

Tailoring Surveillance Colonoscopy in Patients with Advanced Adenomas

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ABSTRACT

Background and Aims: Patients with advanced colorectal adenomas (AA) are directed to undergo intensive surveillance. However, the benefit derived from surveillance may be outweighed by the risk of death from non-colorectal cancer (CRC) causes, leading to uncertainty on how best to individualize follow-up. The aim of this study was to derive a risk prediction model and risk index that estimates and stratifies the risk for non-colorectal cancer mortality (NCM) subsequent to diagnosis and removal of AA.

Methods: We conducted a retrospective cohort study of Veterans ≥ 40 years who had colonoscopy for diagnostic or screening indications at 13 VAMCs between 2002 and 2009, and had one or more AAs. The primary outcome was non-CRC mortality (NCM) using a fixed follow-up time period of 5 years. Logistic regression using the lasso technique was used to identify factors independently associated with non-CRC mortality (NCM), and an index based on points from regression coefficients was constructed to estimate risk of 5-year NCM.

Results: We identified 2,943 Veterans with AA (mean age (SD) 63 (8.6) years, 98% male, 74% white), with an overall 5-year mortality of 16.7%, which was nearly all due to NCM (16.6%). Age, comorbidity burden, specific comorbid conditions, and hospitalization within the preceding year were independently associated with NCM. The risk prediction model had a goodness of fit (calibration) p-value of 0.41, and c-statistic (discrimination) of 0.74 (95% CI, 0.71-0.76). Based on comparable 5-year risks of NCM, the scores comprised 3 risk categories: low (score of 0-1), intermediate (score of 2-4) and high (score of ≥ 5), in which NCM occurred in 6.5%, 14.1%, and 33.2%, respectively.

Conclusions: We derived a risk prediction model that identifies Veterans at high risk of NCM within 5 years, and who are thus unlikely to benefit from further surveillance.

INTRODUCTION

The United States Multi-Society Task Force (USMSTF) recommends a 3-year surveillance colonoscopy in most average-risk patients with advanced adenomas (AA)¹. Patients with AA are at increased risk of metachronous colorectal neoplasia, and surveillance colonoscopy after baseline removal of adenomas with high-risk features is associated with reduction of incident colorectal cancer (CRC), although its effect on CRC mortality is uncertain¹. While patients with low adenoma burdens have been the focus of research assessing the merits of lengthening surveillance intervals², the 3-year recommendation for patients with AA has been uncontested. One of the reasons is that patients with low-risk adenomas comprise the largest group contributing to the surveillance indication; thus, lengthening surveillance intervals in this largest group would have the most impact on colonoscopy resources³. However, although they represent 5-10% of the population requiring surveillance, patients with AA consume considerable colonoscopy resources, given that they require more frequent surveillance colonoscopy^{3, 4}. Importantly, patients may not benefit from surveillance if the benefit is outweighed by risk of death from competing non-CRC-related comorbidity. Understanding the risks of subsequent CRC incidence and mortality and comorbidity burden of AA patients could help optimize colonoscopy resources by directing them to those with higher subsequent CRC risk and / or high comorbidity with high-risk for non-CRC mortality. The primary aim of this study was to derive a risk prediction model and risk index that estimates and stratifies the risk for non-CRC mortality subsequent to diagnosis and removal of AA.

METHODS

Study Cohort

This retrospective cohort study involved 13 Veterans Affairs Medical Centers (VAMCs). The protocol of the parent study was approved with a waiver of informed consent by VA's Central Institutional Review Board, and the current analysis was approved by the Indiana University and Richard L. Roudebush VAMC institutional review boards. Remote data extraction software, designed by Information Resources Management at the Indianapolis VAMC in collaboration with the Indianapolis study investigators, was used to extract clinical and administrative information from the VA's electronic health record, known as Computerized Patient Record System (CPRS). We followed the STROBE guidelines for observational studies in conduct and reporting. We used Current Procedures and Terminology (CPT) codes and International Classification of Diseases – 9th version (ICD-9) codes, to identify Veterans ≥ 40 years who had colonoscopy for diagnostic or screening indications at 13 VAMCs between 2002 and 2009. Demographic and clinical data (ICD-9 diagnoses, comorbidity, physical measures, medications, tobacco use, and certain laboratory data) were extracted closest in time and prior to the index colonoscopy. Comorbidity was measured using the Charlson Comorbidity Index (CCI)^{5,6} and Acute Physiology And Chronic Health Evaluation (APACHE) score. Excluded were subjects with a previous colon resection for any reason, previous diagnosis of inflammatory bowel disease, or those with colonoscopy indication of surveillance (history of adenomatous polyps, CRC, or Lynch syndrome). Natural language processing (NLP) was used to identify the most advanced colonoscopic finding, as described previously⁷. The NLP algorithm has an accuracy of 94.6% compared to blinded, paired, annotated, manual review of colonoscopy and pathology reports⁷. AA included an adenoma ≥ 1 cm, and adenoma with high-grade dysplasia or villous / tubulovillous histologic elements. The medical records of patients diagnosed with CRC after index colonoscopy were reviewed by two investigators (CK and TI).

Follow-up and Outcomes

Based on the aforementioned inclusion and exclusion criteria, we assembled a cohort of Veterans ≥ 40 years old who had a first screening or diagnostic colonoscopy between 2002 and 2009 that identified one or more AAs. Through 2015, we obtained data regarding subsequent receipt of surveillance colonoscopy, CRC incidence, all-cause mortality, CRC-specific mortality, and cancer stage (using the American Joint Committee on Cancer [AJCC] staging system) from VA Corporate Data Warehouse (CDW), which also includes VA oncology data files and linked VA-Medicare data. CDW data includes both VA related care and care outside the VA that is paid for by the VA (i.e. fee-basis data). The National Death Index (NDI)⁸ was used to ascertain cause of death. The primary outcome was non-CRC Mortality (NCM) using a fixed follow-up time period of 5 years for each patient.

Analysis

Logistic regression using the lasso⁹ technique was used to identify factors independently associated with non-CRC mortality (NCM). The lasso is a shrinkage method by which a penalty is imposed on estimates of coefficients in the model¹⁰. Depending on magnitude of this penalty, some coefficients are shrunk all the way to zero whereas other coefficients are not shrunk at all. In this sense, the lasso can be thought of as variable selection technique. For the model in which NCM at 5 years is the dependent variable, we started with twenty-one independent variables (age; smoking status; Charlson comorbidity score; Apache score; history of cancer, diabetes, atrial fibrillation, congestive heart failure (CHF), hypertension, stroke, myocardial infarction, cirrhosis, peripheral vascular disease, chronic obstructive pulmonary disease (COPD), end-stage renal disease, and vascular problems; aspirin, statin and non-steroidal anti-inflammatory drug (NSAID) use; 1 or more prior hospital admissions; 6 or more PCP visits). Lasso logistic regression eliminated 13 variables (because their coefficients were shrunk to zero), resulting in a final model that included eight independent variables. With the exception of

age, all independent variables were based on a 1-year history prior to index colonoscopy. To determine the magnitude of the penalty, a tuning parameter was chosen via 10-fold internal cross-validation to maximize the area under the ROC curve for the model. The `cv.glmnet` function from the `glmnet` R package¹¹ was used to estimate the lasso model. We report the odds ratios (95% confidence intervals) and associated model fit statistics (Hosmer Lemeshow goodness of fit for calibration and area under the ROC curve for discrimination) for variables selected with lasso. Log-odds coefficients from the model were used as inputs to creating a point system¹² in which coefficient-based points were assigned to each variable. These points were then summed over all eight variables to create a risk score with 0 points representing the lowest risk of NCM. Points were scaled such that a given point represented increased risk of 5-year NCM. We collapsed point totals into risk strata for which we calculated risk of 5-year NCM.

RESULTS

We identified 2,943 Veterans with AA as the most advanced finding (mean age (SD) 63 (8.6) years, 98% male, 74% white), with baseline features summarized in Table 1. There were 72 Veterans (2.4%) who were 40-49 years old at the time of study entry. Subjects with subsequent colonoscopy within 5 years of index colonoscopy (n = 1797, 61.1%) were more likely than those without subsequent colonoscopy (n = 1146, 38.9%) to be younger (62.6 vs 64.0 years, $p < 0.01$) and to have less comorbidity (CCI 1.2 vs 1.6, $p < 0.01$). Duration of follow-up was approximately 6 months longer for those with subsequent colonoscopy as compared to those without (4.8 vs 4.3 years, $p < 0.01$). There were no significant differences in gender, race, or tobacco status among subjects with vs. without subsequent colonoscopy.

Table 2 presents patient outcomes within 5 years of index AA findings, overall and based on receipt of subsequent colonoscopy. The overall 5-year mortality rate was 16.7%, which, as expected, was nearly all due to NCM (16.6%). NCM did not vary significantly across

VA facilities or across year of index date at the bivariate level (Chi-square $p=0.4$ and $p=0.3$, respectively), and therefore neither was considered as a potential factor in the multivariable model. The unadjusted hazard ratio for NCM in subjects who had no subsequent colonoscopy was 2.77 (95% CI, 2.31-3.32), compared to those who had at least one. The overall incidence of CRC was 0.61%, of which 77.8% were early stage (AJCC stage 0-2); CSM was 0.17%. These rates did not differ between subjects without subsequent colonoscopy and those with at least one colonoscopy.

Logistic regression using lasso identified eight factors (age, comorbidity burden [measured by CCI and APACHE scores], specific comorbid conditions, and hospitalization within the preceding year) independently associated with NCM. Age ≥ 68 years, CCI ≥ 2 , and liver cirrhosis were most strongly associated with NCM (Table 3). The risk prediction model had a goodness of fit (calibration) p -value of 0.41, and c -statistic (discrimination) of 0.74 (95% CI, 0.71-0.76). Points assigned to each risk factor based on its odds ratio ranged from 0 to 6, with a total possible risk score ranging from 0 to 20; the observed risk score ranged from 0-19. Based on comparable 5-year risks of NCM, the scores collapsed into 3 risk categories: low (score of 0-1), intermediate (score of 2-4) and high (score of ≥ 5), in which NCM occurred in 6.5%, 14.1%, and 33.2%, respectively (Table 4). Using the low risk category as the reference group, the odds ratios for NCM were 2.4 and 7.2 for the intermediate- and high-risk categories, respectively.

The distribution for number of days to death post-index colonoscopy was fairly uniform. The average number of days from index colonoscopy to death date was 986 days (or approximately 2.7 years; SD = 498.2). The median was similar (971 days). The first and third quartiles were 103 (0.3 years) and 1772 (4.9 years) days, respectively. There were 26 patients who died within 6 months of the index date. When these patients were excluded, the model performance with the remaining 2917 was nearly identical to the original model, with a goodness of fit p -value of 0.47, and c -statistic of 0.73 (95% CI, 0.71-0.76). The corresponding

values for the original model were 0.41, and 0.74 (95% CI, 0.71-0.76), respectively, with good calibration throughout the full range of predicted probability (Supplementary Figure).

Of the 18 subjects who were diagnosed with CRC within 5 years of the index colonoscopy, 4 (0.37%) were in the low risk group, 6 (0.56%) were in the intermediate-risk group, and 8 (0.99%) were in the high-risk group. Among 5 CRC deaths within 5 years of the index date, 2 (0.19%) occurred in the low-risk, 2 (0.19) in the intermediate-risk, and 1 (0.12) in the high-risk groups, respectively. Foregoing subsequent colonoscopy among members of the high-risk group would have reduced colonoscopy resource utilization by 27% (808 of 2,943), missed 44% (8 of 18) incident CRCs, and 20% (1 of 5) of CRC deaths.

Clinical characteristics of the 8 subjects in the high-risk group for NCM who were diagnosed with CRC within 5 years are shown in Table 5, and include the likely reason for CRC diagnosis. For two subjects, cancers resulted from delays in definitive (surgical) therapy, while two other subjects were found to have cancers after surveillance delays of 13 and 18 months. Post-colonoscopy CRCs developed in two subjects, while the remaining two developed CRC at sites of incomplete removal of the index lesion, both of which were tubulovillous adenomas (Table 5). The single CRC death occurred in a subject whose surveillance colonoscopy was delayed by 13 months, at which time a T4 cancer was found, with death occurring two weeks post-operatively. In 3 of these 8 subjects, surveillance colonoscopy may have favorably affected long-term outcome by discovering cancers for which surgery was performed. One of the three subjects survived 4 years post-operatively, or 3 years beyond the 5-year interval after index colonoscopy; the other two subjects are alive as of 11/30/2020, with more than 5-year post-operative survival durations.

DISCUSSION

With an annual volume of nearly 11 million, colonoscopy is one of the most commonly performed procedures in the United States⁴. Among average-risk individuals who are 50-75 years old, between 5% and 10% have at least one AA removed^{4, 13}. There is considerable evidence that individuals with AA are at increased risk for metachronous advanced neoplasia (including CRC)^{2, 14-16}, and that surveillance colonoscopy is associated with CRC risk reduction¹. These observations are the basis for intensive surveillance recommendations, which have been recently reaffirmed by several practice guidelines^{1, 17, 18}. However, the rationale for surveillance historically has been based primarily on assessment of colorectal neoplasia risk, without consideration of factors that could impact patients' likelihood of benefiting from surveillance, or their risk of dying from causes unrelated to colorectal neoplasia. Guidelines are either silent regarding this issue or make broad statements regarding the need to balance benefit with harm and competing risk from comorbid conditions, especially those that impact life expectancy.

Several studies have shown that the burdens and risks of colonoscopy are magnified in older patients, including higher rate of unsatisfactory bowel preparation leading to the need for repeat procedures, increased risk of incomplete and aborted procedures, and higher rate of complications including perforation and bleeding¹⁹. One study illustrates why open-ended surveillance is not appropriate for many patients²⁰: In a large cohort of patients undergoing surveillance colonoscopy, those ≥ 75 years old had low CRC incidence, but high rates of hospitalizations after colonoscopy compared to younger individuals. As might be expected, age ≥ 75 (aOR 1.28) and Charlson score ≥ 2 (aOR 2.54) were significantly associated with risk of post-procedure hospitalization²⁰. In addition, despite their constituting a smaller proportion of all patients with adenomas, those with AA are selected for more intensive surveillance, and thus more colonoscopy resource utilization.

Our model identified 3 risk groups, with 5-year non-CRC mortality risks ranging from 6% to 33% subsequent to diagnosis and removal of AA. The model could be used to tailor surveillance recommendations: individuals in the high-risk category, whose risk of death from NCM was 7 times that of individuals in the low risk category, could reasonably forego further surveillance because of their older age, higher comorbidity burden and high mortality risk. In this study, this strategy would have missed one of 5 CRC deaths, and would have decreased colonoscopy utilization by 22%. Persons at intermediate risk, who were twice as likely to die from NCM compared with low-risk patients, could make decisions based on careful assessment of individual risk factors and personal preferences. Such risk-based tailored surveillance has the potential to increase the efficiency of colonoscopy utilization, by directing resources according to likelihood of benefit and death from causes unrelated to colorectal neoplasia.

Among 808 subjects considered high-risk for NCM, there were 8 who were diagnosed with incident CRC following AA removal, one of whom died of post-operative complications. While the benefit of surveillance colonoscopy cannot be determined retrospectively, it appears that at least 3 of 8 subjects may have derived benefit from discovery of early, curable stage CRC, all 3 of whom survived well beyond the 5-year study timeframe. This study cannot determine whether other subsequent colonoscopies performed for surveillance or diagnostic indications, detected subsequent AA, the removal of which may have favorably impacted CRC incidence beyond the 5-year timeframe. Only a randomized trial, such as the ongoing EPoS²¹, can quantify the true benefit of surveillance on long-term outcomes of CRC incidence and mortality.

Several models using demographic and clinical features to predict risk of colorectal neoplasia have been developed²²⁻²⁵ but these have been validated in the screening setting, and used primarily to guide CRC screening modality selection. To our knowledge, no previous risk stratification study has specifically targeted the risk of NCM among individuals with AA. The

model we have developed has potential for clinical application, because it is based on factors that are readily available and measurable. The degree of model discrimination, as measured by the c-statistic, indicates good discrimination while the risk gradient indicates clinically-meaningful separation of NCM risk among the 3 risk categories. Based on the study sample size and expected low rates of CRC incidence and mortality, we decided a priori to use the entire sample for model derivation and to forego split sample validation. For this reason, we utilized the lasso technique for logistic regression model development, which reduces prediction variability and error, and is more robust and less prone to over-fitting compared to standard logistic regression. In addition, lasso shrinks some coefficients to zero, providing a selection process of identifying candidate independent (i.e., predictor) variables for the final model, thereby improving interpretability. In analysis, lasso removed 13 candidate variables from selection for the final model. And while this technique does not preclude the need for independent validation of our findings, it may reduce the likelihood that our derived model is overfitted.

One interesting finding is that liver cirrhosis in particular was strongly associated with NCM: according to the scoring system, a patient with cirrhosis would automatically be placed in the high-risk category. While our data do allow further granularity regarding severity of liver disease as a predictor of NCM, the presence of cirrhosis should serve as a red flag for clinicians who are deciding about subsequent surveillance colonoscopy, especially for patients with decompensated liver disease.

The study has strengths, including the multi-center design, and completeness of data collection. However, the study also has several limitations. First, the sample size is relatively small, as AA are a relatively infrequent finding at colonoscopy. Second, the prediction model has imperfect discrimination; about half of CRC cases would have been categorized as high-risk for NCM, and thus likely missed had colonoscopy not been performed, although some cancers

may have been detected because of symptoms that led to colonoscopy. Whether missing these incident cancers would have impacted the quality or quantity of life is uncertain. However, CRC mortality is the more relevant outcome, and in this context, the risk stratification model would missed only one of 5 CRC deaths, although again, symptoms may have led to detection through diagnostic colonoscopy. Third, the model was derived in a population which is predominantly older, white, and male. And although we used 10-fold cross validation, our findings require external validation in an independent cohort, as its generalizability in non-Veteran populations is uncertain. Finally, we lacked information on quality of the baseline colonoscopy, including bowel preparation, withdrawal time, and adenoma detection rate, and certain relevant predictive variables, such as alcohol use and obesity.

In conclusion, we have derived a risk index that stratifies the risk for non-CRC mortality subsequent to diagnosis and removal of AA among Veterans. The index identifies patients at high risk of death from non-CRC causes within 5 years, who are least likely to benefit from further surveillance. Pending external validation, this risk index could help further improve colonoscopy efficiency among patients with AA.

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Table 1: Baseline Features – Overall and based on subsequent colonoscopy within 5-years of Index Colonoscopy

Variable	Overall cohort N=2943	Subsequent Colonoscopy		Pvalue
		None (n=1146)	≥ 1 (n=1797)	
Age (years) Mean (SD)	63.1 (8.6)	64.0 (9.3)	62.6 (8.0)	<0.0001
Men (%)	98.3	98.9	97.9	0.05
Race (%)				0.98
White	73.9	73.8	74.0	
Black	17.0	17.1	16.9	
Other/Unknown	9.1	9.1	9.2	
APACHE, mean (SD)	6.7 (5.9)	7.3 (6.3)	6.4 (5.6)	<0.0001
CCI, mean (SD)	1.4 (1.8)	1.6 (2.0)	1.3 (1.6)	<0.0001
Tobacco use (%)	42.1	42.6	41.7	0.65
Follow-up (years) mean (SD)	4.6 (1.0)	4.3 (1.4)	4.8 (0.7)	<0.0001

Table 2: Outcomes within 5-years of Index Colonoscopy – overall and based on subsequent colonoscopy

Outcome N (%)	Overall cohort N=2943	Subsequent Colonoscopy		P-value
		None (N=1146)	≥ 1 (n=1797)	
All-cause mortality	492 (16.7)	299 (26.1)	193 (10.7)	<0.001
Non-CRC mortality (NCM)	487 (16.6)	297 (25.9)	190 (10.6)	<0.001
Incident CRC	18 (0.61)	6 (0.52)	12 (0.67)	0.62
AJCC Stages 0-2*	14 (77.8)	5 (83.3)	9 (75.0)	0.43
CRC mortality	5 (0.17)	2 (0.17)	3 (0.17)	1.00
Unadjusted hazard ratio for NCM		2.77 (CI, 2.31-3.32)	1 (reference)	

*Among 18 subjects with CRC

Table 3: Factors independently associated with non-CRC mortality (NCM)

Factor	Odds ratio (95% CI)	Points
Age (years)		
< 60	1.00 (ref)	0
60-67	1.16 (1.01-1.34)	0
≥ 68	2.65 (2.32-3.04)	3
Charlson Comorbidity Index (CCI)		
0	1.00 (ref)	0
1	1.23 (1.05-1.43)	1
≥ 2	2.05 (1.78-2.37)	2
APACHE Score		
0-3	1.00 (ref)	0
4-6	1.07 (0.92-1.26)	0
7-10	1.20 (1.03-1.40)	1
≥ 11	1.65 (1.42-1.93)	2
Comorbid Conditions		
CHF	1.82 (1.52-2.19)	2
TIA/Stroke	1.90 (1.55-2.33)	2
Cirrhosis	6.44 (4.59-9.02)	6
ESRD	1.50 (1.23-1.83)	1
Hospitalized within the year prior to index colonoscopy	1.63 (1.42-1.88)	2

Table 4: Risk categories, cohort distribution, odds ratios, and NCM

Risk category (points)	N (%)	Odds Ratio CI)	(95% Non-CRC Mortality (%)
Low (0-1)	1068 (36.3)	1.00 (reference)	69 (6.5%)
Intermediate (2-4)	1067 (36.3)	2.37 (2.03-2.76)	150 (14.1%)
High (≥ 5)	808 (27.4)	7.19 (6.21-8.31)	268 (33.2%)

Table 5. Clinical characteristics of subjects in the high-risk NCM group diagnosed with

Subject	Indication for index CY	Index findings	Subsequent course	Presumptive Reason for CRC	Could surveillance CY have favorably altered outcome?	Death due to CRC
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CRC within 5 years

Abbreviation key: CT – computed tomography; CRC – colorectal cancer; CY – colonoscopy;

FOBT – fecal occult blood test; TVA – tubulovillous adenoma

79-year-old man	FOBT+	4 cm TVA July 2003	Scheduled for surgery 1 month later; surgery delayed 7 months due to a MI and stent insertion. Surgery reveals CRC, Stage II	Delay in definitive treatment	No	No
56-year-old man	FOBT+	4 cm carpet lesion, cecum and ICV - TVA	Scheduled for surgery 5 months later, but canceled due to a positive urine drug screen. Patient presented with LGI bleeding 4 months later. Repeat CY finds a cecal lesion. Surgery finds a T1N0M0 CRC	Delay in definitive treatment	No	No
80-year-old man	Screening	TVA, ascending colon, incompletely removed	33 months later, patient presents with weight loss, abnormal CT; CY finds a 6 cm mass ascending colon. Right hemicolectomy finds a T1N0M0 CRC	Incomplete removal of index TVA	No	No
81-year-old man	Screening	TVAs of 12 and 20 mm	Surveillance CY finds 2.5 cm malignant polyp, hepatic flexure. Patient has surgery to remove lesion.	Metachronous lesion	Yes	No
75-year-old man	FOBT+	12 mm adenoma	Surveillance CY 38 months later finds mass, hepatic flexure. Right hemicolectomy finds a T2N0M0 CRC	Metachronous lesion	Yes	No
73 year old man	Screening	TVA, ascending colon	Surveillance CY 54 months later finds a mass in the ascending colon. Right hemicolectomy finds a CRC	Metachronous lesion with 18-month delay in surveillance CY	Yes	No
59 year old man	Screening	TVA	Surveillance CY 49 months later finds a sigmoid colon apple core lesion. Left hemicolectomy finds T4b CRC adherent to abdominal wall. Patient died of surgical complications 13 days post-op	Delay in surveillance CY by 13 months	No	Yes
74 year old man	FOBT+	Sigmoid TVA	Presents with abdominal pain and abnormal CT 32 months later; CY finds sigmoid mass; left hemicolectomy finds T4N1M1 CRC	Incomplete removal of index TVA	No	No

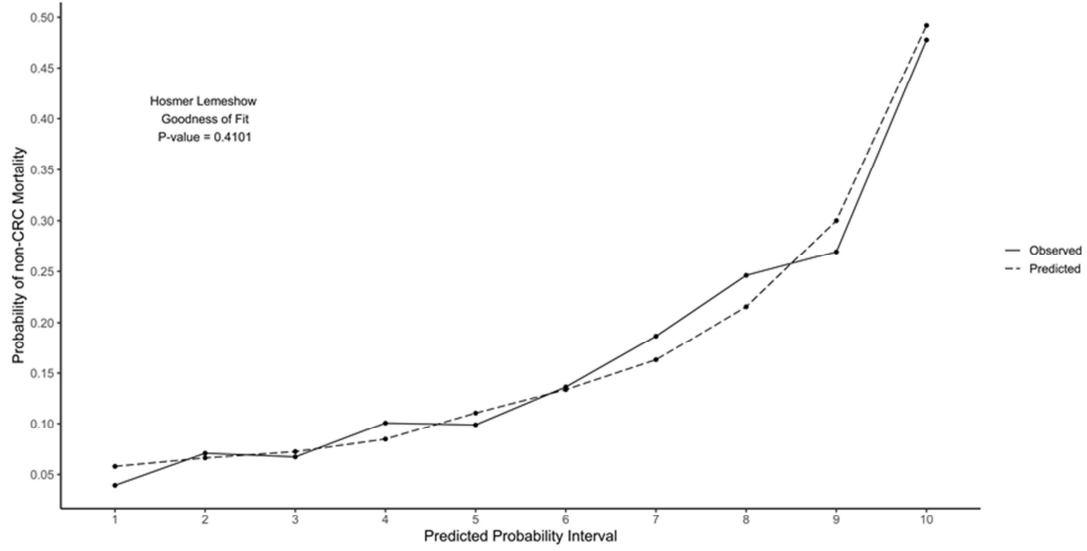
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Supplementary Figure. Calibration Plot.



	1	2	3	4	5	6	7	8	9	10
Number of patients	355	283	268	328	263	308	257	329	282	270
Observed number of events	14	20	18	33	26	42	48	81	76	129
Predicted number of events	20.6	18.7	19.4	27.7	29.1	41.2	41.9	70.9	84.6	132.9
Observed probability	0.04	0.07	0.07	0.1	0.1	0.14	0.19	0.25	0.27	0.48
Predicted probability	0.06	0.07	0.07	0.08	0.11	0.13	0.16	0.22	0.3	0.49
Predicted probability interval	[0.0562,0.0601]	(0.0601,0.0681]	(0.0681,0.0767]	(0.0767,0.0926]	(0.0926,0.123]	(0.123,0.145]	(0.145,0.188]	(0.188,0.245]	(0.245,0.349]	(0.349,0.951]

What You Need to Know

Background:

Patients with advanced colorectal adenomas (AA) are uniformly directed to undergo intensive surveillance, and this paradigm has been historically unchallenged. However, the benefit derived from surveillance may be outweighed by the risk of death from non-colorectal cancer (CRC) causes, leading to inappropriate individual recommendations and misuse of colonoscopy resources.

Findings:

A prediction score for 5-year mortality risk from non-CRC causes comprised 3 risk categories: low, intermediate, and high, in which death occurred in 6.5%, 14.1%, and 33.2%, respectively.

Implications for patient care:

This risk prediction model allows identification of patients with AA at high risk of death, and thus unlikely to benefit from further surveillance.