

Using Risk for Advanced Proximal Colonic Neoplasia To Tailor Endoscopic Screening for Colorectal Cancer

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Background: Colonoscopic screening for colorectal cancer has been suggested because sigmoidoscopy misses nearly half of persons with advanced proximal neoplasia.

Objective: To create a clinical index to stratify risk for advanced proximal neoplasia and to identify a subgroup with very low risk in which screening sigmoidoscopy alone might suffice.

Design: Cross-sectional study.

Setting: A company-based program of screening colonoscopy for colorectal cancer.

Patients: Consecutive persons 50 years of age or older undergoing first-time screening colonoscopy between September 1995 and June 2001.

Measurements: A clinical index with 3 variables was created from information on the first 1994 persons. Points were assigned to categories of age, sex, and distal findings. Risk for advanced proximal neoplasia (defined as an adenoma 1 cm or larger or one with villous histology, severe dysplasia, or cancer) was measured for each score. The index was tested on the next 1031 persons from the same screening program.

Results: Of 1994 persons, 67 (3.4%) had advanced proximal neoplasia. A low-risk subgroup comprising 37% of the cohort had scores of 0 or 1 and a risk of 0.68% (95% CI, 0.22% to 1.57%). Among the validation group of 1031 persons, risk for advanced proximal neoplasia in the low-risk subgroup (comprising 47% of the cohort) was 0.4% (upper confidence limit of 1.49%). Application of this index detected 92% of persons with advanced proximal neoplasms and, if applied following screening sigmoidoscopy, could reduce the need for colonoscopy by 40%. The marginal benefit of colonoscopy among low-risk persons was small: To detect 7 additional persons with advanced proximal neoplasia, 1217 additional colonoscopies would be required.

Conclusions: This clinical index stratifies the risk for advanced proximal neoplasia and identifies a subgroup at very low risk. If it is validated in other cohorts or groups, the index could be used to tailor endoscopic screening for colorectal cancer.

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Use of colonoscopy as a primary screening test has been suggested (1, 2) because recent studies of screening colonoscopy in asymptomatic persons have reported the risk for advanced proximal neoplasia to be 2.5% to 4% in persons with no distal polyps (3, 4). These studies indicate that about half of advanced proximal neoplasms would remain undetected if the decision to perform colonoscopy after sigmoidoscopy were based only on distal findings (3, 4). On the basis of how distal findings are used in decision making, colonoscopy will be performed in 5% of the population if "high-risk adenoma" is used as the criterion, 12% if "any adenoma" is used, and 25% if "any polyp" is used (5). Issues of cost, safety, and availability may limit feasibility of this strategy (6), however, and some experts have noted the importance and necessity of shifting use of colonoscopy from lower-risk to higher-risk groups (7). Although sigmoidoscopy is recommended as a primary screening technique in all current recommendations (8-12), some health care providers are uncomfortable recommending an "incomplete" endoscopic examination. However, the marginal benefit of screening colonoscopy compared with sigmoidoscopy remains unclear.

The decision about who requires colonoscopy, whether after sigmoidoscopy or in place of it, could be guided by knowledge about a person's risk for advanced proximal neoplasia. Several studies have evaluated the predictive utility of distal anatomy (13-17), but it might be possible to

refine prediction by also considering clinical features, such as age, sex, and family history. Desirable properties of a predictive index include the ability to discriminate well between persons with and without advanced proximal neoplasia; the use of reliable, objective, and readily available information; ease of use in clinical practice; and generalizability to different groups (18).

We sought to create an index to stratify risk for advanced proximal neoplasia in asymptomatic adults. The main goal was to identify a subgroup with very low risk for advanced proximal neoplasia, in which sigmoidoscopy alone might suffice even if a general strategy of widespread screening colonoscopy were to be implemented. A second goal was to determine whether a subgroup could be identified in which risk for advanced proximal neoplasia is sufficiently high a priori to warrant consideration for initial colonoscopic screening.

METHODS

Design

We performed a cross-sectional analysis of consecutive asymptomatic adults 50 years of age or older who underwent first-time screening colonoscopy between September 1995 and June 2001. The study was approved by the institutional review board of Indiana University at Indianapolis. Because the study is a retrospective analysis of an ex-

Context

Screening for colorectal cancer with sigmoidoscopy alone often misses proximal neoplasia.

Contribution

Using data from a company-based program of screening colonoscopy, these authors developed a risk index for advanced proximal neoplasia that stratified patients on the basis of age, sex, and distal colon findings. The prevalence of proximal neoplasia was 0.4%, 1.9%, and 3.8% among low-, intermediate-, and high-risk patients, respectively, in the validation sample.

Implications

A risk index that includes distal findings identifies low-risk patients whose probability of advanced proximal neoplasia is 1 in 250. The index may help identify patients who do not need colonoscopy after sigmoidoscopy.

Cautions

The index needs validation in additional populations.

—The Editors

isting data set, written informed consent from participants was not required.

Screening Program

In September 1995, self-insured Eli Lilly and Co., Inc., began providing screening colonoscopy as a health benefit. Employees and retirees and their dependents 40 years of age or older receive written information about the screening program and may call a toll-free number to obtain more information or to schedule an appointment for screening. A brief telephone interview is used to determine eligibility for the screening program. To qualify, persons must be asymptomatic (that is, report no visible rectal bleeding, no change in bowel habits, and no recent or current lower abdominal pain) and must have no personal history of colorectal cancer, polyps, or inflammatory bowel disease. Persons with such symptoms or conditions are urged to seek medical care from their usual provider. Eligible persons may undergo colonoscopy at 1 of 8 sites in central Indiana, where 36 board-certified gastroenterologists and colorectal surgeons participate in the program.

Study Procedures and Definitions

Polyethylene glycol lavage solution was used for bowel preparation. Fecal occult blood testing and sigmoidoscopy were not performed before colonoscopy. Information about previous screening or diagnostic tests involving the colon and about family history of colorectal cancer was unavailable for analysis because it is not routinely obtained or recorded.

During colonoscopy, the location and size of all polyps were determined before their removal. The methods for assessing location and size were chosen by the endoscopist.

Pathologic specimens were examined by 1 of 3 board-certified pathologists, who classified polyps according to World Health Organization criteria (19). The pathologists who interpreted proximal polyps would have interpreted distal polyps as well, but they were unaware of the study hypothesis. Histologic characteristics of polyps were reported as normal mucosa, hyperplastic, tubular, tubulovillous, or villous. An advanced neoplasm was defined as a tubular adenoma 1 cm or larger or any polyp with villous histologic characteristics, high-grade dysplasia, or cancer. Such findings as lipomas, lymphoid aggregates, and non-specific inflammation were considered to indicate normal mucosa. No specimens were considered to be nondiagnostic.

For the purpose of categorizing location, “distal” was defined as descending colon, sigmoid colon, or rectum, as determined by the endoscopist. All other locations were considered “proximal.” If either or both the proximal or distal segments of the colon had more than 1 polyp, the colonic segment was categorized according to its most advanced polyp.

Statistical Analysis

The subgroup from which the index was derived consisted of 1994 asymptomatic adults 50 years of age or older who underwent first-time screening colonoscopy between September 1995 and December 1998. In a previous analysis of this subgroup, age, sex, and distal findings were independent risk factors for advanced proximal neoplasia (4). On the basis of these results, we derived a risk index and then validated it on a subsequent subgroup of 1031 consecutively screened persons.

The scoring system for the risk index was generated by assigning points a priori to each category of age, sex, and distal findings (Table 1). For these 3 factors (or variables) taken together, the range for the index score was 0 to 7. For example, a 50-year-old woman with no distal polyps would have a score of 0, whereas a 70-year-old man with an advanced distal polyp would have a score of 7. The points for each variable were based on their coefficients from logistic regression, modified for ease of clinical use on the basis of the linear and ordinal relationships between the

Table 1. Scoring System for the Risk Index*

Risk Factor	Category	Points
Age	<55 y	0
	55–59 y	1
	60–64 y	2
	≥65 y	3
Sex	Female	0
	Male	1
Most advanced distal finding	No polyps	0
	Hyperplasia	1
	Tubular adenoma <1 cm	2
	Advanced lesion [†]	3

* A score is generated by adding points for age, sex, and most advanced distal finding.

[†] Includes tubular adenomas larger than 1 cm, any polyp with villous histology or severe dysplasia, or cancer.

Table 2. Absolute Risk for Advanced Proximal Neoplasia among the Entire Cohort, according to Sex, Age Category, and Distal Findings*

Age Category	Distal Finding									
	Men					Women				
	No Polyp	Hyperplastic Polyp	Tubular Adenoma <1 cm	Advanced Neoplasm	Total	No Polyp	Hyperplastic Polyp	Tubular Adenoma <1 cm	Advanced Neoplasm	Total
	← n/n (%) →									
50–54 y	4/512 (0.8)	1/72 (1.4)	0/51 (0.0)	2/27 (7.4)	7/662 (1.06)	2/397 (0.5)	0/36 (0.0)	0/21 (0.0)	0/5 (0.0)	2/459 (0.44)
55–59 y	7/340 (2.1)	2/58 (3.5)	5/39 (12.8)	2/17 (11.8)	16/454 (3.52)	1/272 (0.4)	0/26 (0.0)	1/26 (3.9)	1/8 (12.5)	3/332 (0.90)
60–64 y	8/202 (4.0)	4/31 (12.9)	3/23 (13.0)	1/18 (5.6)	16/274 (5.84)	1/158 (0.6)	0/16 (0.0)	1/9 (11.1)	0/5 (0.0)	2/188 (1.06)
≥65 y	14/255 (5.5)	2/38 (5.3)	6/48 (12.5)	7/22 (31.8)	29/363 (7.99)	5/248 (2.0)	0/23 (0.0)	2/12 (6.7)	1/10 (10.0)	8/293 (2.73)
Total	33/1309 (2.5)	9/199 (4.5)	14/161 (8.7)	12/84 (14.3)	68/1753 (3.88)	9/1075 (0.84)	0/101 (0.0)	4/68 (5.88)	2/28 (7.14)	15/1272 (1.18)

* Values are the number of persons with advanced proximal neoplasia/all persons in the group.

categories for each variable and risk for advanced proximal neoplasia. Our goal was to create a simple and logical scoring system. Among the derivation subgroup, the risk for advanced proximal neoplasia was measured for each score level (that is, from 0 to 7). In developing an ordinal set of categories of risk, we combined score levels with similar magnitudes of risk, so that scores of 0 and 1 were combined into a low-risk category, scores of 2 and 3 into an intermediate-risk category, and scores 4 through 7 into a high-risk category. The risk for advanced proximal neoplasia was then measured for each risk category, and 95% CIs for each proportion were derived by using exact methods for the binomial distribution. The proportions of persons with advanced proximal neoplasms in each risk category were compared by using the chi-square method, and the *P* value represents the probability of no difference in risk across categories.

The concordance (or “c”) statistic was used to measure discrimination among persons with and without advanced proximal neoplasia (18). The c-statistic considers all pairs of study patients, of whom one has an advanced proximal neoplasm and one does not. The statistic itself is the percentage of pairs for which the model correctly predicts a higher probability of advanced proximal neoplasia for the patient with this lesion. The c-statistic can range from 0.0 (all incorrect predictions) to 0.5 (chance prediction equivalent to a coin toss) to 1.0 (all correct predictions) (20). A c-statistic of 0.7 to 0.8 indicates good discrimination, and a value higher than 0.8 indicates excellent discrimination. For binary logistic regression models, the c-statistic is the same as the area under the receiver-operating characteristic curve (21, 22).

The scoring system and risk index were validated on the next 1031 consecutive adults 50 years of age or older who underwent screening colonoscopy between January 1999 and June 2001. These examinations were done in the same setting by the same endoscopists and pathologists, who remained unaware of the study hypothesis. With the same risk categories defined in the derivation subgroup, we measured the absolute risk for advanced proximal neoplasia

for each category, along with exact confidence limits. To compare risk across categories, *P* values and the c-statistic were measured.

A *P* value less than 0.05 was considered significant. Analyses were done by using SPSS for Windows software, version 10.0 (SPSS, Inc., Chicago, Illinois).

Role of the Funding Source

The funding source had no direct role in the design, data collection, analysis, or decision to submit the paper for publication.

RESULTS

Descriptive Findings

The potentially eligible sample of employees and retirees from which the study cohort was derived was 32% female, 90% white, middle to upper-middle class in socioeconomic status, and located in central Indiana. There were 1994 persons in the derivation subgroup, who had a mean (\pm SD) age of 59.8 ± 8.3 years. Fifty-eight percent were men, and 67 (3.4%) had an advanced proximal neoplasm. The validation subgroup contained 1031 persons with a mean age of 57.3 ± 7.0 years, of whom 57% were men. Colonoscopy to the cecum was performed in 97.0% of patients. Fifteen persons (1.45%) had advanced proximal neoplasia (*P* = 0.002 versus the derivation subgroup).

Table 2 shows the risk for advanced proximal neoplasia in men and women by age category and distal findings. Of 3025 persons, 83 (2.74%) had advanced proximal neoplasia: 68 (3.88%) of 1753 men and 15 (1.18%) of 1272 women (*P* < 0.001). Risk increased with each 5-year age interval: 9 of 1121 (0.80%) persons 50 to 54 years of age, 19 of 786 (2.42%) persons 55 to 59 years of age, 18 of 462 (3.90%) 60 to 64 years of age, and 37 of 656 (5.64%) 65 years of age or older (*P* < 0.001). For men and women, the risk for advanced proximal neoplasia increased as the age category increased (*P* < 0.001 for men and *P* = 0.037 for women) and as distal findings became more severe (*P* < 0.0001 for both sexes) (Table 2). For example, women younger than 60 years of age with no distal ade-

Table 3. Risk for Advanced Proximal Neoplasia in the Derivation Subgroup, by Index Score

Score	Patients (Proportion of Cohort) with Score, n (%)	Patients with Score Who Had Advanced Proximal Neoplasia, n (%)
0	233 (12)	1 (0.43)
1	506 (25)	4 (0.79)
2	382 (19)	6 (1.57)
3	423 (21)	11 (2.60)
4	301 (15)	25 (8.31)
5	70 (3.5)	7 (10.00)
6	61 (3.1)	8 (13.11)
7	18 (1.0)	5 (27.78)

noma were a very low risk subgroup in which the risk for advanced proximal neoplasia was 0.41% (95% CI, 0.08% to 1.19%) (3 of 731 persons).

Risk Scores

Table 3 shows the risk for advanced proximal neoplasia for each score in the derivation subgroup. For the 233 persons with a score of 0, the risk for advanced proximal neoplasia was 0.43%. Risk for advanced proximal neoplasia increased as the index score increased and was nearly 28% for those with a score of 7. On the basis of similar magnitudes of risk, scores 0 and 1 were combined into a low-risk category, scores 2 and 3 were combined into an intermediate-risk category, and scores 4 through 7 were combined into a high-risk category.

Table 4 shows the risk for advanced proximal neoplasia according to risk category in the derivation subgroup. Thirty-seven percent of the group was considered low risk according to the index, whereas 40% were at intermediate risk and 23% were at high risk. The respective risks for advanced proximal neoplasia in persons at low, intermediate, or high risk were 0.68%, 2.11%, and 10.00% ($P = 0.001$). The high-risk category contained 67% of all persons with advanced proximal neoplasia. The *c*-statistic for the index was 0.81 ± 0.03 , indicating good to excellent discrimination.

The risk for advanced proximal neoplasia in the 3 risk categories for the validation subgroup is also shown in Table 4. Forty-seven percent of the group was considered low

risk according to the index, whereas 40% were at intermediate risk and 13% were at high risk. The respective risk for advanced proximal neoplasia in persons at low, intermediate, or high risk were 0.4% (CI, 0.05% to 1.49%), 1.92%, and 3.79% ($P = 0.01$) and were similar in magnitude to the risk estimates in the derivation subgroup. The *c*-statistic was 0.74 ± 0.06 , which does not differ statistically from that of the derivation cohort ($P = 0.15$).

DISCUSSION

The finding that sigmoidoscopy alone may fail to detect between 40% and 50% of advanced proximal neoplasms has led to calls for universal colonoscopy (1, 2). However, the feasibility of this strategy may be limited by cost; safety; resource constraints; and an uncertain incremental benefit of colonoscopy on meaningful patient outcomes, such as mortality and quality of life (9). Although periodic sigmoidoscopy is recommended as an acceptable and equally preferred option among several tests, it is unclear in which patients sigmoidoscopy alone may be considered especially suitable. Some investigators have suggested that the intensity of testing be tailored to a person's risk (23–26), but tailoring cannot effectively be done without detailed information about risk.

Our study has practical clinical implications for the work-up of asymptomatic adults who undergo screening sigmoidoscopy (Table 5). When applied to the study cohort, the first and most commonly used strategy in the primary care setting—colonoscopy for any distal polyp—would detect 49% of persons with advanced proximal neoplasms, with 540 persons undergoing colonoscopy (21% of the cohort) and a “number needed to screen” of 16 to detect 1 advanced proximal neoplasm. The second strategy, colonoscopy for any distal neoplasm, is recommended by professional organizations (8, 11), even though it requires biopsy of polyps smaller than 1 cm in diameter. This strategy would have detected 39% of persons with advanced proximal neoplasms and would have required colonoscopy in 341 persons (11% of the cohort), with a number needed to screen of 11. The third strategy, colonoscopic screening for everyone, would presumably detect all

Table 4. Risk for Advanced Proximal Neoplasia, by Risk Category

Category (Score)	Derivation Subgroup			Validation Subgroup		
	Patients with Score*	Patients with Score and Advanced Proximal Neoplasia [95% CI]	Proportion of Patients with Advanced Proximal Neoplasia*	Patients with Score*	Patients with Score and Advanced Proximal Neoplasia [95% CI]	Proportion of Patients with Advanced Proximal Neoplasia*
	n (%)		%	n (%)		%
Low (0 or 1)	739 (37)	5 (0.68) [0.22–1.57]	8	483 (47)	2 (0.4) [0.05–1.49]	13
Intermediate (2, 3)	805 (40)	17 (2.11) [1.24–3.36]	25	416 (40)	8 (1.92) [0.83–3.75]	53
High (4–7)	450 (23)	45 (10.00) [7.39–13.15]	67	132 (13)	5 (3.79) [1.24–8.62]	33
Total	1994 (100)	67 (3.36) [2.61–4.25]	100	1031 (100)	15 (1.45) [0.82–2.39]	100

* Proportion relative to all patients.

Table 5. Effect of Different Threshold Criteria for Colonoscopy on the Number Needed To Screen

Reason for Colonoscopy	Persons with Advanced Proximal Neoplasia Detected, n (%)	Persons Undergoing Colonoscopy, n (%)	Number Needed To Screen
Any distal polyp	41 (49)	641 (21)	16
Any distal neoplasm	32 (39)	341 (11)	11
Everyone	83 (100)	3025 (100)	36
Intermediate and high risk	76 (92)	1808 (60)	24

cases of advanced proximal neoplasia and yields a number needed to screen of 36. A fourth strategy is to perform colonoscopy only for persons with intermediate or high risk according to the clinical index. This strategy would detect 92% of persons with advanced proximal neoplasia, of whom 60% would undergo colonoscopy, and yields a number needed to screen of 24.

Colonoscopy for everyone detects all lesions but requires the greatest use of resources. In comparison, colonoscopy using the clinical index detects nearly all (92%) lesions while reducing the number of procedures by 40%. In other words, 3025 colonoscopies can be done to detect 83 advanced proximal neoplasms in the “colonoscopy for everyone” strategy, whereas the clinical index strategy results in 1808 colonoscopies to detect 76 such neoplasms. The marginal benefit of colonoscopy is very small among persons categorized by the index as low risk, such that 1217 additional colonoscopies are needed to detect 7 additional advanced proximal neoplasms (number needed to screen, 174). The index allows tailored use of colonoscopy for screening and works by decreasing the inefficiency involved in looking for advanced proximal neoplasms. When considered as a type of diagnostic test, the index enhances specificity for advanced proximal neoplasia (by decreasing the number of “false-positive” examinations of the proximal colon) with only a small decrease in sensitivity. If validated by further study, application of this index could result in cost savings with little net loss of health.

Our results also suggest that several broad categories based on age, sex, and distal findings may be used to decide whether sigmoidoscopy alone is a sufficient screening test. For example, the risk for advanced proximal neoplasia is very low (0.41%) among women 50 to 59 years of age who have anything other than advanced distal findings. It might therefore be reasonable to defer examination of the proximal colon until age increases. In contrast, for men 60 years of age or older, in whom the overall risk for advanced proximal neoplasia is 6.1% and may be considered high enough to warrant further evaluation regardless of distal findings, an initial strategy that evaluates the proximal colon may be sensible. Readily available information about age, sex, and distal findings may be useful in directing screening strategies by indicating the risk for advanced lesions in the proximal colon. The optimal choice of a screening test could be individualized on the basis of risk rather than on the claim that all screening techniques are appropriate for all persons.

Furthermore, our analysis suggests that the choice of screening technique might evolve for a given person over time as risk changes (7, 10). For example, sigmoidoscopy alone may suffice for women 50 to 59 years of age who have any distal findings other than advanced neoplasia, whereas examination of the proximal colon might be added after 60 years of age.

Application of this index would improve the efficiency of screening for colorectal cancer. Since most sigmoidoscopic screening is performed by physicians other than gastroenterologists, the index would decrease the number of low-yield colonoscopies performed by gastroenterologists. Furthermore, if a person who is considered for screening has a score of 4 or higher (or perhaps 2 or higher) on the basis of age and sex alone, proceeding directly to colonoscopy would decrease the number of persons who undergo both sigmoidoscopy and colonoscopy. Although no formal cost analysis has been done, application of the index would decrease the overall cost of screening by decreasing the number of colonoscopies and decreasing the proportion of persons who undergo both procedures. Thus, clinical use of the index would improve resource allocation.

The extent to which this index could be readily integrated into current clinical practice requires consideration of several matters. First, optimal use of this index requires that sigmoidoscopy be performed with biopsy. The fact that biopsy is not routinely done on most polyps during screening sigmoidoscopy in the United States limits clinical application and suggests that more widespread performance and interpretation of biopsy should be considered. To simply recommend colonoscopy for any polyp discovered by sigmoidoscopy would result in colonoscopy in 21% of persons undergoing sigmoidoscopy and would detect only half of persons with advanced proximal neoplasms. In contrast, use of the index would result in 60% of persons undergoing colonoscopy and detection of 92% with advanced proximal neoplasms. Second, clinical integration of this index requires availability and acceptability of sigmoidoscopic screening. Several barriers limit availability and use of sigmoidoscopy among primary care providers, including training and reimbursement (27, 28). These limitations of resources would have to be addressed for the index to have widespread clinical application. On the other hand, resources for a strategy of universal colonoscopy may also be inadequate to meet the potential demand. Third, it is not known whether physicians and patients will be comfortable not routinely doing the “most

thorough test,” for fear of missing cancer and possible legal liability. Finally, the relatively high fee generated by colonoscopy, certainly in comparison to sigmoidoscopy, may provide motivation to prefer that procedure.

Our study has several limitations. First, the index was derived from patients who underwent screening colonoscopy and had polyps labeled as proximal and distal, rather than from patients with distal polyps detected by sigmoidoscopy who then underwent colonoscopy. As such, the division of the colon into proximal and distal parts was necessarily arbitrary and might differ in actual clinical application. Second, the risk for advanced proximal neoplasia in the low-risk category was not 0, meaning that clinical application of this index would likely result in some missed neoplasms and that clinicians, patients, and policymakers would have to be willing to accept this risk in return for the savings of resources, effort, and colonoscopy-related morbidity. Third, the validation process was limited because it was performed in a subgroup from the same setting as the derivation subgroup. Performance of the index has not been assessed in persons in other locations and socio-demographic groups. Fourth, potentially important clinical data were not available about other risk factors, such as family history or results of previous fecal occult blood testing. These factors must be carefully considered when making decisions about how to screen. For example, a positive fecal occult blood test would require colonoscopy; use of the index in this circumstance would not be appropriate. Likewise, the index would not be used for a person who has one or more first-degree relatives with colorectal cancer because screening recommendations for such persons are more aggressive. Although the index discriminates well without information about other risk factors, obtaining such data might result in improved sensitivity and specificity of the index, resulting in greater stratification of risk for advanced neoplasia. Finally, the natural history and clinical significance of the lesion identified by the index—advanced nonmalignant neoplasia—is not well understood. Stryker and colleagues (29) reported that large polyps (>1 cm in diameter) left intact progress to colorectal cancer at a rate of about 1% per year, but no histologic data were available in that study. It is unclear whether small polyps with advanced histologic features have a natural history that warrants the label of “advanced neoplasia.” If their natural history is more favorable the index may be a conservative estimate of risk, and it may even be safer to forgo colonoscopy in persons classified as low risk. Despite these limitations, our results suggest that the concept of tailoring endoscopic screening merits further consideration, because tailoring is likely to improve cost efficiency with a minimal decrease in detection of disease.

In conclusion, our clinical index uses simple and reliable demographic data combined with distal endoscopic findings to identify a large subgroup of persons with very low risk for advanced neoplasm in the proximal colon. Our findings suggest that sigmoidoscopic screening may be suf-

ficient for women younger than 60 years of age who have no distal polyps or only distal hyperplastic polyps, whereas a screening strategy that evaluates the proximal colon may be most sensible for men 60 years of age or older. If further validated, the index might be used to provide risk-based tailoring of colonoscopy and would be expected to reduce the need for screening colonoscopy by roughly 40%. Further research might incorporate other risk factors into the index in an attempt to improve its ability to stratify risk. With appropriate information, it might be possible to produce screening guidelines that are tailored to risk.

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