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4 Enhanced access to cervical and colorectal cancer screening in rural and remote northern  
5 Alberta: A pilot study  
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4 **Key words:** Integrated cancer screening, cervical cancer screening, colorectal cancer screening,  
5 breast cancer screening, mobile cancer screening  
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## 7 **Abstract**

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10 **PURPOSE:** Women in rural and remote northern Alberta access breast cancer screening  
11 through a mobile mammogram program (Screen Test). The Enhanced Access to Cervical and  
12 Colorectal Cancer Screening (EACS) project was a two-year pilot that aimed to integrate cervical  
13 and colorectal cancer screening with Screen Test. This study compares cervical and colorectal  
14 cancer screening uptake among women screened through the pilot (Screen test-EACS) versus  
15 Screen Test.  
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19 **METHODS:** Screen Test-EACS was offered between 2013-2015 in selected rural and remote  
20 sites, with a focus on First Nations, Métis and Hutterite communities. Participation in cervical  
21 and colorectal cancer screening was analyzed for Screen Test and Screen Test-EACS participants  
22 6 weeks prior to the mammogram and then again three months after.  
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26 **RESULTS:** A total of 8390 and 1312 women participated in Screen Test and Screen Test-EACS  
27 respectively. Screen Test-EACS significantly increased uptake of cervical (10 vs. 27%) and  
28 colorectal (11 vs. 22%) cancer screening, increasing the prevalence of women up to date with  
29 screening from 52 to 62% and 37 to 49% respectively. Repeat testing for cervical and colorectal  
30 were about 7% and 2% higher among Screen Test-EACS participants, and testing peaked around  
31 the time of mammogram.  
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35 **CONCLUSIONS:** Screen Test-EACS increased participation and overall prevalence of cervical and  
36 colorectal cancer screening among hard-to-reach clients in northern Alberta, likely through  
37 removal of barriers to access and increased awareness. Integration of cancer screening needs  
38 to balance the benefits of increased participation with the costs and potential risks of over-  
39 screening.  
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Enhanced access to cervical and colorectal cancer screening in rural and remote northern Alberta: A pilot study

Introduction

Screening for breast, cervical and colorectal cancer is effective in reducing cancer incidence and mortality. Medical organizations recommend these screenings (1), which have been adopted in many countries. Despite their success, population-based cancer screening programs face the challenge of overcoming geographical barriers for rural residents, who are often less likely to be reached by preventive health care services (2).

Progress has been made in Canada to address geographic disparities to cancer screening (3), however geographic disparities in cancer screening remain in Alberta. Travel over great distance is sometimes required to obtain services that are not available closer to home (2) and participation in cancer screening is consistently lower in the northern rural and remote regions compared to provincial rates. In 2015, participation rates in breast, cervical and colorectal cancer screening in Alberta were 56.7%, 62% and 39.2% respectively compared to 48.7%, 56.9%, 36.1% in the northern region of the province.

Like many other jurisdictions in Canada (4), Alberta added mobile mammography (Screen Test) to its breast cancer screening program in the early 1990s. The purpose of Screen Test (5) was to reduce barriers (6) to breast cancer screening for rural women. The program currently operates two mobile mammography units that serve the northern and southern part of the province and provide services to over 100 communities each year.

To further reduce barriers in accessing cervical and colorectal cancer screenings a pilot of cervical and colorectal cancer screening was added to Screen Test in 2013. The Enhanced Access to Cancer Screening (EACS) pilot project was aimed not only to remove barriers to access in rural populations (7) but also to offer a “one stop shop” where women 50 to 69 years old

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4 could access cervical, colorectal as well as breast cancer screening, along with women between  
5 the ages of 70 and 74, the two latter meeting provincial eligibility criteria (8-10)  
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9 The EACS-Screen Test pilot was implemented at selected communities while the rest of the  
10 communities received the regular Screen Test mobile visit without EACS. Both the EACS-Screen  
11 Test pilot and Screen Test targeted women between 50 to 74 years of age. As such, the EACS-  
12 Screen Test pilot was a natural experiment that allowed a comparison of cancer screening  
13 participation outcomes between communities with and without the enhanced intervention.  
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19 This paper presents quantitative results of cervical and colorectal cancer screening uptake  
20 among clients who participated in the Screen Test-EACS pilot compared to clients who  
21 participated in regular Screen Test. In addition to participation in each cancer screening, we  
22 report participation across cancer screenings (11), namely, the proportion of women up to date  
23 for all cancer screenings they are eligible for.  
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## 29 30 Methods

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33 Screen Test and Screen Test-EACS offered mammography to women in Northern Alberta from  
34 November 1, 2013 to October 31, 2015; and from September 18, 2013 to October 8, 2015  
35 respectively. Screen Test-EACS refers to the intervention group, and Screen Test refers to the  
36 control group. In addition to mammography, Screen Test-EACS also offered cervical and  
37 colorectal cancer screening to eligible women. Recall letters were sent to all clients due for  
38 breast cancer screening. For women at locations where Screen-Test-EACS was scheduled, the  
39 letter also included a list of clinics that would be offering the additional screening.  
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47 Screen Test-EACS locations aimed to improve access in rural and remote areas and First  
48 Nations, Métis, and Hutterite communities. These communities were a subset of geographic  
49 areas originally covered by Screen Test, selected using a site readiness assessment that took  
50 into account local clinical and support staff capacity, physical space, community's ability to  
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3 sustain the project, availability of cancer screening services in the community, and other special  
4 considerations or unique challenges in the community.  
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8 All Screen Test and Screen Test-EACS clients included in this study received a mammogram.  
9 Women's date of birth was used to determine eligibility, with women 50 to 74 years of age  
10 included in this study. The clients' unique healthcare number enabled determination of  
11 whether women had records of Pap test, and/or either fecal occult blood test (FOBT) or fecal  
12 immunochemical test (FIT). Women with database records indicating a Pap test within three  
13 years of the study period were considered up to date with cervical cancer screening; and  
14 women with database records of receiving either FIT or FOBT within the two years were  
15 considered up to date with colorectal cancer screening. The three provincial databases (breast,  
16 cervical and colorectal) were linked to determine women's participation in multiple screenings.  
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26 Participation in cervical and colorectal screening was computed for both Screen Test and Screen  
27 Test-EACS clients at two different points in time: six weeks prior to mammogram and three  
28 months after mammogram. The first point in time (6 weeks prior to the date of mammogram)  
29 was treated as the baseline. Chi-square analyses were computed to assess for significant  
30 differences in the proportion of women up to date with cervical and colorectal cancer screening  
31 in the two groups for three different periods six weeks prior to the date of mammogram, within  
32 six weeks prior and three months after mammogram, and three months after the mammogram.  
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41 The "Net Increase" in the prevalence of women up to date with cervical and colorectal cancer  
42 screening was calculated by subtracting the proportion of women up to date three months  
43 after the mammogram from the proportion of women who were up to date at baseline (six  
44 weeks prior to mammogram). "Repeated Screening" was defined as screening tests performed  
45 on women who were up to date with screening for a particular cancer. The number of repeat  
46 screenings was calculated as the difference between the number of women screened during  
47 the study period (three weeks prior and three months after mammogram) and the Net Increase  
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3 for each cancer screening. All statistical analyses reported in this study were conducted using  
4 SAS 9.3. The p-value < 0.05 was considered statistically significant.  
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8 The ethical risk of this project was assessed using A Project Ethics Community Initiative (12)  
9 (ARECCI) online decision-support tool to screen projects, which determined this project carried  
10 minimal risks and therefore ethics approval was not required.  
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## 14 15 Results

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17 Screen Test visited 44 communities and held 74 clinics while Screen Test-EACS visited 16  
18 communities and held 24 clinics (Figure 1). A total of 8,390 and 1,312 women had a  
19 mammogram via Screen Test and Screen Test-EACS respectively. Of these, 6,174 (73.6%) and  
20 958 (73%) women were between 50-69 years of age at the time of mammogram and were thus  
21 considered eligible for cervical and colorectal cancer screening (Table 1)  
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29 Screen Test-EACS showed a significant ( $p < 0.0001$ ) increase in all variables measured versus  
30 Screen Test: proportion of women screened for cervical and colorectal cancer, as well as the  
31 total and net increase of clients up to date with both cancer screenings (Table 2). In addition,  
32 the proportion of women up to date with cervical *and* colorectal cancer screenings was also  
33 significantly higher among Screen Test-EACS three months after mammogram (Table 3).  
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40 The number of women who had a repeat cervical cancer screening for the period six weeks  
41 prior to three months after mammography was calculated as the difference (excess screening)  
42 between the total women screened during the study period and the net increase. For cervical  
43 cancer screening there were 322 (5.22%) and 124 (12.94%) repeat tests in the Screen Test and  
44 Screen Test-EACS respectively. The number of repeat colorectal cancer screening testing was  
45 254 (3.54%) and 64 (5.91%) women in Screen Test clients and Screen Test-EACS respectively.  
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52 Figure 2 shows the cumulative percentage and number of women screened during the study  
53 period in relation to the date of mammogram. Among Screen Test-EACS clients, cervical cancer  
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4 screening uptake showed a sharp increase around the date of mammography and was highest  
5 on the days prior and after mammography with a peak of around 100 clients (38%) compared  
6 to Screen Test (Figure 2 A, B). Colorectal cancer screening uptake increased in both the Screen  
7 Test-EACS and Screen Test clients, with a peak of over 20 screenings (10%) the week after  
8 mammography in the former group and an overall more sustained uptake in the latter group  
9 (Figure 2 C, D).  
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## 15 Discussion

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19 The Screen test-EACS pilot aimed to remove barriers to cervical and colorectal cancer screening  
20 by integrating them on to a mobile mammography program service in Northern rural and  
21 remote communities in Alberta. Mobile services have been effective in delivering preventive  
22 services such as breast (13, 14) and cervical (15) cancer screening, as well as the two screening  
23 combined plus immunizations (16). Given that cancer screening guidelines present some  
24 overlap in age eligibility for cervical, breast and colorectal cancer (8-10) it makes sense to  
25 integrate the provision of these three screenings in order to increase participation (17-19).  
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33 The pilot was successful in increasing participation in cervical (10 vs. 27%) and colorectal (11 vs.  
34 22%) cancer screening among women who received a mammogram through the mobile vans.  
35 Increased uptake resulted in an improved overall prevalence of women up to date with cervical  
36 (52 vs. 63%) and colorectal (37 vs. 49%) cancer screening. Increased participation however, also  
37 resulted in Screen Test-EACS clients having a higher proportion of repeat testing, that is testing  
38 again despite being up to date with either cervical or colorectal cancer screening. Although  
39 some of the repeat testing may have been medically indicated (such as a previous  
40 unsatisfactory sample) it is likely that Screen Test-EACS may have introduced over-screening,  
41 raising concerns of potential harms from the screening tests themselves or from false positive  
42 results.  
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4 We arbitrarily chose to measure participation six weeks prior and three months after  
5 mammogram to ensure baseline was free of any bias introduced from recall letters sent a few  
6 weeks prior to the clinic. The letters included information on cervical and colorectal cancer  
7 screening for Screen Test-EACS but not Screen Test clients. Contrary to what we expected the  
8 letters as well as any promotional events that may have occurred close before the date of the  
9 clinic (such as distribution of posters, newspaper advertisements, and direct contact including  
10 word of mouth) did not seem to prompt clients to get screened in advance, perhaps due to a  
11 lack of providers in the community. Most of the Screen Test-EACS clients who participated in  
12 cervical or colorectal cancer screening received were tested on the day of the mammogram, or  
13 shortly after.  
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24 Strengths of this study include relying on data linkage of the three provincial cancer screening  
25 databases, which contain information on any cancer screening test performed in Alberta. In  
26 addition, this paper adds to the scant literature on performance indicators for integrated cancer  
27 screening (11). Some limitations of our study include communities that were not randomly  
28 assigned to either the Screen Test-EACS or Screen Test. In addition, Screen Test communities  
29 were not blinded to promotional efforts of Screen Test-EACS clinics, which increased the overall  
30 participation underestimating the true effect Screen Test-EACS.  
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38 In summary, the enhanced Screen Test-EACS was more effective than the Screen Test group at  
39 increasing the percentage of women up to date with cervical and colorectal cancer screening,  
40 likely due to increased awareness and removal of geographical and administrative barriers to  
41 access to cervical and colorectal cancer screening. The benefits of increased participation in  
42 cancer screening need to be balanced with the risks and costs of over-screening.  
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## Tables and Figures

Figure 1. Screen Test and Screen Test-EACS mobile clinic locations

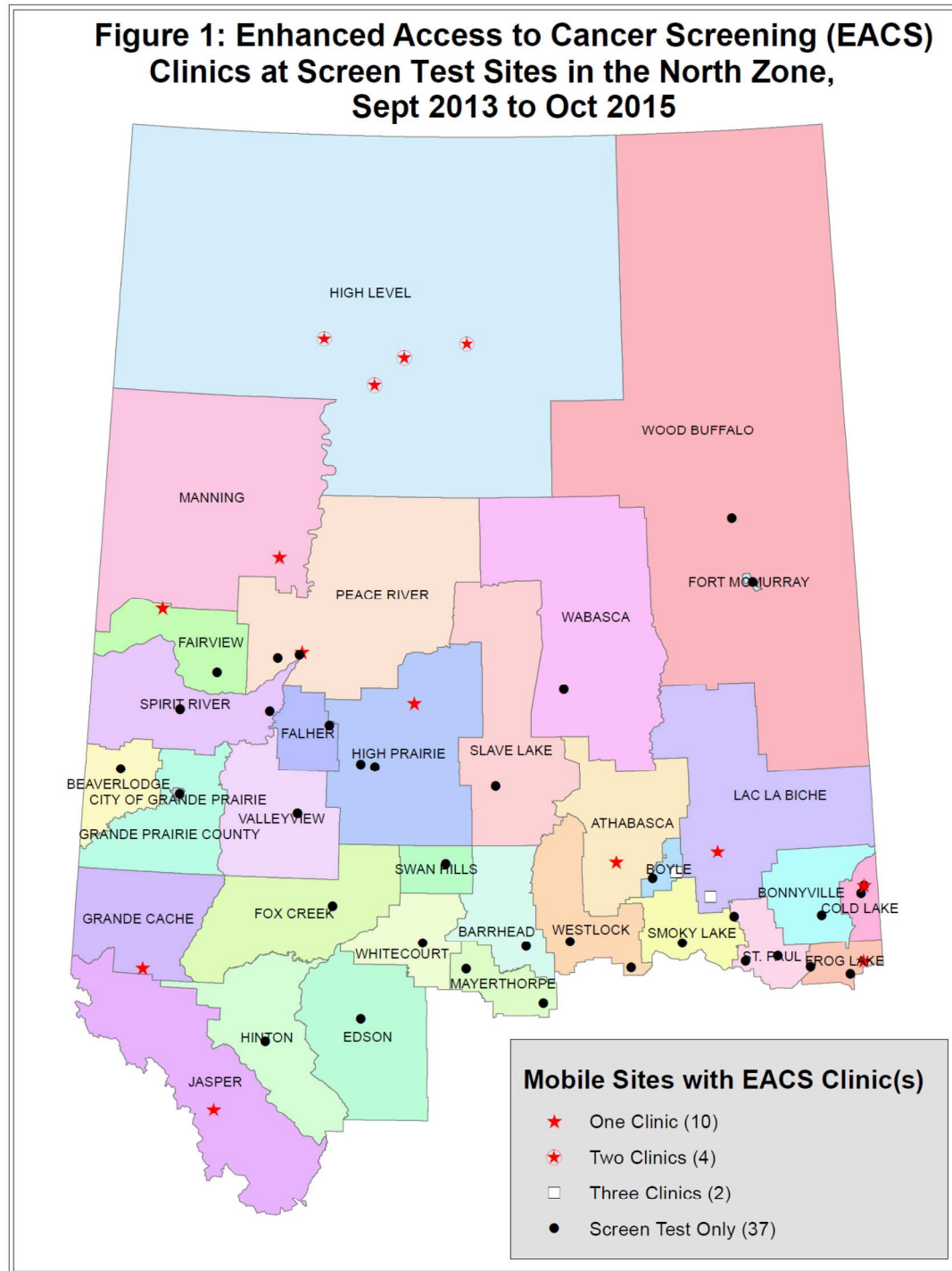


Table 1. Number and age groupings of women who participated in Screen Test and Screen Test-EACS

Age	Screen Test Number of women (%)	Screen Test-EACS Number of women (%)
<50	794 (9.5)	182 (13.9)
50-69	6174 (73.6)	958 (73)
70-74	1011 (12)	124 (9.4)
>75	411 (4.9)	48 (3.6)
<b>Total</b>	<b>8390</b>	<b>1312</b>

For Peer Review Only

**Table 2.** Cervical and colorectal cancer screening among Screen Test and Screen Test Clients-EACS clients

	Cervical (50-69 y)		Colorectal (50-74y)	
	Screen Test (%) [95% CI]	Screen Test-EACS (%) [95% CI]	Screen Test (%) [95% CI]	Screen Test-EACS (%) [95% CI]
<b>Total (1)</b>	6174 (100)	958 (100)	7185 (100)	1082 (100)
<b>Total screened (2)</b>	623 (10.09) [9.34 – 10.84]	<b>263 (27.45)*</b> <b>[24.63 – 30.28]</b>	782 (10.88) [10.16 – 11.60]	<b>243 (22.46)*</b> <b>[19.97 – 24.94]</b>
<b>Up to date 6 weeks prior (3)</b>	2940 (47.62) [46.37 – 48.86]	464 (48.43) [45.27 – 51.60]	2150 (29.92) [28.86 – 30.98]	348 (32.16) [29.38 – 34.95]
<b>Up to date 3 months after (4)</b>	3241 (52.49) [51.25 – 53.74]	<b>603 (62.94)*</b> <b>[59.89 – 66]</b>	2678 (37.27) [36.15 – 38.39]	<b>527 (48.71)*</b> <b>[45.73 – 51.68]</b>
<b>Net increase (5) =(4)-(3)</b>	301 (4.88) [4.34 – 5.41]	<b>139 (14.51)*</b> <b>[12.28 – 16.74]</b>	528 (7.35) [6.75 – 7.95]	<b>179 (16.54)*</b> <b>[14.33 – 18.76]</b>

\* EACS higher, p&lt;0.0001

(1) Total number of women who had a mammogram either through Screen Test or Screen Test-EACS during the study period

(2) Women screened within 6 weeks prior to 3 months after mammogram

(3) Women who were up to date with cancer screening 6 weeks prior to the date of their mammogram

(4) Women who were up to date three months after the date of their mammogram

(5) Net increase is calculated as the difference between the number of women up to date three months after mammography, and the number of women up to date with cancer screening six weeks prior to mammography

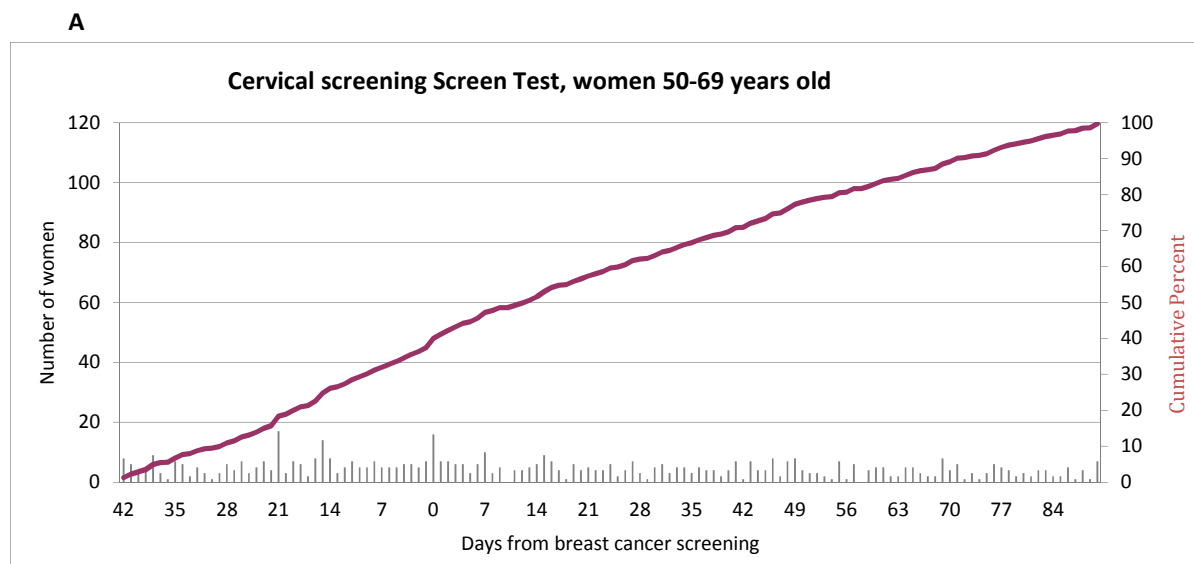
**Table 3.** Number of Screen Test and Screen Test-EACS among women 50-69 years old who were up to date with all three cancer screenings three months after their last mammograms

	Cervical and Colorectal Cancer Screening, women 50-69 years old	
	Screen Test (%) [95% CI]	Screen Test-EACS (%) [95% CI]
<b>Total (1)</b>	6174 (100)	958 (100)
<b>Total up to date (2)</b>	205 (3.32) [2.87 – 3.77]	<b>107 (11.17)* [9.17 – 13.16]</b>

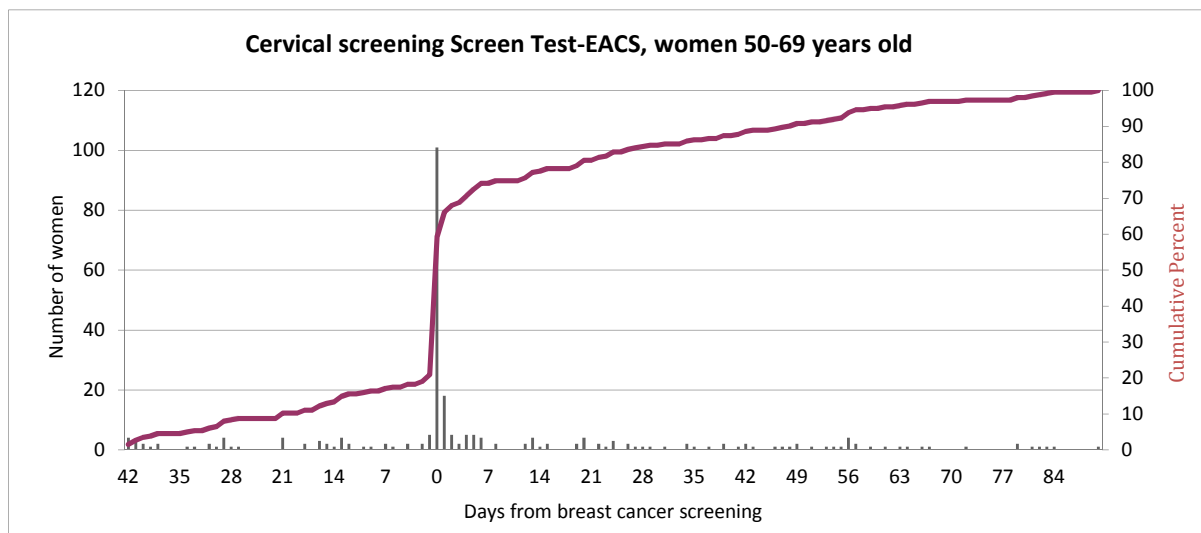
\* EACS higher, p&lt;0.0001

(1) Total number of women who had a mammogram

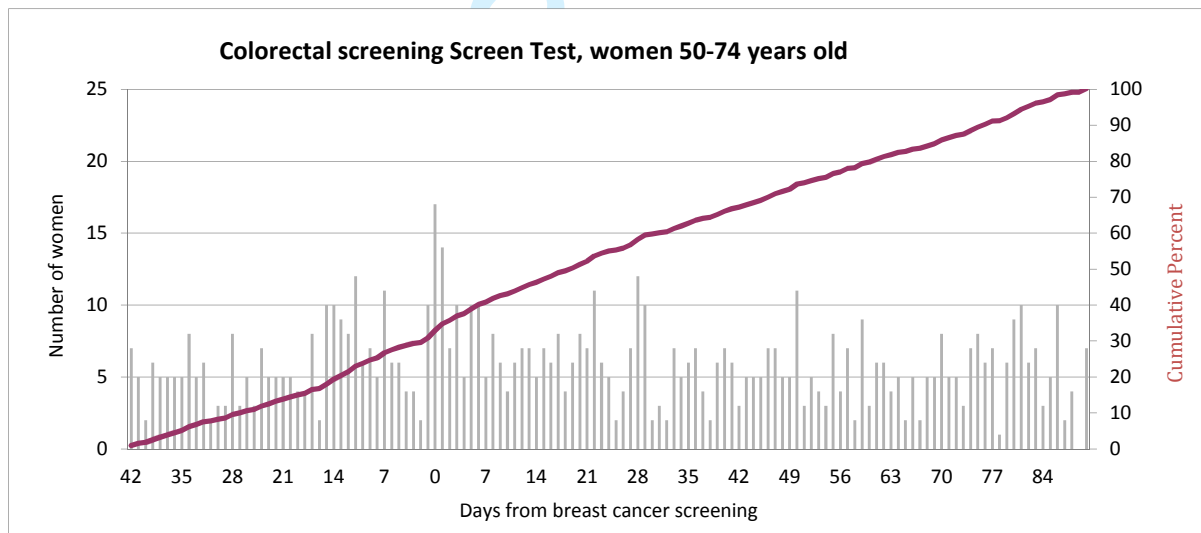
(2) Women up to date with both cervical and colorectal cancer screening 3 months after mammogram

**Figure 2.** Number of women and cumulative percentage of women screened through Screen Test (A, C) or Screen Test-EACS (B, D).

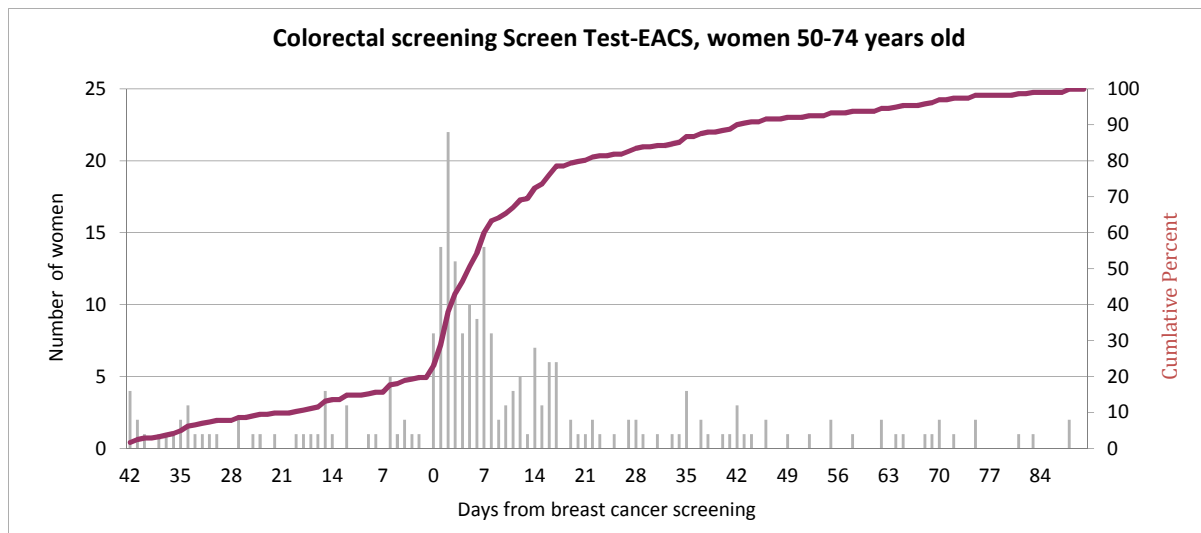
B



C



D



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Supplementary Information: Location of Screen Test-EACS clinics during the pilot.

Clinic Location (Clinic Year)	Other Communities in Screen Test Catchment			
<b><i>The clinics below offered Cervical, Colorectal and Breast Cancer Screening</i></b>				
Athabasca (2015)*	Calling Lake Perryvale White Gull	Colinton South Baptiste	Island Lake Sunset Beach	Island Lake South West Baptiste
High Level (2014)*	Chatech Paddle Prairie	Habay Rainbow Lake	Indian Cabins Steen River	Meander River Zama City
Lac La Biche (2015)*	Atmore Hylo Wandering River	Beaver Lake Imperial Mills	Breynat Plamondon	Fork Lake Rich Lake
John D'or Prairie (2014)**	Fox Lake	Garden River		
Buffalo Lake (2013, 2014, 2015)**	Caslan			
Manning (2015)^	Carcajou North Star	Deadwood Notikewin	Hotchkiss Twin Lakes	Keg River
Peace River (2015)*^	Cadotte Lake Marie-Reine	Chinook Valley Nampa	Dixonville Reno	Little Buffalo St. Isidore
Fort Vermilion (2014)*	Rocky Lane			
La Crete (2014)	Buffalo Head Prairie			
Fishing Lake(2015)**				
Gift Lake (2015)**				
Elizabeth Settlement (2015)**				
Grande Cache (2015)				
Kikino (2013, 2014, 2015)**				
Jasper (2015)				
<b><i>The clinics below offered Colorectal and Breast Cancer Screening</i></b>				
High Level (2015)*	Chatech Paddle Prairie	Habay Rainbow Lake	Indian Cabins Steen River	Meander River Zama City
Worsley (2015)	Bear Canyon	Cherry Point	Cleardale	Eureka River
John D'or Prairie (2015)**	Fox Lake	Garden River		
Fort Vermilion (2015)*	Rocky Lane			
La Crete (2015)	Buffalo Head Prairie			

\* Surrounding Aboriginal community.

\*\* Aboriginal community.

^ Surrounding Hutterite community.