kenneth.Lin@georgetown.edu).

2773-0654/\$36.00

<https://doi.org/10.1016/j.focus.2024.100296>

harms of screening colonoscopy are much more common and include discomfort from bowel preparation and the procedure, minor bleeding, lost days of work, and pain. Harm caused by an unnecessary screening colonoscopy is avoidable and thus can be considered preventable harm.

Progress in reducing the rates of overuse of common procedures and tests has been slow, possibly because scant information exists to quantify the amount of harm associated with low-value services.<sup>10</sup> In the case of screening colonoscopy, the annual incidence of harms associated with overuse of the procedure has been unknown because no study has formally attempted to estimate its frequency. This study represents an effort to estimate the annual incidence of screening colonoscopy overuse and the incidence of the resulting harms it causes in the U.S.

## METHODS

To estimate the annual incidence of low-value screening colonoscopy and the serious and minor harms that result, several baseline statistics were necessary: the number of screening colonoscopies performed annually in the U.S., the rate of serious and minor harms associated with the procedure, and the rate of screening overuse.

### Study Sample

To estimate the total number of screening colonoscopies, the authors obtained data from the 2018 cancer supplement to the National Health Interview Survey (NHIS).<sup>11</sup> The survey included 3 relevant questions: *ever had a colonoscopy*, *reason for colonoscopy*, and *year of most recent colonoscopy*. Sampling weights, survey design variables for poststratification, clustering, and complex study design provided in the NHIS were used to achieve nationally representative estimates of numbers of screening colonoscopies performed annually. Analyses were performed in STATA.

### Measures

For the rates of harms and rates of overuse of screening colonoscopy, the authors relied on 3 recent systematic reviews. A credible rate of minor harms was obtained from Steffenssen et al.,<sup>12</sup> which is a systematic review of the minor adverse events after colonoscopy. The authors took the lowest and highest rates of minor adverse events occurring in the 14 days after colonoscopy as reported by the systematic review. For the rates of serious harm, the authors relied on Huffstetler and colleagues,<sup>13</sup> which provided a credible range of estimates for severe bleeding events and bowel perforation from screening colonoscopy. Fraiman et al.<sup>14</sup> provided a

credible range of estimates for the rate of overuse of screening colonoscopy, with the low and high estimates of the range based on the results of studies included in the review that had the highest and lowest estimates of overuse rates (the systematic reviews by Huffstetler and Fraiman were conducted in preparation for estimating serious harms due to low-value screening colonoscopy in this study).

### Statistical Analysis

To estimate the annual incidence of unnecessary screening colonoscopy in the U.S., the credible range of the screening colonoscopy overuse rate was multiplied by the annual number of screening colonoscopies. To obtain a credible range for the annual incidence of serious and minor harms secondary to those unnecessary screenings, the low and high estimates of the annual incidence of unnecessary colonoscopies performed in the U.S. were multiplied, respectively, by the low and high estimates of the rate of serious and minor harms. The incidence of overuse and harms over a 10-year period was estimated by assuming that the incidence of screening colonoscopy and overuse remains constant over the following 10 years. For ethics statement, because this study did not involve human subjects, ethics committee review was not applicable.

## RESULTS

In the 2018 NHIS cancer supplement, 13,439 respondents answered all 3 of the following questions: *ever had a colonoscopy*, *reason for colonoscopy*, and *year of most recent colonoscopy*. Of the responses, 1,843 had a routine screening colonoscopy (*yes* to the first 2 questions) in 2018. On the basis of NHIS sampling weights, there were approximately 12.4 million screening colonoscopies in the U.S. in 2018.

Fraiman and colleagues<sup>14</sup> provided a credible range for the rate of overuse of screening colonoscopy of 17.0%–25.7% of screening colonoscopies.

Steffenssen et al.<sup>12</sup> reported a total of 7 studies following colonoscopy at varying time points; between days 1 and 14 after colonoscopy, the lowest and highest rates of minor adverse events reported were 17% and 49%, respectively, representing a credible range of acute and subacute minor adverse events after colonoscopy.

Huffstetler and colleagues<sup>13</sup> estimated that the rate of serious bleeding ranged credibly from 16.40 to 36.18 per 10,000 colonoscopies and the rate of perforation ranged credibly from 7.62 to 8.50 per 10,000 colonoscopies, giving a total serious adverse event rate of 24.02–44.68 per 10,000 colonoscopies.

The authors then estimated an annual incidence of unnecessary screening colonoscopies in the U.S. using the NHIS approximation for the number of colonoscopies and overuse rates from Fraiman et al.<sup>14</sup> The number of unnecessary screening colonoscopies performed annually in the U.S. falls between 2.1 and 3.2 million. Assuming that the annual incidence of overuse of screening colonoscopy remains constant over the next 10 years, 21–32 million unnecessary screening colonoscopies will be performed.

Our estimate of the annual incidence of serious and minor harms from overuse of screening colonoscopy in the U.S. was calculated by taking the annual incidence of unnecessary screening colonoscopies and applying the rates of harms. The authors calculate that the annual incidence of serious harm from unnecessary colonoscopies ranges from 9,055 to 11,874. The annual incidence of bowel perforation in the course of a low-value colonoscopy ranges from 1,798 to 2,258, and severe bleeding events fall between 7,257 and 9,616 annually. Estimates of the annual incidence of minor harm resulting from overuse of screening colonoscopy ranged from 359,579 to 1,566,846. If the annual incidence of overuse of screening colonoscopy remains constant over a 10-year screening period, between 90,550 and 118,740 serious harms would result; the incidence of minor harms would range from 3.6 million to 15.7 million.

## DISCUSSION

These findings suggest that over the next 10 years, at least 21 million people in the U.S. could receive unnecessary screening colonoscopies; more than 3 million harms will result, tens of thousands of which will be serious. Previous research has estimated the rates of harm due to overdiagnosis subsequent to other cancer screening tests, including prostate, lung, thyroid, and breast.<sup>15</sup> This study differs because the authors focused not on the harm due to overdiagnosis of colorectal cancer but rather on direct harm from the screening test itself. To the authors' knowledge, this is the first study to estimate a credible range of the annual incidence of low-value screening colonoscopies; it is also the first estimate for the harm caused by these unnecessary procedures and the first study to quantify the harm directly caused by the overuse of any cancer screening test.

Although the risk of serious harm associated with a single screening colonoscopy is relatively low, and the potential benefits of appropriate screening colonoscopy are thought to outweigh the harms, these estimates apply only when the procedure is used appropriately. Low-value screening colonoscopy, by contrast, offers little or no benefit while posing the same risk of harm. A

procedure that offers scant chances of benefit should matter to individual patients, but it becomes especially concerning when the impact on a population level is considered. The findings of this study suggest that at a population level, overuse of screening colonoscopy worsens the harm-to-benefit ratio offered by national screening colonoscopy efforts. In addition, in 2021, the U. S. Preventive Services Task Force broadened the age range for colorectal cancer screening, which increases the total population that may incur unnecessary screening, increasing the absolute number of individuals who experience harm from unnecessary procedures.

In an ideal world, these findings should have an impact on efforts to curb overuse. Over the last decade, there has been increasing attention paid both to documenting the rate of overuse of numerous medical services and the associated financial costs. Because the scope of the problem of overuse has become clearer, many health systems have undertaken efforts to reduce it, mostly in the name of curbing unnecessary spending or waste.<sup>16</sup>

Such efforts have had mixed results. For example, the Choosing Wisely Campaign, a set of do-not-do lists that have been widely circulated among clinicians and patients around the world, has for the most part resulted in modest<sup>17</sup> or minimal<sup>18</sup> reductions in rates of overuse in the U.S.

Quality improvement efforts intended to reduce or prevent overuse may be hampered by the fact that the delivery of low-value care is driven by multiple factors. In the case of screening colonoscopy, widespread lack of awareness of the U.S. Preventive Services Task Force and Multi-Society Task Force guidelines among clinicians<sup>19</sup> appears to be one such factor. Public awareness campaigns often urge the public to get screened, with little attention paid to possible harms of overuse of screening tests. Fee-for-service payment coupled with concerns about missing something may drive some clinicians to recommend screenings that offer little potential benefit to a patient. In addition, some insurance plans provide financial incentives to clinicians to recommend colonoscopy and for patients to undergo them.

Other quality improvement campaigns, by contrast, have been more successful than efforts to curb overuse. For example, the U.S. and other health systems have made strides in addressing patient harm from medication and medical errors. Such harms have been dubbed preventable, a term that is commonly defined as “the presence of an identifiable, modifiable cause of harm.”<sup>20</sup> This definition can be applied to the overuse of screening colonoscopy and indeed to many other overused services. Low-value screening colonoscopy is both identifiable and modifiable, and thus harms that occur in the

course of delivering this service outside of national guidelines are potentially preventable.

The efforts to curb overuse could potentially mimic the success of the campaigns to reduce medical errors by focusing more on the harm caused by overuse and less on waste, which to date has been the most prominent theme in discussions of the problem and which often translates to patients and clinicians as financial cost.<sup>21</sup> However, to use the prevalence of needless harm as a reason to reduce overuse, more studies are needed to quantify it. This study provides one means for accomplishing that goal.

While patients may be more concerned with the potential for physical harm, policy makers and insurers will also want to consider the financial costs of unnecessary harm. Fraiman and colleagues<sup>14</sup> estimated that \$3 billion are wasted annually on the delivery of unnecessary colonoscopies. That waste is compounded by the cost of hospitalizing patients who suffered serious adverse events subsequent to those procedures, and while estimating that amount is beyond the scope of this paper, it is entirely feasible. Policy makers and funders may want to consider promoting research that investigates both the rate of harm from unnecessary procedures and the avoidable cost of caring for patients.

### Limitations

On the basis of evidence from 3 systematic reviews, this paper provides a credible range for the annual incidence of serious and minor harms associated with low-value screening colonoscopy in the U.S. There are ways to more directly estimate harms from overused procedures and tests, but these methods require very large, often expensive and unwieldy databases that, at least in the case of patients who are privately insured, are not widely available. In addition, using medical record data to link an individual harm to a low-value procedure can be challenging.<sup>10</sup> The method for estimating harm from overuse detailed in this paper has the advantage of relying on published data.

Two of the systematic reviews the authors relied on for their calculations for serious harm and overuse reported their credible ranges as likely underestimates of the true rate. For example, Fraiman et al.<sup>14</sup> found that the studies they used to create their estimates for rates of overuse of screening colonoscopy all used definitions of overuse that were more specific than sensitive; this would result in underestimates of the overuse rates.<sup>13</sup> Given that the overuse studies employed such specific definitions, the authors can be relatively confident the actual incidence of serious harms from overuse of screening colonoscopy is not lower than their credible range. It follows that the true annual incidence of serious

harm from overuse of screening colonoscopy is probably higher than the low end of the credible range offered in this study (9,055) and potentially higher than the high end (11,874).

It should be noted that the estimate of minor adverse events after colonoscopy was based on a systematic review that included multiple types of colonoscopies. That review reported that screening/surveillance colonoscopies resulted in a higher rate of minor adverse events than therapeutic colonoscopies, with an OR of 1.6. In light of this finding, it is possible that the estimate of minor adverse events from overuse of screening colonoscopy is also an underestimate of the true rate.

Finally, although the NHIS data provide the best available estimate for the number of screening colonoscopies performed annually in the U.S., it relies on a self-reported survey that could potentially over or underestimate the actual number of colonoscopies performed.

## CONCLUSIONS

The large number of low-value screening colonoscopies performed each year and identified in this study suggests that hundreds of thousands of U.S. patients are suffering harms that are potentially preventable, with thousands of patients being seriously harmed. Harms associated with low-value screening colonoscopy are completely preventable. Primary care physicians and endoscopists have an opportunity to reduce risk to their patients by improving guideline adherence. The authors hope that their findings motivate both patients and clinicians to avoid low-value colorectal cancer screening.

## ACKNOWLEDGMENTS

The authors are grateful to the Lown Institute for logistical support and for the contributions of Michael Stoto (statistical analysis of prior estimates of overuse and harms), Richelle Cooper (conceptualization), and Jerry Hoffman (conceptualization). The authors would also like to thank Anuradha Jetty and Elizabeth Wilkinson for their assistance with National Health Interview Survey estimate and weighting.

Disclaimers: The funder had no role in design, execution, analysis, or writing of this study or the decision to submit for publication.

Funding: This work was supported by the Robert Wood Johnson Foundation through Grant Number 75223.

Declaration of interest: none.

## CREDIT AUTHOR STATEMENT

Shannon Brownlee: Conceptualization, Investigation, Resources, Writing — original draft, Funding acquisition. Alison N. Huffstetler: Methodology, Validation, Formal analysis, Investigation, Data curation, Writing — review & editing, Visualization. Joseph Fraiman: Conceptualization, Validation, Investigation, Writing —

original draft, Visualization. Kenneth W. Lin: Conceptualization, Methodology, Validation, Investigation, Data curation, Writing – review & editing, Supervision.

## REFERENCES

1. U.S. Preventive Services Task Force, Davidson KW, Barry MJ, et al. Screening for colorectal cancer: U.S. Preventive Services Task Force recommendation statement. *JAMA*. 2021;325(19):1965–1977. <https://doi.org/10.1001/jama.2021.6238>.
2. 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. *Am J Gastroenterol*. 2017;112(7):1016–1030. <https://doi.org/10.1038/ajg.2017.174>.
3. Patel SG, May FP, Anderson JC, et al. Updates on age to start and stop colorectal cancer screening: recommendations from the U.S. Multi-Society Task Force on Colorectal Cancer. *Gastroenterology*. 2022;162(1):285–299. <https://doi.org/10.1053/j.gastro.2021.10.007>.
4. Murphy CC, Sandler RS, Grubber JM, Johnson MR, Fisher DA. Underuse and overuse of colonoscopy for repeat screening and surveillance in the Veterans Health Administration. *Clin Gastroenterol Hepatol*. 2016;14(3):436–444.e1. <https://doi.org/10.1016/j.cgh.2015.10.008>.
5. Saini SD, Powell AA, Dominitz JA, et al. Developing and testing an electronic measure of screening colonoscopy overuse in a large integrated healthcare system. *J Gen Intern Med*. 2016;31(suppl 1):53–60. <https://doi.org/10.1007/s11606-015-3569-y>.
6. Mittal S, Lin YL, Tan A, Kuo YF, El-Serag HB, Goodwin JS. Limited life expectancy among a subgroup of medicare beneficiaries receiving screening colonoscopies. *Clin Gastroenterol Hepatol*. 2014;12(3):443–450.e1. <https://doi.org/10.1016/j.cgh.2013.08.021>.
7. Goodwin JS, Singh A, Reddy N, Riall TS, Kuo YF. Overuse of screening colonoscopy in the Medicare population. *Arch Intern Med*. 2011;171(15):1335–1343. <https://doi.org/10.1001/archinternmed.2011.212>.
8. Reumkens A, Rondagh EJA, Bakker CM, Winkens B, Masclee AAM, Sanduleanu S. Post-colonoscopy complications: a systematic review, time trends, and meta-analysis of population-based studies. *Am J Gastroenterol*. 2016;111(8):1092–1101. <https://doi.org/10.1038/ajg.2016.234>.
9. Day LW, Kwon A, Inadomi JM, Walter LC, Somsouk M. Adverse events in older patients undergoing colonoscopy: a systematic review and meta-analysis. *Gastrointest Endosc*. 2011;74(4):885–896. <https://doi.org/10.1016/j.gie.2011.06.023>.
10. Brownlee SM, Korenstein D. Better understanding the downsides of low value healthcare could reduce harm. *BMJ*. 2021;372:n117. <https://doi.org/10.1136/bmj.n117>.
11. National health interview survey; 2015. Data Release. [https://archive.cdc.gov/www\\_cdc\\_gov/nchs/nhis/releases/released201905.htm](https://archive.cdc.gov/www_cdc_gov/nchs/nhis/releases/released201905.htm). Accessed 26 September 2023.
12. Steffenssen MW, Al-Najami I, Baatrup G. Patient-reported minor adverse events after colonoscopy: a systematic review. *Acta Oncol*. 2019;58(suppl 1):S22–S28. <https://doi.org/10.1080/0284186X.2019.1574979>.
13. Huffstetler AN, Fraiman J, Brownlee S, Stoto MA, Lin KW. An estimate of severe harms due to screening colonoscopy: a systematic review. *J Am Board Fam Med*. 2023;36(3):493–500. <https://doi.org/10.3122/jabfm.2022.220320R2>.
14. Fraiman J, Brownlee S, Stoto MA, Lin KW, Huffstetler AN. An estimate of the U.S. rate of overuse of screening colonoscopy: a systematic review. *J Gen Intern Med*. 2022;37(7):1754–1762. <https://doi.org/10.1007/s11606-021-07263-w>.
15. Løberg M, Lousdal ML, Bretthauer M, Kalager M. Benefits and harms of mammography screening. *Breast Cancer Res*. 2015;17(1):63. <https://doi.org/10.1186/s13058-015-0525-z>.
16. Shrank WH, Rogstad TL, Parekh N. Waste in the U.S. health care system: estimated costs and potential for savings. *JAMA*. 2019;322(15):1501–1509. <https://doi.org/10.1001/jama.2019.13978>.
17. Baltz AP, Siegel ER, Kamal AH, et al. Clinical impact of ASCO Choosing Wisely guidelines on staging imaging for early-stage breast cancers: a time series analysis using SEER-Medicare data. *JCO Oncol Pract*. 2023;19(2):e274–e285. <https://doi.org/10.1200/OP.22.00500>.
18. Encinosa W, Davidoff AJ. Changes in antiemetic overuse in response to Choosing Wisely recommendations. *JAMA Oncol*. 2017;3(3):320–326. <https://doi.org/10.1001/jamaoncol.2016.2530>.
19. John BJ, Irukulla S, Mendall MA, Abulafi AM. Do guidelines improve clinical practice? – a national survey on surveillance colonoscopies. *Colorectal Dis*. 2010;12(7):642–645. <https://doi.org/10.1111/j.1463-1318.2009.01869.x>.
20. Nabhan M, Elraiyah T, Brown DR, et al. What is preventable harm in healthcare? A systematic review of definitions. *BMC Health Serv Res*. 2012;12:128. <https://doi.org/10.1186/1472-6963-12-128>.
21. Hicks LK. Reframing overuse in health care: time to focus on the harms. *J Oncol Pract*. 2015;11(3):168–170. <https://doi.org/10.1200/JOP.2015.004283>.