INCOME, PATIENT ENROLMENT MODEL AND CERVICAL CANCER SCREENING UPTAKE WITHIN THE CENTRAL EAST LOCAL HEALTH INTEGRATION NETWORK

by

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A thesis submitted to the School of Nursing
In conformity with the requirements for
the degree of Master of Nursing Science

Queen’s University
Kingston, Ontario, Canada
(August, 2018)

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Abstract

Cervical cancer screening detects cancer at early stages and is available to Ontario women ages 21 to 69 years of age. Notwithstanding cancer screening initiatives, sub-groups of Ontario women are under-screened based on current literature. The most common primary health care delivery system in Ontario are patient enrolment models (PEMs) which allows for physician-incentives when rostering and cancer screening benchmarks are met. Notwithstanding, little is known about the effect of PEM enrolment and other socioeconomic (SES) factors, such as income, on screening uptake. This study considered differences in cervical screening uptake by PEM status and neighbourhood income levels by women residing in the Central East Local Health Integration Network (CELHIN).

A descriptive, comparative study using record level, administrative data from Cancer Care Ontario of eligible CELHIN women between January 1, 2012 and June 30, 2015 was conducted (N=490,574). The variables of interest were cervical screening uptake (dependent variable), PEM status (primary exposure variable), neighbourhood income quintile (independent variable) and controlled for age and rurality.

Using logistic regression, it was determined non-enrolled women were more likely not to be screened (OR =6.98, 95% CI, 6.87-7.08) compared to enrolled women, representing the strongest association. Given heterogeneous effects in odds ratios, multivariate stratified logistic regression analyses were undertaken for PEM enrolled and non-enrolled women separately. A significant association was found between older, non-enrolled women (ages 60-69) and not being screened (OR=1.87, 95% CI, 1.78-1.96).
Unexpectedly, enrolled women in the lowest neighbourhood income quintile were more likely to not be screened (OR=1.49, 95% CI, 1.46-1.53) compared to their non-enrolled counterparts (OR=1.20, 95% CI, 1.14-1.25). Urban dwellers were slightly less likely to be screened (enrolled women: OR=1.10, 95% CI, 1.07-1.12; non-enrolled women, OR=1.06, 95% CI 1.01-1.11) relative to rural women.

As older women have the greatest risk of high-grade invasive cervical cancer and PEM status is not protective for women living in lower SES, the priority for the CELHIN should be addressing barriers to cervical screening uptake, regardless of PEM status, for marginalized at-risk women including older women, and women living in lower SES environments.
Acknowledgements

I am reminded on a daily basis that the most powerful force in the universe blows in my direction, guiding my steps and lifting me up. I give thanks for both answered and unanswered prayer that originates from a place of unconditional love and peace.

I am most grateful for the ongoing guidance from my Supervisor, Dr. Dana Edge. Her dedication to this research project was obvious at all times. Dr. Edge has recently retired from Queen’s University after many years of dedicated service and I wish her well as she embarks on her next adventure. I also extend sincere thanks to my esteemed Supervisory Committee: Dr. Elizabeth VanDenKerkhof, Dr. Joan Almost and Dr. Marian Luctkar-Flude. This thesis was made possible by the dedicated team at Cancer Care Ontario. In particular, I would like to thank the following individuals: Entela Zaffino, Brooke Filsinger, Anna Kone and Dr. Nicole Mittmann.

To my husband Mark and daughter Miranda Ulrich, thank you for your love and support. I would be remiss if I did not acknowledge my son Greyson Ulrich specifically. Thank you very much for your computer services fixing my ongoing “user error” fiascos, as you so affectionately referred to my lack of IT skills. Thank you to my mother, Donna Roka, a pioneer in a man’s world and a force to be reckoned with.

Lastly, this research is dedicated to the patients that I am lucky enough to care for. It is my hope that research such as this will have policy implications that will improve health outcomes for patients adversely affected by health inequities. It has been my pleasure to see this research come to fruition and I extend my sincere thanks to all who have supported me along this journey.

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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSM</td>
<td>Blended Salary Model</td>
</tr>
<tr>
<td>CIHI</td>
<td>Canadian Institute for Health Information</td>
</tr>
<tr>
<td>CPAC</td>
<td>Canadian Partnership against Cancer</td>
</tr>
<tr>
<td>CTFPHC</td>
<td>Canadian Task Force on Preventative Health Care</td>
</tr>
<tr>
<td>CCO</td>
<td>Cancer Care Ontario</td>
</tr>
<tr>
<td>CSDH</td>
<td>Commission on Social Determinants of Health (2010) - WHO</td>
</tr>
<tr>
<td>CQCO</td>
<td>Cancer Quality Council of Ontario</td>
</tr>
<tr>
<td>CELHIN</td>
<td>Central East Local Health Integration Network</td>
</tr>
<tr>
<td>CHDB</td>
<td>Claims History Database [OHIP]</td>
</tr>
<tr>
<td>CAPE</td>
<td>Client Agency Program Enrolment Database</td>
</tr>
<tr>
<td>CCM</td>
<td>Comprehensive Care Model</td>
</tr>
<tr>
<td>CHC</td>
<td>Community Health Centre</td>
</tr>
<tr>
<td>CNO</td>
<td>College of Nurses of Ontario</td>
</tr>
<tr>
<td>DA</td>
<td>Dissemination Area</td>
</tr>
<tr>
<td>FFS</td>
<td>Fee-for-Service</td>
</tr>
<tr>
<td>FHG</td>
<td>Family Health Group</td>
</tr>
<tr>
<td>FHN</td>
<td>Family Health Network</td>
</tr>
<tr>
<td>FHT</td>
<td>Family Health Team</td>
</tr>
<tr>
<td>FHO</td>
<td>Family Health Organization</td>
</tr>
<tr>
<td>FOBT</td>
<td>Fecal Occult Blood Test</td>
</tr>
<tr>
<td>FIT</td>
<td>Fecal Immunochemical Test</td>
</tr>
<tr>
<td>FSA</td>
<td>Forward Sorting Area</td>
</tr>
<tr>
<td>GHC</td>
<td>Group Health Centre</td>
</tr>
<tr>
<td>HBM</td>
<td>Health Belief Model</td>
</tr>
<tr>
<td>HHN</td>
<td>Health Information Number</td>
</tr>
<tr>
<td>HSREB</td>
<td>Health Sciences &amp; Affiliated Teaching Hospitals Research Ethics Board</td>
</tr>
<tr>
<td>HPV</td>
<td>Human Papillomavirus</td>
</tr>
<tr>
<td>IDD</td>
<td>Intellectual and Developmental Disabilities</td>
</tr>
<tr>
<td>LHIN</td>
<td>Local Health Integration Network</td>
</tr>
<tr>
<td>MOHLTC</td>
<td>Ministry of Health and Long-Term Care</td>
</tr>
<tr>
<td>NPLC</td>
<td>Nurse Practitioner-Led Clinic</td>
</tr>
<tr>
<td>OCR</td>
<td>Ontario Cancer Registry</td>
</tr>
<tr>
<td>OCSP</td>
<td>Ontario Cervical Screening Program (2000)</td>
</tr>
<tr>
<td>OHIP</td>
<td>Ontario Health Insurance Plan</td>
</tr>
<tr>
<td>PAP</td>
<td>Papanicolaou Cervical Screening Test (also referred to as PAP smear or cervical cytology)</td>
</tr>
<tr>
<td>PEM</td>
<td>Patient Enrolment Model</td>
</tr>
<tr>
<td>PCCF+</td>
<td>Postal Code Conversion File Plus [v.6A]</td>
</tr>
<tr>
<td>RPDB</td>
<td>Registered Persons Database</td>
</tr>
<tr>
<td>SAGE</td>
<td>WHO Study on Global Ageing and Adult Health</td>
</tr>
</tbody>
</table>
SDOH  Social Determinants of Health
SES  Socioeconomic Status
SPSS  Statistical Packages for the Social Sciences (Software Version 24)
WHO  World Health Organization
Chapter 1

Introduction

Cancer screening contributes to saving lives. Over the past two decades, there have been reductions in breast, cervical and colon cancer mortality due to early detection and treatment as a result of publicly-funded, population-based cancer screening programs in Ontario (Cancer Quality Council of Ontario [CQCO], 2015). A cancer screening test is a non-diagnostic test intended to identify at-risk otherwise healthy, asymptomatic individuals with pre-cancerous changes or cancer at early stages (CQCO, 2017).

Alongside the implementation of cancer screening programs, Ontario experienced a primary care reform shift in 2001-2002 from a fee-for-service (FFS) health care delivery model to a predominately capitation payment system. Physicians are paid a set amount for each enrolled patient assigned to them within one of several patient enrolment models (PEMs) irrespective of the number of patient visits made to the physician (Kralj & Kantarevic, 2012; Ministry of Health and Long-Term Care [MOHLTC], 2012a). The 2012 Physician Services Agreement with the MOHLTC describes primary health care PEMs as follows (see Appendix A for Glossary):

Models of payment for primary care physicians to encourage moving from an independent practice (where they are the only physician or health care provider for their patients) to a group practice (this model includes other primary care physicians and/or other health care providers such as nurse practitioners) (MOHLTC, 2012b, para. 1).
The shift to PEMs, with physician-incentives for cancer screening, resulted in the enrolment of 2.1 million Ontarians who were previously not linked with a physician (non-enrolled) and demonstrated a positive impact on cancer screening (Kralj & Kantarevic, 2012). According to Health Council of Canada (2014), “enrolment with a primary care physician has grown from less than 600,000 in 2002 to 10.1 million (74% of the Ontario population) in June 2013” (p. 15). Preventative care bonuses were first introduced in Ontario in 2006 (MOHLTC, 2006). With the implementation of cancer screening programs and PEMs, a significant increase in cancer screening uptake for the population of Ontario is a reasonable expectation.

Notwithstanding such initiatives, there continues to be sub-groups of eligible individuals in Ontario who are consistently under-screened or never screened. Such sub-groups include individuals living in areas that have low income neighbourhoods and higher proportions of immigrants and ethnic diversity compared to the average Canadian population (Borkhoff et al., 2013; Chan et al., 2014; Cobigo et al., 2013; Elit et al., 2012; Gesink et al., 2014; Katz & Hofer, 1994; Singh et al., 2004; Spayne, Rabeneck, & Guerriero, 2015; Sun et al., 2009). This research study sought to use existing administrative data to address this gap in our understanding about income and PEM status while recognizing that other factors not gathered in this research study may influence cervical cancer screening uptake such as provider recommendations, culturally-sensitive care and personal beliefs, and, financial incentives.
Recent research in Ontario suggests that not being part of a primary care PEM is associated with lower cancer screening rates (Jaakkimainen, Barnsley, Klein-Geltink, Kopp, & Glazier, 2011; Lofters, Moineddin, Hwang, & Glazier, 2011; Vahabi, Lofters, Kumar, & Glazier, 2015). The researchers suggested incentive payments offered within PEMs as a contributing factor to increased cancer screening uptake. In an effort to boost cancer screening, researchers have identified the need to study the characteristics of primary care delivery models and screening uptake (Glazier, Klein-Geltink, Kopp, & Sibley, 2009; Jaakkimainen et al., 2011). Therefore, research is needed to study cancer screening uptake interventions across different populations as well as by the type of healthcare practitioner delivering the intervention (i.e. physician, nurse practitioner, pharmacist) (Brouwers et al., 2011).

Given our understanding that certain subgroups (i.e., low income) are observed to be less likely to engage in cancer screening, it is reasonable to question whether there is a relationship between income status and PEM status that affects cancer screening uptake. Identification of a potential relationship between lower income status and not being enrolled to a PEM with a resulting low screening uptake has healthcare policy implications.

A conceptual model was developed herein that built upon existing knowledge of the relationships between income and cervical screening, as well as the emerging knowledge of patient enrolment on screening uptake. At the beginning of this research study, the proposed study aim was to examine all three cancer screening programs (breast, colon and cervical) including a review of the literature. However, for logistical
reasons, this study was narrowed with emphasis on cervical cancer PAP screening uptake as per Cancer Care Ontario’s direction. Accordingly, in Chapter two (Background), a review of PEMs and cancer screening in Ontario (breast, colon and cervical) together with a review of the literature, conceptual model, justification for this study and problem statement, research questions and hypothesis related specifically to cervical cancer PAP screening is provided. From Chapter three onward, the focus is on cervical screening. In Chapter three (Methods), the study’s design, population and setting, data access and linkages, variables of interest, data cleaning, data analysis, assumptions and limitations of logistic regression, and ethical considerations and approvals are discussed. In Chapter four (Results), the demographic and PEM status characteristics, bivariate relationships between the independent variables, descriptive bivariate results by cervical screening, bivariate logistic regression results, stratified univariate logistic regression results and stratified multivariate logistic regression results are presented. Finally, an overview of the research findings, study limitations and strengths, implications for nursing practice, policy and research and final conclusions for this study are found in Chapter 5 (Discussion).
Chapter 2

Background

With the *Local Health System Integration Act* (2006), the Ontario government created 14 regional health boards called Local Health Integration Networks (LHINs) in an effort to delegate authority for health care planning and delivery to local community-based health structures, while the MOHLTC focused on directing the development of Ontario’s health care system at a more macro level (Barker, 2007). By 2007, the LHINs began their mandate of being responsible for financing and coordinating many of Ontario’s health services including preventative cancer screening. The Central East LHIN (CELHIN), also known as region 9, is depicted in Figure 1, map of Ontario LHINs.

![Figure 1. Ontario LHINs (Local Health Integration Networks, 2018)](image-url)
Patient Enrolment Models (PEMs)

PEMs consist of voluntary patient enrolment or “rostering” with a primary care physician who participates in any of the PEM models in Ontario. The group-based PEMs include Family Heath Networks (FHNs), Family Health Groups (FHGs), and Family Health Organizations (FHOs). Other PEMs include Comprehensive Care Models (CCMs), Blended Salary Models (BSMs) and Group Health Centre (GHC) of Sault Ste. Marie (Group Health Centre, 2018; Health Analytics Branch, 2014; Health Force Ontario, 2017; The Conference Board of Canada, 2014). By 2012, more than two-thirds of Ontario’s primary care physicians were participating in a PEM (Kralj & Kantarevic, 2012). Community Health Centres (CHCs), which are not considered a PEM, register patients with the organization with a most responsible provider, and physicians are salaried employees of the CHCs (Health Force Ontario, 2017). Nurse Practitioner-Led Clinics (NPLCs) are also not considered a PEM. The following (Table 1) summarizes common PEM funding models (Health Analytics Branch, 2014; Health Force Ontario, 2017; The Conference Board of Canada, 2014).

Table 1
Overview of common Patient Enrolment Models (PEMs) in Ontario

<table>
<thead>
<tr>
<th>Funding Model</th>
<th>Introduced</th>
<th>Funding Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group Health Centre (GHC)</td>
<td>1963 and revised in 2012</td>
<td>Union-sponsored CHC. Capitation for MDs and base funding for specialists</td>
</tr>
<tr>
<td>Family Health Network (FHN)</td>
<td>2001</td>
<td>Blended capitation with incentive payments; first model to have formal enrolment</td>
</tr>
</tbody>
</table>

6
Family Health Group (FHG) 2003  
FFS plus bonuses for services provided to enrolled patients

Comprehensive Care Model (CCM) 2005  
FFS plus incentives for solo physicians – patient enrolment encouraged

Family Health Organization (FHO) 2006  
Merge of Health Services Organization (introduced in 1978) and Primary Care Networks (PCN) (introduced in 1999); blended capitation model with defined basket of services

Blended Salary Model (BSM) 2006  
Salary based on roster size plus benefits, bonuses and incentives – MDs are employees of community sponsored FHTs

Family Health Teams (FHTs) were introduced in 2005 and represent an interdisciplinary model of primary care with voluntary patient enrolment but are not considered a funding model or PEM; the funding models of many FHTs are FHOs and FHNs (MOHLTC, 2016; The Conference Board of Canada, 2014). Approximately 10.3 million people were rostered to an Ontario PEM in 2014, with approximately 8,100 physicians and 749 physician groups (The Conference Board of Canada, 2014). As of March, 2018, 10.7 million Ontarians were rostered to a PEM (P. Graham, Director Primary Health Care Branch, MOHLTC, personal communication, May 28, 2018).

In order to be rostered to an Ontario physician who participates within a PEM, patients must complete and sign the Patient Enrolment and Consent to Release Personal Health Information form (MOHLTC, 2011). Physicians have the option to terminate the enrolment if the patient consistently fails to meet the obligations agreed to in the enrolment process. Such patient obligations include seeking care from their primary
health care group or designated telephone health advisory service first, and not changing from the physician they are enrolled with more than twice a year (MOHLTC, 2011). In order for physicians to be eligible for the preventative care fees and bonuses, they must comply with screening and rostering guidelines (MOHLTC, 2015a).

Cancer Screening in Ontario

Cancer Care Ontario (CCO) reports to the MOHLTC as the advisor for, among other matters, provincial cancer prevention and screening programs (CCO, 2015a). CCO has launched the following publicly-funded provincial cancer screening programs: Ontario Breast Screening Program in 1990; Ontario Cervical Screening Program (OCSP) in 2000; and, ColonCancerCheck in 2008 (Spayne et al., 2015). For completeness, Canadian best practices for cancer screening, mortality rates and screening rates for each of the Ontario screening programs are discussed below. Specific attention is directed to cervical cancer screening, as it was the focus of this research project.

Breast cancer. Mammograms are recommended every two years for women of average risk between 50 and 74 years of age, as breast cancer is the most prevalent female cancer diagnosis and has the second highest mortality rate among women after lung cancer (CQCO, 2015; Spayne et al., 2015). Breast cancer mortality in the Ontario population declined by roughly 37% for women ages 50 to 74, and by nearly 32%, for women of all ages between 1990 and 2009, and this decline is attributed to increased breast cancer screening as well as improved cancer treatments (CCO, 2013; Spayne et al., 2015).
The national target for breast screening is ≥70% (Canadian Partnership against Cancer [CPAC], 2017). In 2014–2015, 65% of women in Ontario aged 50 to 74 years (approximately 2 million) eligible to be screened received mammography through Ontario Breast Screening Program or other screening clinics (CQCO, 2018a). During the same time period, 82% of women were screened at Ontario Breast Screening Program-affiliated sites with an 81% retention rate (CQCO, 2018a). Retention rate refers to those individuals who return for their next screening within the time frame identified as best cancer screening practices. Within the CELHIN, 67% of women between the ages of 50 - 74 years completed at least one mammogram within a 30 month interval during the years 2014-2015, which was slightly higher than the provincial average of 65%, but still below the national target (CQCO, 2018b).

**Colon cancer.** Colorectal screening every two years with fecal occult blood test (FOBT) kits are recommended for adults between ages 50-74 and can reduce colon cancer deaths by 15% (CQCO, 2018c). CCO recommends colonoscopies for follow-up of abnormal FOBT results, as well as for those individuals at increased risk because of a family history of one or more first-degree relatives (parent, sibling or child) with a diagnosis of colorectal cancer (CQCO, 2018c). Colon cancer is the second most common cause of cancer deaths overall in Ontario (MOHLTC, 2015b). In 2014, approximately 8,900 Ontarians were diagnosed with colon cancer and it was estimated that 3,400 would die as a result of this illness (MOHLTC, 2015b).

In 2015, 39% of eligible Ontarians (approximately 1.6 million), aged 50 to 74 years, were not screened with FOBTs (CQCO, 2018c). In 2015, 78% (15,766) of
Ontarians who had an abnormal FOBT had a colonoscopy within six months (CQCO, 2018d). As of 2011, the provincial target for FOBT non-participation is 40% of eligible individuals being an inverse indicator for overdue screening (Cancer Screening Quality Index, 2010). In 2015, 37% of individuals within the CELHIN between the ages of 50 and 74 years were overdue for colorectal screening because they had not had a recent colorectal screening test in the last 12 months (CQCO, 2018b). This is close to the 2015 provincial rate of 39% who were reported as overdue for colorectal screening (CQCO, 2018b).

It is expected that CCO will replace the FOBT in late 2018 with the new fecal immunochemical test (FIT) in an effort to garner greater primary health care provider support (CCO, 2018b). As the FIT is considered a more sensitive test to detect precancerous lesions and easier to use than the FOBT, it is anticipated there will be improved primary health care provider uptake and individual compliance in the future (CCO, 2018b; Rabeneck et al., 2012; Spayne et al., 2015).

**Cervical cancer.** The human papillomavirus (HPV) is the cause of nearly all cervical cancers (Canadian Task Force on Preventative Health Care [CTFPHC], 2013; CCO, 2016; Choosing Wisely Canada, 2014; Dickinson et al., 2012). According to LifeLabs (2018):

persistent infection with HPV is the principal cause of cervical cancer and its precursor cervical intraepithelial neoplasia (CIN). The presence of HPV has been implicated in greater than 99% of cervical cancers, worldwide. There are more than 118 different types of HPV and approximately 40 different HPVs that can
infect the human anogenital mucosa. However, only a subset of 13 to 18 of these types is considered high-risk for the development of cervical cancer and its precursor lesions (para. 2).

HPV testing, which is a highly sensitive test, assesses a sample of cervical cells collected by a health care provider. The HPV test costs $90.00 and is not publicly funded in Ontario but may be covered under private health insurance plans (CCO, 2018a; Lifelabs, 2018). Currently, HPV self-sampling is not part of Canadian screening guidelines notwithstanding evidence that this approach is an effective alternative to traditional cervical PAP screening (Vahabi & Lofters, 2018).

Both CCO (2016) and Choosing Wisely Canada (2014) recommend cervical screening every three years for sexually active women aged 21 to 69 years, whereas the CTFPHC (2013) and Canadian Partners Against Cancer (CPAC, 2016a) recommend screening to begin at age 25. Immunocompromised women, including women who are HIV-positive or on long-term immunosuppressant, are to receive yearly cervical cancer screening. Transgender men or women with history of hysterectomy who have retained their cervix should continue cervical cancer screening as per the guidelines (CCO, 2016). Currently, transgender men who have changed their sex on their birth certificates from female to male will not receive notices from OCSP. Accordingly, both transgender men and their health care providers should ensure they receive their cervical cancer screening according to CCO guidelines (CCO, 2016).

In 2013, 610 women from Ontario were diagnosed with cervical cancer and there were 150 reported deaths (CCO, 2014; CQCO, 2015). Despite the low mortality
rates, it remains important to prevent and detect this preventable disease by engaging in routine PAP screening, appropriate follow-up of abnormal results and HPV vaccination, particularly among at-risk groups.

From 2013 to 2015, 61% of Ontario women aged 21 to 69 years were screened for cervical cancer falling short of the provincial target of 85% outlined in the Ontario Cancer Plan 2011-2015 (CCO, 2015b; CQCO, 2018e; Spayne et al., 2015). In 2012, the retention rate was 66% for women with a normal cervical PAP screening returned within 42 months for their next PAP (CQCO, 2018e).

Within the CELHIN, 61.5% of screen-eligible women completed at least one PAP screening in a 42 month interval during the years 2013-2015 which is comparable to the provincial average of 61% (CQCO, 2018b). As a collective, the CELHIN is performing well compared with other LHINs in terms of cancer screening rates.

**Literature Review**

The literature review sought to identify what is known about the effects of income and PEMs on cancer screening uptake generally, and then specifically to cervical cancer screening. An initial search strategy undertaken for this literature review was devised in the summer of 2015. Search terms were focused on finding existing literature on cancer screening within primary health care and the impact of socioeconomic status. No restrictions were applied to publication date. Databases included EMBASE, MEDLINE and CINHAL with variations of the following major subject headings: “cancer screening”, “Ontario”, “patient enrolment model”, “PEM”, “socioeconomic status”
Another search specific to cervical cancer screening and SES (i.e., income) was undertaken in December 2016 using the same databases, but restricted to 1996 to 2016, and updated to capture recent literature in Fall 2017 following data analysis and interpretation.

The initial literature search strategies yielded 261 articles from EMBASE, 171 articles from Medline and 56 articles from CINHAL with some overlapping of articles between these three databases that had relevance to the topic of interest. While none of these research articles specifically addressed the research questions, 33 articles were particularly useful in the identification of patterns that could explain cancer screening uptake. The second literature review conducted in December 2016 was undertaken to narrow the focus of investigation to specifically consider cervical cancer screening, income and PEMs using the same databases with variations of the following major headings: “cervical cancer”, “screening”, “income”, “patient enrolment model”, “access to primary care”. This subsequent literature review yielded 1,447 articles from EMBASE, 489 articles from Medline and 587 articles from CINHAL. While none of these research articles specifically examined the effect of income status and PEM status simultaneously on cervical cancer screening uptake, 13 articles were reviewed, with seven articles being particularly useful in the identification of patterns that could explain cervical cancer screening uptake.
Based on the literature, the following broad influences on cancer screening were first examined and critiqued: (1) general sociodemographic factors; (2) influence of primary care provider and models of care; (3) financial incentives to boost cancer screening rates; and, (4) culturally sensitive care. This was followed by a more focused examination of: (1) characteristics of women with low cervical screening rates; (2) low cervical screening rates and cancer rates; and, (3) associations between low income, enrolment status and cervical cancer.

**General Sociodemographic Factors**

Health is influenced by the conditions people live in and the circumstances they are affected by including income and social status, education, social and physical environments, gender, and culture (Public Health Agency of Canada, 2018; WHO, 2018). Health inequities can be largely attributed to disparities in the social determinants of health (SDOH).

Given the universal access to cancer screening, it remains unclear why the uptake of screening for some Ontarians falls short of provincial targets. It is reasonable to consider that for some individuals, the act of engaging in cancer screening, considered secondary prevention, could be unsettling as such interventions specifically seek to detect cancer (World Health Organization (WHO), 2017). For others who are considered *marginalized*, cancer screening may not be easily accessed due to other factors such as lower SES or lack of access to consistent primary health care. Marginalized people refers to those who are:
frequently excluded from decision-making, public institutions, basic services, and even citizenship. They are more vulnerable to poverty, are more likely to be afflicted by life-threatening diseases (like HIV/AIDS, malaria, tuberculosis, or mental health disorders), and are more likely to be victims of violence and exploitation (Government of Canada, 2018b, para. 2).

In 1990, a population-based survey using data from the Ontario Health Survey and the US National Health Interview Survey was conducted to compare the association of income and education with the uptake of breast and cervical cancer screening in Ontario, which has universal, publicly-funded screening (n = 23,521) and the United States (n = 23,932) (Katz & Hofer, 1994). The researchers hypothesized disparities in screening rates for women with low SES would be much lower in Canada compared to their more affluent counterparts due to Canadian universal coverage. Canadian and American women with higher incomes were more likely to receive cervical screening compared to their poorer counterparts (OR=1.7, 95% CI, 1.3-2.1; OR=1.9, 95% CI, 1.6-2.2, respectively). This study concluded that, in keeping with similar findings in the United States, universal screening coverage does not translate to utilization of cancer screening programs by marginalized people in Ontario. While the researchers do not identify how they addressed the potential of sample selection bias, they did report the mode of questioning had relatively little effect on the accuracy of information collected regarding use of health care services.

A second population-based retrospective cohort study was conducted between 2004 and 2005 to determine the sociodemographic factors associated with cervical cancer
screening in Ontario (Elit et al., 2012). The study population consisted of women between the ages of 18 – 70, eligible for Ontario Health Insurance Plan (OHIP) (n = 3,713,531). Using administrative sources from Ontario health care data, this study found barriers continued to exist for individuals living in lower SES environments that prevented adequate screening utilization and follow-up for abnormal results. Women residing in the lowest income neighbourhoods were nearly half as likely to be screened for cervical cancer compared to their more affluent counterparts (OR 0.56, 95% CI, 0.55-0.56). Given the limitations of the administrative data, the researchers could not determine if the findings were related to failure to communicate abnormal results by healthcare professionals or failure to return for follow-up by the individual. In an effort to target at-risk women for cervical cancer screening, the researchers suggested the implementation of alternative screening that would be more conducive to marginalized women such as offering at-risk women a HPV test, which is highly sensitive and could extend the retest interval (CCO, 2018a). The researchers pointed out new methods of cancer screening are needed to address inadequate cervical screening, and future research should investigate the unique needs of marginalized women.

**Influence of Primary Care Provider and Models of Care**

It is generally accepted that health care providers can influence patient behaviours including the uptake of cancer screening (Asano, 2005; Ferroni et al., 2012; Hoffman-Goetz, Thomson, & Donelle, 2008; Zarychanski, Chen, Bernstein & Hebert, 2007). A population-based retrospective study examined the practices of primary care physicians in Ontario (n=7,955 to 8,419) between the years 1996 and 2005 to determine the uptake
of colonoscopies by patients (Jacob et al., 2011). This study concluded marginalized patients were less likely to access colonoscopies suggesting a social disparity, and recommended further research to appraise how the variation in rates of colonoscopies affects cancer rates. Interestingly, as the use of colonoscopy increased in Ontario, physicians ordered more colonoscopies for higher income patients compared to lower income patients. The researchers concluded social disparities exist related to the ordering of colonoscopies by physicians and further research is warranted to determine how this variation in ordering colonoscopies affects colorectal cancer screening as well as other health outcomes. In an earlier Ontario study, Asano (2005) considered the physician-patient relationship in a population-based study to determine if colorectal cancer screening rates were affected by the physician’s decision-making style. A telephone survey to randomly-selected Ontario homes gathered information from 1,002 general population participants between the ages of 50 – 75 and 69% of respondents provided contact information for their current family physician. Multiple wave mailed surveys to physicians netted 472 responses. The results indicated screening rates were higher when the doctor informed the patient of the importance of colorectal cancer screening, and 62% of the physician participants reported they routinely recommended FOBT screening.

Similarly, a pilot study in 2008 explored older Canadians’ perspectives of barriers, as well as enabling factors, to participating in colorectal screening (Hoffman-Goetz et al., 2008). One hundred individuals from a larger convenience sample in southern Ontario were recruited by way of advertisements on public bulletin boards and in local newspapers. To be eligible, participants had to be age 50–90 years old, living
independently in the community and able to participate in English. All interviews (n=100) were 90 minutes long, audio recorded and transcribed verbatim, and analyzed using a mixed qualitative and quantitative methods approach. It was noted that cancer screening uptake was increased with physician recommendation. It was also noted that there was a general lack of awareness of colorectal cancer signs and symptoms amongst the participants and it was suggested knowledge deficits may contribute to lack of screening uptake. In conclusion, enhanced education emphasizing the importance of early cancer detection through screening was recommended for the public population; however, the study included healthy English-speaking people only, thereby making generalizations to the larger Ontario population more difficult.

A more recent systematic literature review of studies (n = 32) compared the effectiveness of two ways of providing screening: population-based programs (both invitation letter-based and physician-based), and spontaneous screening (Ferroni et al., 2012). Electronic databases and national and regional websites were searched to identify studies published between 1999 and 2009 aimed at increasing screening participation. The researchers consulted the Jepson et al. (2000) review for those studies published before 2000. The results of the review indicated there was greater cancer screening uptake (colon/breast/cervical) when a general practitioner engaged patients by way of either a letter or population-based programming compared to spontaneous screening (i.e., no intervention or usual care) (Ferroni et al., 2012).

Although no research articles specifically related to comparisons of cancer screening uptake by nurses or nurse practitioners were found, there were several studies
that addressed cancer care follow-up by nurses. A randomized multi-centre study in England followed 374 women with low to moderate risk of breast cancer reoccurrence (Beaver et al., 2009). The object of this study was to compare traditional hospital follow-up with telephone follow-up by specialist nurses after treatment for breast cancer. Participants were randomized to traditional hospital follow-up (consultation, clinical examination, and mammography as per hospital policy) or telephone follow-up by specialist nurses (consultation with structured intervention and mammography as per hospital policy). It was concluded telephone follow-up was well received by participants, with no physical or psychological disadvantages noted. The researchers also concluded telephone follow-up with specialist nurses is suitable for women at low to moderate risk of recurrence with long travelling distances or mobility problems and can decrease the burden on busy hospital clinics.

Between October 2005 and June 2006, a cross-sectional survey, with a parallel nested (embedded) qualitative case study component (two sites per practice model), was conducted in 137 randomly selected primary care practices in Ontario, including FFS, FHNs, health service organizations and CHCs (Russell et al., 2009). It was determined CHCs had high-quality chronic disease care, and that across the entire sample, high quality chronic disease care was more likely with the presence of a nurse practitioner. This study was limited as it did not have participants from the far north. A potential bias is also noteworthy as outcome measures were based on chart audits, which can be prone to underestimating level of care completed but not captured (Russell et al., 2009). The researchers concluded that nurse practitioners add value to primary care teams, as well as
noting the contributions of CHCs. While this study does not address secondary prevention such as cancer screening specifically, it is reasonable to consider that primary health care nurse practitioners would also provide high quality secondary prevention skills as well as tertiary care.

A recent study in 2017 considered whether team-based care was associated with fewer access problems and less unmet need compared to non-team-based care (Zygmunt, Asada, & Burge, 2017). Utilizing data from a cross-sectional survey, 2008 Canadian Survey of Experiences with Primary Health Care, conducted by Statistics Canada (n=10,858), the researchers measured primary care type (team-based or non-team-based) and SES by income and education. The researchers reported the likelihood of Canadian adults reporting access problems or unmet need was not statistically different between team-based and non-team-based care. In addition, team-based care observed no statistically significant SES (education or income) variations in overall access problems or unmet needs. However, non-team-based care had a statistically significant education gradient whereby individuals with higher education were more likely to report access problems compared to those with less education. It was observed that self-rated health status was the sole variable that was statistically significantly associated with all access problem variables and all unmet need variables. The researchers suggest further research should focus on comparing different models of team-based care utilizing longitudinal and/or mixed-methods designs in order to better understand how team-based care may enhance health care policy goals. The researchers point out team-based care must be
understood within a broad policy context by evaluating remuneration methods, financial incentives and electronic medical records.

Financial Incentives to Boost Cancer Screening Rates

Authors of a systematic literature review examined studies published between January 2004 and October 2008 (n = 9) that assessed the effectiveness of interventions to increase screening for breast, cervical, and colorectal cancers (Sabatino et al., 2012). This American systematic review was an update to a previously conducted systematic review of the effectiveness of interventions to increase cancer screening uptake as reported in The Guide to Community Preventative Services (Community Preventative Services Task Force, 2008). This 2012 update identified a need for more research to establish if incentives to patients as well as to health care providers would be helpful in boosting low screening rates. The authors concluded there was insufficient evidence, as the results on the effects of incentives were generally small and inconsistent.

A longitudinal study was performed using administrative data over a 10-year time span from fiscal year 1999 to 2009 to determine if Ontario screening rates (breast, colon, cervical) changed after paid incentives to primary care providers were initiated in 2006 (Kiran, Wilton, Moineddin, Paszat, & Glazier, 2014). It was determined there was no significant increase in screening rates for breast, cervical and colon cancer the year after incentives were introduced. Between fiscal years 2006 and 2009, $109.6 million (CND) was spent on financial incentives in Ontario but had limited impact on cancer screening rates three years after incentives were introduced. The researchers pointed out incentives
were largely paid to physicians who historically had higher than average cancer screening rates (Kiran et al., 2014).

In addition to studies that explored the effect of incentives on screening within PEMs, two recent studies in Ontario investigated the selective rostering of prospective patients, based on risk profiles, also referred to as ‘risk selection’ (Kantarevic & Kralj, 2014; Rudoler, Laporte, Barnsley, Glazier & Deber, 2015). Kantarevic and Kralj (2014) studied the risk-selection and cost shifting behavior of physicians in a unique capitation payment model in Ontario using an incentive three times the regular capitation rate to enroll complex and marginalized patients (n = 3,074) into primary health care between 2009 and 2011. Using longitudinal administrative data, as well as a control group of FFS physicians who were eligible for the same incentive, the researchers found no evidence of termination of the physician-patient relationship or cost shifting one year after the incentive was removed. Yet, the analysis of a large administrative dataset of patient encounters (n=11,600,911) among primary care physicians during the same timeframe revealed a positive relationship between capitation-based payment models and having healthy, low-cost patients compared to FFS physicians, thereby suggesting risk selection (Rudoler et al., 2015). The researchers reported notwithstanding the observed relationship between payment type and risk selection with healthy patients, there was no evidence that physicians in capitation-based models limited or reduced care to sick and high-cost patients.
Culturally Sensitive Care

Building upon Leininger’s work (1991) on cultural awareness, the College of Nurses of Ontario (CNO) (2009) indicates that “culture refers to the learned values, beliefs, norms and way of life that influence an individual’s thinking, decisions and actions in certain ways” (p. 3). In an effort to establish an effective therapeutic relationship with clients, nurses are required to reflect upon their own culture as well as the culture of their clients. Care that is culturally sensitive begins with respect and tolerance. From this stance, client-centred care builds therapeutic relationships with all clients.

Using secondary data from the 2003 Canadian Community Health Survey, Sun et al. (2009) used multivariate logistical regression analysis to identify factors related to breast cancer screening rates among Asian immigrant women in Canada. The authors reported that of the 508 Asian immigrant women who were eligible for breast screening, 71% never had a mammogram. Furthermore, contact with a physician did not affect breast cancer screening rates. Although the researchers point out the primary strength of their study was that data were derived from a large national population-based survey, reliance on patient recall for mammography history was a study weakness. The results may have been biased by participants with inaccurate recall.

A second study reported in 2013 used a participatory action research approach whereby 18 professionals (such as nurses, nurse practitioners, social workers) were interviewed to gain their perspective on structural barriers to cervical cancer screening among First Nations Women (Maar et al., 2013). Based on the participants’ experience
working with First Nations communities, it was concluded that First Nations communities would benefit from culturally-sensitive cancer screening that addresses barriers to accessing screening, including health literacy and SES status.

In summary, broad influences that affect cancer screening including SES status, primary health care provider influence, and culturally sensitive care were identified from the literature. Interventions to boost cervical cancer screening should be woman-focused with flexibility to target hard-to-reach women. Innovative screening programs that are better able to reach women living in lower SES need to be delivered by health care providers in a culturally-sensitive manner. More investigation is warranted into the benefits of financial incentives for health care providers.

**Characteristics of Women with Low Cervical Screening Rates**

Lower cervical screening rates are observed among marginalized women outside of Canada and within. Researchers in Boston, Massachusetts conducted a longitudinal analysis between 2004 and 2010 to determine if there was any difference in cancer screening uptake for low-income uninsured women who transitioned from a federally subsidized program to insurance-paid screening (n=1,214) (Clark et al., 2014). Researchers observed women with unsubsidized private insurance or Medicare had decreased cervical screening and suggested continued need for safety-net programs to support low-income women, as 31% of women required state safety-net funds to pay for screening. In addition, it was noted that low-income Hispanic and Asian women were particularly vulnerable and should be a focus of future study to ensure continuous quality of health care.
A review of data from the WHO Study on Global Ageing and Adult Health (SAGE) examined the association between individual, parental and life-course SES in relation to breast and cervical cancer screening for women age 18-65 recruited from China, India, Mexico, Russia and South Africa (n=22,283) (Akinyemiju, Ogunsina, Sakhuja, Oghodo, & Braithwaite, 2016). It was observed a higher life-course SES increased cervical cancer screening by more than fourfold. Individuals with a higher SES were more likely to access breast and cervical cancer screening. The researchers pointed out that education-based SES measures were stronger predictors of screening compared to employment-based measures. The researchers suggested screening rates in low-income and middle-income countries may increase if improved health teaching related to the benefits of cancer screening was integrated into routine healthcare practice for low SES women.

Women living in lower SES are also observed to have lower cervical cancer screening rates within Canada and abroad (Akinyemiju et al., 2016; Benard, Royalty, Saraiya, Rockwell, & Helsel, 2015; Clark et al., 2014; Elit et al., 2012; Kerner et al., 2015; Lofters, Moineddin, Hwang, & Glazier, 2010). A population-based, retrospective cohort study published in 2012 was conducted to determine the sociodemographic factors associated with cervical cancer screening and follow-up of abnormal results in Ontario (n=3,713,531) (Elit et al., 2012). Women living in the lowest income neighbourhoods were half as likely to be screened and had a 42% follow-up rate compared to 47% in the most affluent neighbourhoods. The researchers queried if lack of communication is the reason for poor follow-up of abnormal results for women living with lower incomes and
identified the need to study the unique needs of at-risk women for both screening and follow-up.

A retrospective cohort study using administrative data was conducted during 2003 to 2005 to examine cervical screening of immigrant women living in metropolitan areas of Ontario (n=2,273,995) (Lofters et al., 2010). Screening rates were lower within the following groups: older women ages 50 to 69; women living in lower income areas; and, recent immigrants. Women with all three of the characteristics had a screening rate of 31% compared to 70.5% of women with none of these characteristics. The researchers identified that a gap in screening exists notwithstanding universal health care and recommended targeted research to address age, income and immigration status as barriers to screening.

Kerner et al. (2015) considered Canadian screening disparities by examining income (2005 income quintiles not including the territories), geography (urban, rural, rural remote and rural very remote) and immigrant status. The researchers observed cervical screening gaps for women with the fewest resources, the most geographically isolated and the least culturally integrated into Canadian society. Cervical cancer screening rates (2005 – 2012) for women living in the lowest income quintile consistently remained between 16% to 18% lower compared to women in the highest income quintile. The researchers identified that “adaption and adoption of evidence-based screening promotion interventions can increase the utilization of available screening services by populations that have experienced the greatest burden of disease with the least access to screening services” (Kerner et al., 2015, p. 1). In summary, women most vulnerable to
lower cancer screening rates are those with lower SES status, who are immigrants or older.

**Low Cervical Screening Rates and Cancer Rates**

In a study of 1.8 million women, researchers considered the impact of the National Breast and Cervical Cancer Early Detection Program (NBCCEDP) on cervical cancer mortality among uninsured low-income women in the United States between 1991 and 2007 (Ekwueme et al., 2014). Three separate simulations were performed for the following three scenarios: (1) women who received both NBCCEDP programming and screening; (2) women who did not receive NBCCEDP programming but did receive screening; and, (3) women who did not receive any NBCCEDP programming or screening. The researchers reported NBCCEDP programming prevented 325 cervical cancer deaths relative to not receiving NBCCEDP programming, with an estimated 3,829 prevented deaths relative to those who received no screening. The researchers concluded by suggesting the NBCCEDP program reduced mortality rates among medically underserved low-income women.

In a second study, researchers considered the effectiveness of targeting underscreened or never screened American women in a national cervical cancer screening program for underserved women (Benard et al., 2015). These researchers analyzed NBCCEDP data of women in the United States between 2002 and 2012 (n = 1,485,251) with age, ethnicity, residence and region being the characteristics examined. They observed that 31% reported being under-screened or never screened and 69% reported being screened in the past five years. Women ages 50 years or greater, Asian and Pacific
Islander, American Indian or Alaska Native, multiracial, living in non-metro areas, or living in the South or a territory were more likely to report being under-screened or never screened. Bernard et al. (2015) reported the percentage of abnormal PAP tests and the rate of pre-cancer and cancer (combined) were higher in the under-screened or never screened group compared with the screened group. Therefore, the researchers called for a priority to focus on screening under-screened or never screened women as they have a greater prevalence of high-grade invasive cervical cancers at later stages than women screened more recently.

A population-based case-control study considered the association between cervical screening and prevention of invasive cervical cancer in Ontario (Vicus et al., 2015). The researchers identified women in this study as cases and controls. Women diagnosed with cervical cancer between 1998 and 2008 (n = 5,047) were identified as cases with cervical cytology history greater than three months before the diagnosis date of cervical cancer. The researchers reported controls were women cancer-free on, or before, December 31, 2008 (n = 10,094). Regionally-adjusted median household income quintiles were assigned based on postal codes using Statistics Canada’s Postal Code Conversion File (PCCF+). The 5,047 women (cases) were matched to controls by 5-year age groups and median household income quintile on the date of diagnosis of a case (index date for its controls). Using conditional logistic regression to estimate the odds ratio for having been screened among those with cervical cancer, two controls were matched to each case on year of birth and neighbourhood income quintile, as of the index date. They were able to match women to controls on median household income quintiles
as the risk for invasive cervical cancer is inversely related to income. Furthermore, the researchers reported attendance for abnormal screening follow-up may be a barrier for lower-income women who would have difficulty attending daytime office hours on weekdays. Unfortunately, lower-income women were at higher biological risk in addition to risk of non-participation of cervical cancer screening and follow-up. In conclusion, the researchers observed that cervical cancer screening was associated with a reduced risk for invasive cervical cancer among women older than 40 years. The researchers pointed out that cervical cancer screening is opportunistic in Ontario as it depends on a woman’s physician or nurse practitioner to offer screening or for the woman to ask for screening.

**Associations between Low Income, Enrolment Status and Cervical Cancer**

As noted in the introduction, recent research in Ontario suggests that not being part of a primary care PEM is associated with lower cancer screening rates overall (Jaakkimainen et al., 2011; Lofters, Moineddin, Hwang, & Glazier, 2011; Vahabi et al., 2015). Utilizing multivariate Poisson models, Lofters et al. (2011) reported that among immigrant women in Ontario, not being part of a PEM negatively affected cervical cancer screening uptake, as well as being younger than 35 or older than 49, residing in the lowest-income neighbourhoods, or lacking access to a female healthcare provider. The researchers encouraged future researchers to examine the reasons for lower cervical screening rates among immigrant women. The study did not distinguish between the various types of PEMs in Ontario.

In a cross-sectional study, Dahrouge and colleagues (2012) reviewed 137 primary care practices in Ontario, which were 35 FFS practices, 35 salaried physicians within
Patient profiles considered age, sex, insurance status, number of visits to the family physician in the previous years but did not consider other factors such as income levels or immigration status. The researchers surveyed 288 family physicians, reviewed 4,108 randomly selected patient charts and assigned prevention scores based on preventative care uptake; 3,284 patients were eligible for at least one of six preventative manoeuvres. According to Dahrouge et al. (2012), factors related to physician characteristics and practice structure were stronger predictors of cancer screening uptake than the type of funding model associated with the physician. The researchers found that practices with one or more female physicians, smaller patient loads and electronic reminder systems had superior prevention scores.

Jaakkimainen et al. (2011) conducted a review of Ontario administrative claims data to compare cancer screening performance between FHGs and FHNs. The study population included physician practices that were affiliated to a FHN or FHG for at least two years; patients in the practice were included in the analyses if they enrolled with a physician in the two years after the physician joined the FHN or FHG and also if they saw a physician in a two-year period prior to the physician joining the FHN or FHG. While the researchers reported some improvements in colorectal screening and diabetes management after enrolment, there were no significant changes in cervical or breast screening after joining either a FHN or FHG. The researchers suggested primary care models need to be compared with other delivery models in order to describe what aspects of model delivery and incentives affect care.
Another study examined enrolment status and income quintiles. Kiran et al.’s (2014) investigation examined PEM and income through stratification of screening rates by neighbourhood income quintiles and PEM status using Ontario administrative databases. The researchers reported that disparities in screening related to neighborhood income persisted over time for all three types of cancer screening, including cervical screening. However, the focus of their work was to examine if income-related disparities in cancer screening persisted after the start of incentives, and did not fully explore the relationship between income and enrolment status. The current study aimed to further investigate potential associations between women’s neighbourhood income and patient enrolment status and cervical screening uptake.

**Conceptual Framework**

Although no frameworks were found specifically related to the impact of the relationship between income status and PEM status on cancer screening uptake, the analytic model first described in 2008 by Baron and colleagues and utilized in the *Guide to Community Preventative Services* provided some guidance to the development of the conceptual model in this current study (Baron, Rimer, Breslow, et al., 2008a; Baron, Rimer, Coates, et al., 2008b; Sabatino et al., 2012).

The conceptual approach adopted by Baron and colleagues describes three analytic models that hypothesized relationships between interventions in order to achieve the desired outcome of increased breast, cervical and colorectal cancer screening (Baron, Rimer, Breslow, et al., 2008a; Baron, Rimer, Coates, et al., 2008b; Sabatino et al., 2012). These analytic models (also referred to as analytic frameworks by the authors) propose
that client-directed actions as well as provider-directed interventions increase cancer screening demand and access (See Appendix B). In utilizing these models, the researchers focused on increasing community demand for screening, reducing access barriers and boosting healthcare providers’ delivery of screening as the three primary strategies to meet the identified outcomes (Baron, Rimer, Breslow, et al., 2008a). They highlighted that barriers to accessing screening can differ among population subgroups which further supports the need for research to determine differences in screening uptake related to sub-group characteristics, such as income and PEM status.

Certain aspects of the analytic model that address client-directed actions are helpful to guide efforts to increase community access for cancer screening services in Ontario (Baron, Rimer, Coates, et al., 2008b). In particular, consideration to reducing structural barriers such as lack of PEM status was central to this current study. While there are no direct out-of-pocket expenses for cancer screening in Ontario, there are associated costs to patients when accessing screening such as lost wages to attend screening appointment, transportation costs, and parking. In addition, it is noteworthy that provider-directed interventions contemplated by Sabatino et al. (2012) are similar to Ontario’s PEMs, as both have provider incentives associated with cancer screening uptake. In the initial stages of proposal development, the previously discussed models informed this current study. In particular, the model related to increasing access was interesting in its discussion of boosting cancer screening in hard-to-reach populations such as those with low income (Baron, Rimer, Coates, et al., 2008b).
Although patient enrolment is voluntary, in order to be part of a PEM, patients must commit to seeking care from their enrolled physicians or the physicians’ affiliated group first unless travelling or medical emergency. As there are financial consequences for physicians with failure to comply with this commitment, physicians have the right to terminate the PEM relationship (MOHLTC, 2011). For some individuals, particularly those living in lower SES environments, this commitment may be too rigid to be able to comply with. Population-based cancer screening interventions may be more effective at reaching individuals living in the middle to highest income quintiles and less effective for those individuals living in lower SES environments. Accordingly, effective cancer screening interventions need to be considered that will meet the unique needs of individuals living in lower income status environments.

Given what is known about the importance of the SDOH, the conceptual framework from the WHO Commission on Social Determinants of Health (CSDH) (2010) influenced the final development of the conceptual framework, in conjunction with the work of Baron and colleagues. In the CSDH model, one’s socioeconomic position as determined by social class, gender, and ethnicity, are classified as structural determinants of health inequities (see Appendix C, Figure 8). Socioeconomic position influences the education, occupation and income of individuals. Behavioural and biological responses, psychosocial factors and material circumstances, as well as the health system are situated in the framework as intermediary determinants of health. The final conceptual framework for this thesis is represented by Figure 2.
Figure 2. Conceptual framework: Structural determinants of Health Inequities and Intermediary Determinants of Health on Cervical Cancer Screening Uptake (*=key independent variables)
In the study’s conceptual framework, income and geographical location represent structural determinants of health inequity concepts, whereas PEM status and age are intermediary determinants of health variables examined in this study. The main independent study variables are represented by concepts in light blue, whereas age and rurality, two variables controlled for within the study, are depicted by the model concepts in green. Incentives for screening (depicted in red) represent increased access as contemplated by the work of Baron, Rimer, Coates, et al. (2008b). Additional variables not examined in this study include SES position, material circumstances and psychosocial factors, and are represented in orange in the conceptual framework.

Study Justification

According to Kerner et al. (2015), cervical screening has improved as observed in rural and remote Canadian populations. In addition, as previously reported, the CELHIN as a collective, has a cervical screening rate comparable to the provincial average of 61% for 2013-2105. However, cervical cancer screening disparities continue to exist, particularly for older women, women living in lower SES and immigrant women, who have the greatest prevalence of high-grade invasive cervical cancer (Benard et al., 2015). While women under age 30 are at high risk for developing an HPV infection, they rarely develop cervical cancer (Vicus et al., 2015). It is the perceived low-risk population of women over the age of 60 who may be at elevated risk due to their lower cervical screening rates.

From the literature review, it is clear that healthcare providers can positively influence cancer screening uptake. Screening uptake has been shown to be less likely
amongst individuals living in lower SES environments regardless of physician recommendation. No studies were found that examined the effect of income and PEM status on cervical cancer screening uptake. Having a universal, low-cost screening test is not sufficient to reach all target populations and a greater understanding of the women who access screening is foundational to developing a successful screening program. By examining a possible relationship between income and PEM status, it may be possible to close the screening gap for hard-to-reach women.

**Problem Statement, Research Questions and Hypothesis**

As a result of a review of the literature, no studies were found that examined both income levels and PEM status on cervical cancer screening uptake. The objective of this study was to explore the independent effects of neighbourhood income levels and PEM status on the uptake of cervical cancer screening by eligible individuals residing in the CELHIN. This study explored the following research questions:

(i) What are the independent effects of neighbourhood income and PEM status on cervical cancer screening among women in the CELHIN?

(ii) What are the factors associated with cervical cancer screening uptake among women enrolled or not enrolled in a PEM in the CELHIN?

Based on the literature, it was expected that low-income women, regardless of enrolment status would have lower screening uptake; that women not enrolled in a PEM would have lower screening rates related to potential access issues; and, women living in lower income neighbourhoods would be less likely to be enrolled in a PEM.
Chapter 3

Methods

This chapter describes the design, population and setting, data access and linkages, variables of interest, data cleaning, data analysis, assumptions and limitations of logistic regression, and ethical considerations and approvals related to the research questions.

Design

The research design was a descriptive, comparative study using record level, administrative data from CCO to identify variations in cervical cancer screening uptake (Huston & Naylor, 1996). Databases linked by CCO to provide an anonymized data file to the researcher included: a) OHIP: Claims History Database (CHDB); b) Ontario Cancer Registry (OCR); c) Registered Persons Database (RPDB); d) PCCF+ (v.6A); e) Client Agency Program Enrolment Database (CAPE); and, f) Cytobase (CQCO, 2011). Access to immigration data was not available to the researcher for this project. See Appendix (D) for details about the various databases.

Population and Setting

The focus of this study is the CELHIN. It is the sixth-largest geographical LHIN spanning 16,673 km² in southern Ontario and home to 1.4 million people according to the 2006 Census (CELHIN, 2018a). Representing 11% of Ontario’s population, the CELHIN’s rich diversity of urban and rural landscapes, ethnicities, languages and socio-demographic characteristics makes it the ideal population to examine neighbourhood income levels, PEMs and cervical cancer screening rates. With this diversity comes the
challenge to engage marginalized and hard-to-reach populations, such as uninsured individuals, new immigrants and refugees. The Canadian Centre for Refugee and Immigrant Healthcare, located in Scarborough, operates with a volunteer interdisciplinary team in order to provide free community-based primary and specialist medical and social care to new Canadian refugees, immigrants, temporary foreign workers, migrants and others. This approach to providing primary health care that is culturally appropriate to meet the needs of hard-to-reach marginalized populations results in fewer emergency room visits and better health outcomes (CELHIN Primary Health Care Advisory Group, 2015).

Within the CELHIN, there are seven smaller geographic planning sub-regions in place to assist with identifying and managing patients’ needs at the community level with the goal of equitable access for the entire CELHIN (Figure 3) (CELHIN, 2018b). “This includes the needs of Francophone Ontarians, Indigenous communities, newcomers and other individuals and groups within the CELHIN whose health care needs are unique and who often experience challenges accessing and navigating the health care system” (CELHIN, 2018b, para. 1).
In Table 2, the CELHIN population, income and primary health care services within the sub-LHIN regions are described (CELHIN, 2017a; Office of Auditor General of Ontario, 2017). Among the seven CELHIN sub-regions, Scarborough North and Scarborough South have the highest proportion of low income based on the National
Household Survey (Statistics Canada, 2011), visible minorities and new immigrants (Canada Post, 2010; CELHIN, 2017b) (See Appendix E).

Table 2

<table>
<thead>
<tr>
<th>Sub-LHIN Region Geographical Area</th>
<th>Total Population (2011)</th>
<th>Low Income Population (^1)</th>
<th>Low Income Population (%)</th>
<th>Primary Health Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scarborough North</td>
<td>174,745</td>
<td>35,320</td>
<td>20.21</td>
<td>148 MDs in 41 offices; 2 FHTs; 1 NPLC; 10 walk-in clinics; 0 CHC</td>
</tr>
<tr>
<td>Scarborough South</td>
<td>411,955</td>
<td>82,150</td>
<td>19.94</td>
<td>459 MDs in 81 offices; 2 FHTs; 0 NPLC; 26 walk-in clinics; 2 CHC</td>
</tr>
<tr>
<td>Durham West</td>
<td>317,870</td>
<td>27,255</td>
<td>8.57</td>
<td>152 MDs in 40 offices; 1 FHT; 0 NPLC; 21 walk-in clinics; 0 CHC</td>
</tr>
<tr>
<td>Durham North East</td>
<td>284,155</td>
<td>29,840</td>
<td>10.50</td>
<td>206 MDs in 27 offices; 1 FHT; 1 NPLC; 15 walk-in clinics; 3 CHC</td>
</tr>
<tr>
<td>Northumberland County</td>
<td>68,890</td>
<td>8,165</td>
<td>11.85</td>
<td>40 MDs in 14 offices; 2 FHTs; 0 NPLC; 1 walk-in clinic; 1 CHC</td>
</tr>
<tr>
<td>Peterborough City and County</td>
<td>130,560</td>
<td>17,765</td>
<td>13.61</td>
<td>107 MDs in 21 offices; 1 FHT; 1 NPLC; 3 walk-in clinics; 0 CHC</td>
</tr>
<tr>
<td>Haliburton County and City of Kawartha Lakes</td>
<td>88,280</td>
<td>11,615</td>
<td>13.16</td>
<td>55 MDs in 11 offices; 3 FHTs; 0 NPLC; 1 walk-in clinic; 1 CHC</td>
</tr>
<tr>
<td><strong>Total CELHIN</strong></td>
<td><strong>1,476,455</strong></td>
<td><strong>212,110</strong></td>
<td><strong>14.37</strong></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)Low-income is a fixed percentage (50\%) of median adjusted after-tax income of households
To be eligible for this study, women 21 to 69 years of age living in private dwellings within the CELHIN, who were continuously screen-eligible for health coverage of PAP screening from January 1, 2012 to June 30, 2015, were selected from the databases. The study cohort was based on individuals coded as female in the RPDB and exclusive to women residing in the CELHIN as determined by the PCCF+.

Individuals excluded from this study were women: a) with missing or invalid health information numbers (HIN), date of birth, LHIN, sex or postal code; b) diagnosed with an invasive cervical cancer prior to the study period; c) identified with a hysterectomy through OHIP’s CHDB prior to study period; d) diagnosed with an invasive cervical cancer before the subsequent PAP date or during follow-up interval; e) with a hysterectomy before the subsequent PAP date or during the follow-up interval for cases where there was no subsequent PAP; and, f) who died during follow-up and retention periods and were not re-screened for cervical cancer (see Appendix F for more details on excluded individuals).

Data Access and Linkages

Pursuant to the Research Data Disclosure Agreement dated October 4, 2016 between CCO and Queen’s University record level data extracted by CCO on July 7, 2016 was released to the researcher on October 16, 2016 by way of a Microsoft Excel program within a Tumbleweed Managed File Transfer account and subsequently imported into Statistical Packages for the Social Science (SPSS) software version 24 (IBM Corporation, 2016).
Access to the CCO record-level data specific to the CELHIN was made available for this study off-site by way of a secured encrypted process. Variables in the encrypted dataset included: a) de-identified patient ID; b) three-digit Forward Sorting Area (FSA) postal code; c) neighbourhood income quintile; d) age at October, 2013; e) age group at October, 2013 (i.e., five groups, ranging from ages 21 to 69); f) screened in past 42 months (Y/N); g) date of last PAP; h) PEM rostered status (attached, unattached, expired, unknown); i) rostered at time of PAP (Y/N); j) start date of rostered enrolment; k) end date of rostered enrolment; and, l) payment model (type of PEM).

All client identifiers were removed prior to the researcher receiving the data and did not contain any personal health identifiers such as health card numbers or names in full or part. In the interest of protecting personal health identifiers, the data from CCO contained the age and corresponding age groups of women, rather than specific birthdates. Two additional variables were computed from the original dataset: rurality (rural vs urban), and a new variable that accurately captured PEM status (enrolled vs non-enrolled).

Variables of Interest

The variables were accessed by CCO from the following databases between January 1, 2012 and June 30, 2015. In Table 3, study variables are identified as being original or recoded/computed, with the indication of the original CCO database source.
Table 3
Study variables, from CCO linked databases and computed, specific to the CELHIN between January 1, 2012 and June 30, 2015

<table>
<thead>
<tr>
<th>Type of Variable</th>
<th>Variable</th>
<th>Database</th>
<th>Inclusion and Exclusion Study Criteria</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable</td>
<td>Cervical Cancer Screening</td>
<td>CytoBase</td>
<td>PAP tests</td>
<td>2012 JAN 01 to 2015 JUN 30</td>
</tr>
<tr>
<td>Independent Variable (Primary)</td>
<td>PEM Status (recoded &amp; computed)</td>
<td>CAPE</td>
<td>PEM affiliation; Funding model designation.</td>
<td>2012 JAN 01 to 2015 JUN 30</td>
</tr>
<tr>
<td>Independent Variable (Primary)</td>
<td>Neighbourhood Income</td>
<td>PCCF+</td>
<td>SES demographics</td>
<td>Mid-point of study*</td>
</tr>
<tr>
<td>Independent Variable (Secondary)</td>
<td>FSA (recoded into Rurality)</td>
<td>PCCF+</td>
<td>Rural and urban areas</td>
<td>Mid-point of study*</td>
</tr>
<tr>
<td>Independent Variable (Secondary)</td>
<td>Age Group</td>
<td>RPDB</td>
<td>Demographic variables including age</td>
<td>Mid-point of study*</td>
</tr>
<tr>
<td>OCR</td>
<td>women with unresolved invasive cervical cancers (excluded from study); women with resolved invasive cervical cancers (included in study)</td>
<td></td>
<td></td>
<td>2012 JAN 01</td>
</tr>
<tr>
<td>OHIP: CHDB</td>
<td>PAP tests; hysterectomies (excluded from study)</td>
<td></td>
<td></td>
<td>2015 JUN 30; 2012 JAN 01</td>
</tr>
</tbody>
</table>

Note. *Midpoint of Study: 2013 OCT; CAPE = Client Agency Program Enrolment Database; PCCF+ = Postal Code Conversion File Plus; RDB = Registered Persons Database; OCR = Ontario Cancer Registry; OHIP = Ontario Health Insurance Plan; CHDB = Claims History Database
**Cervical cancer PAP screening.** Every PAP screening reported in this study was performed within the CELHIN. Only screen-eligible women residing within the CELHIN during the study’s time period (January 1, 2012 to June 30, 2015) were included in the study. It is possible that the woman may have moved after having a PAP screening assigning her a different FSA that may or may not be within the CELHIN. As noted in Table 3, the FSA variable was determined at the midpoint of the study period.

**PEM status.** Women who were attached (enrolled) in a PEM between January 1, 2012 to June 30 2015 were coded as *attached*. Not being enrolled in a PEM refers to a woman whose enrolment status with a PEM either expired during the period of January 1, 2012 to June 30, 2015 or she was never attached to a PEM during the study period and was coded as *unattached*. For the purpose of this study, the term *expired* means the woman had been attached (enrolled) with a PEM on or after January 1, 2012 and her enrolment status ended prior to or on June 30, 2015. To be clear, the term *expired* does not mean the woman died. For clarity, the term *unattached/expired* will be referred to as *non-enrolled* and *attached* will be referred to as *enrolled* going forward within this document.

The PEM status variable in the original dataset was coded with four sub-categories (expired enrolment; attached; unattached; unknown). During the initial running of frequency tables, it was observed that women enrolled in a PEM, but who had not been screened, were not being captured. A series of recoding and computations were undertaken to create a new variable to accurately capture PEM status (Appendix G). A decision was made to group ‘unattached’, ‘expired’ and ‘unknown’ into a single value of
non-enrolled. The final PEM variable was dichotomous: enrolled versus non-enrolled. It should be noted that women who were classified as non-enrolled in a PEM may have received primary health care from non-PEM models of care such as CHCs, NPLCs or FFS physicians.

**Neighbourhood income quintile.** “Neighbourhood income quintiles are a measure of average after-tax income per single-person equivalent in a Dissemination Area (DA), adjusted for household size” (Canadian Institute for Health Information [CIHI], 2015, p. 9). CCO derived income quintiles for each individual woman by utilizing the PCCF+ database to assign each woman to a neighbourhood income quintile based on Canadian census DA for each geographical area. By using the PCCF+, CCO was able to map the woman’s postal code of her residence at the midpoint in the study time of January 1, 2012 and June 30, 2015. In doing this, CCO was able to assign the neighbourhood income quintile for that DA to each woman (CIHI, 2015). Income quintiles, based on national income quintiles, range from income quintile 1, being the lowest, to income quintile 5, being the highest.

It is noteworthy that there are limitations to neighbourhood income quintile measures such as: (1) individuals with missing or invalid postal codes as well as those living in institutions will not be assigned an income quintile; (2) neighbourhood income quintiles derived from PCCF+ are less accurate for rural areas as they cover larger geographical areas; and, (3) the neighbourhood income quintile is considered a proxy measure representing the neighbourhood and not the individual (CIHI, 2015).
**Rurality.** The rurality variable was computed from the FSA codes by separating rural geographical homes (second digit of the FSA is a zero when considered rural) from urban geographical homes (second digit of the FSA is a number when considered urban) utilizing a map of the CELHIN (Figure 3) (CELHIN, 2018b) and organizing the FSAs by geographical area (Canada Post, 2010). Although every PAP screening reported within this study was performed within the CELHIN, and the woman had a postal code at the time of the PAP within the CELHIN, the postal code may have changed since the PAP screening (i.e. the woman moved within or outside the CELHIN after the cervical PAP screening). As previously noted, the CELHIN is divided into seven geographical sub-regions (see Table 2 and Figure 3). Full sub-region analyses of the CELHIN was not possible, as FSAs overlapped with the exception of two urban regions, Scarborough North and Scarborough South. The remaining sub-regions (three to seven) have FSAs in common rendering the count of women inaccurate. Additional descriptive supplementary analyses related to the Scarborough sub-regions were undertaken and reported in the appendices.

**Age Groups.** Age group was defined using five, 10-year age groupings from ages 21 to 69 years. Using age rather than age group would require reporting on observations (increase or decrease of the odds) for each year and would be difficult to report results. Table 4 describes the level of measurement of the independent variables.
Table 4  
*Level of Measurement of Independent Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Variable Type</th>
<th>Coding of Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEM Status</td>
<td>Dichotomous</td>
<td>1 = Unattached</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 = Attached</td>
</tr>
<tr>
<td>Income</td>
<td>Ordinal</td>
<td>1 = Income Quintile 1 [lowest]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 = Income Quintile 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 = Income Quintile 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 = Income Quintile 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 = Income Quintile 5 [highest]</td>
</tr>
<tr>
<td>Rurality</td>
<td>Dichotomous</td>
<td>0 = Rural</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Urban</td>
</tr>
<tr>
<td>Age Group</td>
<td>Ordinal</td>
<td>1 = 21-29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 = 30-39</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 = 40-49</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 = 50-59</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 = 60-69</td>
</tr>
</tbody>
</table>

**Data Cleaning**

Initial data cleaning included utilizing frequency tables to check for duplicate cases and missing values. Some cases were identified as duplicates (160,636) as they had the same ID number, age and screening information with differing information related to rostering status or type of PEM. The final data set with the duplicate cases removed had 490,574 valid cases. Utilizing the “Descriptives” option in SPSS no outliers were found; one empty case at end of the dataset was found and removed prior to starting the data analysis. In addition, 196 cases were observed to have no neighbourhood income quintile information. Given this is a very low number of missing information, a decision was made to not remove the 196 cases from the overall analysis.
**Data Analysis**

Frequency distributions and cross-tabulations were carried out for each of the variables. Descriptive univariate statistical analyses were performed on all of the study variables to observe the frequency and proportion. Bivariate analyses were conducted to investigate relationships between the binary outcome variable, screening status (screened vs not screened), and each independent variable using chi-square analyses, odds ratio and 95% confidence interval. Significant unadjusted odds ratios and their corresponding 95% confidence intervals were reported.

Prior to modelling, data was next assessed for potential effect modification, as this is the initial step in logistic regression analysis (Kleinbaum & Klein, 2010, p. 232). Stratified bivariate analyses using logistic regression were conducted to investigate for any potential effect modification of two or more independent variables on the dependent variable prior to multivariate analysis (Field, 2013). The presence or absence of an effect modification was determined using stratified analysis to determine if an effect at one level was different compared to other levels, or was in the opposite direction; for example, if the observed effect by one variable (such as income or age group) on the primary exposure variable (PEM status) resulted in significantly different odds ratios for dependent variable outcome (cervical cancer screening uptake) by strata, then effect modification was presumed to exist (Corraini, Olsen, Pedersen, Dekkers, & Vandenbroucke, 2017; Kleinbaum, Kupper & Morgenstern, 1982). If effect modification was detected, further multivariate logistic regression analyses stratifying by PEM status would occur.
Originally it had been planned that those independent variables whose univariate tests were \( p < 0.20 \) would be entered into a full multivariate model (Hosmer & Lemeshow, 2000) and the analysis would proceed using forced entry logistic regression to determine the strength of the associations between the primary independent variables (PEM status and income status) and the dependent variable (screened or not screened). As each of the independent variables (PEM status, neighbourhood income quintile, rurality, age group) were statistically significant with the outcome variable, all variables were entered into the logistic regression models. Results are reported as adjusted odds ratios with corresponding 95% confidence intervals. The alpha level for testing the overall model for significance was set at 0.05.

**Assumptions and Limitations of Logistic Regression**

Logistic regression is useful in identifying the strength and direction of an association between two independent variables, in this case PEM status and neighbourhood income, after adjusting for the influence of age group and rurality. In addition, at the onset of the analysis it was anticipated that logistic regression would assist the researcher to identify the best fitting model to describe the relationship between cervical cancer screening uptake and the independent variables (Kellar & Kelvin, 2013). While logistic regression does not have assumptions pertaining to the distribution of independent variables, the researcher considered the following: large sample size; and, absence of multicollinearity (Field, 2013; Kleinbaum & Klein, 2010; Pallant, 2013; Tabachnick & Fidell, 2013).
**Large sample size.** An assumption of any large sample size is statistical significance of the independent variables resulting in all of the independent variables going into the final logistic regression model (Khalilzadeh & Tasci, 2017; Lin, Lucas, & Shmueli, 2013; Sullivan & Feinn, 2012). This study has a very large sample size with 490,574 valid cases and four independent variables of interest (PEM status, income, age group, rurality). The advantage with a large sample size is that it can be assumed the beta ($b$) results collected were from a normally distributed sample and, therefore, generalizable to a wider population demonstrating a practical significance (Field, 2013; Pallant, 2013). In addition, large sample sizes (over 300) can offer an observation of rare associations or rare events that cannot be seen in smaller samples (Khalilzadeh & Tasci, 2017; Lin, Lucas & Shmueli, 2013). Studies with a small or moderate sample size with many independent variables are at risk of having problems with the analysis and inability to converge (Pallant, 2013; Tabachnick & Fidell, 2013). As the sample size grows closer to the actual population size, the power of the test also increases which can reveal small, impractical effects (Khalilzadeh & Tasci, 2017).

**Absence of multicollinearity.** Ideally, the independent variables are related to the dependent variable but not strongly related to the other independent variables (Pallant, 2013). Bivariate non-parametric correlations between all independent variables were reviewed to assess multicollinearity ($r_s = .9$ or above); all correlations were less than .14, indicating no collinearity (Fields, 2013; Pallant, 2013).
**Ethical Considerations and Approvals**

A Letter of Support dated March 4, 2016 was provided by Dr. Nicole Mittmann, Chief Research Officer, CCO, in support of the research study that included cervical cancer screening, breast cancer screening and colon cancer screening (Appendix H). The researcher obtained approval from Queen’s University Health Sciences & Affiliated Teaching Hospitals Research Ethics Board (HSREB) on April 1, 2016 based on the original research proposal dated March 13, 2016 that reflected the three cancer screenings (Appendix I). On July 20, 2016, the researcher obtained approval from Data Disclosure Subcommittee at CCO to access CCO record-level administrative data related to the revised scope of the project (cervical cancer screening only) (Appendix J). An amendment was approved by Queen’s University HSREB on August 25, 2016 prior to the commencement of the research study reflecting the more narrow focus of cervical cancer screening only (Appendix K).

Ethical considerations were adhered to by the researcher including ensuring personal health information were held in confidence in accordance with the Research Data Disclosure Agreement. In order to ensure the data was secure, the researcher complied with all security protocols set by CCO including keeping all data in a secure location and not accessible by any individuals not approved in this research process. Data was password protected on a stand-alone encrypted computer.
Chapter 4

Results

This chapter describes the demographic and PEM status characteristics, bivariate relationships between independent variables, descriptive bivariate results by cervical screening status, bivariate logistic regression results, stratified univariate logistic regression results, and stratified multivariate logistic regression results.

Demographic and PEM Status Characteristics

A total of 490,574 women living in the CELHIN were eligible for PAP screening during the period of January 1, 2012 to June 30, 2015 inclusive and met the eligibility criteria for this study (Table 5). Thirty-seven percent of eligible women did not have cervical cancer PAP screening during the period of January 1, 2012 and June 30, 2015 in the CELHIN.

Age group. The cohort included women age 21 to 69 inclusive in keeping with CCO cervical cancer screening guidelines (CCO, 2016). The greatest proportion of women were between ages 40-49 (22.7%) with a mean age of 43.9 years and standard deviation of 13.5. Women between the ages 60-69 years made up the smallest proportion of the cohort (15.5%) (Table 5).

Rurality. Only 10.9% of women resided in rural areas. The majority of women (94.4%; 462,915) resided within the CELHIN. A very small portion of women (0.2%; 1,170) resided outside of the CELHIN and 5.4% of women (26,489) resided in a geographical location with a FSA that included the CELHIN and another bordering Local
Health Integration Network (LHIN). Recall that the FSA and rurality were captured as at the midpoint of the study being October, 2013 and not at the time of the PAP screening.

Table 5
*Characteristics of Female Cohort in CELHIN Eligible for Cervical Screening, 2012-2015 (n=490,574)*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Sample</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PAP Screening</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>309,059</td>
<td>63.0</td>
</tr>
<tr>
<td>No</td>
<td>181,515</td>
<td>37.0</td>
</tr>
<tr>
<td><strong>Age Groups</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21-29</td>
<td>94,653</td>
<td>19.3</td>
</tr>
<tr>
<td>30-39</td>
<td>101,781</td>
<td>20.7</td>
</tr>
<tr>
<td>40-49</td>
<td>111,178</td>
<td>22.7</td>
</tr>
<tr>
<td>50-59</td>
<td>106,853</td>
<td>21.8</td>
</tr>
<tr>
<td>60-69</td>
<td>76,109</td>
<td>15.5</td>
</tr>
<tr>
<td><strong>Neighbourhood Income</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quintile 1 (lowest)</td>
<td>119,832</td>
<td>24.4</td>
</tr>
<tr>
<td>Quintile 2</td>
<td>118,600</td>
<td>24.2</td>
</tr>
<tr>
<td>Quintile 3</td>
<td>97,895</td>
<td>20.0</td>
</tr>
<tr>
<td>Quintile 4</td>
<td>86,496</td>
<td>17.6</td>
</tr>
<tr>
<td>Quintile 5 (highest)</td>
<td>67,555</td>
<td>13.8</td>
</tr>
<tr>
<td>Missing</td>
<td>196</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Forward Sortation Area (FSA)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>53,460</td>
<td>10.9</td>
</tr>
<tr>
<td>Urban</td>
<td>437,114</td>
<td>89.1</td>
</tr>
<tr>
<td><strong>Payment Model (PEM)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Health Group</td>
<td>163,713</td>
<td>33.4</td>
</tr>
<tr>
<td>Family Health Organization</td>
<td>232,055</td>
<td>47.3</td>
</tr>
<tr>
<td>Comprehensive Care Model</td>
<td>17,965</td>
<td>3.7</td>
</tr>
<tr>
<td>Family Health Network</td>
<td>1,185</td>
<td>0.2</td>
</tr>
<tr>
<td>Community Sponsored Agreement</td>
<td>1,255</td>
<td>0.3</td>
</tr>
<tr>
<td>Other</td>
<td>591</td>
<td>0.1</td>
</tr>
</tbody>
</table>
Total PEM Status

| Enrolled in PEM | 382,848 | 78.0 |
| Non-enrolled*   | 107,726 | 22.0 |

*Includes never enrolled, previously enrolled, and unknown; note non-enrolled women may be receiving services from non-PEM models of care, i.e., CHCs, NPLCs, FFS

Neighbourhood income quintile. A trend was observed within the income quintiles; as income levels rose, the proportion of women within each income quintile dropped.

PEM status. The majority of women (n=382,848) were enrolled in a PEM (78%). The two most common PEMs observed in this study were FHOs with 47.3% of enrolled women (n=232,055) and FHGs with 33.4% of enrolled women (n=163,713) (Table 5).

Bivariate Relationships between Independent Variables

A series of bivariate analyses between the independent variables were undertaken to understand the sample population in more detail (see Appendices L and M). In addition, two graphs are provided as visual representations of the sample characteristics (Figures L1 and L2, Appendix L).

Descriptive Bivariate Results by Cervical Screening

The overall proportion of women who did not receive cervical PAP screening was 37%. The results of cross-tabulations examining PAP screening (outcome variable) by age group, rurality, neighbourhood income quintile levels, and PEM status are found in Table 6. Women between 60 and 69 years were proportionately most likely not to be screened (47%) based on cross-tabulation (Figure 4). Furthermore, women living in an urban setting were slightly less likely to be screened (62.6%) compared to women living in a rural setting (66.2%) (Table 6). The PAP non-screening rates by FSA that meet or
are lower than the CELHIN average (37%) are listed in Appendix N; those FSA regions with better cervical cancer screening rates than the average CELHIN are found in Appendix O. Screen-eligible women in the CELHIN sub-regions of Scarborough North and Scarborough South had non-screening rates of 42.8% and 41.2%, respectively (Appendix P).

Table 6
Distribution of Cervical PAP Screening Status by Age Group, Rurality, Neighbourhood Income Quintile, and PEM Status (n= 490,574)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Screened</th>
<th>Not Screened</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n= 309,059 (%)</td>
<td>n= 181,515 (%)</td>
<td>n= 490,574</td>
</tr>
<tr>
<td>Age Group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21-29</td>
<td>56,691 (59.9)</td>
<td>37,962 (40.1)</td>
<td>94,653</td>
</tr>
<tr>
<td>30-39</td>
<td>68,598 (67.4)</td>
<td>33,183 (32.6)</td>
<td>101,781</td>
</tr>
<tr>
<td>40-49</td>
<td>74,335 (66.9)</td>
<td>36,843 (33.1)</td>
<td>111,178</td>
</tr>
<tr>
<td>50-59</td>
<td>69,161 (64.7)</td>
<td>37,692 (35.3)</td>
<td>106,853</td>
</tr>
<tr>
<td>60-69</td>
<td>40,274 (52.9)</td>
<td>35,835 (47.1)</td>
<td>76,109</td>
</tr>
<tr>
<td>Rurality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>273,682 (62.6)</td>
<td>163,432 (37.4)</td>
<td>437,114</td>
</tr>
<tr>
<td>Rural</td>
<td>35,377 (66.2)</td>
<td>18,083 (33.8)</td>
<td>53,460</td>
</tr>
<tr>
<td>Income Quintile</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (lowest)</td>
<td>69,034 (57.6)</td>
<td>50,798 (42.4)</td>
<td>119,832</td>
</tr>
<tr>
<td>2</td>
<td>72,308 (61.0)</td>
<td>46,292 (39.0)</td>
<td>118,600</td>
</tr>
<tr>
<td>3</td>
<td>62,626 (64.0)</td>
<td>35,269 (36.0)</td>
<td>97,895</td>
</tr>
<tr>
<td>4</td>
<td>58,304 (67.4)</td>
<td>28,192 (32.6)</td>
<td>86,496</td>
</tr>
<tr>
<td>5 (highest)</td>
<td>46,691 (69.1)</td>
<td>20,864 (30.9)</td>
<td>67,555</td>
</tr>
<tr>
<td>Missing Cases</td>
<td>96</td>
<td>100</td>
<td>196</td>
</tr>
<tr>
<td>PEM Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-enrolled</td>
<td>29,972 (27.8)</td>
<td>77,754 (72.2)</td>
<td>107,726</td>
</tr>
<tr>
<td>Enrolled</td>
<td>279,087 (72.9)</td>
<td>103,761 (27.1)</td>
<td>382,848</td>
</tr>
</tbody>
</table>
Figure 4. Age Group by Cervical PAP Screening

Bivariate Logistic Regression Results

Bivariate logistic regression was undertaken for each independent variable on the outcome variable, screening. The following describes the bivariate logistic regression analysis of PAP screening by PEM status, neighbourhood income quintile, age group and rurality (Table 7). All analyses were statistically significant with corresponding narrow confidence intervals, reflecting the large sample size of the cohort.

PEM status at time of Cervical PAP screening. A strong association was found between non-PEM enrolled women and not being screened (OR=6.98 95% CI, 6.87-7.08, reference=enrolled) compared to women enrolled in a PEM.
Neighbourhood income quintile and cervical PAP screening. Women in the lowest three neighbourhood income quintile (income quintiles 1, 2 and 3) were more likely not to be screened compared to women in the highest quintile (income quintile 5): OR=1.65 95% CI 1.61-1.68; OR=1.43 95% CI 1.40-1.46; and, OR=1.26 95% CI 1.23-1.29, respectively. As the income quintile decreased, women had a higher likelihood of not being screened, demonstrating a dose-response relationship.

Age group and cervical PAP screening. The likelihood of not being screened was less than 1.00 for all age groups, with the exception of the oldest women (ages 60-69, OR=1.33, 95% CI, 1.30-1.36, reference=youngest group ages 21-29). Women between ages 30 and 39 had the lowest odds of not being screened (OR=0.72, 95% CI, 0.71 - 0.74, reference= youngest group ages 21-29).

Rurality and cervical PAP screening. Women living in urban settings were more likely not to be screened compared to women living in a rural setting (OR =1.17, 95% CI, 1.15-1.19, reference=rural).
Table 7

Bivariate Logistic Regression Analysis of Odds of Not Receiving Cervical PAP Screening by PEM Status, Neighbourhood Income Quintile, Age Group and Rurality

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total (n)</th>
<th>Percent Not Screened</th>
<th>Unadjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEM Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-enrolled</td>
<td>107,726</td>
<td>78.0</td>
<td>6.98 (6.87-7.08)</td>
</tr>
<tr>
<td>Enrolled</td>
<td>382,848</td>
<td>22.0</td>
<td>1.00</td>
</tr>
<tr>
<td>Income Quintile</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 - Lowest</td>
<td>119,832</td>
<td>42.4</td>
<td>1.65 (1.61-1.68)</td>
</tr>
<tr>
<td>2</td>
<td>118,600</td>
<td>39.0</td>
<td>1.43 (1.40-1.46)</td>
</tr>
<tr>
<td>3</td>
<td>97,895</td>
<td>36.0</td>
<td>1.26 (1.23-1.29)</td>
</tr>
<tr>
<td>4</td>
<td>86,496</td>
<td>32.6</td>
<td>1.08 (1.06-1.11)</td>
</tr>
<tr>
<td>5 - Highest</td>
<td>67,555</td>
<td>30.9</td>
<td>1.00</td>
</tr>
<tr>
<td>Missing Cases</td>
<td>196</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age Group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21-29</td>
<td>94,653</td>
<td>40.1</td>
<td>1.00</td>
</tr>
<tr>
<td>30-39</td>
<td>101,781</td>
<td>32.6</td>
<td>0.72 (0.71-0.74)</td>
</tr>
<tr>
<td>40-49</td>
<td>111,178</td>
<td>33.1</td>
<td>0.74 (0.73-0.75)</td>
</tr>
<tr>
<td>50-59</td>
<td>106,853</td>
<td>35.3</td>
<td>0.81 (0.80-0.83)</td>
</tr>
<tr>
<td>60-69</td>
<td>76,109</td>
<td>47.1</td>
<td>1.33 (1.30-1.36)</td>
</tr>
<tr>
<td>Rurality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>53,460</td>
<td>33.8</td>
<td>1.00</td>
</tr>
<tr>
<td>Urban</td>
<td>437,114</td>
<td>37.4</td>
<td>1.17 (1.15-1.19)</td>
</tr>
</tbody>
</table>

Stratified Univariate Logistic Regression Results

Stratified univariate logistic regression analyses were conducted to investigate for any potential effect modification of covariates on the relationship between PEM status and the dependent variable (screened or not screened). Possible effect modification between PEM status and the neighbourhood income quintile was detected (Table 8); this
assessment was based on variability between strata and non-overlapping confidence intervals that affected PAP cancer screening uptake within the CELHIN (non-enrolled OR=1.18, 95% CI 1.12-1.24, reference=highest income quintile, 5; enrolled OR=1.48, 95% CI 1.45-1.52, reference=highest income quintile, 5). The confidence intervals for enrolled and non-enrolled PEM status overlapped within income quintiles 2, 3 and 4.

Stratified univariate logistic regression analyses were also conducted to investigate for any potential effect modification between the other two independent variables (age group and rurality) and PEM status. No variability across strata was found between rurality and PEM status (data not shown). However, there was an observed potential effect modification between age groups and PEM status (Table 9); of particular note, the crude bivariate odds ratios for age groups (Table 7) are all intermediate compared to the stratified analysis results, and there are no overlapping confidence intervals. Non-PEM enrolled women compared to enrolled women have higher likelihood of not being screened in all age categories, with a notable marked increased odds for women between 60 to 69 years of age (OR=1.86, 95% CI 1.77-1.95).
Table 8
Stratified Analysis of the Effect of Income on Cervical PAP Screening by PEM Status (n=490,378)*

<table>
<thead>
<tr>
<th>Income Level</th>
<th>Total (n)</th>
<th>(%) Not Screened</th>
<th>Unadjusted OR (95% CI)</th>
<th>Income Level</th>
<th>Total (n)</th>
<th>(%) Not Screened</th>
<th>Unadjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - Lowest</td>
<td>32,733</td>
<td>72.9</td>
<td>1.18 (1.12-1.24)</td>
<td>1 - Lowest</td>
<td>87,099</td>
<td>30.9</td>
<td>1.48 (1.45-1.52)</td>
</tr>
<tr>
<td>2</td>
<td>27,798</td>
<td>73.7</td>
<td>1.23 (1.17-1.29)</td>
<td>2</td>
<td>90,802</td>
<td>28.4</td>
<td>1.31 (1.28-1.35)</td>
</tr>
<tr>
<td>3</td>
<td>20,344</td>
<td>72.1</td>
<td>1.13 (1.08-1.19)</td>
<td>3</td>
<td>77,551</td>
<td>26.6</td>
<td>1.20 (1.17-1.23)</td>
</tr>
<tr>
<td>4</td>
<td>15,598</td>
<td>70.0</td>
<td>1.02 (0.97-1.08)</td>
<td>4</td>
<td>70,898</td>
<td>24.4</td>
<td>1.07 (1.04-1.09)</td>
</tr>
<tr>
<td>5 - Highest</td>
<td>11,202</td>
<td>69.5</td>
<td>1.00</td>
<td>5 - Highest</td>
<td>56,353</td>
<td>23.2</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*Missing = 196

Table 9
Stratified Analysis of the Effect of Age Group on Cervical PAP Screening by PEM Status (n=490,574)

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Total (n)</th>
<th>(%) Not Screened</th>
<th>Unadjusted OR (95% CI)</th>
<th>Age Group</th>
<th>Total (n)</th>
<th>(%) Not Screened</th>
<th>Unadjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-29</td>
<td>23,735</td>
<td>70.5</td>
<td>1.00</td>
<td>21-29</td>
<td>70,918</td>
<td>29.9</td>
<td>1.00</td>
</tr>
<tr>
<td>30-39</td>
<td>22,721</td>
<td>68.5</td>
<td>0.91 (0.88-0.95)</td>
<td>30-39</td>
<td>79,060</td>
<td>22.3</td>
<td>0.67 (0.66-0.69)</td>
</tr>
<tr>
<td>40-49</td>
<td>23,158</td>
<td>70.4</td>
<td>0.99 (0.96-1.03)</td>
<td>40-49</td>
<td>88,020</td>
<td>23.3</td>
<td>0.71 (0.70-0.73)</td>
</tr>
<tr>
<td>50-59</td>
<td>21,072</td>
<td>72.4</td>
<td>1.10 (1.05-1.14)</td>
<td>50-59</td>
<td>85,781</td>
<td>26.2</td>
<td>0.83 (0.81-0.85)</td>
</tr>
<tr>
<td>60-69</td>
<td>17,040</td>
<td>81.6</td>
<td>1.86 (1.77-1.95)</td>
<td>60-69</td>
<td>59,069</td>
<td>37.1</td>
<td>1.38 (1.35-1.41)</td>
</tr>
</tbody>
</table>
Stratified Multivariate Logistic Regression Results

A multivariate logistic regression was performed initially to assess the independent effects of neighbourhood income quintile, PEM status, rurality and age group on PAP screening without considering the possibility of effect modification. Each of the independent variables (PEM status, neighbourhood income quintile, rurality, age group) were statistically significant $\chi^2 (4, n = 490,574) = 78,880.53, p < .001$ and therefore, all were entered into the logistic regression model (Table 1, last column, “non-enrolled and enrolled”).

PEM status and cervical PAP screening. Women not enrolled to a PEM had an adjusted odds of not being screened of 6.95 (95% CI 6.84 – 7.06) compared to women enrolled in a PEM. Comparing this odds ratio to the univariate logistic regression analysis odds ratio, there was a minimal difference in the odds from 6.98 to 6.95. As the main exposure variable, non-PEM enrolment status showed a clear independent association with not being screened, while controlling for neighbourhood income quintile, age group and rurality. A decision was made not to assess a full logistic regression model for effect modification, but rather to run two multivariate analyses to compare non-enrolled and enrolled women to delineate group differences (Table 10). The remainder of the multivariate findings are reported separately, as odds ratio estimates for non-enrolled and for enrolled women.

Age group and cervical PAP screening. The oldest group of non-enrolled women (age 60-69) had an adjusted odds of not being screened of 1.87 (95% CI 1.78 – 1.96, reference group = youngest group, age 21-29), whereas the oldest group of enrolled
women (age 60-69) had a lower odds of not being screened of 1.41 (95% CI 1.38 – 1.44, reference group=youngest group, age 21-29). Therefore, older women ages 60 to 69 years who are not enrolled in a PEM have the greatest likelihood of not having cervical cancer screening after controlling for neighbourhood income quintile and rurality.

**Income and cervical PAP screening.** Enrolled women in the lowest income quintile had an adjusted odds of not being screened of 1.49 (95% CI 1.46 – 1.53, reference group = highest income quintile, 5). By contrast, in the lowest two income quintiles (income quintiles 1 and 2), non-enrolled women had an adjusted odds of not being screened of 1.20 (95% CI 1.14 – 1.25, reference group = highest income quintile, 5) and 1.24 (95% CI 1.18 – 1.30, reference group = highest income quintile, 5), respectively.

**Rurality and cervical cancer screening.** For urban dwelling women who were enrolled in a PEM, there was a small association of not being screened (OR=1.10 (95% CI 1.07-1.12) compared to their non-enrolled urban counterparts (OR = 1.06, 95% CI 1.01-1.11). The difference in screening between the urban enrolled and non-enrolled women is negligible.
Table 10
Multivariate Logistic Regression Analysis of Non-enrolled Women (n= 107,675), Enrolled Women (n=382,703) and Non-enrolled & Enrolled Women (n=490,378) Not Receiving Cervical PAP Screening by Neighbourhood Income Quintile, Age Group and Rurality

<table>
<thead>
<tr>
<th>Variable</th>
<th>Non-enrolled (n=107,675)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Enrolled (n=382,703)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Non-enrolled &amp; Enrolled (N=490,378)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>S.E.</td>
<td>Wald</td>
<td>Adjusted OR (95% CI)</td>
<td>B</td>
<td>S.E.</td>
<td>Wald</td>
<td>Adjusted OR (95% CI)</td>
<td>B</td>
<td>S.E.</td>
<td>Wald</td>
<td>Adjusted OR (95% CI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEM Status</td>
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<td></td>
<td></td>
<td></td>
<td>1.94</td>
<td>.01</td>
<td>61,771.61</td>
<td>6.95 (6.84 – 7.06)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income Quintile</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 - Lowest</td>
<td>0.18</td>
<td>.02</td>
<td>53.96</td>
<td>1.20 (1.14 - 1.25)</td>
<td>0.40</td>
<td>.01</td>
<td>1,025.54</td>
<td>1.49 (1.46 - 1.53)</td>
<td>0.35</td>
<td>.01</td>
<td>1,006.83</td>
<td>1.42 (1.39 - 1.45)</td>
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</tr>
<tr>
<td>2</td>
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<td>72.71</td>
<td>1.24 (1.18 - 1.30)</td>
<td>0.28</td>
<td>.01</td>
<td>488.01</td>
<td>1.32 (1.29 - 1.35)</td>
<td>0.27</td>
<td>.01</td>
<td>573.72</td>
<td>1.31 (1.28 - 1.33)</td>
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</tr>
<tr>
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<td>.03</td>
<td>23.80</td>
<td>1.14 (1.08 - 1.19)</td>
<td>0.18</td>
<td>.01</td>
<td>201.90</td>
<td>1.20 (1.17 - 1.23)</td>
<td>0.18</td>
<td>.01</td>
<td>230.00</td>
<td>1.19 (1.16 - 1.22)</td>
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</tr>
<tr>
<td>4</td>
<td>0.03</td>
<td>.03</td>
<td>1.05</td>
<td>1.03 (0.98 - 1.08)</td>
<td>0.07</td>
<td>.01</td>
<td>30.47</td>
<td>1.08 (1.05 - 1.11)</td>
<td>0.07</td>
<td>.01</td>
<td>30.30</td>
<td>1.07 (1.04 - 1.09)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 - Highest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td>1.00</td>
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<td></td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age Group</td>
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<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>21-29</td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
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</tr>
<tr>
<td>30-39</td>
<td>-0.10</td>
<td>.02</td>
<td>23.84</td>
<td>0.91 (0.87 - 0.94)</td>
<td>-0.40</td>
<td>.01</td>
<td>1,133.73</td>
<td>0.67 (0.66 - 0.69)</td>
<td>-0.33</td>
<td>.01</td>
<td>1,000.88</td>
<td>0.72 (0.71 - 0.74)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-49</td>
<td>-0.01</td>
<td>.02</td>
<td>0.25</td>
<td>0.99 (0.95 -1.03)</td>
<td>-0.33</td>
<td>.01</td>
<td>820.44</td>
<td>0.72 (0.70 – 0.74)</td>
<td>-0.25</td>
<td>.01</td>
<td>634.31</td>
<td>0.78 (0.76 - 0.79)</td>
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<td></td>
</tr>
<tr>
<td>50-59</td>
<td>0.10</td>
<td>.02</td>
<td>20.53</td>
<td>1.10 (1.06 - 1.15)</td>
<td>-0.17</td>
<td>.01</td>
<td>225.93</td>
<td>0.84 (0.83 – 0.86)</td>
<td>-0.11</td>
<td>.01</td>
<td>115.66</td>
<td>0.90 (0.88 - 0.92)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>0.63</td>
<td>.02</td>
<td>657.80</td>
<td>1.87 (1.78 - 1.96)</td>
<td>0.34</td>
<td>.01</td>
<td>838.10</td>
<td>1.41 (1.38 - 1.44)</td>
<td>0.41</td>
<td>.01</td>
<td>1,449.97</td>
<td>1.50 (1.47 - 1.54)</td>
<td></td>
<td></td>
</tr>
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Chapter 5

Discussion

The dramatic decline since the 1980s in cervical cancer rates is almost entirely attributed to PAP screening (CCO, 2017a; Lofters, Vahabi, Fardad, & Raza, 2017b). In 2000, CCO and the Government of Ontario launched the publicly-funded, population-based screening program. At the inception of this thesis work, the reported Ontario cervical cancer screening rate was 64% for the years 2010-2012; however, in the past year, the reported rate for 2013-2015 dropped to 61% (CCO, 2017a), well below the Ontario screening target of 85% or higher (CQCO, 2018e) and the national screening target of 80% or higher (CPAC, 2016b). With cervical cancer representing 1.5% of all new female cancers in 2017, the estimated incidence in Ontario for 2017 was 710 new cervical cancer cases, with 150 projected deaths (Canadian Cancer Society, 2017). It is well understood women living in lower SES neighbourhoods have the lowest PAP screening rates and the highest burden of cervical cancer (CCO, 2014). Furthermore, older women have the greatest risk of high-grade invasive cervical cancer when not accessing testing or follow-up treatment (Benard, et al., 2015; CCO, 2017b; Pefoyo, Wang, Gao, & Kupets, 2017). Yet, research that assesses the effect of PEM status and income levels simultaneously on PAP screening uptake is limited. This study was novel in its examination of these relationships in one Ontario LHIN.

The purpose of this study was to explore the independent effects of income levels and PEM status on the uptake of PAP cancer screening by eligible women residing in the CELHIN, and to compare the factors associated with non-screening among women with
enrolled versus non-enrolled PEM status. A conceptual model (Figure 2) was developed that sought to explain a possible relationship between income levels and PEM status that might affect PAP screening uptake. The chapter begins with a discussion of the findings with respect to the research questions and existing literature, followed by the study limitations and strengths, and concludes with implications for nursing practice, policy and research.

**Overview of the Research Findings**

Based on the literature, it was proposed that a relationship would exist between income status and PEM status that affects cervical cancer screening rates of eligible women within the CELHIN. Initially, it was hypothesized that cervical cancer screening uptake would be lower for those women living in lower income neighbourhoods who were not linked with a PEM. While both enrolled and non-enrolled women living in lower income neighbourhoods were less likely to be screened, the higher association among enrolled women was not expected. To recap, the findings of each research question are presented below.

Research Question 1. What are the independent effects of neighbourhood income and PEM status on cervical cancer screening among women in the CELHIN?

Neighbourhood income analysis did show that CELHIN women living in the lowest income quintile had an adjusted increased odds (OR=1.42) of not being screened compared to those in the highest income quintile. Despite the expectation that neighbourhood income would have been a stronger factor in screening uptake, income status remains a significant barrier to cervical cancer screening. However, a strong,
nearly seven-fold association was found between the exposure of being non-enrolled in a PEM and not being screened (adjusted OR=6.95).

Research Question 2. What are the factors associated with cervical screening uptake among women enrolled or not enrolled in a PEM in the CELHIN? From the stratified multivariate logistic analysis, it became clear that PEM enrolment was not protective for women living in the lowest neighbourhood income, and that the strongest association for not being screened was for non-enrolled older women (ages 60-69 years; adjusted OR: 1.87). In the following sections, explanations for the findings of each variable examined in the stratified logistic regression models are explored in more depth, beginning with the least significant findings.

**Geographical location.** Women living in an urban setting were 6-10% less likely to be screened compared to rural-living women, depending on the PEM status. Therefore, urban living is weakly associated with not being screened for cervical cancer. It is important to point out that rural residence within the CELHIN does not have the same geographical barriers compared to remote areas of Ontario which observe greater distances to primary health care access.

From limited descriptive findings, it was found that slightly higher proportions of women in Scarborough North and Scarborough South were not screened compared to the study average. Within the CELHIN, Scarborough has the highest percentage of low income, visible minorities and immigrant populations (CELHIN, 2017a). Accordingly, the results of this study are in keeping with the literature that reports sub-groups of women less likely to engage in cancer screening include those individuals living in low
income environments, and in areas with higher proportions of immigrants and ethnic diversity compared to the average Canadian population (Elit et al., 2012; Lofters et al., 2010; Spayne et al., 2015).

Neighbourhood income quintile. Due to limitations of administrative data, other geographical factors were not examined, however, research has shown there are sub-groups of eligible individuals in Ontario who are consistently under or never screened. One such group includes those individuals living in low income environments (Borkhoff et al., 2013; Cobigo et al., 2013; Elit et al., 2012; Gesink et al., 2014; Katz & Hofer, 1994; Lofters et al., 2010; Singh et al., 2004; Spayne et al., 2015; Sun et al., 2009).

The findings in this study are consistent with other investigations within Canada (Elit et al., 2012; Kerner et al., 2015; Lofters et al., 2010) and abroad (Akinyemiju et al., 2016; Benard et al., 2015; Clark et al., 2014) that have demonstrated women living in lower SES environments have lower cervical cancer screening rates. Women living in poverty experience health inequities, including barriers to accessing primary health care and cancer screening (Government of Canada, 2018b; Public Health Agency of Canada, 2018; WHO, 2018). Elit et al. (2012) observed Ontario women residing in the lowest neighbourhood income quintile were 44% less likely to have cervical cancer screening (OR 0.56, 95% CI, 0.55-0.56). Kerner et al. (2015) reported women with the fewest resources, most geographically isolated and least culturally integrated into Canadian society remain yet to be reached for routine cervical screening.

The results of this study are in keeping with those of an Ontario study of disparities in receipt of screening tests for cancer, diabetes and high cholesterol (Borkhoff
et al., 2013). Using administrative data and prevalence ratios, frequency of cancer screening, diabetes and high cholesterol were calculated. The researchers reported 52% of eligible women living in low-income and high immigration neighbourhoods had at least one cervical screening (RR 0.80, CI 0.78-0.81). These findings are similar to the current study’s identification of low cervical screening in CELHIN sub-regions Scarborough North and Scarborough South. The researchers concluded that organized population-based cancer screening programs were insufficient to eliminate disparities in screening for individuals of lower SES or recent immigrants (Borkhoff et al., 2013).

It is reasonable to consider there is a gap in how much the health care provider knows of SDOH affecting individual patients. According to Pinto et al. (2016), few health service organizations routinely collect data on sociodemographic information that can be linked with the health records of patients. The researchers point out that, as part of a joint initiative, the Department of Family and Community Medicine at St. Michael’s Hospital, Toronto, the Centre for Addiction and Mental Health (CAMH), Mount Sinai Hospital and Toronto Public Health, identified a need to collect sociodemographic data from their patient population for the purpose of identifying and understanding SDOH in order to reduce health inequities. While the researchers found participants were willing to answer questions about sensitive subjects such as sexual orientation or religion, the highest rate of non-disclosure (10%) was related to questions about financial status. In a similar Ontario study conducted in a large FHT, patients (n=5,766) eligible for at least one of the three cancer screening tests (breast, cervical, colon) had answered at least one question on a SES survey to be included in the study (Lofters et al., 2017a). The self-
reported socio-demographic data from the survey was linked with the patient’s electronic medical records and cancer screening records. The researchers reported they created an individual-level income variable (low-income cut-off) that defined a poverty threshold with household size taken into consideration. The SES characteristics of patients overdue for cancer screening were compared to those who were up-to-date for screening for each of the three cancer screening types using chi-square tests. It was observed neighbourhood income may under-estimate income-related disparities in cancer screening as individual-level income was the most challenging variable to collect. The researchers advised future work should focus on the income disparity in cancer screening and, at the same time, explore how best to collect measures of poverty.

**Age groups.** Proportionately, women aged 40 to 49 years formed the largest age group in the cohort with the smallest proportion of women between ages 60 and 69. Among non-enrolled women, the odds of not being screened is observed to be higher compared to enrolled women at all age levels, with the highest odds found among the non-PEM enrolled women aged 60 to 69 years.

Two Ontario studies investigated cancer screening behaviors of older women (Lofters et al., 2010; Tavasoli, Kane, Chiarelli & Kupets, 2018). Lofters et al. (2010) studied cervical cancer screening uptake of eligible women age 25-69 (n = 2,273,995) residing in Ontario’s metropolitan areas. This population-based retrospective cohort study found that older immigrant women (age 50-69) living in lower SES neighbourhoods had a cervical cancer screening rate of 31% compared to the 70.5% rate of younger, non-immigrant women living in higher SES neighbourhoods (Lofters et al., 2010). A recent
cross-sectional study considered women’s behaviors towards mammograms and cervical cancer PAP screening uptake of eligible women (n = 1,173,456) residing in Ontario (Tavasoli, Kane, Chiarelli & Kupets, 2018). PEM status and neighbourhood income quintiles were considered as possible factors that might influence cancer screening uptake (mammogram and PAP). The researchers reported older women, age 67 to 69, were more likely to be overdue for PAP screening and up-to-date with breast screening compared to younger women age 52 to 54. The current study findings, which revealed that older women are less likely to engage in cervical cancer screening uptake (52%), are in accordance with these recent provincial studies.

**PEM status.** All individuals in Ontario are entitled to equal access to primary health care services including cancer screening as a matter of equity. Health inequity has been defined as “differences in health which are unnecessary and avoidable, but in addition, are considered unfair and unjust” (Whitehead, 1992, p. 433). Ontarians have access to primary health care professionals, programs and services depending on the model of care chosen by their doctor or nurse practitioner (Glazier, 2016). To be clear, only doctors are part of the PEM process but nurse practitioners are employed within PEMs. Having said this, all Ontarians have access to cervical cancer screening regardless of the type of primary health care model.

The majority of women in this study were enrolled in a PEM and the vast majority of enrolled women were screened. It is noted Scarborough has lower PEM enrolments and cervical screening uptake in the CELHIN. Rural-living women were enrolled in a PEM at a slightly higher rate compared to urban-living women. Women not
enrolled to a PEM had a nearly seven-fold odds of not being screened compared to women enrolled in a PEM. These findings are in keeping with research findings in Ontario that suggest that not being part of a PEM is associated with lower cancer screening rates (Jaakkimainen et al., 2011; Lofters et al., 2011; Vahabi et al., 2015).

**PEM status and pay-for-service incentives.** According to Jaakkimainen et al. (2011), improvements in preventative screening in Ontario, including cervical cancer screening, were noted when patients moved to a PEM and may be attributed to physician incentives which were introduced in 2006/2007. Lofters et al. (2011) reported that among immigrant women in Ontario, not being part of a PEM negatively affected cervical cancer screening uptake, as well as not being in the 35-49 year age group, residing in the lowest-income neighbourhoods, and lack of access to a female healthcare provider. Vahabi et al. (2015) reported incentive payments offered within PEMs as a contributing factor to increased cancer screening uptake in Ontario.

Alternatively, Kiran et al. (2014) using longitudinal data from 1999 to 2009 determined there was no significant increase in cervical screening rates one year after incentives were introduced and found incentives had a limited impact on cervical cancer screening rates three years after incentives were introduced in Ontario. A similar review of administrative data for all Ontarians between 1998 to 2008, with a focus on primary care services provided by the four dominant PEMs (FHNs, FHGs, CCMs, and FHOs), found financial incentives led to modest improvement in PAP screening uptake (Li, Hurley, Decicca, & Buckley, 2014). Their findings are consistent with existing research that incentives generate mixed and mostly modest physician responses (Li et al., 2014).
The researchers hypothesized the reason incentives do not generate larger uptake in Ontario is due to both supply and demand barriers. According to Li et al. (2014) services such as cervical cancer screening remains below targets for the following reasons: (1) patients are not requesting the service or they decline offered services; and, (2) incentives are too small to motivate a change in physician behaviour. It should be noted that a recent study in Ontario reported participation in cancer screening decreased slightly as the primary care physician patient caseload increased due to time constraints and competing demands (Dahrouge et al., 2016).

**PEM status and risk-selection of patients.** The Ontario PEM enrolment document delineates a patient’s commitment to being enrolled and the circumstances when a patient can be released from PEM enrolment, including failing to comply with the agreed-upon obligations. There has been concern that vulnerable women, who may not be able to comply with PEM obligations, may not receive adequate preventive screening. This study observed that enrolled women in the lowest neighbourhood income quintile had a greater likelihood of not being screened compared to enrolled women in higher SES environments; this finding is not consistent with previously reported results that observed no evidence of reduction in care to poorer patients (Kantarevic & Kralj, 2014; Rudoler, Laporte, Barnsley, Glazier & Deber, 2015).

**Study Limitations and Strengths**

This study has several limitations to consider when interpreting the results. The sample of women is specific to the CELHIN, reducing generalizability to women beyond this jurisdiction. However, given the CELHIN’s rich diversity and mix of urban and rural
landscapes, limited generalizations beyond the CELHIN are reasonable. As this study was a descriptive, comparative study using existing record level administrative data, it is not possible to draw conclusions related to the existence of causal inferences (Polit & Beck, 2012).

The four variables in the study represented concepts related to the SDOH structural determinants to health inequities (income and geographical location) and the intermediary determinants of health (PEM status and age) (Figure 2). Since the available data was from a large administrative dataset, examination of socioeconomic position (social class, ethnicity), material circumstances (housing, transportation, employment), behaviours and biological factors and psychological factors (mental health, patient perceptions and beliefs) were not possible, prohibiting the full consideration of factors that may affect cervical cancer screening uptake as contemplated by the conceptual model (Figure 2).

Furthermore, it is recognized other factors not gathered in this research study may influence cervical cancer screening such as provider recommendations, culturally-sensitive care, financial incentives, family history of cervical cancer, transgender identification, education, immigration status, ethnicity, attitudes and beliefs toward cervical PAP screening and access barriers (transportation, childcare, out-of-pocket costs). For women not screened, it is unknown whether screening was offered and declined or if non-screening was related to inaccessible services. This study did not consider cervical cancer screening uptake for eligible women with intellectual and developmental disabilities (IDD). Cobigo and colleagues (2013) conducted a population-
based Ontario study examining observed differences between women with and without IDD controlling for age, SES, rurality and healthcare utilization. Included in this study were all eligible Ontario women age 20-69 (April 1, 2009 to March 31, 2010). Women with IDD were nearly twice as likely not to receive cervical cancer screening compared to women without IDD (34% vs 66.8%). Furthermore, women with IDD had an adjusted odds of 0.21 (79%) more likely not to be screened compared to women without IDD.

Although the use of neighbourhood income quintile is less accurate than individual-level income data, neighbourhood income quintile is a commonly used measure in administrative database research. The study did not consider what possible protective aspects exist in rural locations within the CELHIN that makes rural living slightly more protective than urban living for cervical screening uptake. Given that postal code designation (FSA) was determined at the mid-point of the study time period, some discrepancies may exist in capturing FSAs as women may have moved during the period of the study. In addition, as previously reported, full sub-region analyses of the CELHIN was not possible, as FSAs overlapped with the exception of two urban regions, Scarborough North and Scarborough South.

Lastly, for those women considered as non-enrolled in a PEM, it was not determined if they were accessing primary health care from another model of care (i.e. NPLC, CHC, Aboriginal Health Access Centres), a stand-alone FFS physician, or if the women were truly not attached to any primary healthcare provider.

The three major strengths of this study are as follows: 1) accessing all eligible individuals within the CELHIN increases ability to generalize to a large population; 2)
using administrative databases allows for efficient collection and analysis of large amounts of data pertaining to relationships among independent variables (Polit & Beck, 2012); and, 3) having a retrospective, observational study design involves no direct contact with individuals minimizing risk, in contrast to recruited study participants.

**Implications for Nursing Practice, Policy and Research**

**Nursing practice.** This research study highlighted the need for nurses and primary health care professionals to be mindful of SDOH inequities that may create barriers for at-risk women, with aging identified as a significant barrier to cervical cancer screening. While this study did not directly measure cancer screening uptake and ethnicity, it is reasonable to submit the importance of health care providers understanding why older women experience barriers to screening. To be clear, this retrospective, administrative database study could not determine possible barriers, including possible cultural bias amongst health care providers. However, it is well documented that hard-to-reach women, which includes aging women, immigrants, and those living in lower SES neighbourhoods, have lower cancer screening uptake (Elit et al., 2012; Katz & Hofer, 1994; Kerner et al., 2015; Kiran et al., 2014; Lofters et al., 2010; Maar et al., 2013; Sun et al., 2009). For screening interventions to be successfully implemented, health care providers need to ensure strategies designed to engage hard-to-reach populations are based on cultural humility, with a full understanding of the health consequences of marginalization and health inequity.

Tervalon and Murray-Garcia (1998) suggested a shift from assuming cultural competence, as one cannot master a culture other than one’s own, to a position of
humility. By encouraging health care professionals to engage in self-reflection and life-long learning, it is more likely that a more balanced relationship between clients and health care provider will evolve. With a firm understanding of the term cultural humility, “individuals and communities will be better equipped to understand and accomplish an inclusive environment with mutual benefit and optimal care” (Foronda, Reinholdt, & Ousman, 2016, p. 210). In order to reach out to the women of this study who have high cervical cancer non-screening rates, particularly in Scarborough which has a high minority and immigrant population, health care providers will need to engage this population with culturally humility. Resources should be available in local languages with an appreciation of religious and ethnic customs of the women who live there.

Investigations to identify, quantify and reduce the barriers to cervical screening uptake were the subject of two recent studies (Gesink et al., 2016; Williams & Carter, 2016) and have ramifications for practice. Gesink and colleagues (2016) employed a multi-phased mixed methods in four communities in Ontario with low screening rates for breast, cervical, and colorectal cancer. Quantitative data was used to generate maps of cancer screening rates; focus group interviews with health care providers and under or never screened women, together with a self-administered online survey (n=2,783), provided information regarding barriers and facilitators to cancer screening. Of note was the consistency among facilitators and barriers in all four communities and across the three cancers; the researchers hypothesized this finding “…is because the most significant barriers and facilitators to cancer screening relate to the universal human condition of fear and easing fear through connection and relationship (p.133).” Nurses
and primary healthcare providers can play a significant role in facilitating cancer screening by establishing trust and allaying fears especially for at risk older women. The basis of a therapeutic nurse-client relationship is based on trust, respect, professional intimacy, empathy and power being the five core fundamental components (CNO, 2006).

Australian researchers used grounded theory methods to identify from 23 experts how the experts discuss social disparities in cervical cancer screening, and what they consider to be the best ways to overcome these disparities (Williams & Carter, 2016). Most experts were from Australia or New Zealand (n=19), with concepts from these interviews tested against interviews from international experts (n=4). Williams and Carter reported that while it is assumed by experts that providing access to screening will translate to actual participation and, presumably improved outcomes, there was no clear evidence of any such outcomes. Similar to Gesink et al. (2016), the researchers concluded that while increased access to cervical screening is beneficial as a matter of good health, cervical cancer screening is inevitably irrelevant to the most disadvantaged. Therefore, public health programs should include goals to eliminate SDOH inequities in order to boost cancer screening rates. Such programming is in keeping with the Health Belief Model (HBM) that was developed to understand why some people do not participate in public health programming. The HBM was originally developed in the 1950s by psychologists working at the United States Public Health Service with influences by Kurt Lewin to explain non-participation in public health programming such as cervical cancer screening. The model suggests a person’s behaviour is determined by an analysis of a cost/benefit analysis of a perceived threat (University of Ottawa, 2018). Accordingly,
applying the HBM to this study, cervical cancer may be perceived as a lower threat than poverty by women living in areas of lower SES such as Scarborough. The model has utility in clinical practice to consider the client’s most salient threats and facilitators to action.

**Policy considerations.** This research has demonstrated that being enrolled to a PEM is protective in terms of accessing cervical screening for women in higher neighbourhood income quintiles. According to Glazier, Hutchison and Kopp (2015), FHTs serve more high-income people with fewer health care needs as well as fewer recent immigrants compared to CHCs. To recap, while FHTs are not considered a funding model or PEM, many FHTs are funded by way of FHOs and FHNs.

In Ontario, capitation payments vary according to the age and sex of the patient but not according to how sick they are. Capitation served to over-pay practices with high-income patients and under-pay those with low-income patients. Health policies in Ontario that meant to improve health care inadvertently directed new resources to those who are healthier and wealthier, creating a decline in health equity (Glazier, 2016, p. 6).

With the release of the Patients First: Action Plan for Health Care (MOHLTC, 2015c), the LHINs have made plans to strengthen patient-centred health care in Ontario at the community level (Glazier, 2016). The goal is to address structural issues that created inequities including ensuring resources and services are distributed equitably (MOHLTC, 2015c). Structural policy questions arise. Specifically, why were enrolled women living
in lower SES environments less likely to access cervical cancer screening compared to non-enrolled women living in lower SES within the CELHIN? Are there better primary health care delivery models that would be better suited to meeting needs of impoverished women? Future policy interventions within the CELHIN should focus on addressing economic barriers for women, removing barriers to cervical PAP screening uptake, and improving access to primary health care for women, e.g. alternative delivery models of primary health care other than PEMs. In particular, addressing SDOH that act as barriers to screening should be a priority, including Scarborough, Ontario.

**Future research.** Given the disparity in cervical cancer screening rates identified for older women, and those living in poorer neighbourhoods regardless of PEM attachment, future research is warranted to consider characteristics of primary care delivery models, including incentives and screening uptake. More research is needed to determine the effectiveness of incentives, commonly found in PEMs, on cancer screening uptake. Additional research is needed to study cancer screening uptake interventions such as self-screening across different populations as well as by the type of healthcare practitioner delivering the intervention (i.e. physician, nurse practitioner, pharmacist). Additional potential research includes the following: identifying the benefits of patient incentives; exploring the impact of cultural bias and lack of cultural humility on screening uptake; ascertaining how many women are truly unattached from a primary care provider in the CELHIN thereby making it difficult to obtain cervical cancer screening; characterising the experience of transgender men with a cervix accessing cervical cancer screening; and, considering how age, SES status, PEM status and rurality
affects colon cancer and breast cancer screening uptake in the CELHIN. Future research should focus on finding solutions to gaps in cancer screening to meet the one clear health promise: delivering better coordinated integrated health care in the community with improved patient health care experiences and outcomes by simply putting patients first (MOHLTC, 2015c).

**Conclusion**

The findings from this large, population-based research study indicate that older women not enrolled in a PEM are at a significant disadvantage to receiving cervical cancer screening in the CELHIN. This study also confirmed results of previous studies that older women (ages 60 to 69) had the greatest odds of not being screened. In addition, PEM enrolled and non-enrolled women who live in lower income neighbourhoods are at risk for not being screened. Given that older women have the greatest risk of high-grade invasive cervical cancer and PEM status is not protective for women living in lower SES, the priority for the CELHIN needs to be on addressing barriers to cervical cancer screening uptake, regardless of PEM status, for marginalized at-risk women including older women, and women living in lower SES environments.
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**Appendix A**

**Glossary**

**Attached**
For the purposes of this research study, the term *attached* refers to women who were attached (enrolled) with a patient enrolment model (PEM) during the period of January 1, 2012 and June 30, 2015.

**Canadian Cancer Society**

**Canadian Partnership Against Cancer (CPAC)**
Founded in 2007, CPAC is an independent organization funded by the federal government with goal of facilitating policies and practices that reduces incidence of cancer for Canadians (CPAC, 2018) [https://www.partnershipagainstcancer.ca/about-us/our-mandate/](https://www.partnershipagainstcancer.ca/about-us/our-mandate/)

**Canadian Task Force on Preventative Health Care (CTFPHC)**
An independent body of experts established by the Public Health Agency of Canada (PHAC) to develop evidenced-based clinical practice guidelines that support primary care providers in delivering preventive health care (CTFPHC, 2018).

**Cancer Care Ontario (CCO)**
Reports to the Ministry of Health and Long-Term Care (MOHLTC) as advisor on provincial cancer prevention and screening programs and maintains the mandated cancer registry in Ontario (CCO, 2015a).

**Dissemination Area (DA)**
According to Statistics Canada (2015), DAs are “small, relatively stable geographic units composed of one or more adjacent dissemination blocks. It is the smallest standard geographic area for which all census data are disseminated and covers all the territory of Canada” (para. 2). [http://www12.statcan.gc.ca/census-recensement/2011/ref/dict/geo021-eng.cfm](http://www12.statcan.gc.ca/census-recensement/2011/ref/dict/geo021-eng.cfm)

**Enrolled**
For the purposes of this research study, the term *enrolled* has the same meaning as *attached*.

**Expired**
For the purposes of this research study, the term *expired* refers to women who were attached (enrolled) with a patient enrolment model (PEM) on or after January 1, 2012 and...
their enrolment status ended prior to or on June 30, 2015. For the purposes of analysis, 
those women who were considered either expired or unattached were combined into one 
category called expired/unattached.

**Family Health Team (FHT)**
FHTs were introduced in 2005 and represent an interdisciplinary model of primary care 
with voluntary patient enrolment but are not considered a PEM funding model; the 
funding models of many FHTs are Family Health Organizations and Family Health 
Networks (MOHLTC, 2016; The Conference Board of Canada, 2014).

**Forward Sorting Area (FSA)**
A geographical unit based on the first three characters of a Canadian postal code 
(Government of Canada, 2018a).

**Neighbourhood Income Quintiles (NICs)**
According to CCO (2014), neighbourhood income quintiles are “derived within each 
census metropolitan area (CMA), census agglomeration (CA), or provincial residual area 
not in any CMA or CA. Therefore, the cut-points for each income quintile are 
community-specific, to reflect the relative nature of this measure and to minimize the 
effect of large difference in housing costs on household welfare” (para. 2). 

According to Canadian Institute for Health Information (CIHI) (2015), NICs are a 
“measure of average after-tax income per single-person equivalent in a DA, adjusted for 
household size” (p. 9).

**Ontario Cervical Screening Program (OCSP)**
An organized screening program run by CCO and the Government of Ontario launched in 
2000 with the goal of lowering the number of new cervical cancer cases and deaths from 
cervical cancer by increasing the number of women who get screened regularly. The 
OCSP sends letters to Ontario women inviting them to participate in cervical PAP 
screening, advising them of next steps following a Pap test and reminding them when it is 
time to return for screening. The program supports doctors and nurse practitioners so they 
can provide the best possible cervical screening for their patients (CCO, 2018c)

**Patient Enrolment Model (PEM)**
“A model of payment for primary care physicians to encourage moving from 
an independent practice (where they are the only physician or health care 
provider for their patients) to a group practice (this model includes other 
primary care physicians and/or other health care providers such as nurse 
practitioners)” (MOHLTC, 2012a, para. 1). (See Table 1) 
Patient Enrolment Models (PEMs) – Common Types
The group-based PEMs includes but are not limited to: Family Health Networks (FHNs), Family Health Groups (FHGs), Family Health Organizations (FHOs), Comprehensive Care Models (CCMs), Blended Salary Models (BSMs) and Group Health Centre (GHC) of Sault Ste. Marie (Health Analytics Branch, 2014; Health Force Ontario, 2017; The Conference Board of Canada, 2014).

Rostered
For the purposes of this research study, the term rostered has the same meaning as attached.

Rural vs Urban
There are several definitions at the national policy level and it is encouraged to identify the issue as being a local, community or regional issue prior to determining the appropriate definition of rurality. It is understood that while the characteristics of rural people are different for each definition, all definitions will have similar analytical conclusions. To understand Canada’s rural population, it is recommended that the “rural and small town” definition be considered as a starting point or benchmark (Statistics Canada, 2001). The CELHIN identifies their rural population as being “compact” or dispersed” and urban as “city, town or urban community” as follows (CELHIN, 2017b):

Rural: Compact
Population areas that between 100 and 2,500 people with few to no businesses and the dwellings are in relatively close proximity (CELHIN, 2017b);

Rural: Dispersed
Population areas that between 100 and 2,500 people with few to no businesses and the dwellings are not in relatively close proximity (CELHIN, 2017b); and,

City, Town or Urban Community
Population 2,500 or greater (CELHIN, 2017b).

Rural and Small Town
“Population living in towns and municipalities outside the commuting zone of larger urban centres (i.e. outside the commuting zone of centres with population of 10,000 or more)” (Statistics Canada, 2001, para. 2).

Unattached
For the purposes of this research study, the term unattached refers to women who were not attached (enrolled) with a patient enrolment model (PEM) during the period of January 1, 2012 and June 30, 2015.
Appendix B

Client-Directed Interventions to Increase Community Demand

The Analytic Framework Model illustrates client-directed interventions to increase community demand for cancer screening services (Figure 5) (Baron, Rimer, Breslow, et al., 2008a). It is hypothesized that interventions such as client reminders, client incentives, media campaigns and educational sessions with clients can lead to greater uptake of cancer screening which, in turn, will lead to a reduction in cancer-related morbidity and mortality. Research is needed to determine if client incentives, group education and media campaigns are effective.

![Analytic Framework](image)

**Figure 5.** Analytic Framework: client-directed interventions to increase community demand for cancer screening services (Baron, Rimer, Breslow, et al., 2008a)
**Client-Directed Interventions to Increase Community Access**

The Analytic Framework Model illustrates client-directed interventions to increase community access to cancer screening services (Figure 6) (Baron, Rimer, Coates, et al., 2008b). It is hypothesized that interventions that address reducing barriers such as structural barriers and out-of-pocket client expenses can lead to greater uptake of cancer screening which, in turn, will lead to a reduction in cancer-related morbidity and mortality. Client-directed approaches include health promotion interventions that influence the clients’ knowledge and motivation to be screened. Provider-directed interventions include opportunities for health care providers to boost screening. Research is needed to determine if interventions are needed for specific populations such as hard to reach individuals and never screened individuals.

**Figure 6:** Analytic Framework: client-directed interventions to increase community access for cancer screening services by reducing structural barriers (Baron, Rimer, Coates, et al., 2008b)
Provider-Directed Interventions

The analytic framework model illustrates provider-directed interventions to increase screening services (Figure 7) (Sabatino et al., 2012). It is hypothesized that interventions that involve provider reminders and incentives can lead to greater uptake of cancer screening which, in turn, will lead to a reduction in cancer-related morbidity and mortality. Provider-directed interventions include changing providers’ attitudes and intentions. Research is needed to determine effectiveness of interventions using incentives and client reminders.

Figure 7: Analytic Framework: provider-directed interventions to increase screening for breast, cervical and colorectal cancers (Sabatino et al., 2012)
Figure 8. World Health Organization Commission on Social Determinants of Health: Conceptual Framework for Action on the Social Determinants of Health (2010)
### Appendix D

#### Databases

<table>
<thead>
<tr>
<th>Database Abbreviation</th>
<th>Database Description</th>
<th>Data Availability and Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>CytoBase</td>
<td>Pap Tests</td>
<td>A small proportion of Pap tests performed as a diagnostic test could not be excluded from the analysis. Limited to community-based laboratories. Some women with a scheduled Pap tests (follow-up) may be included in this cohort.</td>
</tr>
<tr>
<td>OHIP’s CHDB</td>
<td>Claims History Database, Pap Tests, hysterectomy claims</td>
<td></td>
</tr>
<tr>
<td>OCR</td>
<td>Ontario Cancer Registry, Resolved invasive cervical cancers</td>
<td></td>
</tr>
<tr>
<td>RPDB</td>
<td>Registered Persons Database, Demographics</td>
<td>Historical RPDB address information is incomplete; therefore, the most recent primary address was selected for reporting, even for historical study periods.</td>
</tr>
<tr>
<td>PCCF+</td>
<td>Postal Code Conversion File Plus (Version 6A), Residence and socio-demographic information</td>
<td></td>
</tr>
<tr>
<td>CAPE</td>
<td>Client Agency Program Enrolment Database, Patients enrolled in PEMs</td>
<td></td>
</tr>
</tbody>
</table>
Appendix E

Demographics of CELHIN Sub-regions: Scarborough North and Scarborough South

According to the CELHIN (2017), CELHIN sub-region Scarborough North (1) has the following demographics:

**CELHIN Sub-Region Scarborough North (1):**

1. highest proportion of low income population (20.2%) in the CELHIN with Tam O’Shanter/Sullivan areas (FSA MIT) with 24.9% proportion of low income population in sub-region (1);

2. highest proportion of visible minority population (83.7%) in the CELHIN with Milliken area (FSA M1V) having a proportion of 95.1%;

3. highest proportion of immigrant population (69%) in the CELHIN with Tam O’Shanter/Sullivan areas (FSA MIT) having the highest proportion of recent immigrants (11.2%) in the sub-region and Steeles area (FSA M1V) having the highest proportion of all immigrants in the sub-region;
CELHIN Sub-Region Scarborough South (2):

4. second highest proportion of low income population (19.9%) in the CELHIN with Scarborough Village (FSA MIJ) having the highest proportion of low income population (33.4%) in the CELHIN;

5. second highest proportion of visible minority population (66.3%) in the CELHIN with Malvern area (FSA M1B) having the highest visible minority (87.5%) and immigrant populations (61.9%) in the sub-region; and,

6. second highest proportion of immigrant population (53.2%) in the CELHIN with Eglinton East (FSA M1L, M1K, M1J) having the highest proportion of recent immigrants (11.9%) in the sub-region; and,

7. Second highest proportion of youth aged 1-18 years in the CELHIN (23.5%); Sub-region Durham West (3) has the highest proportion of youth aged 0-18 years in the CELHIN (26.2%).
Appendix F

Excluded Individuals from Research Study

- women with missing or invalid HIN, date of birth, LHIN, sex or postal code;
- women diagnosed with an invasive cervical cancer prior to January 1st that begins the three-year period of interest;
- women identified with a hysterectomy through OHIP’s CHDB prior to January 1st that begins the three-year period of interest;
- women diagnosed with an invasive cervical cancer before the subsequent PAP date or during follow-up interval;
- women with a hysterectomy before the subsequent PAP date or during the follow-up interval for cases where there was no subsequent PAP; and,
- women who died during follow-up and retention periods and were not re-screened for cervical cancer.

Cancer Quality Council of Ontario [CQCO], (2016)
http://www.csqi.on.ca/cms/One.aspx?portalId=351209&pageld=354643
Appendix G

Recoding PEM Variable

Step 1:
Recoded *Rostered_doc* into new variable, *PEM_Pap*
- Recode 1=1; . = 0
- Should end up with 1=279,087 (56.9%) and 0= 211,487 (43.1%)

Step 2:
Recoded *Rostered_Status* into new variable *Status_2016*
- Attached =1
- Expired =3
- Unattached =5
- Unknown=5

Step 3:
Computed new variable, *PEM_Status = PEM_Pap + Status_2016*
The number in the 3\textsuperscript{rd} column is generated (by adding column 1 and column 2) automatically with the compute function.

Resulting categories:

<table>
<thead>
<tr>
<th>PEM_Pap</th>
<th>Status_2016</th>
<th>PEM_Status</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attached =1</td>
<td>2</td>
<td>Attached at time of PAP</td>
</tr>
<tr>
<td>1</td>
<td>Expired =3</td>
<td>4</td>
<td>Attached at time of PAP, expired in 2016</td>
</tr>
<tr>
<td>0</td>
<td>Attached =1</td>
<td>1</td>
<td>Attached in 2016</td>
</tr>
<tr>
<td>0</td>
<td>Expired =3</td>
<td>3</td>
<td>Expired in 2016</td>
</tr>
<tr>
<td>0</td>
<td>Unattached &amp; Unknown =5</td>
<td>5</td>
<td>Unattached</td>
</tr>
</tbody>
</table>

Step 4:
The compute function is important to separate out the expired category properly.
Therefore:
Recoded *PEM_Status* to *PEM_Final* using the following:
- PEM_Status
  - 1= 1
  - 2 =1
  - 4 =1
  - 3 =2
  - 5 =3
- The resulting PEM_Final is:
  - 1= attached
  - 2= expired
  - 3= unattached
March 4, 2016

Dr. Albert Clark
Chair, Health Sciences and Affiliated Teaching Hospitals Research Ethics Board
University Research Services
Fleming Hall-Jemmott Wing
Queen's University
Kingston, ON K7L 3N6

Re: Kathryn Roka's MNSc Thesis Proposal

Dear Dr. Clark:

As the Ontario government's advisor on the cancer and renal systems, as well as on access to care for key health services, CCO drives continuous improvement in disease prevention and screening, the delivery of care and the patient experience for chronic diseases. CCO directs and oversees approximately $1.5 billion in funding for hospitals and other cancer and chronic kidney disease care providers, enabling them to deliver high quality, timely services and improved access to care.

I am writing to confirm that Kathryn Roka, a Queen’s MNSc student, has been working with CCO staff and analysts over the past year to secure the use of anonymous record-level data for her masters thesis work.

As Chief Research Officer at CCO, I am pleased to offer my support for the application entitled "Income Status, Patient Enrolment Model (PEM) and Cancer Screening uptake within the Central East Local Health Integration Network (CELHIN)". Following approval by your ethics board, Ms. Roka will be submitting her research proposal to CCO, where it will go through additional scrutiny and clearance processes. We have been apprised of her research proposal throughout its development this past year, and support Ms. Roka’s research endeavor.

Sincerely,

Dr. Nicole Mittmann, MSc, PhD
Chief Research Officer
CCO
Appendix I

QUEEN'S UNIVERSITY HEALTH SCIENCES & AFFILIATED TEACHING HOSPITALS RESEARCH ETHICS BOARD (HSREB)

HSREB Initial Ethics Clearance

April 01, 2016

Ms. Kathryn Roka
School of Nursing
Queen's University

ROMEOTRAQ: #6018010
Department Code: NURS-366-16
Study Title: Income Status, Patient Enrolment Model (PEM) and Cancer Screening Uptake within the Central East Local Health Integration Network (CELHIN)
Co-Investigators: Dr. D. Edge
Review Type: Delegated
Date Ethics Clearance Issued: April 01, 2016
Ethics Clearance Expiry Date: April 01, 2017

Dear Ms. Roka,

The Queen's University Health Sciences & Affiliated Teaching Hospitals Research Ethics Board (HSREB) has reviewed the application and granted ethics clearance for the documents listed below. Ethics clearance is granted until the expiration date noted above.

- Protocol – March 13, 2016
- Letter of Support – Dr. N. Mittmann

Documents Acknowledged:

- CORE Certificate – K. Roka

Amendments: No deviations from, or changes to the protocol should be initiated without prior written clearance of an appropriate amendment from the HSREB, except when necessary to eliminate immediate hazard(s) to study participants or when the change(s) involves only administrative or logistical aspects of the trial.

Renewals: Prior to the expiration of your ethics clearance you will be reminded to submit your renewal report through ROMEO. Any lapses in ethical clearance will be documented on the renewal form.

Completion/Termination: The HSREB must be notified of the completion or termination of this study through the completion of a renewal report in ROMEO.
Reporting of Serious Adverse Events: Any unexpected serious adverse event occurring locally must be reported within 2 working days or earlier if required by the study sponsor. All other serious adverse events must be reported within 15 days after becoming aware of the information.

Reporting of Complaints: Any complaints made by participants or persons acting on behalf of participants must be reported to the Research Ethics Board within 7 days of becoming aware of the complaint. Note: All documents supplied to participants must have the contact information for the Research Ethics Board.

Investigators please note that if your trial is registered by the sponsor, you must take responsibility to ensure that the registration information is accurate and complete.

Yours sincerely,

[Signature]

Chair, Health Sciences Research Ethics Board

The HSREB operates in compliance with, and is constituted in accordance with, the requirements of the TriCouncil Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2); the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Devices Regulations, Canadian General Standards Board, and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The HSREB is qualified through the CTO REB Qualification Program and is registered with the U.S. Department of Health and Human Services (DHHS) Office for Human Research Protection (OHRP). Federalwide Assurance Number: FWA#: 00004184, IRB#: 00001173

HSREB members involved in the research project do not participate in the review, discussion or decision.
Appendix J

To: Kathryn Roka
Date: July 20, 2016
Subject: Income Status, Patient Enrolment Model (PEM) and Cancer Screening Uptake within the Central East Local health Integration Network (CELHIN)

Request ID Number: 15-046
Approval Date: July 20, 2016

The Data Disclosure Subcommittee (DDSC) at CCO has reviewed your Application for Disclosure of Information for Research Purposes, which includes the protocol and all supporting documents for the study referenced above.

We are pleased to inform you that the DDSC has approved your request for data contingent upon RES approval of the amendment addressing the revised scope of the project.

If the Data Disclosure Team hasn’t already done so, they will notify you of the anticipated delivery date for your request within the next few weeks. The team may also seek clarification from you regarding your request, as needed.

Kindly arrange for all individuals who will have access to the data provided by CCO, as listed in your application, to sign the attached Research Data Disclosure Agreement. Please send a scanned copy of the signed agreement to datarequest@cancercare.on.ca. The requested data will not be released until the agreement is fully executed.

Please cite the Request ID Number listed above in all future correspondence related to this request. Should you have any questions regarding this request, please email datarequest@cancercare.on.ca.

Sincerely,

Nicole Mittmann M.Sc., Ph.D.
Chief Research Officer
Analytics and Informatics

Sara Elseviers, B Lib.
Group Manager
Legal & Privacy Office

Ontario Cancer Care Ontario
620 University Ave, Toronto, ON M5G 2L7
T 416.971.9800 | F 416.971.6988 | publicaffairs@cancercare.on.ca | cancercare.on.ca

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QUEEN'S UNIVERSITY HEALTH SCIENCES & AFFILIATED TEACHING HOSPITALS
RESEARCH ETHICS BOARD (HSREB)

HSREB Amendment Acknowledgment/Ethics Clearance

August 25, 2016

Ms. Kathryn Roka
School of Nursing
Queen's University

ROMEQ/TRAQ: #6018010
Department Code: NURS-366-16
Study Title: Income Status, Patient Enrolment Model (PEM) and Cancer Screening Uptake within the Central East Local Health Integration Network (CELHIN)
Review Type: Delegated
Date Ethics Clearance Issued: August 25, 2016

Dear Ms. Roka,

The Queen's University Health Sciences & Affiliated Teaching Hospitals Research Ethics Board (HSREB) has reviewed the amendment application and granted ethics clearance/acknowledgement for the documents listed below.

- Revised Protocol – 2016 AUG 15

Yours sincerely,

[Signature]
Chair, Health Sciences Research Ethics Board

*The HSREB operates in compliance with, and is constituted in accordance with, the requirements of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2); the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Devices Regulations, Canadian General Standards Board, and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The HSREB is qualified through the CTO REB Qualification Program and is registered with the U.S. Department of Health and Human Services (DHHS) Office for Human Research Protection (OHRP). Federalwide Assurance Number: FWA#00004184, IRB#0000173

*HSREB members involved in the research project do not participate in the review, discussion or decision.
Appendix L
Bivariate Relationships between Independent Variables

A series of bivariate analyses between the independent variables were undertaken to understand the sample population and are set out below. The two figures provide an overall description of the sample characteristics.

Table L1
*Distribution of Age Group by PEM Status (n = 490,574)*

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Enrolled n= 382,848 (%)</th>
<th>Non-enrolled n= 107,726 (%)</th>
<th>Total n= 490,574</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-29</td>
<td>70,918 (74.9)</td>
<td>23,735 (25.1)</td>
<td>94,653</td>
</tr>
<tr>
<td>30-39</td>
<td>79,060 (77.7)</td>
<td>22,721 (22.3)</td>
<td>101,781</td>
</tr>
<tr>
<td>40-49</td>
<td>88,020 (79.2)</td>
<td>23,158 (20.8)</td>
<td>111,178</td>
</tr>
<tr>
<td>50-59</td>
<td>85,781 (80.3)</td>
<td>21,072 (19.7)</td>
<td>106,853</td>
</tr>
<tr>
<td>60-69</td>
<td>59,069 (77.6)</td>
<td>17,040 (22.4)</td>
<td>76,109</td>
</tr>
</tbody>
</table>

Table L2
*Distribution of Rurality by PEM Status (n = 490,574)*

<table>
<thead>
<tr>
<th>Rurality</th>
<th>Enrolled n= 382,848 (%)</th>
<th>Non-enrolled n= 107,726 (%)</th>
<th>Total n= 490,574</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>43,716 (81.8)</td>
<td>9,744 (18.2)</td>
<td>53,460</td>
</tr>
<tr>
<td>Urban</td>
<td>339,132 (77.6)</td>
<td>97,982 (22.4)</td>
<td>437,114</td>
</tr>
</tbody>
</table>
Neighbourhood income quintile by age group. As shown in Figure L1, younger women ages 21 to 39 (51,254) were most likely to live in areas represented by the lowest neighbourhood income quintile (26%) compared to all other age groups. As women age, the proportion of women living in areas with the lowest neighbourhood income quintile (income quintile 1) decreased steadily with 22.6% of women age 60-69 years old living in income quintile 1.

![Figure L1. Neighbourhood Income Quintile by Age Group](image-url)
**Neighbourhood income quintile by PEM status.** As income quintiles rise, PEM enrolment rises without exception (Figure L2). Of the 119,832 women in neighbourhood income quintile 1, 87,099 (72.7%) were enrolled in a PEM. Of the 67,555 women in neighbourhood income quintile 5, 56,353 (83.4%) were enrolled in a PEM.

![Neighbourhood Income Quintiles by PEM Status](attachment:image.png)

**Figure L2.** Neighbourhood Income Quintile by PEM Status
Table L3

Distribution of Neighbourhood Income Quintile, PEM Status and Age Group by Rurality (n = 490,574)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Rural</th>
<th>Urban</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=53,460 (%)</td>
<td>n=437,114 (%)</td>
<td>n=490,574</td>
</tr>
<tr>
<td><strong>Inc</strong>ome Quintiles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (lowest)</td>
<td>5,871 (4.9)</td>
<td>113,961 (95.1)</td>
<td>119,832</td>
</tr>
<tr>
<td>2</td>
<td>10,571 (8.9)</td>
<td>108,029 (91.1)</td>
<td>118,600</td>
</tr>
<tr>
<td>3</td>
<td>11,377 (11.6)</td>
<td>86,518 (88.4)</td>
<td>97,895</td>
</tr>
<tr>
<td>4</td>
<td>15,144 (17.5)</td>
<td>71,352 (82.5)</td>
<td>86,496</td>
</tr>
<tr>
<td>5 (highest)</td>
<td>10,417 (15.4)</td>
<td>57,138 (84.6)</td>
<td>67,555</td>
</tr>
<tr>
<td>Missing</td>
<td>80</td>
<td>116</td>
<td>196</td>
</tr>
<tr>
<td><strong>PEM Status</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Non-enrolled</td>
<td>9,744 (9.0)</td>
<td>97,982 (91.0)</td>
<td>107,726</td>
</tr>
<tr>
<td>Enrolled</td>
<td>43,716 (11.4)</td>
<td>339,132 (88.6)</td>
<td>382,848</td>
</tr>
<tr>
<td><strong>Age Group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21-29</td>
<td>9,086 (9.6)</td>
<td>85,567 (90.4)</td>
<td>94,653</td>
</tr>
<tr>
<td>30-39</td>
<td>8,556 (8.4)</td>
<td>93,225 (91.6)</td>
<td>101,781</td>
</tr>
<tr>
<td>40-49</td>
<td>10,400 (9.4)</td>
<td>100,778 (90.6)</td>
<td>111,178</td>
</tr>
<tr>
<td>50-59</td>
<td>13,768 (12.9)</td>
<td>93,085 (87.1)</td>
<td>106,853</td>
</tr>
<tr>
<td>60-69</td>
<td>11,650 (15.3)</td>
<td>64,459 (84.7)</td>
<td>76,109</td>
</tr>
</tbody>
</table>
Appendix M

Table M1. Cross-tabulations: Age Group by Neighbourhood Income Quintile

<table>
<thead>
<tr>
<th>Income Quintile</th>
<th>Age Group 1: 21-29</th>
<th>Age Group 2: 30-39</th>
<th>Age Group 3: 40-49</th>
<th>Age Group 4: 50-59</th>
<th>Age Group 5: 60-69</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quintile 1</td>
<td>24,747 [20.7%]</td>
<td>26,507 [22.1%]</td>
<td>26,979 [22.5%]</td>
<td>24,396 [20.4%]</td>
<td>17,203 [14.4%]</td>
<td>119,832</td>
</tr>
<tr>
<td>Quintile 2</td>
<td>23,330 [19.7%]</td>
<td>24,765 [20.9%]</td>
<td>26,419 [22.3%]</td>
<td>25,621 [21.6%]</td>
<td>18,465 [15.6%]</td>
<td>118,600</td>
</tr>
<tr>
<td>Quintile 3</td>
<td>18,643 [19.0%]</td>
<td>20,264 [20.7%]</td>
<td>22,041 [22.5%]</td>
<td>21,394 [21.9%]</td>
<td>15,553 [15.9%]</td>
<td>97,895</td>
</tr>
<tr>
<td>Quintile 4</td>
<td>15,675 [18.1%]</td>
<td>17,913 [20.7%]</td>
<td>19,851 [23.0%]</td>
<td>19,257 [22.3%]</td>
<td>13,800 [16.0%]</td>
<td>86,496</td>
</tr>
<tr>
<td>Quintile 5</td>
<td>12,231 [18.1%]</td>
<td>12,312 [18.2%]</td>
<td>15,854 [23.5%]</td>
<td>16,135 [23.9%]</td>
<td>11,023 [16.3%]</td>
<td>67,555</td>
</tr>
<tr>
<td>missing</td>
<td>27 [13.8%]</td>
<td>20 [10.2%]</td>
<td>34 [17.3%]</td>
<td>50 [25.5%]</td>
<td>65 [33.2%]</td>
<td>196</td>
</tr>
<tr>
<td>Total</td>
<td>94,653</td>
<td>101,781</td>
<td>111,178</td>
<td>106,853</td>
<td>76,109</td>
<td>490,574</td>
</tr>
</tbody>
</table>
Appendix N
Cervical cancer PAP Non-Screening rates by FSA that meet or are lower than CELHIN average (37%)

The average proportion of eligible women not having cancer PAP screening during the period of January 1, 2012 and June 30, 2015 in the CELHIN is 37%. The following FSAs within the CELHIN had cervical cancer PAP non-screening rates that meet or are lower than the CELHIN average for non-screening (37%).

<table>
<thead>
<tr>
<th>FSA</th>
<th>Not Screened (%) within FSA</th>
<th>Urban/Rural - FSA</th>
<th>CELHIN Sub-LHIN Regions within FSA</th>
<th>Neighbourhood Income Quintile (%) within FSA (Census 2016)</th>
<th>Women age 60-69 within FSA (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1G</td>
<td>36.9</td>
<td>Urban</td>
<td>Durham North East (4)</td>
<td>Q1: 32.3 Q2: 18.5 Q3: 28.4 Q4: 13.4 Q5: 7.4</td>
<td>18.3</td>
</tr>
<tr>
<td>K0K</td>
<td>36.4</td>
<td>Rural</td>
<td>Northumberland County (5);</td>
<td>Q1: 7.2 Q2: 14.0 Q3: 22.3 Q4: 36.8 Q5: 19.7</td>
<td>20.1</td>
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<tr>
<td>L1S</td>
<td>35.8</td>
<td>Urban</td>
<td>Durham West (3)</td>
<td>Q1: 8.8 Q2: 10.1 Q3: 57.4 Q4: 15.7 Q5: 8.1</td>
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<tr>
<td>M1C</td>
<td>35.1</td>
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<td>Scarborough South (2)</td>
<td>Q1: 1.1 Q2: 4.8 Q3: 22.2 Q4: 38.1 Q5: 33.8</td>
<td>18.1</td>
</tr>
<tr>
<td>Code</td>
<td>Population</td>
<td>Location</td>
<td>Winter Temperature Q1-Q5 (°C)</td>
<td>L4 Temperature (°C)</td>
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<tr>
<td>K9H</td>
<td>34.9</td>
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<td>Rural Durham North East (4); Peterborough County (6); Haliburton County and City of Kawartha Lakes (7)</td>
<td>Q1: 11.8, Q2: 26.3, Q3: 25.7, Q4: 22.0, Q5: 14.2</td>
<td>25.7</td>
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<tr>
<td>K9J</td>
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<td>Q1: 29.9, Q2: 21.8, Q3: 16.4, Q4: 16.3, Q5: 15.6</td>
<td>18.2</td>
<td></td>
</tr>
<tr>
<td>K0L</td>
<td>33.9</td>
<td>Rural Northumberland County (5); Peterborough County (6); Haliburton County and City of Kawartha Lakes (7)</td>
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<td></td>
</tr>
<tr>
<td>Code</td>
<td>Population (%)</td>
<td>Type</td>
<td>Description</td>
<td>Q1</td>
<td>Q2</td>
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<td>----------------</td>
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<td>L1T</td>
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<td>L0A</td>
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<td>5.2</td>
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<td>K9L</td>
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<td>Urban</td>
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<td>Urban</td>
<td>Durham West (3)</td>
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<td>30.7</td>
<td>Rural</td>
<td>Durham West (3); Durham North East</td>
<td>0.0</td>
<td>10.2</td>
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</table>
| L1P  | 30.6 | Urban | Durham West (3) | Q1: 15.5  
|      |      |       |                | Q2: 0.0   
|      |      |       |                | Q3: 25.9  
|      |      |       |                | Q4: 28.6  
|      |      |       |                | Q5: 30.0  
|      |      |       |                | Q3: 17.8  
|      |      |       |                | Q4: 36.5  
|      |      |       |                | Q5: 35.5  | 10.3 |
| L1R  | 30.4 | Urban | Durham West (3) | Q1: 2.3  
|      |      |       |                | Q2: 10.9  
|      |      |       |                | Q3: 34.2  
|      |      |       |                | Q4: 18.7  
|      |      |       |                | Q5: 33.9  | 9.6 |
| L1K  | 30.2 | Urban | Durham North East (4) | Q1: 8.7  
|      |      |       |                | Q2: 10.0  
|      |      |       |                | Q3: 13.1  
|      |      |       |                | Q4: 59.1  
|      |      |       |                | Q5: 9.1   | 11.3 |
| L1C  | 30.2 | Urban | Durham North East (4) | Q1: 7.1  
|      |      |       |                | Q2: 41.6  
|      |      |       |                | Q3: 23.4  
|      |      |       |                | Q4: 21.3  
|      |      |       |                | Q5: 6.6   | 11.5 |
| L1L  | 29.1 | Urban | Durham North East (4) | Q1: 0.0  
|      |      |       |                | Q2: 0.0   
|      |      |       |                | Q3: 13.4  
|      |      |       |                | Q4: 2.8   
|      |      |       |                | Q5: 83.8  | 10.8 |
| L1B  | 29.1 | Urban | Durham North East (4) | Q1: 6.0  
|      |      |       |                | Q2: 29.1  
|      |      |       |                | Q3: 18.8  
|      |      |       |                | Q4: 37.9  
|      |      |       |                | Q5: 8.3   | 19.0 |
| L1E  | 28.5 | Urban | Durham North East (4) | Q1: 1.5  
|      |      |       |                | Q2: 29.5  
|      |      |       |                | Q3: 15.6  
|      |      |       |                | Q4: 27.4  
|      |      |       |                | Q5: 25.9  | 10.3 |
| L9P  | 28.3 | Urban | Durham North East (4) | Q1: 0.0  
<p>|      |      |       |                | Q2: 6.0   | 13.7 |</p>
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<th></th>
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<th>Q3: 27.1</th>
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<td>28.3</td>
<td>Urban</td>
<td>Peterborough County (6)</td>
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<td></td>
<td>Q3: 5.3</td>
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<td></td>
<td>Q4: 51.4</td>
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<td></td>
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<td>17.1</td>
</tr>
<tr>
<td>L9L</td>
<td>26.1</td>
<td>Urban</td>
<td>Durham North East (4)</td>
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</tr>
<tr>
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<td></td>
<td></td>
<td>Q4: 12.3</td>
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<td></td>
<td></td>
<td>Q5: 74.9</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>18.3</td>
</tr>
<tr>
<td>L1M</td>
<td>26.0</td>
<td>Urban</td>
<td>Durham West (3); Durham North East (4)</td>
<td>Q1: 0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Q2: 2.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Q3: 9.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Q4: 36.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Q5: 52.6</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>8.6</td>
</tr>
</tbody>
</table>
Appendix O

Cervical cancer PAP Non-Screening rates by FSA that are higher than CELHIN average

The average proportion of eligible women not having cervical cancer PAP screening during the period of January 1, 2012 and June 30, 2015 in the CELHIN is 37%.

The following FSAs within the CELHIN had a higher cervical cancer PAP non-screening rate compared to the CELHIN average for non-screening (37%):

<table>
<thead>
<tr>
<th>FSA</th>
<th>Not Screened (%) within FSA</th>
<th>Urban/ Rural</th>
<th>CELHIN Sub-LHIN Regions within FSA</th>
<th>Income Quintile (%) within FSA (Census 2016)</th>
<th>Total (%) Women age 60-69 within FSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1T</td>
<td>44.0</td>
<td>Urban</td>
<td>Scarborough North (1)</td>
<td>Q1: 44.0&lt;br&gt;Q2: 34.8&lt;br&gt;Q3: 15.4&lt;br&gt;Q4: 4.6&lt;br&gt;Q5: 1.2</td>
<td>14.5</td>
</tr>
<tr>
<td>M1K</td>
<td>44.0</td>
<td>Urban</td>
<td>Scarborough South (2)</td>
<td>Q1: 54.0&lt;br&gt;Q2: 38.2&lt;br&gt;Q3: 7.8&lt;br&gt;Q4: 0.0&lt;br&gt;Q5: 0.0</td>
<td>14.1</td>
</tr>
<tr>
<td>M1H</td>
<td>43.9</td>
<td>Urban</td>
<td>Scarborough South (2)</td>
<td>Q1: 24.0&lt;br&gt;Q2: 50.7&lt;br&gt;Q3: 20.9&lt;br&gt;Q4: 4.4&lt;br&gt;Q5: 0.0</td>
<td>12.6</td>
</tr>
<tr>
<td>M1G</td>
<td>43.9</td>
<td>Urban</td>
<td>Scarborough South (2)</td>
<td>Q1: 54.0&lt;br&gt;Q2: 24.6&lt;br&gt;Q3: 17.8&lt;br&gt;Q4: 3.6&lt;br&gt;Q5: 0.0</td>
<td>13.9</td>
</tr>
<tr>
<td>Code</td>
<td>Median</td>
<td>Type</td>
<td>Location</td>
<td>Percentiles</td>
<td>Score</td>
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<td>---------------------------------</td>
<td>-----------------</td>
<td>-------</td>
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<tr>
<td>M1W</td>
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<td>16.5</td>
</tr>
<tr>
<td>M1P</td>
<td>43.4</td>
<td>Urban</td>
<td>Scarborough South (2)</td>
<td>Q1: 50.7, Q2: 34.1, Q3: 8.9, Q4: 6.2, Q5: 0.0</td>
<td>13.8</td>
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<tr>
<td>M1S</td>
<td>43.3</td>
<td>Urban</td>
<td>Scarborough North (1)</td>
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<td>15.7</td>
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<tr>
<td>M1J</td>
<td>43.2</td>
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<td>Scarborough South (2)</td>
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<tr>
<td>M1R</td>
<td>42.9</td>
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<td>Scarborough South (2)</td>
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<tr>
<td>L1A</td>
<td>42.0</td>
<td>Urban</td>
<td>Northumberland County (5)</td>
<td>Q1: 21.9, Q2: 20.8, Q3: 20.1, Q4: 18.3, Q5: 18.9</td>
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<tr>
<td>M1V</td>
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<tr>
<td>M1B</td>
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<td>Scarborough South (2)</td>
<td>Q1: 40.7, Q2: 39.8, Q3: 15.6, Q4: 4.0, Q5: 0.0</td>
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</tr>
<tr>
<td>Code</td>
<td>Value</td>
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<td>Location</td>
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<td>Q2</td>
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<td>Urban</td>
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<td>Scarborough South (2)</td>
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<td>M1N</td>
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<td>Urban</td>
<td>Scarborough South (2)</td>
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<td>Urban</td>
<td>Scarborough South (2)</td>
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<td>18.5</td>
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<td>L1H</td>
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<td>Urban</td>
<td>Durham North East (4)</td>
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<td>Q2:</td>
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<td>Urban</td>
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<td>K9V</td>
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<td>Urban</td>
<td>Haliburton County and City of Kawartha Lakes (7)</td>
<td>33.3</td>
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<td>Rural</td>
<td>Durham West (3)</td>
<td>11.7</td>
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</table>
Appendix P

Screen-eligible women age 60 to 69 in the CELHIN sub-regions
Scarborough North and Scarborough South

Additional analyses were undertaken for two urban sub-LHIN regions, Scarborough North and Scarborough South. Among women, ages 60 to 69, those in Scarborough North had a non-screening rate of 50.8%, followed by Scarborough North at 47%.

Table P1
Characteristics of Older Women in CELHIN Sub-Regions for Scarborough North and Scarborough South, ages 60-69 Years

<table>
<thead>
<tr>
<th>No.</th>
<th>CELHIN Sub-Region</th>
<th>Total Women in Sub-Region</th>
<th>Total Women Not Screened in Sub-Region (%)</th>
<th>Women age 60-69 in Sub-Region (%)</th>
<th>Women age 60-69 not Screened in Sub-Region (%)</th>
<th>Enrolled Women age 60-69 in Sub-Region (%)</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Scarborough North</td>
<td>70,432</td>
<td>30,157 (42.8%)</td>
<td>11,090 (15.7%)</td>
<td>5,209 (47%)</td>
<td>8,102 (73.1%)</td>
</tr>
<tr>
<td>2</td>
<td>Scarborough South</td>
<td>144,020</td>
<td>59,377 (41.2%)</td>
<td>21,162 (14.7%)</td>
<td>10,740 (50.8%)</td>
<td>15,536 (73.4%)</td>
</tr>
</tbody>
</table>