Understanding those overdue for cancer screening by five years or more: A retrospective cohort study in Ontario, Canada

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ABSTRACT

Populations that are more than just slightly overdue for breast, cervical and colorectal screening should likely be targeted for policy and practice interventions. We used provincial-level administrative data to describe the Ontario population who are screen-eligible for breast, cervical and colorectal cancers but overdue by at least five years. For each cancer screening type, we created three cohorts and a binary outcome: screened at least once in the previous five years or not, using March 31, 2017 as our index date. We conducted simple descriptive analyses as well as multivariable logistic regression, where age category, immigrant status, neighbourhood income quintile, region, urban/suburban/rural status, primary care model type, and healthcare utilization were included in the models. More than 20% of Ontarians eligible for each of breast, cervical and colorectal cancer screening respectively had no history of screening in the previous five years. In multivariable analyses, people were significantly more likely to have no recent screening history if they lived in lower-income neighbourhoods (e.g. adjusted odds ratio [95% confidence interval]: 0.59 [0.58–0.59] for cervical screening), were recent immigrants, did not have a primary care provider, had a provider who practiced in a traditional fee-for-service model. Despite the presence of three provincial organized screening programs, we have found that more than one-fifth of Ontarians who are eligible for each of breast, cervical and colorectal screening respectively have not been screened for five years or more. Ensuring that all Ontarians have access to high-quality primary care, may be crucial to increasing screening uptake.

1. Introduction

Screening for cancers is a core component of prevention in primary care. Screening for breast, cervical and colorectal cancers are all recommended by Cancer Care Ontario, the provincial agency responsible for Ontario's cancer care system, due to the evidence for reductions in cancer morbidity and mortality (CancerCareOntario, n.d.). Screening guidelines for the province state that: i) sexually active women between the ages of 21 and 69 should receive cervical screening with the Pap test every three years, ii) women between the ages of 50 and 74 years should be screened for breast cancer with mammogram every two years, and iii) adults between the ages of 50 and 74 years should be screened for colorectal cancer (CRC) every two years with fecal blood testing (About the Ontario Breast Screening Program, n.d.; What is the ColonCancerCheck program?, n.d.; https://www.cancercare.on.ca/pcs/screening/cervscreening/, 2012). Adults with a flexible sigmoidoscopy or colonoscopy every 10 years are also considered up-to-date on screening (What is the ColonCancerCheck program?, n.d.).

People who meet eligibility criteria but are not screened within the aforementioned time frames are considered overdue for screening and at higher risk of developing cancers. However, those who are overdue for screening for a longer period of time are presumably at even higher risk as that time period extends. For example, Jackson et al. found that 22.1% of Ontario women with cervical cancer had not had a Pap test in the three to five years prior to their diagnosis, but 55% had not received screening for at least five years prior to their diagnosis (Jackson et al., 2019). Regarding the never-screened, Voruganti et al. found that more than 50% of women diagnosed with cervical cancer in Ontario had no recorded screening history (Voruganti et al., 2016), Choi et al. found that late-stage breast cancer was significantly more frequent in women

who had never been screened compared with those who had ever been screened (Choi et al., 2018), and Steffen et al. found that ever having undergone CRC screening was associated with a 44% reduced risk of developing CRC compared to those who had never undergone screening (Steffen et al., 2014).

Populations that are more than just slightly overdue for screening should likely be targeted for policy and practice screening interventions. In this population-based retrospective cohort study, we used provincial-level administrative health data to describe the Ontario population who are screen-eligible for each of breast, cervical and colorectal cancers but overdue for screening by at least five years, in order to highlight subpopulations and regions in Ontario with the most urgent needs for screening interventions.

2. Methods

2.1. Study setting

According to the 2016 Canadian Census, the province of Ontario has over 13 million residents and is the country's largest province by population. Ontario has a universal healthcare system that provides medically necessary healthcare services, including primary care physician services, at no cost to all citizens and permanent residents. Each citizen and permanent resident has a unique Ontario Health Insurance Plan (OHIP) number that is documented on a card that is presented at each physician visit.

Ontario has several relatively new blended primary care model types that physicians can participate in, including those where physicians are primarily paid based by capitation or primarily paid based by fee-for-service (Glazier and Redelmeier, 2010; Hutchison and Glazier, 2013). Interprofessional team models also exist where funding is provided by the government to support non-physician health care professionals as part of the care team (Glazier and Redelmeier, 2010; Hutchison and Glazier, 2013). A small number of primary care physicians still practice in traditional fee-for-service, including physicians who are practicing in walk-in clinics, and a small number also have unique model types (classified as "other" in this study). Ontario is divided up into 14 regions with each region responsible for local health care planning (Ontario's LHINs, 2019).

2.2. Study population

We created three cohorts, one for each cancer screening type. All ages and time periods were anchored to an index date of March 31, 2017 and allowed for a five-year look-back window. For example, as guidelines recommend breast screening from ages 50 to 74 years, the breast screening cohort consisted of women who were aged 55–74 years on March 31, 2017. Women with a history of breast cancer or of mastectomy were excluded. The cervical screening cohort consisted of women aged 26–69 years, excluding women with a history of cervical cancer or hysterectomy. The colorectal screening cohort consisted of adults aged 55–74 years, excluding those with a history of colorectal cancer, inflammatory bowel disease, or colectomy. Cohort members also had to be eligible for the universal provincial health plan for the full five-year study period and were excluded if they had no contact with the health care system in the preceding seven years.

2.3. Outcomes

We created a binary outcome for each cancer screening type: screened at least once in the previous five years or not, using March 31, 2017 as our index date.

2.4. Study variables

We categorized each cohort member based on age category,

immigrant status (immigrated in previous 10 years versus all others), neighbourhood income quintile, region of the province, urban/sub-urban/rural status, primary care model type, and healthcare utilization category.

2.5. Data sources

We linked several provincial-level administrative datasets to determine the cohort, outcomes and additional study variables. All datasets are housed at ICES, which is an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyze health care and demographic data, without consent, for health system evaluation and improvement. These datasets were linked using unique encoded identifiers and analyzed at ICES. Specifically, we used the Registered Persons Database (RPDB) to identify adults aged 18 years and over and eligible for health care. The RPDB contains basic demographic information for those who have ever received a health card number. We used the Immigration, Refugee and Citizenship database to determine immigrant status and time since landing in Canada. We determined neighbourhood income quintile, provincial region and rural/urban status from each person's postal code based on the Rurality Index of Ontario (RIO) score (Kralj, 2005), Postal Code Conversion File (Wilkins, 2004) and Statistics Canada 2016 Census data. We obtained data on the primary care model type from the Corporate Physicians Database and Client Agency Program Enrolment Database. We defined healthcare utilization using Resource Utilization Bands (RUBs) from the Johns Hopkins Adjusted Clinical Groups Case Mix System, which identifies morbidities from diagnosis codes in outpatient billing and inpatient (hospital) records (*Johns Hopkins ACG System*, n.d.). The RUBs represent groupings based on expected level of healthcare resource use, with 0 representing non-use and 5 representing a very high level of morbidity and healthcare use. We used the OHIP Database and Ontario Cancer Registry to determine when someone had received cancer screening and to determine when someone was ineligible for screening due to history of cancer or previous surgical procedures.

2.6. Data analysis

We conducted simple descriptive analyses of the study cohorts, stratifying the outcome by the variables listed above. We also conducted multivariable logistic regression, where all study variables noted above were included in the model.

This study received ethics approval from the St. Michael's Hospital Research Ethics Board in Toronto, Ontario.

3. Results

Table 1 displays the demographic characteristics of the three screening cohorts. More than two-thirds of people lived in urban settings for all cohorts. The proportion of recent immigrants ranged from 2.5% (colorectal cohort) to 6.7% (cervical cohort). The most common primary care model type was primarily capitation-based, and few people were seeing physicians who practiced in a traditional fee-for-service model. Approximately 5% of people in each cohort were not connected to primary care at all.

Rates of screening uptake for the preceding five years are shown in Table 2. Overall, 20.1% of women eligible for breast cancer screening had no record of mammography in the preceding five years, and age category did not seem to play a meaningful role. This value rose to 25.3% for women living in the lowest income quintile, and to 30.1% for recent immigrants. This value dropped to 16% for women whose primary care provider was in an interprofessional team or primarily capitation-based model. Overall, 23.1% of women eligible for cervical screening had no record of a Pap test in the preceding five years. For both women living in the lowest income neighbourhoods and women

Table 1
Demographic characteristics of the three study cohorts.

	Breast	Cervical	Colorectal
N (%)	1,534,000 (100)	3,630,981 (100)	3,102,453 (100)
Age group			
26–34 years	n/a	837,313 (23.1)	n/a
35–49 years	n/a	1,265,902 (34.9)	n/a
50–64 years	911,014 (59.4)	1,229,981 (33.9)	1,841,769 (59.4)
65–74 years	622,986 (40.6)	297,802 (8.2)[a]	1,260,684 (40.6)
Rurality			
Urban	1,045,469 (68.2)	2,695,178 (74.2)	2,100,520 (67.7)
Suburban	335,581 (21.9)	665,373 (18.3)	683,183 (22.0)
Rural	139,297 (9.1)	241,842 (6.7)	289,816 (9.3)
Missing	13,653 (0.9)	28,588 (0.8)	28,934 (0.9)
Income quintile			
1 (lowest)	262,476 (17.1)	640,289 (17.6)	525,560 (16.9)
2	295,803 (19.3)	692,446 (19.1)	592,800 (19.1)
3	303,902 (19.8)	728,948 (20.1)	614,595 (19.8)
4	330,480 (21.5)	799,917 (22.0)	671,418 (21.6)
5	335,795 (21.9)	754,372 (20.8)	686,544 (22.1)
Missing	5535 (0.4)	15,009 (0.4)	11,536 (0.4)
Immigration status			
More than 10 years	1,494,087 (97.4)	3,386,706 (93.3)	3,023,815 (97.5)
Within 10 years	39,443 (2.6)	244,275 (6.7)	78,638 (2.5)
Primary Care Model			
Primarily capitation	496,142 (32.3)	1,116,413 (30.7)	985,048 (31.8)
Primarily fee-for-service, individual MD	52,183 (3.4)	128,319 (3.5)	108,155 (3.5)
Primarily fee-for-service, group of MDs	383,336 (25.0)	1,022,933 (28.2)	774,503 (25.0)
Interprofessional team-based	445,323 (29.0)	944,823 (26.0)	880,079 (28.4)
Traditional fee-for-service	75,076 (4.9)	190,232 (5.2)	161,443 (5.2)
No primary care	68,374 (4.5)	203,430 (5.6)	162,766 (5.2)
Other group	13,566 (0.9)	24,831 (0.7)	30,459 (1.0)
Region			
Erie St. Clair	78,190 (5.1)	159,265 (4.4)	159,401 (5.1)
South West	117,362 (7.7)	244,514 (6.7)	236,247 (7.6)
Waterloo Wellington	81,050 (5.3)	203,627 (5.6)	162,953 (5.3)
Hamilton Niagara Haldimand Brant	172,269 (11.2)	370,494 (10.2)	347,086 (11.2)
Central West	85,475 (5.6)	245,391 (6.8)	175,119 (5.6)
Mississauga Halton	121,213 (7.9)	326,493 (9.0)	246,213 (7.9)
Toronto Central	120,150 (7.9)	363,410 (10.0)	243,239 (7.8)
Central	192,710 (12.6)	503,116 (13.9)	384,898 (12.4)
Central East	183,373 (12.0)	415,562 (11.4)	368,977 (11.9)
South East	70,024 (4.6)	131,293 (3.6)	140,039 (4.5)
Champlain	147,520 (9.6)	342,391 (9.4)	301,467 (9.7)
North Simcoe Muskoka	60,827 (4.0)	124,628 (3.4)	123,528 (4.0)
North East	74,932 (4.9)	139,573 (3.8)	153,921 (5.0)
North West	28,649 (1.9)	61,224 (1.7)	59,365 (1.9)
Healthcare utilization			
0 (non-users)	87,887 (5.7)	312,235 (8.6)	210,431 (6.8)
1	37,707 (2.5)	148,884 (0.4)	79,873 (2.6)
2	171,375 (11.2)	543,432 (15.0)	364,385 (11.7)
3	891,634 (5.8)	1,877,966 (51.7)	1,738,418 (56.0)
4	239,491 (15.6)	634,777 (17.5)	473,041 (15.2)
5 (highest users)	105,906 (6.9)	113,687 (3.1)	236,305 (7.6)

[a] Women in this cohort were up to 69 years of age.

who were recent immigrants, 29.0% had no record of a Pap test in the preceding five years. More than 31% of women 65–69 years of age and more than 68% of women with no primary care provider had not had a documented Pap test in the preceding five years. The proportion of those unscreened at five years was highest for the colorectal screening cohort, at 24.2%. For this cohort, 32.6% of immigrants and 29.9% of people in the lowest income quintile had no record of screening in the past five years. Those under 65 years had higher prevalence of no recent screening compared to those aged 65–74 years (26.8% vs. 20.4%). Approximately two-thirds of those with no primary care providers had no record of colorectal screening in the past five years. For all three cohorts, increasing healthcare utilization was associated with increasing proportions who had been screened in the preceding five years, with a drop-off at the highest level of healthcare use.

In multivariable regression (Table 3), adjusted odds ratios (AORs) of screening in the past five years followed similar patterns for all three cancers. A clear income gradient was seen, with AORs of approximately 0.60 across cancer types for the lowest versus highest income quintile. Recent immigrants also had consistently lower adjusted odds of screening compared to other cohort members. The most striking values for AORs were seen for primary care model type, (where having no primary care provider and seeing a provider who practiced in a traditional fee-for-service model had AORs of no greater than 0.36), and for non-users of healthcare (AOR 0.22 [95% confidence interval 0.22–0.23] for breast screening, 0.20 [0.20–0.20] for cervical screening, 0.29 [0.28–0.29] for colorectal screening). At the regional level, there was a high degree of variation but the Hamilton Niagara Haldimand Brant had consistently lower AORs than other regions whereas Champlain consistently had the highest values.

4. Discussion

In this population-based retrospective cohort study, we have found that more than 20% of Ontarians eligible for each of breast, cervical and

Table 2
Breast, cervical and colorectal screening uptake in the previous 5 years for the three study cohorts.

	Breast	Cervix	Colorectal
	Not screened	Not screened	Not screened
N (%)	308,298 (20.1)	839,422 (23.1)	751,852 (24.2)
Age group			
26–34 years	n/a	208,895 (24.9)	n/a
35–49 years	n/a	254,870 (20.1)	n/a
50–64 years	185,382 (20.3)	282,318 (23.0)	494,368 (26.8)
65–74 years	122,916 (19.7)	93,339 (31.3)	257,484 (20.4)
Rurality			
Urban	211,262 (20.2)	630,785 (23.4)	506,281 (24.1)
Suburban	63,686 (19.0)	142,580 (21.4)	163,074 (23.9)
Rural	29,965 (21.5)	57,039 (23.6)	73,326 (25.3)
Missing	3385 (24.8)	9018 (31.5)	9171 (31.7)
Income quintile			
1 (lowest)	66,348 (25.3)	185,781 (29.0)	157,104 (29.9)
2	63,717 (21.5)	173,708 (25.1)	153,842 (26.0)
3	60,225 (19.8)	166,098 (22.8)	148,485 (24.2)
4	59,583 (18.0)	162,820 (20.4)	149,274 (22.2)
5	57,060 (17.0)	146,145 (19.4)	139,367 (20.3)
Missing	1365 (24.6)	4870 (32.4)	157,104 (29.9)
Immigration status			
More than 10 years	296,287 (19.8)	768,640 (22.7)	726,182 (24.0)
Within 10 years	12,011 (30.1)	70,782 (29.0)	25,670 (32.6)
Primary Care Model			
Primarily capitation	82,320 (16.6)	210,976 (18.9)	200,545 (20.4)
Primarily fee-for-service, individual MD	10,640 (20.4)	32,489 (25.3)	25,585 (23.7)
Primarily fee-for-service, group of MDs	73,550 (19.2)	231,394 (22.6)	173,879 (22.5)
Interprofessional team-based	71,096 (16.0)	156,268 (16.5)	176,826 (20.1)
Traditional fee-for-service	23,380 (31.1)	62,458 (32.8)	60,445 (37.4)
No primary care	44,002 (64.4)	139,848 (68.7)	107,786 (66.2)
Other group	3310 (24.4)	5989 (24.1)	200,545 (20.4)
Region			
Erie St. Clair	211,262 (20.2)	41,151 (25.8)	38,800 (24.3)
South West	63,686 (19.0)	55,637 (22.8)	59,713 (25.3)
Waterloo Wellington	29,965 (21.5)	44,092 (21.7)	41,106 (25.2)
Hamilton Niagara Haldimand Brant	3385 (24.8)	84,642 (22.8)	91,820 (26.5)
Central West	14,504 (18.5)	60,098 (24.5)	43,208 (24.7)
Mississauga Halton	25,280 (21.5)	76,737 (23.5)	58,974 (24.0)
Toronto Central	16,813 (20.7)	91,545 (25.2)	63,365 (26.1)
Central	38,007 (22.1)	112,073 (22.3)	81,804 (21.3)
Central East	18,043 (21.1)	95,509 (23.0)	85,350 (23.1)
South East	24,410 (20.1)	28,223 (21.5)	36,473 (26.0)
Champlain	26,965 (22.4)	68,672 (20.1)	67,734 (22.5)
North Simcoe Muskoka	34,350 (17.8)	26,113 (21.0)	28,334 (22.9)
North East	34,429 (18.8)	39,118 (28.0)	38,525 (25.0)
North West	15,071 (21.5)	15,812 (25.8)	16,646 (28.0)
Healthcare utilization			
0 (non-users)	60,573 (68.9)	216,252 (69.3)	145,353 (69.1)
1	13,344 (35.4)	48,371 (32.5)	32,935 (41.2)
2	44,529 (26.0)	138,295 (25.4)	115,858 (31.8)
3	138,271 (15.5)	326,943 (17.4)	337,326 (19.4)
4	32,145 (13.4)	82,277 (13.0)	76,062 (16.1)
5 (highest users)	19,436 (18.4)	27,284 (24.0)	44,318 (18.8)

colorectal cancer screening respectively have no recent (i.e. in the previous five years) history of screening despite being eligible for screening and for the province's universal health care coverage for the entire five-year period. More than two-thirds of screen-eligible Ontarians who do not have a regular primary care provider, who have a provider in a traditional fee-for-service model (which includes walk-in clinicians), and who are non-users of healthcare have no record of screening in the previous five years. In multivariable analyses, people were significantly more likely to have no recent screening history if they lived in lower-income neighbourhoods, had immigrated in the previous ten years, did not have a primary care provider, had a provider who practiced in a traditional fee-for-service model, or lived in certain regions of the province. Healthcare utilization showed somewhat of an inverted U-shaped pattern in analyses, where increased utilization was associated with increased adjusted odds of having screening in the previous five years, but with a drop-off at the highest level of utilization

and morbidity. The patterns that we have observed are in line with previous literature on sociodemographic groups who are more likely to be overdue for screening in Ontario (Borkhoff et al., 2013; Fernandes et al., 2015; Shen et al., 2018; Guilcher et al., 2014; Lofters et al., 2010a; Vahabi et al., 2015; Vahabi et al., 2016), but highlight the large minority of residents of the province who are not simply overdue, but are years overdue for screening as per guideline recommendations. Although our findings are specific to the Canadian province of Ontario, the screening disparities that we observed likely have broader applicability to other similar settings. As well, it is feasible that other jurisdictions that do not have universal health care or organized cancer screening programs may exhibit even higher prevalence of no recent screening and wider disparities than those observed in this study.

Our findings seem to exemplify the importance of primary care for ensuring that cancer screening occurs, including the importance of interprofessional team-based care. The low level of screening among

Table 3

Adjusted odds ratios [with 95% confidence interval] for screening in past 5 years. All models adjusted for all variables listed in the table.

	Breast	Cervical	Colorectal
Age group			
26–34 years	n/a	1.03 [1.02–1.03]	n/a
35–49 years	n/a	1.37 [1.36–1.38]	n/a
50–64 years	1.0	1.0	1.0
65–74 years	0.94 [0.93–0.94]	0.56 [0.55–0.56]	1.28 [1.27–1.28]
Rurality			
Urban	1.04 [1.03–1.06]	0.98 [0.97–0.99]	1.04 [1.03–1.06]
Suburban	1.06 [1.04–1.08]	1.02 [1.01–1.03]	0.99 [0.98–1.00]
Rural	1.0	1.0	1.0
Missing	1.15 [1.10–1.21]	1.02 [0.99–1.05]	0.97 [0.94–1.00]
Income quintile			
1 (lowest)	0.62 [0.61–0.63]	0.59 [0.59–0.60]	0.62 [0.62–0.63]
2	0.75 [0.74–0.76]	0.71 [0.71–0.72]	0.74 [0.73–0.74]
3	0.83 [0.82–0.84]	0.80 [0.79–0.80]	0.81 [0.80–0.81]
4	0.92 [0.90–0.93]	0.90 [0.89–0.91]	0.88 [0.87–0.89]
5	1.0	1.0	1.0
Missing	0.71 [0.66–0.76]	0.59 [0.57–0.62]	0.63 [0.60–0.66]
Immigration status			
More than 10 years	1.0	1.0	1.0
Within 10 years	0.83 [0.81–0.85]	0.90 [0.89–0.91]	0.89 [0.87–0.90]
Primary Care Model			
Primarily capitation	0.88 [0.87–0.89]	0.79 [0.78–0.79]	0.90 [0.90–0.91]
Primarily fee-for-service, individual MD	0.66 [0.65–0.68]	0.51 [0.51–0.52]	0.73 [0.71–0.74]
Primarily fee-for-service, group of MDs	0.70 [0.69–0.71]	0.60 [0.59–0.60]	0.76 [0.75–0.77]
Interprofessional team-based	1.0	1.0	1.0
Traditional fee-for-service	0.36 [0.35–0.37]	0.34 [0.33–0.34]	0.36 [0.35–0.36]
No primary care	0.30 [0.29–0.31]	0.29 [0.29–0.29]	0.33 [0.32–0.33]
Other group	0.59 [0.57–0.62]	0.77 [0.74–0.79]	0.85 [0.83–0.88]
Region			
Erie St. Clair	1.14 [1.11–1.17]	0.84 [0.83–0.86]	1.00 [0.99–1.02]
South West	0.94 [0.92–0.96]	1.01 [1.00–1.02]	0.96 [0.95–0.97]
Waterloo Wellington	1.02 [0.99–1.04]	1.09 [1.07–1.10]	0.98 [0.96–1.00]
Hamilton Niagara Haldimand Brant	0.89 [0.87–0.90]	0.97 [0.96–0.98]	0.86 [0.85–0.87]
Central West	1.02 [0.99–1.04]	0.90 [0.89–0.92]	1.01 [0.99–1.02]
Mississauga Halton	1.05 [1.02–1.07]	0.96 [0.95–0.97]	1.02 [1.01–1.04]
Toronto Central	1.0	1.0	1.0
Central	1.27 [1.25–1.29]	1.09 [1.08–1.11]	1.24 [1.22–1.25]
Central East	1.16 [1.14–1.19]	1.02 [1.01–1.03]	1.10 [1.08–1.11]
South East	0.99 [0.97–1.02]	1.19 [1.16–1.21]	0.96 [0.94–0.98]
Champlain	1.29 [1.27–1.32]	1.31 [1.30–1.33]	1.19 [1.17–1.20]
North Simcoe Muskoka	1.21 [1.18–1.24]	1.01 [1.00–1.03]	1.05 [1.03–1.07]
North East	1.04 [1.01–1.07]	0.80 [0.79–0.82]	1.11 [1.09–1.13]
North West	1.14 [1.10–1.19]	1.03 [1.01–1.05]	0.99 [0.97–1.01]
Healthcare utilization			
0 (non-users)	0.22 [0.22–0.23]	0.20 [0.20–0.20]	0.29 [0.28–0.29]
1	0.65 [0.64–0.67]	0.70 [0.69–0.71]	0.69 [0.68–0.71]
2	1.0	1.0	1.0
3	1.93 [1.90–1.95]	1.73 [1.71–1.74]	1.87 [1.86–1.88]
4	2.35 [2.31–2.39]	2.52 [2.49–2.54]	2.34 [2.31–2.36]
5 (highest users)	1.65 [1.62–1.68]	1.33 [1.31–1.35]	1.95 [1.92–1.97]

persons seeing providers in traditional fee-for-service models likely at least partially reflects use of walk-in clinics, and thus a lack of high-continuity prevention-focused primary care. The patterns we observed for healthcare utilization may reflect increased opportunities for screening with increased contact with the healthcare system, but with competing priorities at the highest level of morbidity, where screening may be de-prioritized due to managing more acute medical conditions, or may even be inappropriate.

Primary care practices and organized screening programs may want to develop targeted strategies specific for people who have only a remote screening history or have never been screened as they are likely at higher risk of developing cancers than their peers who are simply out of date (Jackson et al., 2019; Voruganti et al., 2016; Choi et al., 2018; Steffen et al., 2014). However, outreach for these two groups may require different strategies, and strategies that re-engage people who are slightly overdue may not be enough to engage those who were remotely screened or have perhaps never been screened. Promising practices exist in the literature. In the city of Toronto, Dunn et al. led a multi-faceted community-based intervention targeted at women who were

immigrants and/or living with low income that consisted of peer-led education sessions and facilitation for cervical and breast cancer screening (Dunn et al., 2017a). Although both under- and never-screened women showed higher screening uptake after the intervention, the effect was most noticeable among never-screened women who had an adjusted odds ratio of 13.3 (95% CI: 4.0–44.1) for screening within eight months versus control. In a similar intervention, Mock et al. found a lay health worker outreach and education program for promoting cervical screening among Vietnamese American women was particularly successful among women who had never been screened (Mock et al., 2007). As speculated by Dunn et al. (Dunn et al., 2017b), the combination of tailored education and support with system navigation may be of particular importance for those who have never been screened, particularly those from immigrant communities or who otherwise face challenges accessing the healthcare system. Self-sampling for HPV has also showed promise at the system level for cervical screening specifically; Wilkstrom et al. offered self-sampling versus Pap testing at a midwifery clinic to women overdue for screening by at least six years, with 39% versus 9% taking up screening (Wikström et al.,

2011). Tranberg et al. found mailing self-sampling kits to be effective for women who were overdue for screening both by several months and by three to five years (Tranberg et al., 2018). Despite these promising practices, there are still likely patients for whom the fear of a cancer diagnosis and competing social and health priorities will remain very challenging barriers to overcome (Green et al., 2017; Jones et al., 2010; Honein-AbouHaidar et al., 2016).

This study had several limitations. First, it is possible that some people may have left the province or died and been erroneously categorized as unscreened. However, everyone in each cohort had to be eligible for health care for the entire five-year study period. Second, it is not possible to determine which cohort members had an informed discussion with their provider and chose not to participate in screening. For example, the Canadian Task Force for Preventive Health Care now recommends that women have an informed discussion with their primary care provider about the risks and benefits of breast cancer screening (Klarenbach et al., 2018). Third, we did not examine the role of more distant immigrant status or of region of origin for immigrants. More distant immigrants have also been found to have screening disparities compared to Canadian-born residents (Lofters et al., 2010a; Lofters et al., 2014; Lofters et al., 2010b), and immigrants from particular world regions of origin have been found to have greater screening disparities than others (Shen et al., 2018; Lofters et al., 2010a; Vahabi et al., 2016; Lofters et al., 2014; Vahabi et al., 2017). Fourth, it is not possible to determine from this study if the association between participation in capitation and interprofessional team-based models and higher likelihood of more recent screening is causal. Previous literature has suggested that providers in practices with higher screening rates (and other related practice characteristics) may simply be more likely to gravitate to these particular model types (Lofters et al., 2018; Kiran et al., 2014).

5. Conclusions

Despite the presence of three provincial organized screening programs, we have found that more than one-fifth of Ontarians who are eligible for each of breast, cervical and CRC screening respectively have not been screened for five years or more. Tailored education with patient navigation, innovations in screening, and ensuring that all Ontarians have access to high-quality primary care, including interprofessional team-based care, may all be crucial strategies to encourage screening uptake.

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