Cancer Screening Results and Follow-up Using Routinely Collected Electronic Health Data: Estimates for Breast, Colon, and Cervical Cancer Screenings

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INTRODUCTION

Routinely collected electronic health data about cancer screening and follow-up would be helpful adjuncts for assessing guideline adherence in real-world populations. We compared the use of insurance claims data to other sources to describe (1) abnormal colorectal cancer, breast cancer, and cervical cancer screening results and (2) follow-up after abnormal cancer screening results.

METHODS

We evaluated over 100 million person-years of curated claims data from one large national and 2 smaller regional insurers participating in the National Institutes of Health (NIH) Health Care Systems Research Collaboratory Distributed Research Network (DRN).[1–4] We assessed rates of new colorectal, breast, and cervical cancer screenings and abnormal cancer screening results from January 1, 2007 to December 31, 2014, and in 2013, we assessed selected follow-up events (cancer diagnosis, imaging, or biopsy) within 90 days following a new abnormal colorectal, breast, or cervical cancer screening result (Fig. 1). We used US Preventative Services Task Force recommendations[5] to establish lower boundaries for age at screening. Individuals aged at least 50, 40, and 21 years for colon, breast, or cervical cancer, respectively, were required to have continuous medical and pharmacy coverage for $\geq$ 9 months (270 days) before their index cancer screening or abnormal cancer screening result, allowing gaps in coverage $\leq$ 45 days.

A "new" screening was defined as a cancer screening with no previous screenings of that type in the preceding 270 days. A new abnormal cancer screening result was defined similarly. Screenings, abnormal results, and subsequent follow-up events were defined based on ICD-9-CM diagnosis/procedure codes, CPT codes, and HCPCS codes (codes available from authors).

Each data partner used the same data structure (at the FDA Sentinel common data model).[4] The DRN coordinating center distributed a cohort identification and analysis program that executed against each organization's existing transformed, curated dataset, and returned aggregate results. We measured days to follow-up within 90 days following a first abnormal result among those with medical and pharmacy coverage for

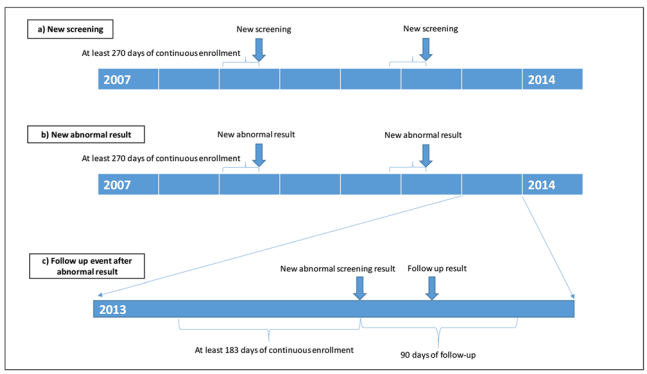

Figure 1 Study time and enrollment criteria used to assess (a) new cancer screenings, (b) new abnormal cancer screening results, and (c) timing of follow-up event after abnormal screening results. [a]An individual could have more than 1 record of a new cancer screening or abnormal screening result during the study period. For example, for an individual who is continuously enrolled for 4 years, multiple new screenings may exist as long as the screenings were separated by at least 270 days. [b]Screenings, abnormal cancer screening results, and follow-up events to abnormal cancer screening results were defined using a combination of International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) diagnosis and procedure codes as well as Current Procedural Terminology (CPT) and Healthcare Common Procedure Coding System (HCPCS) codes. Briefly, the definition of a follow-up event following an abnormal cancer screening colonoscopy or fecal occult blood test included codes indicating colonoscopy, sigmoidoscopy, CT scan, and MRI of the abdomen as well as neoplasm diagnoses. The definition of a follow-up event for abnormal breast cancer screening results included codes indicating mammograms, digital tomosynthesis, MRI, ultrasound, excision, or neoplasm diagnoses. An abnormal cervical cancer screening result was indicated by an abnormal cervical or vaginal pap smear. The definition of a follow-up event included codes indicative of relevant procedures (e.g., colposcopy, biopsy, laparoscopy, hysterectomy) and neoplasm diagnoses.

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≥ 6 months (183 days) (Fig. 1). The numbers of eligible members, unique patients with new screenings, abnormal screening results, and follow-up events to abnormal results were stratified by age group for each cancer.

The Harvard Pilgrim Health Care Human Studies Committee determined that this project did not constitute human subjects research and therefore did not require further review or approval by the Committee.

RESULTS

Detailed results are shown in Tables 1 and 2. Of > 6 million eligible individuals aged 50–64 years, 2.1 million (309.5 new screening patients/1000) had ≥ 1 new colorectal cancer screening from 2007 to 2014. In the same age group, the absolute number of new breast cancer and cervical cancer screening patients were more common. New screening patients/1000 eligible members were most frequent among patients aged 50–64 years for both colorectal and breast cancers, while those aged 30–39 years had the highest proportion of new cervical cancer screening patients (Table 1).

The proportion of abnormal results among new screening patients varied (1.8–7.7 for colorectal cancer, 23.8–26.0 for breast cancer, and 9.5–18.2 for cervical cancer). For those with abnormal screening results, new patients with follow-up events per 1000 eligible members were fewest for colorectal cancer (68.0–71.9). Mean time to follow-up event was shortest for breast cancer (Table 2).

Table 2 Follow-up Events to Patients' First New Abnormal Results, by Cancer Type and Age Group, 2013

Cancer type by age group	Follow-up events		
	New patients w/ abnormal results[h]	New patients w/ FU events, *N* (%)[i]	Mean time to FU (days)[j]
Colorectal			
50–64 years	6675	4798 (71.9)	30.4
65–74 years	3115	2161 (69.4)	33.4
75+ years	2331	1586 (68.0)	34.8
Breast			
40–49 years	73,935	72,657 (98.3)	2.8
50–64 years	107,882	105,571 (97.9)	3.1
65–74 years	27,095	26,372 (97.3)	3.8
75+ years	12,800	12,382 (96.7)	4.3
Cervical			
21–29 years	37,516	28,150 (75.0)	23.8
30–39 years	31,004	23,212 (74.9)	24.2
40–49 years	29,084	21,760 (74.8)	24.1
50–64 years	25,646	18,320 (71.4)	27.0

[h]*New patients with abnormal results = unique no. of patients with new abnormal colorectal, breast, or cervical cancer screening result, without other abnormal cancer screening results of that type in the previous 183 days in 2013*
[i]*New patients with follow-up events = no. of new patients with abnormal results (column h) with a valid follow-up event during the 90 day follow-up time in 2013*
[j]*Mean time to follow-up (days) = mean time between all valid, new abnormal colorectal, breast, or cervical cancer screening results and the occurrence of a follow-up event*

Table 1 New Cancer Screenings and New Abnormal Cancer Screening Results, by Cancer Type and Age Group, 2007–2014

Cancer type by age group		Screening			Abnormal results			
	Total person-years	Members eligible for screening[a]	New screening patients[b]	New screening patients/1000 eligible members[c]	Members eligible for abnormal results[d]	New abnormal results patients[e]	New abnormal results patients/1000 eligible members[f]	% new screening patients with abnormal results[g]
Colorectal								
50–64 years	15,401,777.9	6,779,854	2,098,192	309.5	6,888,703	39,316	5.7	1.8
65–74 years	4,033,474.9	1,840,061	427,106	232.1	1,875,680	16,808	9.0	3.9
75+ years	3,256,372.1	1,042,409	178,126	170.9	1,049,425	13,727	13.1	7.7
Breast								
40–49 years	4,642,801.2	3,001,516	1,467,246	488.8	3,133,127	397,747	126.9	26.0
50–64 years	6,157,912.7	3,376,362	1,977,389	585.7	3,532,027	521,522	147.7	25.2
65–74 years	1,575,987.2	914,020	486,345	532.1	961,137	128,543	133.7	25.1
75+ years	1,291,935.1	520,448	273,103	524.7	539,340	67,448	125.1	23.8
Cervical								
21–29 years	2,830,327.4	2,565,478	1,151,822	449.0	2,698,221	220,658	81.8	18.2
30–39 years	3,573,484.5	2,738,890	1,388,592	507.0	2,873,450	193,568	67.4	13.3
40–49 years	4,549,387.2	2,986,486	1,502,123	503.0	3,107,195	196,246	63.2	12.6
50–64 years	6,464,676.9	3,393,798	1,625,058	478.8	3,507,895	160,240	45.7	9.5

[a]*Members eligible for screening = no. of members meeting enrollment eligibility requirements who were eligible to have a new colorectal, breast or cervical cancer screening. For breast and cervical cancer screenings, this was determined by multiplying total eligible members by the proportion of female members in the health plans*
[b]*New screening patients = patients with at least 1 new colorectal, breast, or cervical cancer screening (no other cancer screening code of that type in the prior 270 days) between January 1, 2007, and December 31, 2014*
[c]*New screening patients/1000 eligible members = column b divided by column a, multiplied by 1000*
[d]*Members eligible for abnormal results = no. of members meeting enrollment eligibility requirements who were eligible to have a new colorectal, breast, or cervical cancer abnormal screening result. For breast and cervical cancer screenings, this was determined by multiplying total eligible members by the proportion of female members in the health plans*
[e]*New abnormal results patients = patients with at least 1 new abnormal colorectal, breast, or cervical cancer screening result (no other abnormal cancer screening result code of that type in the prior 270 days) between January 1, 2007, and December 31, 2014*
[f]*New abnormal results patients/1000 eligible members = column e divided by column d, multiplied by 1000*
[g]*% new screening patients with abnormal results = column f divided by column c, multiplied by 100*

DISCUSSION

These results, obtained through a distributed data network, are similar to findings reported from a cancer screening-specific consortium.[6] Abnormality rates for colorectal cancer are higher in the 65–74 age group vs. the 50–64 age group, and the highest proportion of patients with follow-up within 90 days was for breast cancer follow-up (> 95%), followed by colorectal and cervical cancers (< 75%).

A strength of this analysis is its employment of a reusable analysis program executing against standardized and curated, routinely collected electronic data from various institutions to enable rapid, privacy-protecting, cost-efficient assessment of practice. These results cannot be extrapolated beyond commercially insured populations and may not capture screenings outside of insured care (e.g., free screenings). We did not account for the results of past tests, follow-up type, or individual health status, all of which may affect observed timing or occurrence of events.

Although additional study is needed to examine the influence of variation in screening processes on disease outcomes, these results support the use of routinely available, quality-checked, observational data to assess adherence to recommended screening and follow-up of common cancers.

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Compliance with Ethical Standards:

Conflict of Interest: *The authors declare that they do not have a conflict of interest.*

Disclaimer: *The views presented here are solely the responsibility of the authors and do not necessarily represent the official views of the National Institutes of Health.*

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