Predicting Follow-up Colonoscopy to an Abnormal Fecal Test in Safety-Net Clinics

Amanda Petrik,
Sr. Research Associate

The Center for Health Research

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Research Team

The Center for Health Research, Kaiser Permanente Northwest, Portland, Oregon

- Gloria Coronado, PhD, Principal Investigator
- Eric Johnson, PhD, Investigator
- David Smith, PhD, RPh, Investigator
- Erin Keast, MS, Analyst

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Background

- Colorectal cancer (CRC) is the 2nd leading cancer killer in the US
- The Strategies and Opportunities to STOP Colon Cancer in Priority Populations (STOP CRC) project conducted a mailed fecal testing program.
  - Mailed Introductory Letter/FIT/Reminders
- Noticed gaps in achieving a follow-up colonoscopy after an abnormal FIT test
  - 89% receiving referrals
  - 59% completing colonoscopy (in FQHC's)
- Interventions like patient navigation can improve follow-up rates, although it can be expensive

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Background:

Barriers to colonoscopy:

Patient-level

- fear of results
- inability to take time off of work
- inability to purchase preparation materials or complete adequate bowel prep
- difficulty finding a driver on the day of the procedure

System-level

- limited colonoscopy capacity
- failure to refer the patient or schedule the procedure
- failure to communicate expectations about the procedure or prep

- Knew we needed to ***identify patients most in need of patient navigation***:
  - aimed to develop a prediction model using patient level data available in the EHR to identify patients unlikely to undergo colonoscopy following an abnormal test.

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Precision Medicine

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NIH National Institutes of Health
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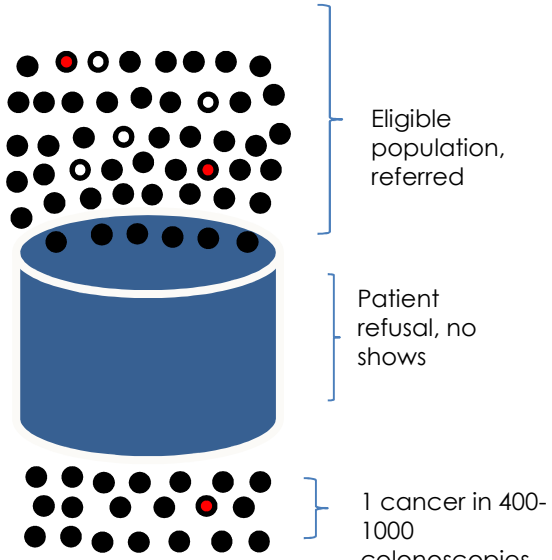
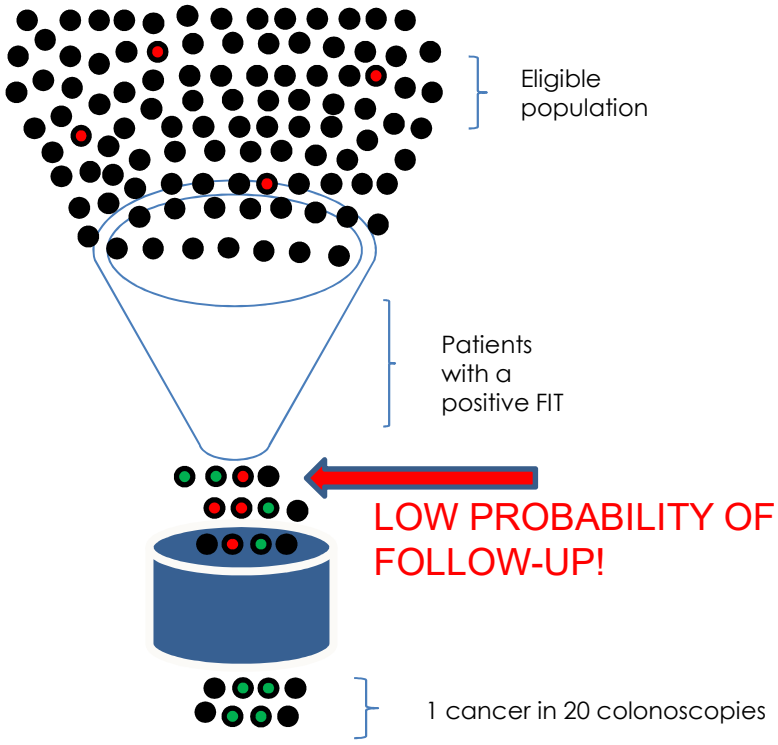
FIT can identify high-risk patients

Screening colonoscopy (refer 1,000 patients)



- Represents 20 patients

FIT testing (2,000 patients)



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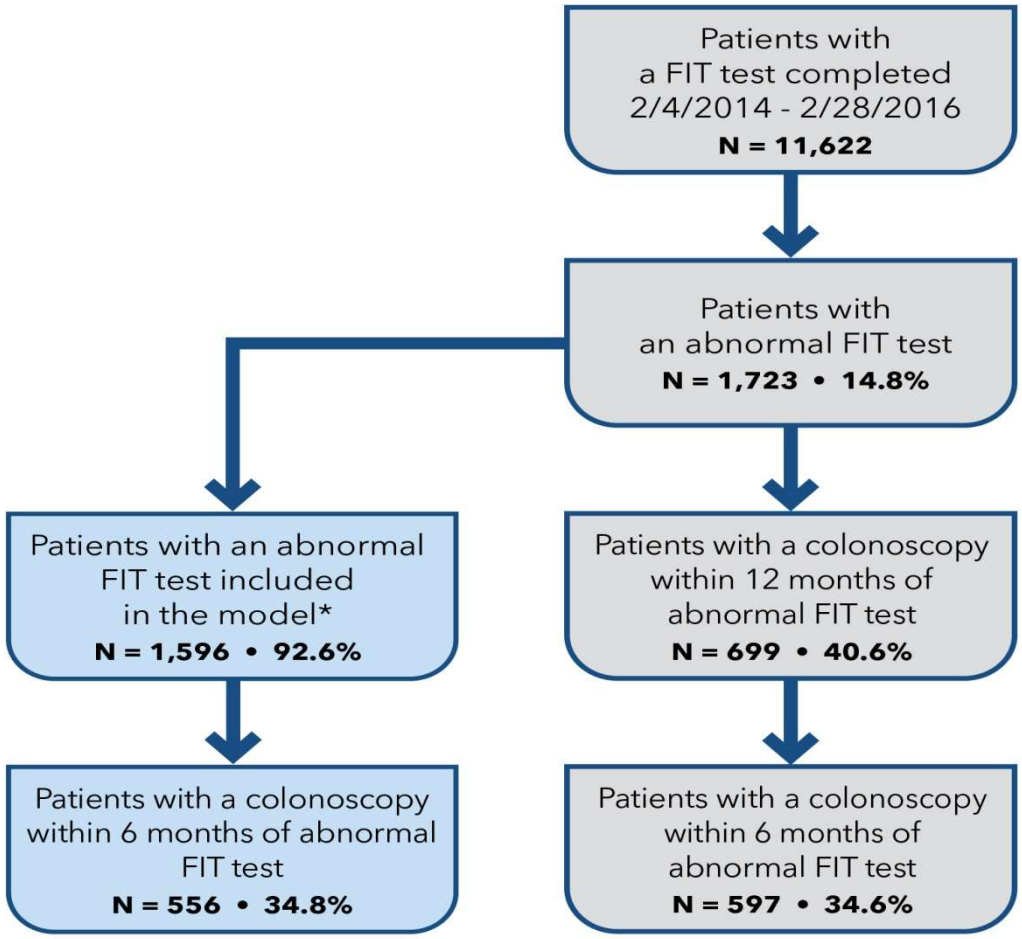
Population:



*Patients excluded from clinics too small to contribute and with missing data.

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Predictors of Colonoscopy

Age
Sex
BMI
Language (English/Non-English)
Race (White/Non-White)
Ethnicity (Hispanic/Non-Hispanic)
Insurance
Tobacco Use
Percent of Census Tract with College Degree
Percent of Census Tract Households below FPL
Census Tract Median Household Income
Census Tract Unemployment
Census Tract Population Density (People per square mile of land area)
Census Tract GINI Income Inequality
Low access Census Tract at 1/2 mile for urban areas or 5 miles for rural areas

Emergency Room Visits per 1,000 Medicare Enrollees (County)
Urban/Rural County
Charlson Comorbidity
Asthma/COPD dx in 2 years prior to index
Diabetes dx in 2 years prior to index
Severe mental illness
Mood disorder (Depression, Bipolar) dx in 2 years prior to index
Substance/alcohol abuse dx in 2 years prior to index
Long term anticoagulant use
Blood in Stool prior to positive FIT
Hemorrhoid/Anal Fissure prior to positive FIT
Prior CRC screening
Flu shot within 1 year of index date
Number of outpatient encounters in year prior to index date
Count of no-show encounters in year prior to index date
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VARIABLE	PATIENTS WITH COLONOSCOPY N (%OF ALL)	ALL PATIENTS N (% OF ALL)	POINTS	HAZARD RATIO	(95% CI)
Age				**0.97**	**(0.96 - 0.99)**
50-54	200 (40.2%)	498 (31.2%)	50		
55-59	156 (36.7%)	425 (26.6%)	38		
60-64	122 (32.4%)	377 (23.6%)	25		
65-69	62 (30.7%)	202 (12.7%)	13		
70-75	16 (17.0%)	94 (5.9%)	0		
Race				**1.49**	**(1.15 - 1.93)**
Non-White	72 (27.1%)	266 (16.7%)	0		
White	484 (36.4%)	1330 (83.3%)	34		
Insurance					
Uninsured	86 (32.5%)	265 (16.6%)	4	ref	
Medicaid	282 (37.7%)	748 (46.9%)	14	1.13	(0.89 - 1.45)
Medicare	136 (31.3%)	435 (27.3%)	4	1.01	(0.76 - 1.34)
Commercial	52 (35.1%)	148 (9.3%)	0	0.96	(0.67 - 1.38)
Census Tract GINI Income Inequality				**1.06**	**(1.00 - 1.12)**
0.27 - 0.38	102 (31.0%)	329 (20.6%)	0		
0.38 - 0.41	115 (35.3%)	326 (20.4%)	5		
0.41 - 0.43	122 (37.4%)	326 (20.4%)	10		
0.43 - 0.47	97 (37.9%)	256 (16.0%)	14		
0.47 - 0.82	120 (33.4%)	359 (22.5%)	19		

VARIABLE	PATIENTS WITH COLONOSCOPY N (%OF ALL)	ALL PATIENTS N (% OF ALL)	POINTS	HAZARD RATIO	(95% CI)
Long term anticoagulant use				**0.52**	**(0.28 - 0.98)**
No	546 (35.3%)	1545 (96.8%)	55		
Yes	10 (19.6%)	51 (3.2%)	0		
Flu shot within 1 year of index date				**1.59**	**(1.28 - 1.98)**
No	452 (33.0%)	1368 (85.7%)	0		
Yes	104 (45.6%)	228 (14.3%)	40		
Count of no-show encounters in year prior to index date				**0.88**	**(0.78 - 0.99)**
0	394 (34.9%)	1128 (70.7%)	22		
1	99 (39.1%)	253 (15.9%)	11		
2+	63 (29.3%)	215 (13.5%)	0		
Health Center				**1.06**	**(1.00 - 1.12)**
HC 2	193 (31.4%)	615 (38.5%)	44	1.68	(1.14 - 2.47)
HC 3	64 (48.1%)	133 (8.3%)	100	3.22	(2.09 - 4.96)
HC 4	44 (42.3%)	104 (6.5%)	81	2.59	(1.63 - 4.12)
HC 5	139 (48.4%)	287 (18.0%)	97	3.09	(2.08 - 4.60)
HC 6	66 (28.5%)	232 (14.5%)	28	1.38	(0.89 - 2.13)
HC 7	19 (27.1%)	70 (4.4%)	32	1.46	(0.82 - 2.59)
HC 8	31 (20.0%)	155 (9.7%)	0	ref	

Not significant characteristics include gender, BMI, language, ethnicity, tobacco use, % of census tract with college degree, percent of census tract households below FPL, census tract median household income, census tract unemployment, census tract population density, census tract low access, ER visits per 1,000, urban/rural, Charlson comorbidity, asthma/COPD, diabetes, severe mental illness, mood disorder, substance/alcohol abuse, blood in stool, hemorrhoid/anal fissure, prior CRC screening, number of outpatient encounters.

© **ABBREVIATIONS:** CI, Confidence Interval; GINI, Gini Coefficient on Income Inequality

Performance statistics

C-statistic (95% CI)	**0.6598**
R^2 (95% CI)	13.08 (9.36-17.13)
D (95% CI)	0.794 (0.658-0.931)
Bootstrap-corrected c-statistic	0.6328
Slope Shrinkage	0.0997
A D-statistic of zero means that the model failed to separate higher and lower risk patients. The R^2 statistic measures the amount of variation explained in the model.	

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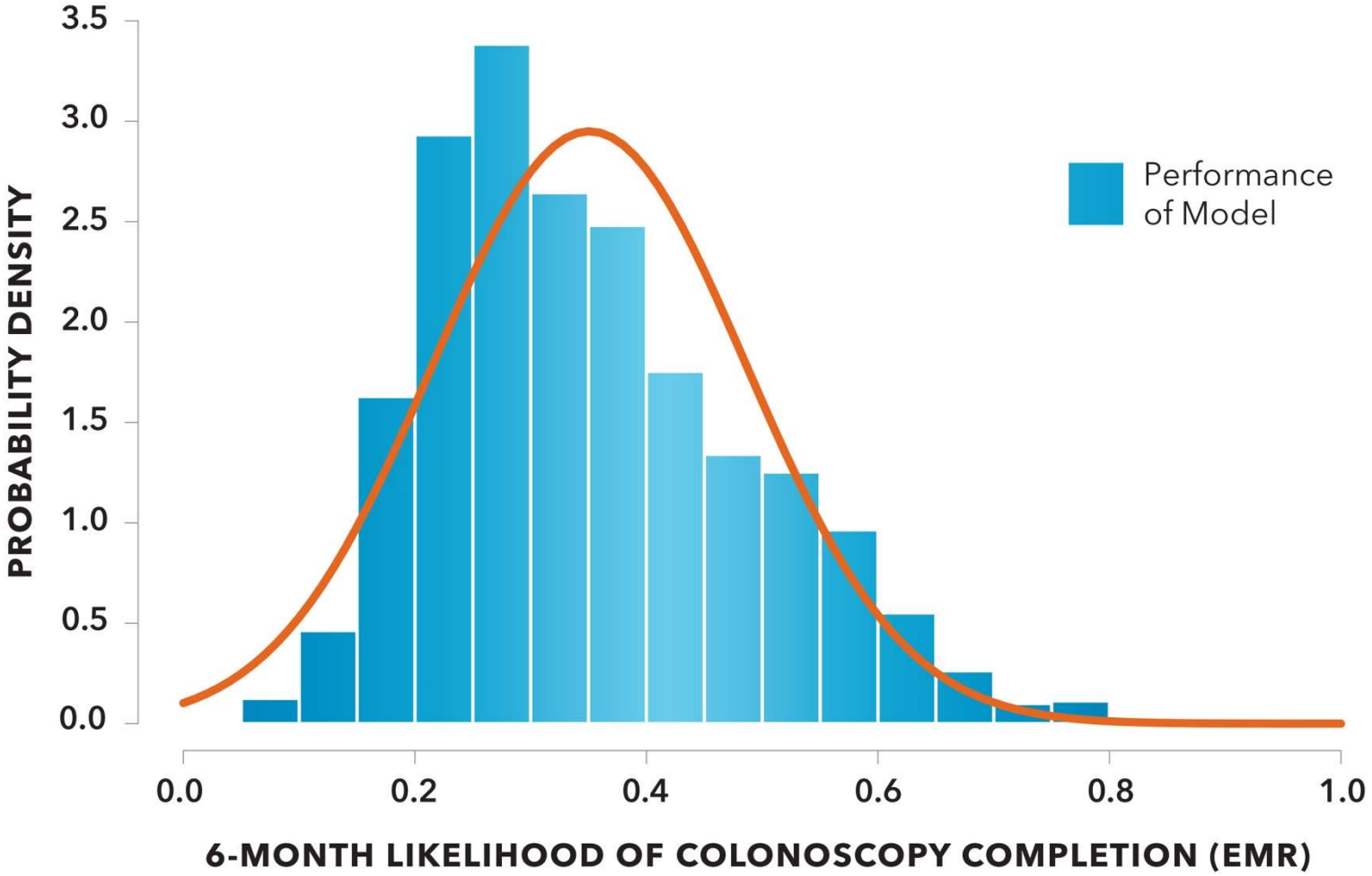
Histogram of Predicted Probability



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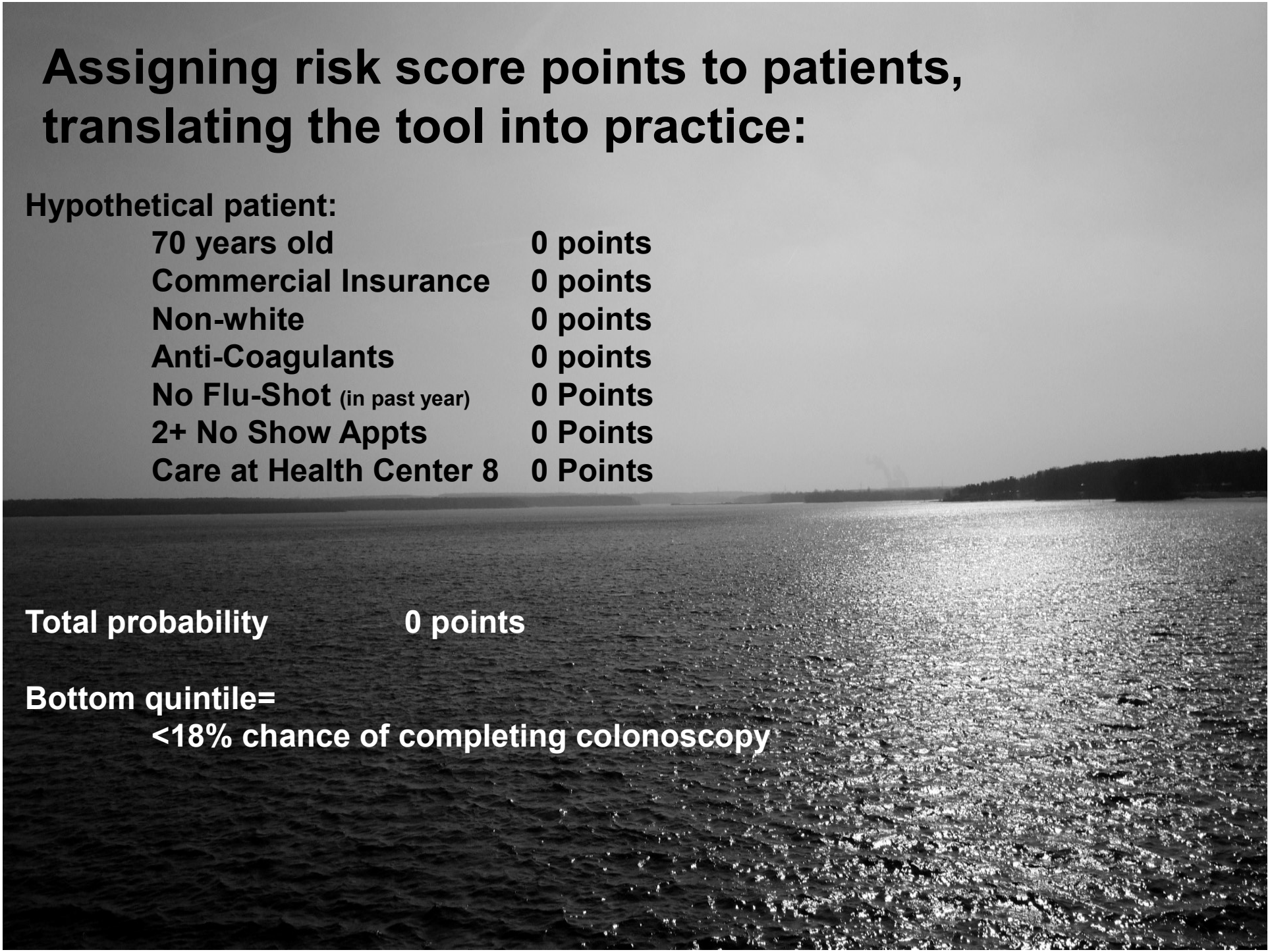

Assigning risk score points to patients, translating the tool into practice:

Hypothetical patient:

70 years old	0 points
Commercial Insurance	0 points
Non-white	0 points
Anti-Coagulants	0 points
No Flu-Shot (in past year)	0 Points
2+ No Show Appts	0 Points
Care at Health Center 8	0 Points

Total probability **0 points**

Bottom quintile=

<18% chance of completing colonoscopy

It takes a village:

- CHR research team:
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