TeamCare: An Interprofessional Team-Based Primary Health Care Program for Patients with Complex Health and Social Needs

by

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Abstract

TeamCare encompasses several programs designed to improve access to team-based care for complex patients that have been implemented through Community Health Centres (CHCs) in Ontario. Two studies were conducted to determine whether TeamCare has reached its intended population of patients with complex health and social needs and evaluate its impact on patient health care utilization. The studies used electronic health record data from CHCs linked with administrative data for fiscal years 2013-2016. A modified Difference-in-differences approach was employed to analyze the impact of participation in TeamCare on emergency department, primary, and secondary care utilization. The results of the studies indicate that TeamCare reached its intended population but did not have a meaningful impact on the utilization of formal healthcare services for patients enrolled in 2015. The results of this study and continued research will inform efforts to expand access to interprofessional team-based primary care in Ontario.

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Chapter 1
The Problem

1 The Problem

Interprofessional team-based care has become an integral part of health care reforms in many countries aiming to achieve high quality, equitable, accessible, and comprehensive primary health care. By improving access to comprehensive and appropriate primary health care, interprofessional team-based care is expected to reduce inequities in access to health care and reduce unmet need and avoidable acute care utilization (1). An interprofessional team approach has been shown to improve health outcomes, quality of care, and reduce acute care utilization (2–4). Team-based care is particularly effective in the management and delivery of care for individuals with chronic illnesses, significant medical complexities, and/or social vulnerabilities (2,5–7), who often require a level of support beyond that which a physician can provide on their own (8,9).

Despite evidence for its effectiveness, in Ontario, many patients with medical and social complexity who could benefit from interprofessional team-based care do not have access. The primary interprofessional team models in Ontario are Community Health Centres (CHCs) and Family Health Teams (FHTs). The CHC, established in the 1970s, was the first interprofessional team-based primary care model introduced in Ontario (10). CHCs are community-led, salaried models that employ physicians and allied health professionals (e.g., social workers, physiotherapists, dieticians, etc.) to deliver team-based care to populations or geographic areas with higher levels of vulnerabilities or barriers to access (10). The next push to expand interprofessional team-based care in Ontario occurred as part of its primary care reform efforts of the early 2000s (11). The provincial government increased access to CHCs, establishing 21 new CHCs and 28 satellite sites to add to the 55 existing CHCs, and implemented the FHT, a new patient enrolment model with attributes of the patient medical home (i.e., patient rostering, incentives for preventative care, and team-based care) (10,11). In 2018, CHCs and FHTs continued to be the main interprofessional team-based models in primary care: 74 CHCs were delivering care to 500,000 Ontarians, 250,000 of whom received primary care services (12); and 200 FHTs were serving approximately 3.5 million Ontarians (13). However, as of 2019, approximately 70% of the Ontario population – including many with complex health and social needs who could most

benefit from team-based care (14,15) – remained without access to interprofessional primary care teams (16).

To address this access gap, a program intervention called TeamCare has been implemented in a network of CHCs and some FHTs in Ontario. The program allows primary care physicians who are not part of an interprofessional practice (i.e., "non-team physicians") to refer their patients to a CHC or FHT to enable access to interprofessional team-based care. The program is intended for patients with complex needs, though there are no strict eligibility criteria. Once referred, patients receive support and care from allied health professionals at the CHC while maintaining their relationship with their primary care physician.

This study proposes to describe the characteristics of patients who received TeamCare services, determining whether the program has reached its intended population, and to evaluate the impact of the TeamCare program on health system outcomes.

1.1 Research Objectives

The research objectives of this thesis are:

1. To characterize the patient population that has been reached by TeamCare;
2. To determine whether TeamCare patients represent those with complex needs when compared to the patient populations of their most responsible physicians and the general Ontario population; and
3. To evaluate the impact of the TeamCare program on health system utilization.

1.2 Research Questions

The primary research questions of this thesis are:

1. What are the characteristics of patients enrolled in the TeamCare program?

    a. *What are the characteristics of TeamCare patients' most responsible primary care physicians?*

2. How do TeamCare patients compare with the patient population treated by their most responsible primary care physicians and the general population on characteristics related to medical and social complexity?

3. How does the TeamCare program affect health care utilization for the TeamCare patient population compared to a similar patient population who did not participate in the program?

    a. *How does the likelihood of having avoidable emergency department (ED) visits (non-urgent ED visits and ED visits not resulting in hospitalization) differ for the TeamCare patient population after having received the intervention as compared to before, in relation to a propensity score-matched comparison group?*

    b. *How does the rate of primary care physician visits differ for the TeamCare patient population after having received the intervention as compared to before, in relation to a propensity score-matched comparison group?*

    c. *How does the rate of specialist physician visits differ for the TeamCare patient population after having received the intervention as compared to before, in relation to a propensity score-matched comparison group?*

1.3 Implications

Though evidence suggests that interprofessional team-based care is an effective model of primary care service delivery for patients with complex needs, current interprofessional team-based care models in Ontario serve only approximately 30% of the population and do not reach many individuals with complex needs who could benefit from team-based care. Unless and until further large-scale or provincial-level reforms and innovations are implemented that would equitably deliver team-based care to those who need it, the TeamCare model may be a solution that can fill a significant access gap in Ontario and reduce pressures on the acute care health system. The current study will describe the role of the TeamCare program in delivering care to high needs populations and the characteristics of the patients and physicians it is serving. This study will also determine whether the TeamCare program affects unnecessary or avoidable acute health services utilization, specifically avoidable ED visits, and use of physician services in primary and

secondary care. These findings will inform future efforts to improve access to team-based care and improve health system outcomes.

Chapter 2
Background

2 Background

2.1 Literature Review

2.1.1 Primary Health Care

Primary care has been shown to improve health outcomes and access to care (17). Studies in the United States and other developed nations have consistently shown that regions with a high ratio of primary care physicians (PCPs) to population have lower all-cause mortality, rates of hospitalization, rates of ED utilization, and costs (17–19). Primary health care has also been shown to reduce inequities in health across population subgroups; increased supply of primary care physicians has been shown to reduce the effect of income inequality and sociodemographic characteristics on health outcomes, including all-cause mortality and self-rated health (17). However, despite this evidence, socio-economic status remains a significant predictor of an individual's access to primary health care and quality of care received (20). While access to primary health care has been shown to reduce inequities in health, vulnerable patient populations who have complex health and social needs continue to experience disparities in access to primary health care and poorer health outcomes (21,22). The traditional health system is not ideally designed for the care of patients with complex needs, who often "fall through the cracks" (23). Moreover, efforts to reform primary care in Canada have not been specifically targeted to vulnerable populations and "may not be well adapted" to their needs (24).

2.1.2 Patients with Complex Medical and Social Needs

Patients with complex needs are a heterogeneous patient population, defined by the interaction of multiple biological, socioeconomic, cultural, environmental, and/or behavioural challenges: often experiencing two or more co-occurring chronic conditions, psychosocial vulnerabilities, and/or behavioural health issues (9,25–28). Individuals with complex needs are likely to interact frequently with the health care system, resulting in high costs to the system, and are at higher risk for poor outcomes compared to those who do not face complexity (29).

As the first point of contact with the health care system for individuals, families, and communities, primary health care is the setting best positioned to deliver health promotion, disease prevention, and chronic illness management (5,8,23,30). However, the status quo of primary care delivery in Canada is ill-designed to provide for patients with complex needs. For example, Bodenheimer et al. (2002) describe the traditional system, with brief physician visits and little care planning, as designed for acute rather than chronic care; physician time and resources get taken up with acute needs while the care and management of long-term chronic illnesses become a lower priority (5). Caring for patients with complex needs often requires extensive coordination and resources dedicated to address multiple (sometimes concurrent) physical and psychological conditions and/or socioeconomic challenges (8). Providers attempting to care for such patients on their own have been known to experience increased levels of stress, burnout, and may feel unable to provide adequate care for these patients (8,23,31). However, even the perception of additional help in the management of complex patient care can significantly reduce provider stress associated with the time required to coordinate care (31).

2.1.3 Interprofessional Primary Health Care Teams

The involvement of non-physician personnel in team-based care has been frequently proposed, recommended, and employed to improve population health and access to care, quality of care, and cost-effectiveness (3), as well as address the problem of caring for patient populations with complex needs (5,23,32–35). A number of different terms have been used in the literature to describe this model of care delivery, including multidisciplinary, interdisciplinary, multiprofessional, and interprofessional teams (36). Each term has a slightly different meaning, but they are often used synonymously (37). Generally, the inter- prefix is understood to refer to a greater degree of collaboration between the disciplines or professions rather than simply working side-by-side or in silos (38). This study uses the term *interprofessional team-based care* and defines it as follows: "the development of a cohesive practice between professionals from different disciplines […which] involves continuous interaction and knowledge sharing between professionals…all while seeking to optimize the patient's participation" (39).

Models of co-located interprofessional team-based care have been implemented in many jurisdictions, often based on the concept of the "medical home". In the United States, the Patient-Centred Medical Home (PCMH) is a model that has been implemented in many contexts in an

effort to reorganize the delivery of primary care to provide high quality and efficient health care (40). The concept of the PCMH has evolved over time, incorporating elements of other models such as the Chronic Care Model (CCM), but more recently has been defined by a set of core principles including team-based care, patient-centeredness, care coordination, enhanced access, and quality improvement (40). Canada has developed its own conceptualization of the Patient Medical Home, which also includes team-based care as one of its pillars. The College of Family Physicians Canada defines team-based care in the medical home as "a team or network of caregivers, including nurses, physician assistants, and other health professionals—located in the same physical site or linked virtually from different practice sites throughout the local or extended community—[working] together with the patient's personal family physician to provide and coordinate a comprehensive range of medical and health care services required by each person" (41). The FHT is Ontario's "flagship" medical home model (42). Other models of centralized team-based care include Federally Qualified Health Centers in the U.S. (FQHCs), a model similar to the CHC model in Ontario, and the Primary Care Home Model in the United Kingdom (43).

Another model of interprofessional team-based care prominent in the literature on team-based care for high needs populations is Intensive Primary Care (IPC). While PCMH models generally do not target specific populations, IPC models are designed to meet the needs of patient populations at high risk of health care utilization or mortality through the use of interprofessional teams and delivery of higher intensity, targeted primary care services (6). Examples include Montreal-based System of Integrated Care for Older Persons (SIPA), Program of All-Inclusive Care for the elderly (PACE), and the Geriatric Resources for Assessment and Care of Elders (GRACE) model, all of which are targeted to frail seniors (6). These programs are more intensive and encompass a wider range of health care services than PCMH models; they involve integrated care across acute and community-based services (44–46), and, in the case of PACE, integrated financing (45).

Interprofessional primary health care teams are designed to improve access to care, continuity, and coordination of care (47). From the patient perspective, interprofessional team-based care has been shown to improve patient-reported quality of care (4,48,49) and patient satisfaction with care (4,33,50). By improving access to comprehensive and appropriate primary health care, interprofessional team-based care is expected to reduce inequities in access to health care and reduce unmet need and avoidable acute care utilization (1). Patients have reported improved

accessibility and reduced unmet needs associated with receiving interprofessional team-based care (24,51).

From the provider perspective, interprofessional team-based care has been shown to improve provider-reported quality of care (2,52), patient-centeredness (53), and provider work satisfaction (33). However, studies have demonstrated mixed results with regard to provider-reported care efficiency, burnout, and workload (2,52). Evidence from Ontario's FHTs shows that same-day access and wait times for physician care improved while wait times for allied health professionals remained high (54), suggesting that the burden of patient care had been shifted to non-physician personnel. A study of Ontario FHTs found that perceived improvement of interprofessional collaboration was seen to be related to improved patient care (55). Similarly, physicians and nurse-practitioners in CHCs reported that interprofessional collaboration facilitated and supported high-quality care (56).

Interprofessional team-based care has been shown to improve quality of care for patients with complex medical and psychosocial needs in particular (6,7). In terms of chronic disease management, research suggests that a team-based approach that incorporates non-physician health care professionals is ideal for the management of chronic illness in primary care (5,21). Evidence suggests that interprofessional team-based care improves adherence to guidelines and management of chronic illness (30,48,57). The CHC in particular has been identified as a model that delivers high-quality care for chronic illnesses when compared to other primary care models in Ontario (56).

Patients with complex medical needs and with socioeconomic risk factors are more likely to have high rates of health services utilization than those without (20). A population-based study examining determinants of ED use for adults over 65 in Quebec found that an increased rate of ED use was associated with lack of a primary care physician, low or medium levels of continuity of care with a primary care physician, residence in a rural area, and low socioeconomic status (58). Based on the literature summarized here, interprofessional team-based care could be expected to reduce inequities in access to health care and reduce unmet need and avoidable acute care utilization by improving access to comprehensive and appropriate primary health care (1,49).

Evidence for the effect of integrated and/or co-located interprofessional teams on acute health care utilization is mixed, but the literature suggests that targeted interventions are the most effective. Two systematic review of PCMHs found mixed effects on ED visits and hospital admissions in the overall patient populations (40,59). However, when the study populations were limited to older adults and high-risk patients, a reduction in ED visits was observed (40,59). A study of a statewide PCMH initiative demonstrated reductions in acute care utilization and costs across the entire study population, but reductions were 3-4 times greater for patients with chronic conditions than for those without (60). Other PCMH models have been shown to reduce health care utilization for patients with complex health needs (e.g. chronically ill, disabilities, mental health, behavioural health issues) (60–63). Taken together, this evidence suggests that PCMH models are most effective when targeted to specific patient populations with defined needs and risk of acute care utilization.

Models of IPC targeted to patients at high risk of utilization have generally been successful in reducing acute care utilization. Intensive primary care programs designed for frail seniors demonstrated reductions in ED visits (GRACE (4,64)) and hospitalizations (GRACE (4,64), SIPA (44), and PACE (45)). Variations on the Veterans Affairs (VA) Patient-Aligned Care Team (PACT) model targeted to homeless populations (H-PACT) (65) and patients with the 5% highest cost or highest risk of hospitalization (ImPACT) (66) both demonstrated reductions in acute care utilization. In comparison to the PCMH models, the IPC models offer a higher intensity and broader scope of services (across sectors) to a more targeted high-risk population.

Federally qualified health centers in the U.S. and CHCs in Ontario are models with co-located interprofessional teams that typically serve low income or marginalized populations. Patients of FQHCs were less likely to be hospitalized or visit the emergency room for ambulatory care sensitive conditions (ACSC) than those receiving care from other providers (67). A recent Institute for Clinical Evaluative Sciences (ICES) evaluation conducted in 2015 revealed that, when compared to other primary care models in Ontario, CHC patients had the highest rates of ED use, hospital admissions, and referrals to specialists, followed by FHTs (68). A report released in 2012 by the ICES demonstrated that CHC patients have lower than expected ED visit rates given the complexity of the patient populations they serve (lower income, higher rates of social assistance, more severe mental illness and chronic conditions, and higher morbidity and comorbidity), though

the reason(s) for the lower than expected ED use were not identified or explored (69). This evidence suggests that CHC patients have higher rates of ED utilization compared to patients of other models by virtue of their high degree of complexity, but that CHCs are particularly effective in delivering care for this population and reducing ED visit rates to lower than would be expected given this complexity.

Models that link general or family practice to an interprofessional team (rather than having an integrated team, as in the PCMH) are less well represented in the literature on team-based care. There are early examples of models using this approach in the care of mental health conditions by linking family medicine practices to dedicated interprofessional mental health teams (51,70). These models had positive results with regard to patient satisfaction and self-reported unmet health needs, increased contacts with allied health professionals, and decreased outpatient visits and referrals to external specialty mental health services (51,70). A program in the U.S. designed to reduce ED visits for patients with previously high rates of ED utilization was successful in significantly decreasing all-cause ED use following the intervention, but its particular context (it was conducted by medical trainees in a large academic setting) may limit the generalizability of results to other settings (71). Preliminary results from a similar program in Toronto, Ontario suggested that it had a positive impact on patient and provider satisfaction and that patients had, on average, a high frequency of visits to their primary care physician during the program, but this finding was not analyzed quantitatively and further results or evaluations on the impact of the program on health care utilization have not been published (30). Research on the TeamCare model will therefore fill an important gap in the literature.

2.2 Policy Context

The World Health Organization (WHO)'s Alma-Ata Declaration of 1978 conceptualized primary health care in its ideal form as integrated, comprehensive, interdisciplinary, and universally accessible (72). The Declaration set out a vision of primary health care as the central function of a health system and the first point of contact for individuals, families, and communities (72). In 2008, WHO asserted that interprofessional teams are a crucial component of health services delivery in a primary health care-oriented health system (73) and, in the recent 2018 Declaration of Astana, reaffirmed the central role of interprofessional collaboration in meeting the health care needs of a population (74).

In the Canadian context, and specifically in the province of Ontario, models of primary care that deviate from the traditional solo-practice, fee-for-service (FFS) model, with the aim of delivering more comprehensive and accessible care, have existed since the 1970s. Ontario first experimented with group physician practice models in the 1970s with the Health Service Organization (HSO), which was largely phased out by 2000 (10). The CHC model, created to provide interdisciplinary primary health care services to vulnerable geographical regions and neighborhoods, was also introduced in the 1970s (10,47). However, in contrast to the HSO, CHCs have continued to serve an important role in the Ontario primary care landscape (12).

In the early 2000s, the federal government invested heavily in primary care reform; Ontario used federal contributions through targeted transfer payments to reorganize the funding and delivery of primary care in the province (47). The main objectives of the reforms were to improve access, quality and continuity of care, provider and patient satisfaction, and to increase the cost-effectiveness of primary health care services (10). To achieve these objectives, the province incrementally introduced new primary care practice models, known as patient enrolment models (47). Between 2000 and 2005, several models were introduced, including two enhanced FFS models — Comprehensive Care Model (CCM) and Family Health Group (FHG) — which receive payment primarily through FFS with additional incentives for preventative care and chronic disease management, and two capitation-based models — Family Health Organization (FHO) and Family Health Network (FHN) — which receive payment primarily through capitation (a fee per patient enroled adjusted for age and sex) with additional FFS and incentive payments (16). Primary care physicians could voluntarily switch into one of the new models from their existing practice model (75). All models, with the exception of the CCM, required that physicians practice in groups (though they did not need to be co-located) (16). By 2012, 76% of PCPs in Ontario were practicing in the new patient enrolment models and the remainder continued to practice in traditional FFS models (11).

A key aim of the reforms was to expand access to interprofessional team-based care in the province (76). In 2004, the province invested heavily to expand the pre-existing CHC model to increase the number of CHCs and satellite sites (77). In 2005, the province introduced the FHT, its “flagship” medical home model offering interprofessional team-based care (42). Practices in a FHO or FHN patient enrolment model could apply to become an FHT (10). By 2012 approximately half of

practices in the newly formed capitation-based models had interprofessional teams (78), serving close to one fifth of the Ontario population (11). By 2019, just under 30% of the Ontario population had access to interprofessional team-based care through CHCs and FHTs (16).

Though the reforms produced great success in terms of the uptake of the new patient enrolment models, there were gaps in access to these models for many patients (14,15). Rudoler et al. (2015) found that primary care practices self-selected into the patient enrolment models based on existing practice characteristics; those with more complex patient populations were less likely to switch to a capitated model than to an enhanced FFS model or remain in traditional FFS (14). Moreover, a report by Glazier et al. (2009) found that, compared to patients in enhanced FFS models, patients in blended capitation models had similar demographic characteristics but lower morbidity and co-morbidity, received less after-hours care, and had more ED visits (14). The authors also found that the capitated models enrolled fewer new patients (14). Another study found that patients who saw an FFS physician were more likely to live in low-income neighborhoods in urban areas and receive poorer quality care when compared with patients who visited the patient enrolment models (15). An ICES study using administrative data from 2008-2009 identified 6.1% of the population of Ontario - approximately 725,500 individuals - as having high comorbidity, 85% of whom were rostered to or visiting physicians who did not practice in an interprofessional team ("non-team physicians") (69). Together, this evidence suggests that many patients with complex needs continue to visit FFS physicians and physicians who are part of patient enrolment models but not interprofessional teams.

While the intent of the reforms was to improve access to primary health care services for all Ontarians, the evidence suggests that there continue to be gaps and inequities in access to medical homes and team-based care. , FHTs and CHCs remain the primary interdisciplinary models in Ontario (47). However, no new FHTs have been created since the last wave of implementation of the initial reforms in fiscal year 2011/2012 (79). And, though the CHC has been recognized as a model that delivers high-quality care for chronic illnesses when compared to other primary care models in Ontario (56), it traditionally serves a specific niche—for example, Planned Parenthood delivers care related to sexual health, and TAIBU CHC serves Black communities across the Greater Toronto Area—and collectively CHCs provide care for only about 4% of the Ontario population (12).

2.3 Description of the Intervention

Recognizing that many individuals with complex needs lacked access to interprofessional care, a program called TeamCare was developed to bridge the gap. TeamCare operates through a network of CHCs and some FHTs to deliver interprofessional team-based care to patients who visit a primary care physician who does not practice as part of an interprofessional team (i.e., a non-team physician). The program is intended to support patients with complex health and social needs and their physicians by improving the connection between non-team physicians and supportive community-based primary care services.

The TeamCare program allows patients of non-team physicians to access non-physician services at CHCs and FHTs. These services include but are not limited to counselling, community health work, health promotion, dietician services, and chiropody. The program is based on voluntary referral: patients are referred by and at the discretion of their own primary care physician. There are no strict criteria determining patient eligibility. While receiving care through TeamCare, patients maintain their relationship with their existing primary care physician.

Team-based care as defined in the TeamCare model differs from the interprofessional team-based models typically described in the literature (such as the PCMH) in that the primary care physician is not a core member of the team and the patient is not rostered to the team itself. Rather, the primary care physician is linked through referral to a team made up of allied health professionals associated with a CHC or FHT who deliver team-based care to the patient.

2.4 Hypotheses

Given that the TeamCare programs targeted patients with complex health and social needs, the hypothesis with regard to the first research question was that TeamCare patients would represent those with complex needs when compared to the non-TeamCare patient populations of their primary care physicians and the general Ontario population.

The literature suggests that interprofessional team-based care improves the care management for, and quality of care delivered to, high-needs patients (6,7,30,48,57). If patients are well-supported and receiving comprehensive, high-quality care in a primary care setting, they will be less likely to visit the ED for non-urgent issues (49). The literature also suggests that team-based care reduces

ED visits and is particularly effective in reducing ED visits for patients with mental health issues and/or a high degree of medical complexity (60–63). The hypothesis for the impact of TeamCare on avoidable ED visits was therefore that non-urgent ED visits and ED visits not resulting in hospitalization would decrease for the TeamCare patient population relative to a similar comparator population.

There is limited literature reporting mixed results on the effect of interprofessional team-based care on specialist visits or primary care visits. The hypotheses as to the direction of the effect of the TeamCare program on either specialist or primary care physician visits were therefore undetermined. The TeamCare program may deliver care that meets all patients' needs and reduces the need to refer to specialists. However, the program—by virtue of the comprehensive assessment and increased contacts with health professionals—may uncover previously unknown medical or mental health issues and increase referrals to specialists. For primary care physician visits, the program may reduce visits to the primary care physician for issues that were previously handled by the physician but can be more appropriately handled by allied health professionals. In contrast, the patient may be better supported by increased contacts with allied health professionals through the program as well as with their primary care physician. Changes in specialist referrals and physician visits will be explored empirically but, given the uncertainty around the expected direction of the change, they were interpreted with added caution.

Chapter 3
Paper One

3 An interprofessional team-based primary care program for patients with complex health and social needs: who gets access?

3.1 Introduction

With an aging population, growing prevalence of chronic disease, and increasing social disparities, health systems and health care professionals are increasingly grappling with the challenge of caring for patients with dynamic and complex needs. Patients with complex needs are a heterogeneous patient population, defined by the interaction of multiple biological, socioeconomic, cultural, environmental, and/or behavioural challenges: often experiencing two or more co-occurring chronic conditions, psychosocial vulnerabilities, and/or behavioural health issues (9,25–28). Individuals with complex needs are at higher risk for poor outcomes compared to those who do not face complexity and are likely to interact frequently with the health care system, resulting in high costs to the system (29). The greater level of support required by these patients is often beyond the scope and capacity of primary care physicians alone, particularly when complex social issues need to be addressed (9,23). Data from the Commonwealth Fund suggest that high-needs patients often do not have access to the services that they need – such as care coordination, emotional counseling, and assistance in managing functional limitations – despite having a regular doctor or place of care (22). Patients with unmet needs are more likely to delay care, less likely to participate in preventative care, and more likely to visit the ED (22).

Interprofessional primary care teams are particularly well-suited to address the multifaceted needs of patients with medical and social complexity and have been increasingly implemented for that purpose. A recent review by the Commonwealth Fund identified 28 promising interventions designed specifically for high needs patients, 25 of which included interprofessional teams (34). Interprofessional teams are groups of professionals from different disciplines collaborating and working together toward a common goal of providing care for a patient and/or a patient population,

often with engagement of patients and families (39,80–82). Interprofessional team-based care is designed to provide high quality, accessible, comprehensive, and coordinated primary health care (3,47). By improving access to comprehensive and appropriate primary health care, interprofessional team-based care is expected to reduce inequities in access to health care and reduce unmet need and avoidable acute care utilization (1,49).

A large evidence base suggests that interprofessional team-based interventions targeted to patients with complex needs are effective in improving health outcomes and reducing acute care utilization (2,4–7,60–63,83–85). Team-based care has also been shown to improve quality of care (54,56,86), particularly when related to the management of chronic illness (30,48,56,57). A majority of interprofessional models described in the literature are integrated or co-located teams, such as patient-centered medical home (PCMH) models or federally qualified health centers in the United States. Models that link general or family practice to an interprofessional team targeted for complex patients are less well represented in the literature on team-based care and tend to be targeted to mental health (51,70) or specific disease conditions such as diabetes (87) and dementia (88) rather than to patients with complex needs more generally.

Despite evidence for its effectiveness, in Ontario, many patients with medical and social complexity who could benefit from interprofessional team-based care do not have access. Two models of interprofessional team-based primary care, the FHT and CHC, serve approximately 30% of the Ontario population (16). FHTs are Ontario's "flagship" medical home model, with care delivered by a team of physicians and allied health professionals to a roster of patients (42). As of 2019, approximately 3.5 million people were enrolled with an FHT (13). CHCs are a community-governed model comprised of teams of interdisciplinary health care professionals, including physicians, who receive salaried payment (10). As a result of incentives built into their capitation-based payment model and without an accompanying social mandate, FHTs are less likely to serve patients who require complex care, are low income, are newcomers to the province, or live in urban centres (15,78). In contrast, CHCs are specifically mandated to serve vulnerable, marginalized, and complex patients but serve a relatively small proportion of the overall population, having delivered primary care services to approximately 250,000 people in 2017 (89).

The majority of the remaining population is rostered to primary care physicians practicing in models of care based on blended capitation (FHNs and FHOs) or enhanced FFS (FHGs and CCMs), or visit a FFS physician (10,11). There are differences across models in terms of the complexity profiles of their patient populations, but each of them deliver care to patients with complex needs needs (14,90). An ICES study using administrative data from 2008-2009 identified 6.1% of the population of Ontario – approximately 725,500 individuals – as having high comorbidity, 85% of whom were rostered to or visiting non-team physicians (69). The number of patients enrolled with an FHT has increased since thesa data were published (13), but a large proportion of patients with complex needs remains without access to interprofessional team-based care.

Recognizing that many individuals with complex health needs were visiting physicians who did not practice in an interprofessional team ("non-team physicians") and lacked access to such teams, a program, now called TeamCare, was implemented by several CHCs and some FHTs in Ontario. TeamCare allows patients of non-team physicians to access non-physician services at CHCs and FHTs. These services include but are not limited to counselling, community health work, health promotion, dietician services, and chiropody. TeamCare is intended to support patients with complex health and social needs and their physicians by improving the connection between non-team physicians and the health system. The program model is based on voluntary referral: patients are referred by and at the discretion of their own primary care physician. There are no strict criteria determining patient eligibility. While receiving services through TeamCare, patients maintain their relationship with their existing primary care physician. To date, no research has been undertaken to assess the appropriateness of the patients who receive TeamCare services.

This study was undertaken to address two specific aims: 1. To characterize the patients and physicians participating in TeamCare; and 2. To determine whether patients who received TeamCare services represent those individuals with complex health needs when compared to the practice population of their primary care physician and the general population of Ontario in terms of their characteristics and health care utilization. This study presents an opportunity to examine whether TeamCare is effectively reaching its target population and whether its patients have high health care resource utilization as compared to other populations, representing pressure on the system that could be addressed by the intervention. The results have implications for programs

that allow for physician self-selection and voluntary referral and for future expansion of the TeamCare model in Ontario.

3.2 Methods

3.2.1 Study Setting and Design

TeamCare operates in various regions of the province through CHCs and some FHTs. For consistency and due to data availability (there are no identifiers for TeamCare patients in FHTs), this analysis included only CHC participants. Services offered at CHCs are provided free-of-charge and are available to patients who are insured and uninsured by the provincial public health insurance plan (91). There are three distinct programs under the umbrella of the TeamCare initiative: Primary Care Outreach (PCO), Solo Practitioners in Need (SPiN), and TeamCare (formerly People in Need of Teams [PINOT]). PCO operates in Ottawa and delivers home-based team-based care services–primarily nursing and interprofessional support services–to frail seniors. SPiN operates through a network of CHCs in Toronto and delivers care to medically complex and socially vulnerable patients. Both PCO and SPiN are referral-based programs. TeamCare (PINOT) is the most recent iteration of the program and aims to move beyond the referral model by emphasizing ongoing communication between the referring primary care physician and the interprofessional team. TeamCare (PINOT) has been implemented in several CHCs and a few FHTs in various regions across the province.

In this cross-sectional study, the patients who participated in TeamCare between April 1, 2015 and March 31, 2017 and their primary care physicians were identified and described. The TeamCare exposure group was compared to the patient population of TeamCare patients' most responsible primary care physicians (excluding those patients who participated in TeamCare) and the general population on characteristics that contribute to patient complexity and previous health care utilization. To assess whether the health service utilization of TeamCare patients differed from that of the comparison groups, the difference in mean ED, primary care physician, and specialist visits in the year prior to the intervention between the TeamCare exposure group and comparison groups were examined.

3.2.2 Data Sources

This study used anonymized administrative databases held ICES, which were linked using a unique patient-level identifier based on an individual's encrypted health insurance number. ICES is an independent, not-for-profit corporation that receives core funding from the Ontario Ministry of Health and holds an inventory of data from publicly funded administrative health services in Ontario (92,93). All databases used in this study are listed in Table 3-3 in Appendix A with a description of the type of information provided. A database of electronic health record data collected by CHCs was also available as an ICES data holding and linked to the administrative databases. The CHC data included a special program variable which flagged participation in a TeamCare program, allowing for the identification of the TeamCare exposure group as well as standardized data about patient encounters, including the date of contact.

Additional administrative data sources provided information on inpatient admissions and ED use (DAD and NACRS), patient and physician sociodemographic, geographic, and socioeconomic characteristics (RPDB, CPDB, IPDB, CAPE, CENSUS, ONMARG), clinical conditions (ICES-derived cohorts for ASTHMA, CHF, COPD, HYPER, ODD), and information from the Ontario Drug Benefit (ODB), Drugs List (DIN), and Ontario Mental Health reporting System (OMHRS) required to identify patients with dementia and chronic psychotic illness using validated algorithms (94,95).

3.2.3 Study Population and Identification of Exposure

3.2.3.1 Patients

All patients flagged in the CHC data as having participated in a TeamCare program were identified. Each patient was assigned an index date based on their date of first encounter at a CHC. All individuals with an index date between April 1, 2015 and March 31, 2017 were selected for inclusion in the TeamCare exposure group. All baseline characteristics were measured at the index date and health care utilization was analyzed in the year prior to the index date. Individuals were excluded from the exposure group if they were not adults (<18 years of age) or had an unreliable age (>105), were not an Ontario resident, or were not eligible for the Ontario Health Insurance Plan (OHIP) at the index date.

Two comparison groups were selected to determine whether patients who received TeamCare services represent those with complex needs when compared with: 1) the non-TeamCare patient population of their most responsible primary care physicians; and 2) the general population of the province. An index date of March 31, 2017 was assigned to all individuals in the comparison cohorts, at which point baseline characteristics were measured. Patients were selected for inclusion in the 'Non-TeamCare Patients of Most Responsible Physicians' comparison group if they were assigned to the most responsible physicians of TeamCare patients based on OHIP claims in the year prior to the index date. Patients were excluded from this group if they had visited a CHC between April 1, 2015 and March 31, 2017 to account for any potential errors in flagging TeamCare patients (i.e., to exclude patients whom the physician had referred but who were not identified in the CHC data as having participated in TeamCare). To represent the general population of Ontario, a 1% random sample was drawn from the provincial population eligible for OHIP at the index date. For both comparison groups, individuals were excluded if they were less than 18 years old, were in the TeamCare group, or were not an Ontario resident as of March 31, 2017.

3.2.3.2 Physicians

To characterize the physicians and physician practice populations of the TeamCare participants, the most responsible physicians of patients in TeamCare were identified. Patients were assigned to the primary care physician who provided the most visits in the previous year based on OHIP claims. To determine whether there were any characteristics of physicians who had patients participating in TeamCare that differentiated them from the remaining population of primary care physicians in the province, characteristics of the most responsible physicians were compared to Ontario primary care physicians who did not have any patients in the TeamCare exposure group (i.e., physicians who did not participate in TeamCare).

3.2.4 Covariates

3.2.4.1 Patient-Level Covariates

Patient-level covariates were used to characterize the TeamCare exposure group and compare the complexity and previous health care utilization of TeamCare patients to the non-TeamCare patient population of their most responsible primary care physicians and the provincial population.

Patient demographics included age, sex, and rurality. Rurality was identified using the Rurality Index of Ontario (RIO) Score – a 0-100 scale where a higher score indicates a higher degree of rurality (96). A geographic area can be defined using the RIO score as major urban, non-major urban, or rural (0-9 – major urban; 10-39 - non major urban; 40-100 - rural) (96–98).

3.2.4.1.1 Measuring Patient Complexity

Covariates capturing elements that contribute to patient complexity included an indicator for whether the patient was a recent migrant to Ontario (i.e., within the last 10 years), neighborhood income quintile, measures of marginalization, comorbidities, and health care resource use.

Marginalization was measured using the Ontario Marginalization Index – an area-based tool that measures marginalization on multiple dimensions: dependency (e.g., proportion of adults older than 65 years of age, individuals not participating in the labour force), material deprivation, ethnic concentration, and residential instability (99). A score of one to five is assigned for each dimension, with one being the lowest and five the highest score (e.g., a score of five on the residential instability dimension indicates that the patient is highly residentially unstable).

Comorbidity and disease burden were estimated using the Johns Hopkins Aggregated Diagnosis Groups™ (ADGs) and Resource Utilization Bands (RUBs). ADGs are based on ICD-10 codes and group diagnoses based on severity and likelihood of persistence (100). There are 32 ADGs, which can be further condensed into 12 Collapsed ADGs (CADGs) based on likelihood of persistence, severity, and types of health care services required (100). RUBs further group the ADGs into six categories based on expected resource use: 0 – no use or invalid diagnosis; 1 - healthy use; 2- low; 3- moderate; 4 – high; and 5 – very high use (100). ICES-derived disease cohorts were also used for specific chronic conditions. These cohorts are derived using validated algorithms for asthma (101), CHF (102), COPD (103), hypertension (104), and diabetes (105). Cohorts were also generated for dementia and chronic psychotic illness using validated algorithms (94,95).

Patients' mean non-urgent ED visits in the previous 12 months, defined as ED visits with a Canadian Emergency Department Triage and Acuity Scale (CTAS) score of 4-5 (less-urgent/semi urgent - non-urgent) (106) were assessed. Non-urgent ED visits were selected as patients who are not well managed in, or do not perceive sufficient access to, primary care are at greater risk of visiting the ED for non-urgent issues (49). All-cause ED visits (i.e., of all CTAS levels) in the

previous 12 months were also assessed to determine whether TeamCare patients were at risk of having an ED visit for any acuity. Finally, mean primary care physician and specialist visits were measured to assess any differences in primary and secondary care utilization prior to the intervention.

3.2.4.2 Physician-Level Covariates

Physician-level covariates were used to characterize the most responsible primary care physicians of TeamCare patients. Covariates measured for the study included age, sex, rurality of practice based on the RIO score, whether or not they graduated from a Canadian medical school, number of years since their graduation, whether their primary care practice was an FHT, the number of patient visits in the previous year, and roster size. Whether the most responsible physicians belonged to an FHT model was measured in order to determine whether patients who ostensibly already had access to team-based care required additional interprofessional team-based services from the program.

3.2.5 Statistical Analyses

First, unadjusted frequencies of TeamCare patient characteristics were measured. Second, to examine differences in the complexity of patients who participated in TeamCare with that of the non-TeamCare patient population of their primary care physicians and the general population, unadjusted baseline characteristics and health care utilization in the year prior to the date of exposure were compared. The following comparisons were made: 1) TeamCare exposure group versus non-TeamCare patients of the most responsible physicians; and 2) TeamCare exposure group versus non-TeamCare 1% random sample of the general population. For comparison across categorical variables, Chi-square tests and Cramer's V were used to assess the statistical significance and standardized differences, respectively (107,108). For continuous variables, t-tests and Hedge's g (109) statistics were used. Hedge's g is a variant of the Cohen's d effect size measure that is appropriate for use when there are differences in the sample sizes of the groups being compared; Hedge's g normalizes the difference in means between two groups to a pooled standard deviation weighted based on sample size (109). Hedge's g was selected in this context given the large differences in sample size between the TeamCare exposure group and two non-TeamCare comparison groups.

A p-value of <0.05 was used as a threshold to determine statistical significance. See Table 3-4 in Appendix A for the interpretation of Cramer's V and Hedge's g effect sizes, noting that these thresholds are context-dependent and should be used cautiously for interpretation. All analyses were conducted using Stata v.13.1.

3.2.6 Ethics Approval

This study received ethics approval from the University of Toronto Research Ethics Board (Protocol #36927).

3.3 Results

3.3.1 Characterizing TeamCare Patients

One thousand one hundred and forty-eight patients flagged as TeamCare patients had a date of first encounter at a CHC between April 1, 2015 and March 31, 2017 and were included in the TeamCare exposure group (see Table 3-1below for results by cohort). Most patients in the TeamCare exposure group were female (63.7%), above the age of 60 (79.6%) and lived in major urban centres (55.4%). Only a small proportion of the group (5.7%) were migrants to Ontario within the last 10 years, based on first year of OHIP eligibility.

The overall distribution of neighbourhood income quintiles in the TeamCare group was heavily skewed to the lower quintiles, with over half (56.3%) of TeamCare patients in the first and second quintiles. On the Ontario Marginalization Index, the distribution of scores in the TeamCare group were skewed to higher (i.e. worse) scores on three of the four factors: dependency, material deprivation, and residential instability. Only 11.6% of TeamCare patients lived in areas with high ethnic concentration (score=5), while 38.4% lived in areas with the lowest ethnic concentration (score=1).

TeamCare patients tended to have high expected resource use based on the Johns Hopkins RUBs: 52.9% of patients had high or very high expected resource use (RUB=4-5), and 39.7% had moderate expected resource use (RUB=3). The mean number of ADGs in the sample was 8 (SD=4). In terms of chronic conditions, 17.2% of TeamCare patients had asthma, 16.1% had dementia, 12.6% had diabetes, 12.4% had CHF, 9.9% had COPD, 5.0% had chronic psychotic illness, and 4.0% had asthma.

3.3.2 Comparison of TeamCare Patients to Other Groups on Complexity and Previous Health Care Utilization

At March 31, 2017, a 1% random draw of the Ontario population generated a sample of 117,753 individuals. 546,989 patients were identified as other patients of most responsible primary care physicians of TeamCare patients and were included in the non-TeamCare patients of most responsible physicians group. Descriptive characteristics of the TeamCare patient group and the two comparator groups are presented in Table 3-1, with effect sizes and p-values provided for each comparator group in reference to the TeamCare group.

Table 3-1. Patient characteristics of the TeamCare exposure group versus comparison groups

	TeamCare patients (Reference) N=1,148	**Non-TeamCare Patients of Most Responsible Physicians N=546,989**			**Non-TeamCare Ontario Population 1 % random sample N=117,753**		
Characteristic	n (%)	n (%)	Effect size[l]	p-value	n (%)	Effect size[l]	p-value
Female	737 (63.7)	307,315 (56.2)	0.0074	<0.001	60,143 (51.1)	0.0257	<0.001
Age			0.0430	<0.001		0.1244	<0.001
<30	72 (6.2)	79,570 (14.5)			22,808 (19.4)		
30-39	74 (6.4)	71,651 (13.1)			19,576 (16.6)		
40-49	82 (7.1)	79,767 (14.6)			20,266 (17.2)		
50-59	103 (8.9)	106,053 (19.4)			21,913 (18.6)		
60-69	206 (17.8)	97,939 (17.9)			16,675 (14.2)		
70-79	259 (22.4)	67,646 (12.4)			10,132 (8.6)		
80-89	278 (24.0)	35,413 (6.5)			5,030 (4.3)		
>=90	74 (6.4)	8,950 (1.6)			1,353 (1.1)		
Rurality			0.0188	<0.001		0.0868	<0.001
Major Urban	636 (55.4)	359,226 (65.7)			86,241 (73.2)		
Non-Major Urban	165 (14.4)	102,139 (18.7)			22,241 (18.9)		
Rural	347 (30.2)	84,221 (15.4)			8,343 (7.1)		
Migrant to Ontario within last 10 years	66 (5.7)	48,618 (8.9)	0.0050	<0.001	13,251 (11.3)	0.0171	<0.001
Neighbourhood Income Quintile			0.0217	<0.001		0.0398	<0.001
Quintile 1 (lowest)	305 (26.6)	88,662 (16.2)			21,830 (18.5)		
Quintile 2	341 (29.7)	102,674 (18.8)			22,755 (19.3)		
Quintile 3	222 (19.3)	108,594 (19.9)			23,289 (19.8)		
Quintile 4	147 (12.8)	120,362 (22.0)			25,301 (21.5)		
Quintile 5 (highest)	131 (11.4)	124,956 (22.8)			24,043 (20.4)		
Dependency			0.0218	<0.001		0.0663	<0.001
1 (lowest)	128 (11.1)	134,081 (24.5)			32,249 (27.4)		

2	162 (14.1)	92,793 (17.0)			22,672 (19.3)		
3	132 (11.5)	90,364 (16.5)			20,949 (17.8)		
4	236 (20.6)	91,924 (16.8)			19,627 (16.7)		
5 (highest)	489 (42.6)	135,995 (24.9)			21,585 (18.3)		
Material Deprivation			0.0238	<0.001		0.0351	<0.001
1 (lowest)	95 (8.3)	122,951 (22.5)			20,468 (17.4)		
2	159 (13.9)	123,569 (22.6)			22,932 (19.5)		
3	287 (25.0)	113,453 (20.7)			23,194 (19.7)		
4	231 (20.1)	88,978 (16.3)			24,436 (20.8)		
5 (highest)	375 (32.7)	96,206 (17.6)			26,052 (22.1)		
Ethnic Concentration			0.0176	<0.001		0.0657	<0.001
1 (lowest)	441 (38.4)	126,784 (23.2)			18,482 (15.7)		
2	132 (11.5)	107,252 (19.6)			18,982 (16.1)		
3	233 (20.3)	109,498 (20.0)			21,050 (17.9)		
4	208 (18.1)	119,426 (21.8)			24,218 (20.6)		
5 (highest)	133 (11.6)	82,197 (15.0)			34,350 (29.2)		
Residential Instability			0.0186	<0.001		0.0529	<0.001
1 (lowest)	69 (6.0)	80,187 (14.7)			25,089 (21.3)		
2	141 (12.3)	97,070 (17.7)			22,114 (18.8)		
3	219 (19.1)	114,367 (20.9)			21,383 (18.2)		
4	238 (20.7)	111,087 (20.3)			21,570 (18.3)		
5 (highest)	480 (41.8)	142,446 (26.0)			26,926 (22.9)		
Number of ADGs, mean ± SD	8 ± 4	6 ± 3	0.548	<0.001	4 ± 3	-0.993	<0.001
Prevalence of Chronic Conditions							
Asthma	46 (4.0)	19,078 (3.5)	0.0013	0.338	3,020 (2.6)	0.0089	0.002
CHF	142 (12.4)	15,444 (2.8)	0.0263	<0.001	2,055 (1.7)	0.0771	<0.001
COPD	114 (9.9)	13,440 (2.5)	0.0220	<0.001	1,761 (1.5)	0.0662	<0.001
Hypertension	197 (17.2)	73,253 (13.4)	0.0051	<0.001	12,389 (10.5)	0.0211	<0.001
Diabetes Mellitus[1]	145 (12.6)	46,234 (8.5)	0.0069	<0.001	7,984 (6.8)	0.0227	<0.001
Chronic Psychotic Illness[2]	57 (5.0)	7,218 (1.3)	0.0146	<0.001	1,258 (1.1)	0.0364	<0.001
Dementia	185 (16.1)	14,432 (2.6)	0.0382	<0.001	1,761 (1.5)	0.1127	<0.001
Resource Utilization Bands			0.0307	<0.001		0.1093	<0.001
0 – 1 (no – lowest expected use)	33 (2.9)	15,261 (2.8)			22,278 (18.9)		
2	52 (4.5)	64,172 (11.7)			18,486 (15.7)		
3	456 (39.7)	306,470 (56.0)			54,471 (46.3)		
4	282 (24.6)	107,345 (19.6)			16,184 (13.7)		
5 (highest expected use)	325 (28.3)	53,741 (9.8)			6,334 (5.4)		

ADGs = Johns Hopkins Aggregated Diagnosis Groups; CHF = Congestive Heart Failure; COPD = Chronic Obstructive Pulmonary Disease; SD = standard deviation

ł Effect size measure is Cramer's V for binary/categorical variables and Hedge's g for continuous variables.

[1]Calculated using validated algorithm from Jaakkimainen RL, Bronskill SE, Tierney MC, Herrmann N, Green D, Young J, et al. Identification of Physician-Diagnosed Alzheimer's Disease and Related Dementias in Population-Based Administrative Data: A

Validation Study Using Family Physicians' Electronic Medical Records. Journal of Alzheimer's disease : JAD. 2016;54(1):337-49.

[2]Calculated using validated algorithm from Kurdyak, P., Lin, E., Green, D., & Vigod, S. (2015). Validation of a Population-Based Algorithm to Detect Chronic Psychotic Illness. Canadian Journal of Psychiatry. Revue Canadienne de Psychiatrie, 60, 362–368.

Health care utilization in the 12 months prior to the index date for the TeamCare exposure group versus comparison groups is presented in Table 3-2.

Table 3-2. Health care utilization in the year prior to index date

	TeamCare N=1,148	**Non-TeamCare Patients of Most Responsible Physicians N=546,989**			**Non-TeamCare Ontario Population 1 % random sample N=117,753**		
Characteristics	Mean ± SD	Mean ± SD	Effect size (Hedge's g)	p-value	Mean ± SD	Effect size (Hedge's g)	p-value
Non-Urgent ED Visits	0.50 ± 1.44	0.23 ± 0.81	0.342	<0.001	0.13 ± 0.57	0.640	<0.001
All-Cause ED Visits	2.01 ± 3.75	0.70 ± 1.72	0.580	<0.001	0.40 ± 1.16	0.956	<0.001
Primary Care Physician Visits	7.77 ± 8.77	5.55 ± 6.68	0.333	<0.001	3.85 ± 5.95	0.655	<0.001
Specialist Visits	5.45 ± 6.82	3.15 ± 5.19	0.443	<0.001	2.01 ± 4.27	0.801	<0.001

Effect sizes and p-values are reported for each comparison group in reference to the TeamCare exposure group.

3.3.2.1 TeamCare Patients vs. Non-TeamCare Patients of Most Responsible Physicians

TeamCare patients were significantly different from the non-TeamCare patients of their most responsible physicians on all characteristics, though effect sizes were small according to commonly accepted thresholds. The TeamCare exposure group had a higher proportion of rural patients compared to the non-TeamCare patient group (30.2% TeamCare vs. 15.4% non-TeamCare; $P<0.001$). Compared to the non- TeamCare group, TeamCare Patients had a higher mean number of ADGs and higher rates of each of the chronic conditions examined; all differences were statistically significant with the exception of asthma. Though the difference in overall distribution of patients across RUBs between the two groups was statistically significant, the difference between the proportion of individuals in the two lowest RUBs – representing no or low expected use – was not (2.9% TeamCare vs. 2.8% Other Primary Care Patients; $P=0.862$). TeamCare patients had higher mean utilization across all four utilization measures in the year prior

to their date of first encounter when compared to the patient populations of their most responsible physicians.

3.3.2.2 TeamCare patients vs. 1% random sample of the general Ontario population

TeamCare patients were significantly different from the 1% random sample of the general population on all characteristics measured, though with small or small-medium effect sizes according to the Cramer's V and Hedge's g thresholds (see Table 3-4 in Appendix A). Compared to the general population, TeamCare patients were more likely to be female (63.7% vs. 51.1%; Cramer's V=0.0257; $P<0.001$). The age distributions of the two groups also differed significantly, with TeamCare patients heavily skewed to the older age groups (60 and above). The TeamCare exposure group had a higher proportion of patients living in rural areas (30.2% vs. 7.1%; $P<0.001$) and a lower proportion of recent migrants to the province (5.7% vs. 11.3%; Cramer's V=0.0171; $P<0.001$).

Overall, the distributions of TeamCare patients and the random sample of the general population across income quintiles differed significantly with a small effect size (Cramer's V=0.0398; $P<0.001$). The random sample of the general population was relatively evenly distributed across the five income quintiles, while over half (56.3%) of TeamCare patients lived in areas in the lowest two income quintiles (vs. 37.8% of the general population sample). Distributions across each of the Ontario Marginalization Index dimensions differed significantly between the two groups, with TeamCare patients tending to score higher on dependency (Cramer's V=0.0663; $P<0.001$), material deprivation (Cramer's V=0.0351; $P<0.001$), and residential instability (Cramer's V=0.0529; $P<0.001$), and lower on ethnic concentration (Cramer's V=0.0657; $P<0.001$).

The TeamCare exposure group had a mean of 8 ADGs (SD=4), significantly higher than the mean of 4 (SD=3) in the general population (Hedge's g=0.993; $P<0.001$). The TeamCare group also had a significantly higher prevalence of each of the chronic conditions measured. The distribution of patients across RUBs differed significantly between the two groups, with TeamCare patients tending to have higher expected resource use than the general population (Cramer's V=0.1093; $P<0.001$).

TeamCare patients had higher mean utilization across all four utilization measures in the year prior to their date of first encounter when compared to the general population.

3.3.3 Characterizing Physicians of TeamCare Patients

3.3.3.1 Most responsible Primary Care Providers of TeamCare patients vs. Non-TeamCare Primary Care Physicians

Three hundred and fifty-seven physicians were identified as the most responsible primary care providers of TeamCare patients and included in the physician group. The Non-TeamCare primary care physicians group comprised 11,103 general practitioners or family physicians who did not have rostered patients in the TeamCare patient group. See Table 3-5 in Appendix A for physician characteristics.

TeamCare physicians were not significantly different from non-TeamCare physicians except on a few characteristics. TeamCare physicians were more likely than non-TeamCare physicians to practice in rural areas (11.5% TeamCare vs. 7.2% Other Physicians; P=0.002) and varied in terms of roster size: TeamCare physicians had a median roster size of 1180 [IQR 852-1601], while other physicians had a median roster size of 818 [IQR 0-1417]; P<0.001. Surprisingly, the difference in physicians practicing in an FHT model was not significant between the two groups: 14.3% TeamCare vs. 13.6% Other Physicians; Cramer's V = 0.0047; P=0.882).

3.4 Interpretation

The comparison of TeamCare patients to non-TeamCare patients of their most responsible primary care physicians suggests that TeamCare patients were more likely to be lower income and experience a higher degree of marginalization than non-TeamCare patients. TeamCare patients had a higher mean number of ADGs and a higher prevalence of all chronic conditions measured except asthma, including nearly five times the rate of chronic psychotic illness.

Compared to the general population, TeamCare patients were more likely to live in low-income areas and tended to score higher on dimensions of the Ontario Marginalization Index, indicating that TeamCare patients experienced a higher degree of marginalization than the population on average. TeamCare patients had more comorbidities than the general population as measured by the mean number of ADGs, as well as significantly higher rates of chronic illness. TeamCare

patients had significantly higher expected resource use than the general population, as measured by RUB scores.

TeamCare patients had more frequent encounters with the health care system in the year prior to the intervention relative to both comparison groups. TeamCare patients had a significantly higher mean number of non-urgent ED visits, all-cause ED visits, physician visits, and specialist visits.

TeamCare patients were significantly more complex than non-TeamCare patients of their most responsible physicians and the general population, both in terms of socioeconomic status and medical complexity. Patient populations facing complex medical and socioeconomic challenges with high unmet needs are known to experience poor health outcomes and interact frequently with the health system, particularly with the ED (22,29). The findings of this study align with the literature on patients with complex needs; TeamCare patients had significantly higher utilization of the ED for non-urgent issues as well as for any reason, primary care physician visits, and specialist visits in the 12 months prior to entering the program.

The results of this study suggest that there were few significant differences between the most responsible primary care physicians of TeamCare patients and other physicians in the province who did not participate in TeamCare, except that TeamCare physicians were more likely than non-TeamCare physicians to practice in rural areas and had larger roster sizes and number of visits over the past year. However, the majority of both physician groups were practicing in urban centres. Rurality and physician roster size are dimensions known to be related to access to health care (110), and a larger roster has been shown to be associated with decreased access to primary care for individuals and delivery of prevention, health promotion, and chronic disease management services (111). These characteristics may therefore have contributed to a physician's likelihood of referring to TeamCare.

A surprising finding was that the proportion of physicians that utilized TeamCare practicing in an FHT was not significantly lower than that in the general population. Given that TeamCare is targeted to patients who do not have access to an interprofessional primary care team, it is surprising that just under 15% of most responsible physicians of TeamCare patients would be practicing in an FHT model. One possible explanation for this finding is that the CHCs participating in TeamCare offered more extensive services (this is likely true for social services in

particular) than the physician's FHT, and they felt it appropriate to refer their patients for these services.

Overall, the results of this study suggest that the TeamCare initiative has reached its target population of patients with complex needs. That TeamCare patients represented those with complex needs when compared to the non-TeamCare patient population of their most responsible physicians suggests that physicians appeared to be sending their patients with a greater degree of complexity and higher needs. Based on the comparison with other segments of the general and primary care populations in Ontario, TeamCare patients appear to be unique in terms of their degree of social and medical complexity. The most responsible primary care physicians of TeamCare patients did not differ significantly from other physicians in the province except on geography and roster size, which may have contributed to poorer access for their patients.

3.4.1 Limitations

An important limitation of this work is that data constraints limited the ability to identify patients who were referred to the program but did not receive services. As a result, it was not possible to determine whether there were any systematic differences between patients who participated in the program and those who were referred but did not. However, it is likely that this represents very few participants.

It is also important to note that the data used in this study were administrative and would not capture all characteristics that would make a physician likely to refer patients to TeamCare and a patient likely to be referred. However, the characteristics described here do make an important contribution to a patient's profile and may help in the identification of patients who could benefit from the program.

There were also limitations in the data that may influence interpretation of the results. One of the programs, SPiN, contributed very few patients to the overall TeamCare patient sample, while PCO contributed just over 50%. Results were generated by TeamCare program, but small sample sizes limited reporting on this level.

This study sought to identify and describe the population of patients that was reached by TeamCare. While this analysis did not examine the effects of TeamCare on the health and health care utilization of its patients, these outcomes are explored in other studies.

3.5 Conclusion

TeamCare fills an important gap in the Ontario primary care landscape, serving a population of patients with complex needs that did not previously have access to interprofessional team-based care. The initiative has grown considerably since it was first implemented and continues to expand to other regions and evolve its program model to include additional primary care organizations and model types and to serve more patients. The results from this study have the potential to inform further efforts to expand the TeamCare program model across the province of Ontario, as well as the implementation of other voluntary referral-based interprofessional primary care programs in other jurisdictions. Future work will analyze the TeamCare initiative's impact on the health and health care utilization of its patients.

3.6 Appendix A: Supplementary Tables

Table 3-3. ICES databases used in the study

ICES Database	Full Name	Type of Information
ASTHMA	Ontario Asthma Dataset	Prevalence of asthma
CAPE	Client Agency Program Enrolment	Patient enrolment in primary care models
CENSUS	Ontario Census Area Profiles	Patient and physician census area
CHC	Community Health Centre Database	Patient encounter data at CHCs
CHF	Congestive Heart Failure (CHF)	Prevalence of CHF
COPD	Chronic Obstructive Pulmonary Disease (COPD)	Prevalence of COPD
CPDB	Corporate Provider Database	Physician demographics and practice characteristics
DAD	Discharge Abstract Database	Inpatient admissions, clinical data for disease algorithms
DIN	Drugs List	Information on drugs for disease algorithms
HYPER	Ontario Hypertension Dataset	Prevalence of hypertension
IPDB	ICES Physician Database	Physician demographics and practice characteristics
NACRS	National Ambulatory Care Reporting System	Patient visits to EDs
ODB	Ontario Drug Benefit	Prescription drug use for drugs listed under Ontario's public drug coverage plans
ODD	Ontario Diabetes Dataset	Prevalence of diabetes
OHIP	Ontario Health Insurance Plan Claims Database	Physician claims for outpatient services
OMHRS	Ontario Mental Health Reporting System	Inpatient admissions for mental health. Used to identify prevalence of chronic psychotic illness.
ONMARG	Ontario Marginalization Index	Degree of marginalization based on geography (census-based)
RPDB	Registered Persons Database	Patient demographics

Table 3-4. Effect Size Interpretation: Cramer's V and Hedge's g (variant of Cohen's d)[1]

Effect size measure	Small effect size	Medium effect size	Large effect size	Very Large effect size
Cramer's V				
df[ii]=1	0.10	0.30	0.50	n/a
df=2	0.07	0.21	0.35	n/a
df=3	0.06	0.17	0.29	n/a
Hedge's g				
	0.20	0.50	0.80	1.30

[1]Table adapted from Table 17.10 in Gravetter FJ, Wallnau LB. Statistics for the behavioural sciences. 2013. and Maher JM, Markey JC, Ebert-May D. The other half of the story: effect size analysis in quantitative research. CBE life sciences education. 2013;12(3):345-51.

[ii]df=degrees of freedom

Table 3-5. Physician characteristics

Characteristics	Most responsible primary care physicians of TeamCare patients (N=357)	Non-TeamCare physicians (N=11,103)		
	n (%)	n (%)	Effect Size[ł]	P-value
Female	176 (49.3)	4945 (44.6)	0.0166	0.076
Age			0.0287	0.093
<39	46 (12.9)	1727 (15.6)		
40-49	79 (22.1)	2522 (22.7)		
50-59	115 (32.2)	3037 (27.4)		
60-69	91 (25.5)	2606 (23.5)		
>=70	26 (7.3)	1207 (10.9)		
Rurality			0.0374	<0.001
Major Urban	243 (68.1)	8484 (76.4)		
Non-Major Urban	73 (20.4)	1774 (16.0)		
Rural	41 (11.5)	801 (7.2)		
Canadian Medical Graduate	269 (75.4)	8132 (73.3)	0.0082	0.383
Years since Graduation			0.0208	0.291
<10	14 (3.9)	562-576 (5.1-5.2)		
10-19	64 (17.9)	2420 (21.8)		
20-29	93 (26.1)	2604 (23.5)		
>=30	186 (52.1)	5502 (49.6)		
Patient Enrolment Model of Physician's Practice			0.0221	0.350
CCM	6 (1.7)	181 (1.6)		
FHG	36 (10.1)	1346 (12.1)		
FHN	*	122 (1.1)		
FHO	106 (29.7)	2862 (25.8)		
Other	*	167 (1.5)		
Physician practice is an FHT	51(14.3)	1508 (13.6)	0.0047	0.882
# Visits to physician in previous 12 months			4.129	<0.001
Mean ± SD	4028 ± 3178	3793 ± 3748		
Median [IQR]	3307 [2445-4560]	2955 [1411-4997]		
Physician Roster Size			9.703	<0.001
Mean ± SD	1250 ± 693	858 ± 841		
Median [IQR]	1180 [852-1601]	818 [0-1417]		

CCM = Chronic Care Model; FHG = Family Health Group; FHN = Family Health Network; FHO = Family Health Organization; FHT = Family Health Team; Other = Other primary care models

ł Effect size measures: Cramer's V for categorical variables, Wilcoxon rank-sum test for count variables (#visits, roster size)

* n≤6; not reported to prevent possibility of re-identification

Chapter 4
Paper Two

4 TeamCare: The effects of interprofessional team-based care on the health care utilization of patients with complex health and social needs

4.1 Introduction

Interprofessional team-based care has become an integral part of health care reforms in many jurisdictions aiming to achieve high quality, equitable, accessible, and comprehensive primary health care. Interprofessional teams are groups of professionals from different disciplines collaborating and working together toward a common goal of providing care for a patient and/or a patient population, often with engagement of patients and families (39,80–82). The World Health Organization (WHO) has asserted that interprofessional teams are a crucial component of health services delivery in a primary health care-oriented health system (112) and, in the recent 2018 Declaration of Astana, reaffirmed the central role of interprofessional collaboration in meeting the health care needs of a population (74).

Interprofessional primary care teams are particularly well-suited to address the multifaceted needs of patients with medical and social complexity and have been increasingly implemented for that purpose. A recent review by the Commonwealth Fund identified 28 promising interventions designed specifically for high needs patients, 25 of which included interprofessional teams (34). Patients with complex needs are a heterogeneous patient population, defined by the interaction of multiple biological, socioeconomic, cultural, environmental, and/or behavioural challenges: often experiencing two or more co-occurring chronic conditions, psychosocial vulnerabilities, and/or behavioural health issues (9,25–28). Individuals with complex needs are likely to interact frequently with the health care system, resulting in high costs to the system, and are at higher risk for poor outcomes compared to those who do not face complexity (29). The greater level of support required by these patients is often beyond the scope and capacity of primary care physicians alone, particularly when complex social issues need to be addressed (9,23). Data from the Commonwealth Fund suggest that high-needs patients often do not have access to the services that they need - such as care coordination, emotional counseling, and assistance in managing functional

limitations - despite having a regular doctor or place of care (22). Patients with unmet needs are more likely to delay care, less likely to participate in preventative care, and more likely to visit the ED. By improving access to comprehensive and appropriate primary health care, interprofessional team-based care is expected to reduce inequities in access to health care and reduce unmet need and avoidable acute care utilization (1,49).

A large evidence base suggests that interprofessional team-based interventions targeted to patients with complex needs are effective in improving health outcomes and quality of care and reducing acute care utilization (2,4–7,60–63,83–85). Two systematic review of PCMHs found mixed effects on ED visits and hospital admissions in the overall patient populations (40,59). However, when the study populations were limited to older adults and high-risk patients, a reduction in ED visits was observed (40,59). A U.S. study of a statewide PCMH initiative in Michigan showed that reductions in ED and hospital utilization and costs were 3-4 times greater for patients with chronic conditions than for those without chronic conditions (60). A majority of interprofessional models described in the literature are integrated or co-located teams, such as patient-centered medical home (PCMH) models or federally qualified health centers in the United States. Models that link general or family practice to an interprofessional team targeted for complex patients are less well represented in the literature on team-based care and tend to be targeted to mental health (51,70) or specific disease conditions such as diabetes (87) and dementia (88) rather than to patients with complex needs more generally. The impact of team-based care on primary care physician and specialist visits is also less well studied; results are mixed and appear to be highly context-dependent (30,86).

Despite evidence for its effectiveness, in Canada, many patients with medical and social complexity who could benefit from interprofessional team-based care do not have access to such models. Federally funded primary health care reforms of the early 2000s aimed to ensure that Canadians would have routine access to needed care from interprofessional teams (76). To meet this aim, Ontario expanded access to interprofessional primary care teams by introducing a medical home model called the FHT and increasing the number of existing CHCs, a community-governed model comprised of teams of interdisciplinary health care professionals, including physicians, who receive salaried payment (10). Starting in 2004, physician groups practicing in blended capitation or salaried models were given the opportunity to opt in to the FHT model and receive additional

funds for the recruitment of non-physician health care professionals (10). As of 2019, approximately 3.5 million people were enrolled with an FHT (13). As a result of incentives built into their capitation-based payment model and without an accompanying social mandate, FHTs are less likely to serve patients who require complex care, are low income, are newcomers to the province, or live in urban centres (15,78). In contrast, CHCs are specifically mandated to serve vulnerable, marginalized, and complex patients but serve a relatively small proportion of the overall population, having delivered primary care services to approximately 250,000 people in 2017 (89).

All told, approximately 30% of Ontario's population has acess to interprofessional team-based care through FHTs, CHCs, and other, smaller models such as Nurse Practitioner-led clinics (16). The majority of the remaining population is rostered to primary care physicians practicing in models of care based on blended capitation (FHNs and FHOs) or enhanced FFS (FHGs and CCMs), or visit a traditional FFS physician (10,11). There are differences across the models in terms of the complexity profiles of their patient populations, but all deliver care to patients with complex needs (14,90). An ICES study using administrative data from 2008-2009 identified 6.1% of the population of Ontario - approximately 725,500 individuals - as having high comorbidity, 85% of whom were rostered to or visiting physicians who did not practice in an interprofessional team ("non-team physicians") (69).

Recognizing that many individuals with complex health needs were visiting non-team physicians and lacked access to interprofessional teams, a program, now called TeamCare, was implemented by a number of CHCs and some FHTs in Ontario. TeamCare allows patients of non-team physicians to access non-physician services at CHCs and FHTs. These services include but are not limited to counselling, community health work, health promotion, dietician services, and chiropody. TeamCare is intended to support patients with complex health and social needs and their physicians by improving the connection between non-team physicians and supportive community-based primary care services. The program model is based on voluntary referral: patients are referred by and at the discretion of their own primary care physician. There are no strict criteria determining patient eligibility. While receiving care through TeamCare, patients maintain their relationship with their existing primary care physician. A previous study demonstrated that TeamCare has reached its intended population: patients accessing TeamCare

services were highly medically and socially complex. To date, no research has been undertaken to assess whether TeamCare reduced unmet needs measured as avoidable use of ED care and whether TeamCare impacted utilization of primary and secondary care.

The objectives of this study were two-fold: 1. to determine whether TeamCare services reduced unmet need using proxy measures of avoidable ED visits; and 2. to determine the impact of TeamCare services on utilization of primary and secondary care services, namely visits to primary care physicians and specialists. This study presents an opportunity to examine whether TeamCare is reducing unmet need and its impact on the health care system. The results have implications for programs that allow for voluntary referral and for future expansion of the TeamCare model in Ontario.

4.2 Methods

4.2.1 Data Sources

This study used anonymized administrative databases held at ICES in Ontario, which were linked using a unique patient-level identifier based on an individual's encrypted health insurance number. ICES is an independent, not-for-profit corporation that receives core funding from the Ontario Ministry of Health and holds an inventory of data from publicly funded administrative health services in Ontario (92,93). CHC data extracted from electronic health records were also made available and linked to the ICES administrative databases. The CHC data contained a special program flag that allowed for the identification of TeamCare patients and also included data on patient encounters which were used to identify patients' date of first encounter at a CHC. As an identifier was not available for patients who participated at FHTs, this study included only patients who participated at CHCs

Quarterly health care utilization data from fiscal years 2013-2016 were obtained. Information on inpatient admissions, ED use, and physician visits was obtained from the Discharge Abstract Database (DAD), National Ambulatory Care Reporting System (NACRS), and Ontario Health Insurance Plan Claims Database (OHIP), respectively. To measure patient characteristics at baseline, these data were supplemented with databases providing information on patient and physician sociodemographic and geographic characteristics (RPDB, CPDB, IPDB, CAPE, CENSUS, ONMARG), ICES-derived cohorts for clinical conditions (ASTHMA, CHF, COPD,

HYPER, ODD), and information from the Ontario Drug Benefit (ODB), Drugs List (DIN), and Ontario Mental Health Reporting System (OMHRS) required to identify patients with dementia and chronic psychotic illness using validated algorithms (94,95).

4.2.2 Treatment and comparison group definitions

The Difference in differences (DiD) framework is a tool often used in health policy research to evaluate the impact of policy changes (113). A DiD analysis addresses confounding in observational studies by controlling for underlying time trends in the outcome(s) of interest through the use of a counterfactual and pre-post design (113,114). A modified DiD framework (115) using a propensity score-matched comparison group and random/fixed effects models was used for this study to estimate the effect of the intervention on the health care utilization of TeamCare patients relative to the comparison group for periods before and after the start of the intervention.

The treatment group included patients flagged with a TeamCare identifier in the CHC EHR data who had a date of first encounter at a CHC between April 1, 2015 and March 31, 2016. Patients were excluded if they were not an Ontario resident or ineligible for OHIP at the index date (i.e. date of first encounter). Patients younger than 18 years of age and older than 105 were excluded.

A key assumption of the DiD framework is the parallel trends assumption, which requires that the treatment and comparison groups have the same trend in outcomes prior to the intervention to ensure that any observed differences in outcome are due to the intervention and not pre-existing differences between the groups (113,114). Moreover, the DiD design requires that any underlying or background trends be accounted for, in other words, that the comparison group be experiencing or exposed to the same trends as the treatment group, except for the policy change (114). Therefore, a comparison group with similar baseline characteristics and patterns of health care utilization to the TeamCare group was needed. As the TeamCare patient group was diverse in terms of its sociodemographic and disease characteristics and unique in that it did not resemble other primary care populations in the province (as demonstrated in Paper One), an appropriate comparison group would be difficult to find. The comparison group was therefore constructed using propensity score methods, which allow for the creation of a sample of individuals that closely matches another based on observable characteristics.

Individuals from a 20% random sample of the Ontario population were matched to individuals in the TeamCare cohort based on an index, or propensity score, of baseline characteristics related to the likelihood of being selected for the intervention and the outcomes of interest. Index dates for the comparison group were randomly assigned based on the distribution of index dates in the TeamCare group. Individuals in the random sample were matched to individuals in the treatment group based on an exact match on age and sex and the propensity score.

To estimate the propensity score, a logistic regression of treatment status on the covariates described in section 4.2.4 was performed. One-to-one matching without replacement was used. Individuals in the TeamCare group were selected at random and matched to individuals in the comparison group sample pool with the closest propensity score within a prescribed caliper distance (equal to 0.2 of the standard deviation of the logit of the estimated propensity score).

To assess balance between treatment and comparison groups following matching, standardized differences were calculated for each variable included in the propensity score. A standardized mean difference of less than 0.10 was considered to indicate balance between the two groups (116). To determine whether the parallel trends assumption of the DiD framework had been satisfied following matching, differences in pre-intervention quarterly trends in outcome measures for the TeamCare versus matched comparison group were tested graphically.

4.2.3 Outcome measures

The two primary utilization outcomes were non-urgent ED visits (defined as ED visits with a Canadian Emergency Department Triage and Acuity Scale [CTAS] score of 4-5 [less-urgent/semi urgent - non-urgent] (106) and ED visits not resulting in hospitalization. These measures would be expected to decrease if unmet needs were addressed through the intervention. The ED utilization outcomes were measured as the likelihood of having an ED encounter per patient per quarter. Secondary outcomes were primary care physician visits and specialist physician visits. These could be expected to increase or decrease depending on whether the interprofessional team addressed unmet need or uncovered further unmet need that would need to be addressed by physicians and specialists. The physician visit outcomes were measured as counts per patient per quarter.

4.2.4 Covariates

All covariates were measured at the index date, which was the date of the patient's first encounter at a CHC for TeamCare services. The following patient-level covariates were used to construct the propensity score: whether the patient was a recent migrant to Ontario based on OHIP eligibility (i.e., became eligible within the last 10 years); neighborhood income quintile; Rurality Index of Ontario (RIO) Score – a 0-100 scale that defines a geographic area as major urban, non-major urban, or rural depending on their score (96–98); Ontario Marginalization Index – an area-based tool that measures marginalization on multiple dimensions – dependency, material deprivation, ethnic concentration, and residential instability (99); Johns Hopkins Aggregated Diagnosis Groups™ (ADGs); Johns Hopkins Resource Utilization Bands (RUBs); and mean utilization over the two years prior to the index date for all outcome measures. ADGs are based on the ACG case-mix system and use ICD-10 codes and group diagnoses based on severity and likelihood of persistence (100). There are 32 ADGs, which can be further condensed into 12 Collapsed ADGs (CADGs) based on likelihood of persistence, severity, and types of health care services required (100). RUBs further group the ADGs into six categories based on expected resource use: 0 – no use or invalid diagnosis; 1 - healthy use; 2- low; 3- moderate; 4 – high; and 5 – very high use (100).

Additional characteristics that were not included in the propensity score were used in the regression models as covariates to control for additional factors that could be contributing to differences between the groups (114). These covariates were binary indicators for whether the patient was rostered to a primary care practice and whether that practice was an FHT.

4.2.5 Empirical approach

Random and fixed effects models were used to account for the longitudinal nature of the data and clustering on individuals. Fixed effect models control for time-invariant unobserved characteristics at the individual level that may be confounding the true effect of the intervention (117). Fixed effects models estimate impact on outcome only for those individuals who experienced the intervention; they evaluate the within- or within- and between-person differences before and after an intervention, respectively (118). The use of the fixed or random effects model in addition to the DiD framework therefore examines the differential impact on within-person differences or within- and between-person differences, respectively, between two groups before and after an

intervention, with the comparison group acting as a counterfactual. Together, DiD and fixed effects control for all confounders, observed and unobserved, that do not change over time (117). For each outcome, both random and fixed effects models were run, and a Hausman Test was performed to determine which model should be used.

The data contained a panel of 16 quarterly cross-sections. For each patient, pre- and post-intervention periods were centered on the quarter of first encounter, with the assumption that the intervention occurred on the first day of the quarter in which the first encounter occurred. There were therefore between four and eight quarters of follow-up depending on a patient's quarter of first encounter. For likelihood of ED visit outcomes, logit models were used to estimate effects. For the count of physician visit outcomes, Poisson models were used to estimate effects. Statistical significance was assessed at a threshold of α=0.05, or 5%.

The base model (Model 1) for all outcomes included the following independent variables: an indicator for the pre- versus post-intervention periods (*post*), an indicator for whether a patient participated in TeamCare (*intervention*), an interaction term between the two (*intervention*post, or the DiD coefficient)*, and dummy variables for each fiscal quarter to control for any secular trends ($T_{1\text{-}16}$). To assess whether differences between the treatment and comparison groups in terms of their primary care characteristics were confounding the result, for each outcome, a second model (Model 2) was run with indicator variables for whether the patient was rostered to a primary care practice and whether that practice was an FHT. Bootstrapped standard errors were used for all models to account for repeated patient measures. The Akaike information criterion (AIC) and Bayesian information criterion (BIC) were used for model selection between Models 1 and 2, with lower AIC and BIC indicating the better model (119). All analyses were conducted using Stata v.13.1.

4.2.6 Sensitivity Analyses

Sensitivity analyses were conducted to check whether the results were sensitive to assumptions and specifications. A second matched comparison group was constructed using an exact match on age and sex and a propensity score of only mean utilization over the previous two years on the primary outcome variables. Regressions were run using this comparison group to determine whether the results were sensitive to the specification of the propensity score.

In the primary analysis, it was assumed that a patient's date of first encounter at a CHC was at the beginning of the quarter in which it occurred. As a sensitivity analysis, any utilization that occurred within the quarter of first encounter but after the date of first encounter was rounded to the following quarter (i.e., to the quarter following the index quarter). Models were run using this dataset to determine whether the coding of the data had any impact on the results.

Regression to the mean is a concern when individuals are matched based on pre-intervention trends in an outcome and selected based on extreme values of a variable that is unstable over time (e.g., very high ED use) (120). If groups are matched based on time-varying characteristics and if there is little serial correlation in the outcome over time, the outcome will regress to the mean of the group from which the matched individuals were selected (120). To test whether regression to the mean was impacting the results of the primary analyses, sensitivity analyses were planned using a random sample of the general population of Ontario as the comparison group rather than the propensity score-matched comparator.

4.2.7 Ethics Approval

This study received ethics approval from the University of Toronto Research Ethics Board (Protocol #36927).

4.3 Results

4.3.1 Study Population Characteristics

Six hundred and ninety-five individuals met the criteria for inclusion in the TeamCare group. Six hundred and eighty-three of this initial group were matched to individuals in the comparison group. One individual was excluded from the TeamCare group following matching because the date of death was recorded as being prior to the date of first encounter, likely due to a coding error. Following this exclusion, there were 682 individuals included in the TeamCare group with 10,912 patient-quarters and 683 individuals in the comparison group with 10,928 patient-quarters. The comparison group did not also lose an individual because, following matching, it was not possible to identify matched pairs and therefore the match of the individual removed from the TeamCare group. The comparison group was left intact to avoid the potential of introducing bias if another

individual's match was removed unintentionally. Descriptive characteristics are provided in Table 4-1 below for the full matched sample.

At baseline, TeamCare patients were older and more likely to be female compared to the 20% random sample of the Ontario population. They were also more likely to be in the lower two income quintiles and score higher (i.e. worse) on measures of marginalization including dependency, material deprivation, and residential instability. TeamCare patients were more likely to have chronic medical conditions as well as chronic specialty conditions and tended to have higher expected resource use, indicating high and very high morbidity. TeamCare patients had higher mean non-urgent ED visits, ED visits not resulting in hospitalization, primary care physician visits, and specialist visits than the 20% random sample at baseline. After matching, the TeamCare and comparison groups were balanced on most characteristics with a standardized difference of <0.10 (116). Exceptions included the proportion of patients in the second income quintile, with a score of 1 or 5 on ethnic concentration, some of the cADGS, and the mean non-urgent ED visits and ED visits not resulting in hospitalization in the previous two years. However, the standardized difference between the overall propensity scores of the two groups was 0.02, well below the threshold of 0.10.

Seven patients (two in TeamCare and five in the comparison group) had no utilization (ED, primary care, or secondary care) in any quarter during the study period. As the program model is designed such that a patient is referred to the program by a physician, it is unlikely that any patients participating in TeamCare had no contact with a health professional prior to entering the program. It is possible that these patients were referred by a CHC physician or a Nurse Practitioner rather than a non-team primary care physician and that this was not captured in the data. The baseline characteristics of these patients were explored to determine whether there were any patterns that could explain why they had no utilization. No trends in the observable characteristics were found, so these patients were excluded from the analyses.

Table 4-1. Baseline patient characteristics before and after propensity score matching

	Before matching		After matching		Standardized Difference after matching
	TeamCare	Comparison	TeamCare	Comparison	
N	695	2,294,785	683	683	
Age, mean (SD)	69.7 (17.9)	47.8 (18.1)	69.8 (17.8)	69.8 (17.8)	0.000
Female, %	63.7%	51.1%	63.5%	63.5%	0.000
Propensity Score, mean (SD)	n/a	n/a	6.96 (1.40)	6.99 (1.42)	0.02
Rurality Index of Ontario (RIO) 2008 score	17.55 (20.61)	9.63 (16.31)	16.56 (21.83)	17.64 (20.67)	0.05
Migrant to ON within last 10 years, %	4.3%	9.6%	3.7%	4.0%	0.02
Income Quintile, %					
1	26.6%	18.7%	26.5%	26.9%	0.01
2	32.1%	19.5%	32.2%	27.4%	0.11
3	20.0%	19.9%	19.9%	18.4%	0.04
4	11.5%	21.3%	11.7%	14.8%	0.09
5	9.5%	20.3%	9.7%	12.4%	0.09
Ontario Marginalization Index, %					
Dependency					
1	9.1%	26.8%	8.9%	9.4%	0.02
2	12.2%	29.5%	12.4%	11.0%	0.05
3	11.1%	17.9%	11.3%	12.2%	0.03
4	20.0%	16.9%	20.2%	19.9%	0.01
5	47.5%	18.3%	47.1%	47.6%	0.01
Material Deprivation					
1	6.8%	17.5%	6.9%	7.9%	0.04
2	13.1%	19.2%	13.0%	12.2%	0.03
3	27.5%	19.7%	27.5%	28.8%	0.03
4	19.0%	20.8%	19.3%	20.2%	0.02
5	33.5%	22.3%	33.2%	30.9%	0.05
Ethnic Concentration					
1	41.6%	15.7%	41.1%	35.4%	0.12
2	11.4%	16.4%	11.6%	12.9%	0.04
3	21.2%	17.8%	21.4%	21.8%	0.01
4	16.1%	20.7%	16.4%	16.0%	0.01
5	9.6%	28.9%	9.5%	13.9%	0.14
Residential Instability					
1	6.8%	21.3%	6.9%	7.3%	0.02
2	10.9%	18.7%	11.1%	12.4%	0.04
3	19.7%	18.0%	19.9%	22.2%	0.06
4	18.8%	18.6%	19.2%	16.0%	0.08
5	43.6%	22.8%	42.9%	42.0%	0.02
Collapsed ADGs, %					
cADG1: Acute minor	79.1%	64.2%	79.1%	80.7%	0.04
cADG2: Acute major	81.7%	60.9%	81.7%	85.5%	0.10
cADG3: Likely to recur	68.5%	51.7%	68.4%	72.6%	0.09
cADG4: Asthma	5.5%	4.2%	5.4%	3.8%	0.08
cADG5: Chronic medical unstable	58.1%	22.7%	57.7%	62.4%	0.10

cADG6: Chronic medical stable	72.5%	39.1%	72.3%	76.6%	0.10
cADG7: Chronic specialty stable	10.8%	4.4%	20.7%	9.4%	0.04
cADG8: Eye dental	20.3%	6.6%	19.9%	22.1%	0.04
cADG9: Chronic specialty unstable	25.2%	8.2%	24.7%	30.0%	0.12
cADG10: Psychosocial	53.1%	25.5%	52.9%	52.9%	<0.001
cADG11: Prevention, administration	37.4%	25.8%	36.9%	37.9%	0.02
cADG12: Pregnancy	1.0%	3.5%	1.02%	0.20%	0.12
Resource Utilization Bands, %					
0-1 (non-user to healthy user)	3.4%	19.2%	3.4%	2.3%	0.06
2 (low morbidity)	4.0%	16.0%	4.1%	1.8%	0.14
3 (moderate morbidity)	41.0%	46.6%	41.5%	40.6%	0.02
4 (high morbidity)	22.9%	13.4%	23.2%	23.1%	<0.001
5 (very high morbidity)	28.6%	4.8%	27.9%	32.2%	0.10
Health care utilization in 2 years prior to index, mean (SD)					
Non-urgent ED visits	0.94 (2.68)	0.26 (0.96)	0.82 (1.83	0.48 (1.27)	0.22
ED visits not resulting in hospitalization	3.02 (6.2)	0.68 (1.86)	2.75 (4.74)	1.41 (2.49)	0.35
Primary Care Visits	12.00 (13.03)	5.78 (7.43)	11.74 (12.37)	12.18 (12.19)	0.04
Specialist Visits	7.30 (9.62)	2.59 (5.69)	7.21 (9.5)	6.45 (9.36)	0.08
Primary Care Practice Characteristics - not included in the propensity score					
Patient is rostered to a primary care practice	69.4%	75.2%	69.4%	85.6%	0.40
Primary care practice is a Family Health Team	13.0%	20.5%	12.9%	28.7%	0.40

ED = Emergency Department; SD = Standard Deviation

4.3.2 Effect on health care utilization

No statistically significant differences were observed in the likelihood of having an ED visit or the number of specialist visits when comparing the TeamCare to comparison group in the post- versus pre-intervention periods. Figure 4-1 and Figure 4-2 depicting rates of ED use by quarter demonstrate that non-urgent ED visits and ED visits not resulting in hospitalization for the TeamCare group increased to a peak in the first post-index quarter, then decreased thereafter. Based on a visual inspection of the graph, the propensity score-matched comparison group did not have a similar peak in ED utilization in the first quarter post-index, indicating that the parallel trends assumption may not be met for these outcomes. This observation will be tested statistically in subsequent analyses.

As shown in Table 4-2, TeamCare was associated with a relative increase in primary care visits (incidence rate ratio [IRR] = 1.11; 95% confidence interval [CI] 1.01, 1.22; P-value = 0.028) compared to the comparison group for the post- versus pre-intervention periods. The Hausman Test indicated that fixed effects was the preferred model. The AIC and BIC indicated that Model 2 was better specified than Model 1 (Table 4-3). The quarterly trend in mean primary care physicians for TeamCare patients versus the propensity score-matched comparison group is shown in Figure 4-3. The trend graph indicated that while the rate of primary care visits was higher in the post- versus pre-intervention periods, it increased from the earliest quarter until it reached a peak in the quarter of first encounter with the program and declined thereafter.

4.3.3 Sensitivity Analyses

Results did not differ when the models were run on data with the comparator cohort identified based on a hard match on age and sex and a propensity score of only the primary outcome variables. Similarly, recoding the data so that any utilization that occurred within the quarter of first encounter but after the date of first encounter was rounded to the following quarter (i.e., to the quarter following the index quarter) did not have an impact on the results.

As no statistically significant effect was observed for the outcome measures, with the exception of a small increase in primary care visits, regression to the mean was not a large concern. However, when sensitivity analyses were run using a random sample of the general population as the comparison group, the effect observed for primary care visits was no longer significant (incidence rate ratio [IRR] = 1.08; 95% confidence interval [CI] 1.00, 1.16; P-value = 0.054).

Table 4-2. Regression Results

	Model 1							Model 2						
	RE DiD			FE DiD			Hausman	RE DiD			FE DiD			Hausman
Outcome	OR (95% CI)	Boot SE	P	OR (95% CI)	Boot SE	P	prob>chi2	OR (95% CI)	Boot SE	P	OR (95% CI)	Boot SE	P	prob>chi2
ED visits – Non-Urgent	1.10 (0.85, 1.43)	0.15	0.478	1.10 (0.87, 1.38)	0.13	0.442	1.000	1.10 (0.82, 1.48)	0.17	0.516	1.09 (0.80, 1.48)	0.17	0.575	-
ED visits not resulting in hospitalization	1.02 (0.85, 1.22)	0.09	0.829	1.02 (0.88, 1.18)	0.08	0.842	0.987	1.01 (0.83, 1.23)	0.10	0.904	1.00 (0.81, 1.23)	0.11	0.978	-
	RE DiD			FE DiD			Hausman	RE DiD			FE DiD			Hausman
	IRR (95% CI)	Boot SE	P	IRR (95% CI)	Boot SE	P	prob>chi2	IRR (95% CI)	Boot SE	P	IRR (95% CI)	Boot SE	P	prob>chi2
Primary Care Physician visits	1.11 (1.01, 1.23)	0.06	0.036	1.12 (1.02, 1.22)	0.05	0.023	0.008	1.11 (1.02, 1.22)	0.05	0.020	1.11 (1.01, 1.22)	0.05	0.028	0.003
Specialist visits	1.07 (0.95, 1.21)	0.07	0.266	1.07 (0.95, 1.20)	0.06	0.250	0.119	1.10 (0.96, 1.26)	0.08	0.162	1.10 (0.97, 1.24)	0.07	0.125	0.103

Boot SE = Bootstrapped Standard Errors; DiD = Difference-in-Differences; ED = Emergency Department; FE = Fixed Effects; IRR = Incidence Rate Ratio; OR = Odds Ratio; RE = Random Effects

Table 4-3. AIC and BIC for Model 1 and Model 2 for each outcome

		Model 1 post + intervention + DiD + time dummies		Model 2 post + intervention + DiD + time dummies + rostered + FHT	
		AIC	BIC	AIC	BIC
ED visits – Non-Urgent	RE	8940.27	9099.85	7421.55	7593.19
	FE	5347.01	5469.34	4457.70	4577.06
ED visits not resulting in hospitalization	RE	16929.28	17088.86	14007.20	14178.84
	FE	11378.28	11509.36	9411.22	9539.32
Primary Care Physician visits	RE	68430.49	68588.93	57805.35	57975.69
	FE	56734.56	56868.90	48072.47	48203.90
Specialist visits	RE	57685.75	57844.19	48073.34	48243.68
	FE	46917.59	47051.08	39124.94	39255.34

AIC = Akaike information criterion; BIC = Bayesian information criterion

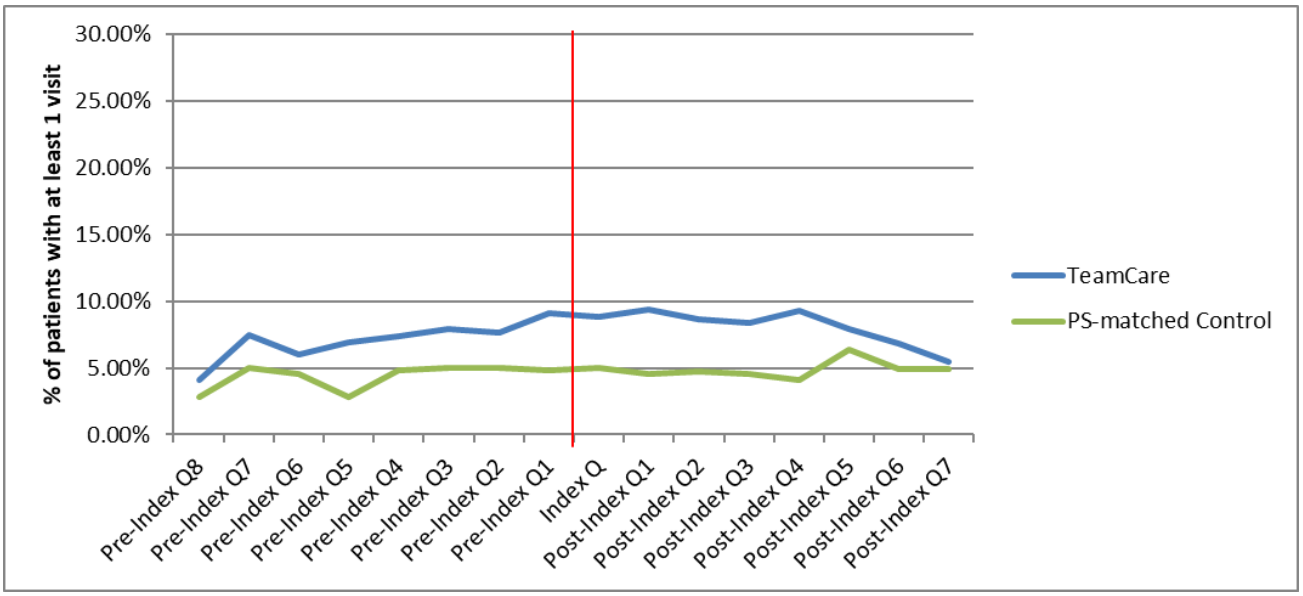

Figure 4-1. Percentage of patients with at least one non-urgent ED visit by quarter, pre- and post-index

PS = Propensity Score

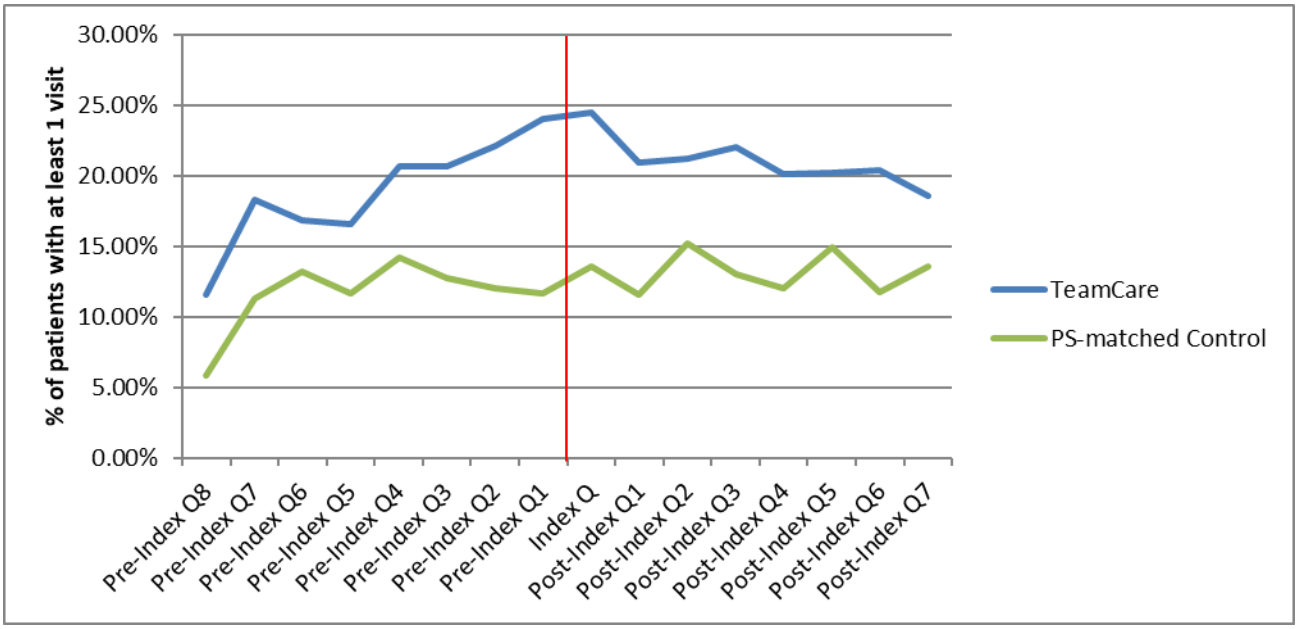

Figure 4-2. Percentage of patients with at least one ED visit not resulting in hospitalization by quarter, pre- and post-index

PS = Propensity Score

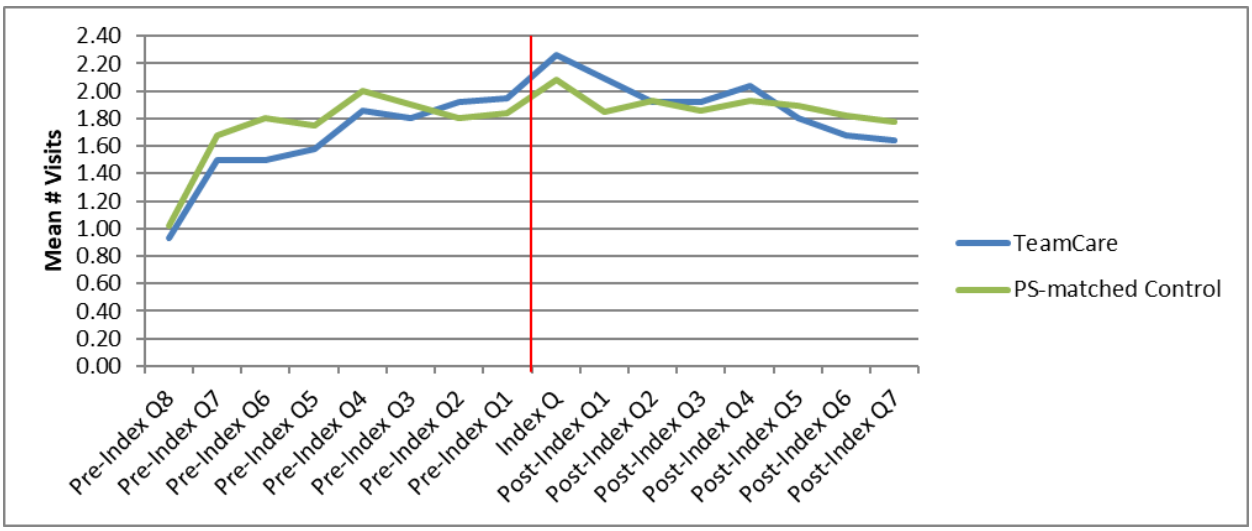

Figure 4-3. Mean number of primary care physician visits by quarter, pre- and post-index

PS = Propensity Score

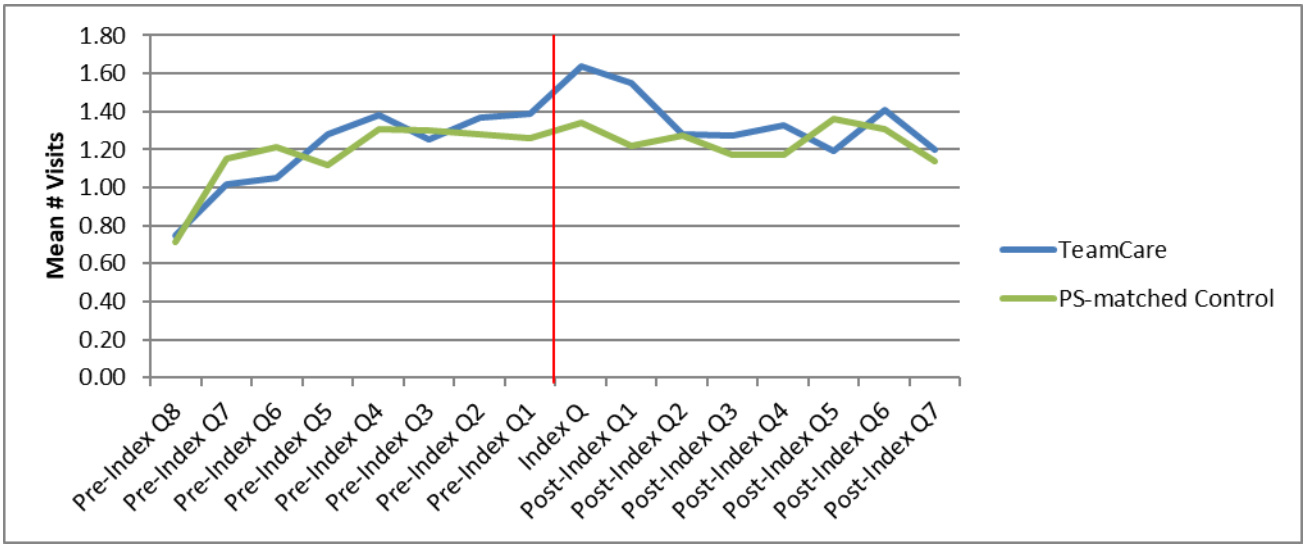

Figure 4-4. Mean number of specialist physician visits by quarter, pre- and post-index

PS = Propensity Score

4.4 Discussion

This study examined the impact of TeamCare on health systems outcomes. The primary analysis examined non-urgent ED visits and ED visits not resulting in hospitalization as measures of potentially avoidable acute care utilization and proxy measures for reduced unmet need. The secondary analysis examined the program's impact on visits to primary care physicians and specialist visits. The results of this study indicate that, between 1-2 years of follow-up after a

patient's date of first encounter, TeamCare did not have a significant impact on avoidable ED utilization or specialist visits, but it was associated with a small relative increase in the number of primary care visits.

There were no significant differences in the likelihood of visiting the ED for non-urgent issues or having an ED visit that did not result in an inpatient admission. Non-urgent ED visits are often used as a proxy for access to primary care (121). A program that increases access to interprofessional team-based care would be expected to decrease patients' unmet need and thereby decrease acute care utilization (1,49). Models of interprofessional team-based care such as the PCMH have been shown to decrease ED utilization when targeted specifically to high needs patients with elevated health care resources use (40,59,60). The TeamCare model differs from these models, however, in that the primary care physician is not a core member of the interprofessional team, and the patient is not rostered to the team itself. It is possible that these structural differences may account for some part of the difference in observed effect on ED visits. It is also possible that a longer follow-up period may be required to observe differences in these outcomes.

While the results of the fixed effects Poisson regression indicate that primary care visits increased for TeamCare patients, it is possible given this trend that primary care visits would continue to decrease with continued follow-up. A graphic representation of mean primary care visits by quarter in the periods prior to and after the intervention demonstrates that primary care visits for the TeamCare group increased steadily until the index quarter, then reversed direction and decreased at a slower rate thereafter. These data would suggest that TeamCare patients' needs were increasing steadily, indicated by more frequent interactions with their primary care physician, until they were referred to the program and their needs began to be addressed by the interprofessional team, resulting in a decrease in visits to their physician.

Based on the graphs of trends for each of the outcomes, there was a concern that the parallel trends assumption of the DiD may not have been met. The trends in quarterly utilization prior to the index date did not align between the treatment and comparison groups, particularly in the quarters immediately preceding the index date. However, given that the comparison group did not demonstrate large changes in the outcomes in the post- versus pre-intervention periods and no

significant effects were found for three of the four outcomes, it is unlikely that the possible violation of the parallel trends assumption had any impact on the findings. Further analyses will be conducted to match groups on trends in the pre-period outcomes rather than levels in the two years prior to the intervention.

This study had several limitations. It was not possible to observe visits to CHC physicians who may have referred patients to the program, though this would likely represent very few participants. Neither the type of services used nor length of treatment were measured; all individuals identified as TeamCare patients who had at least a date of first encounter at a CHC were analyzed in the same group. It was therefore not possible to identify any differences in the intensity of program delivery across individuals that would facilitate subgroup analyses. Additionally, the sample size is relatively small and the length of follow-up following a patient's date of first encounter may not have been long enough to observe an effect for ED utilization and specialist utilization. Utilization outcomes alone do not capture the full impact of the program; future analyses should examine further elements of the Quadruple Aim (population health, patient experience, provider experience, and cost) (122) and data sources beyond administrative databases, such as patient surveys and interviews.

Finally, the potential for self-selection was also a limitation of this study. The traditional DiD framework is used to evaluate policy changes over which individuals have no say (e.g., a change in smoking laws); they cannot choose whether or not to participate. While TeamCare is a referral model, patients had agency over the decision whether to participate. There could therefore be unobserved characteristics associated with the decision to participate in TeamCare that confounded the results. Additionally, patients who were referred but did not have a date of first encounter were not observed, preventing the determination of whether there were any systematic differences between the groups. This limitation was addressed through the use of propensity score matching to generate the comparison group and fixed effects models to control for observed and unobserved individual characteristics. Moreover, the results of Paper One indicate that the program reached its intended patient population.

This study is the first to examine the impact of TeamCare on health care utilization. The results of the study indicate that the program had a small impact on primary care visits but did not impact

avoidable ED utilization or specialist visits. The study adds to the literature on the effectiveness of interprofessional team-based care for patients with complex needs and to the more limited literature on referral models.

4.5 Conclusion

TeamCare fills a significant access gap for patients who have complex health and social needs and did not previously have access to an interprofessional team-based model of primary health care. The initiative has grown considerably since it was first implemented and continues to expand to other regions and evolve its program model to include additional primary care organizations and model types and to serve more patients. The results of this study indicate that TeamCare did not have a meaningful impact on the utilization of formal health care services for patients who participated in 2015. Further research should investigate impacts on intermediate outcomes for patients.

Chapter 5
Discussion

5 Discussion

Previous research has demonstrated that interprofessional team-based primary care is an effective model for patients with complex health and social needs. Individuals with complex needs are likely to have unmet needs and high resource use – both due to increased interactions with the health care system and costly acute care utilization – resulting in high costs and strain on the health system, and are at higher risk for poor outcomes compared to those who do not have complex needs (29). Interprofessional team-based care is designed to deliver comprehensive and appropriate care and in doing so reduce unmet need.

In Ontario, primary care reforms in the 2000's aimed to improve access to interprofessional teams (76). This goal was achieved for many residents of Ontario who gained access to interprofessional teams through newly implemented FHTs and the expansion of CHCs. However, while the reforms did improve access to interprofessional teams for Ontarians, they did so only for approximately 30% of the population and were not targeted to vulnerable populations with the highest need and potential to benefit from such models. As a result, many patients with complex needs who could most benefit from team-based care did not gain access through the reforms and continued to visit non-team physicians, either solo FFS practitioners or physicians who transitioned their practice to a patient enrolment model but one without an interprofessional team (16).

Recognizing that there was a gap in the system, TeamCare was implemented to provide access to CHCs for patients with complex health and social needs who did not previously have access to an interprofessional primary care team through their regular primary care provider. TeamCare is therefore a program that was born out of necessity as a result of policy reforms that were both not expansive and not targeted enough. It is a voluntary referral-based model that targets patients with complex needs but does not have strict eligibility criteria for participation. As a referral-based program, TeamCare differs from the models of interprofessional team-based care typically described in the literature, such as the PCMH, in that physicians are not part of the core team and patients are not rostered to the team itself.

This thesis aimed to determine the appropriateness of patients receiving TeamCare services and the program's impact on unmet need and health services utilization. To do so, three research questions were posed: 1) What are the characteristics of patients enrolled in TeamCare and what are the characteristics of their most responsible primary care physicians? 2) How do TeamCare patients compare with the patient population of their most responsible primary care physicians and the general Ontario population on characteristics related to medical and social complexity? and 3) How does the TeamCare program affect health care utilization for the TeamCare patient population compared to a similar patient population who did not participate in the program?

The first study aimed to answer research questions one and two: it characterized patients who had received TeamCare services and determined whether they represented those individuals with complex needs when compared to the non-TeamCare patient populations of their most responsible primary care physicians and a random sample of the general population of Ontario. Examination of the data demonstrated that TeamCare patients were likely to be older and living in major urban centres and low-income neighborhoods. They scored high on measures of marginalization including dependency, material deprivation, and residential instability. TeamCare patients had high expected resource use and a high degree of comorbidity.

TeamCare patients were significantly more complex in terms of their socioeconomic and disease characteristics when compared to both the non-TeamCare patient populations of their primary care physicians and a random sample of the provincial population. TeamCare patients were more likely to be older, live in low income neighborhoods, and experience a greater degree of marginalization. They also had a higher degree of comorbidity as measured by ADGs and a significantly higher prevalence of chronic illness, including a prevalence rate of chronic psychotic illness nearly five times that of the general population and four times that of the non-TeamCare patients of their primary care physicians. In the year prior to their date of first encounter at a CHC, TeamCare patients were significantly more likely to have interacted with the health care system relative to the comparison groups: they visited the ED for a non-urgent issue, had an ED visit that did not result in an inpatient admission, and visited primary care physicians and specialists more than did non-TeamCare patients of their primary care physicians and the general population.

The most responsible physicians of TeamCare patients had a higher proportion of physicians practicing in rural areas, a higher mean roster size, and a higher mean number of visits over the previous 12 months when compared to primary care physicians in the province. These characteristics are all related to access to health care (110), and, in the case of larger roster size, have been shown to be negatively associated with access to care and delivery of preventative, health promotion, and chronic disease management services (111). Notably, the proportion of physicians within an FHT that referred patients to TeamCare was similar to that of all primary care physicians in the province. As TeamCare is designed to provide access to patients who do not already visit an interprofessional team, this was a surprising finding.

This study was limited by the inability to identify patients who had been referred to the program but did not receive services. It was therefore not possible to determine whether there were any systematic differences between patients who participated in the program and those who were referred but did not. This limitation prevented analysis of the appropriateness of referrals to the program; it is possible that physicians referred patients who were screened out by the program. A second limitation lies in the skewed distribution of patients across the three programs; results were likely skewed by the characteristics of PCO patients who made up the majority of the patient sample. Small sample sizes in the other programs limited the reporting of disaggregated characteristics.

The results of the first study indicate that, even without strict eligibility criteria, TeamCare reached its intended population of patients with complex health and social needs. Moreover, TeamCare patients had a high degree of health care utilization as would be expected based on the literature on patients with complex needs.

Building on the results of the first study, the second aimed to answer the third research question and determine the impact of TeamCare on health services utilization. A modified Difference-in-differences framework with multiple quarterly time periods before and after a patient's date of first encounter with the program was used. Fixed effects and random effects models were run with bootstrapped standard errors to account for the panel nature of the data and repeated patient samples. A comparison group was constructed using propensity score matching methodologies. Our primary outcomes were measures of avoidable ED utilization: the likelihood of visiting the

ED for a non-urgent issue and of having an ED visit that did not result in hospitalization. Secondary outcomes were the number of primary care physician visits and specialist visits.

Participation in TeamCare was associated with a small relative increase in primary care visits in the post- versus pre-intervention periods when compared with the propensity score-matched comparison group. An analysis of trends in primary care visits by quarter demonstrated that primary care visits increased for the TeamCare group from baseline until the quarter in which the first encounter occurred, and then decreased thereafter at a slower pace. These results indicate that TeamCare patients' need likely increased steadily until they were referred to the program, and then the rate of visits declined as their needs began to be met by the interprofessional team. Further research to examine whether quality of care and patient experience of and satisfaction with care were maintained or improved is warranted.

According to the results of this study, TeamCare did not have any significant impact on non-urgent ED visits, ED visits not resulting in hospitalization, or specialist visits. It is possible that the length of follow-up was not enough to observe significant differences in these outcomes. It is also possible that the effect of the intervention may have differed according to the number and variety of services delivered (i.e., the intensity of program delivery) which were not accounted for in this analysis. An additional limitation is that the parallel trends assumption of the difference-in-differences framework may not have been met for these outcomes, despite matching on a propensity score. For both ED outcomes, the propensity score matched comparison group did not experience a similar peak in utilization at or just following the index quarter, according to visual inspection of the trends. However, there was no significant change in either of the ED outcomes for either the intervention or comparison groups in the post- versus pre-intervention period. It is likely that this result would not change even if the parallel trends assumption had been met. Future analyses will match on quarterly utilization in the pre-intervention period rather than on a mean over the entire period to verify this assumption.

The literature on interprofessional team-based care would indicate that, by improving access to comprehensive and appropriate primary health care, interprofessional team-based care is expected to reduce inequities in access to health care and reduce unmet need and avoidable acute care utilization (1,24,51). Moreover, team-based care has been demonstrated to be particularly

successful in reducing acute care utilization when interventions are targeted to high risk and high needs patient populations (40,59–63). It could therefore be expected that TeamCare, a program targeting patients with complex health and social needs for the delivery of interprofessional team-based care, would reduce the acute care utilization of its participants. It is, however, important to recognize that TeamCare differs from the models typically described in the literature: as a referral-based model, the physician is not a part of the core team and the patient is not rostered to the team itself. TeamCare is also of lesser intensity and narrower in scope than many of the IPC models described in the literature that reduced acute care utilization for their high risk and high needs patient populations (4,44,45,64–66).

There are additional utilization outcomes that could be examined to further evaluate the impact of the TeamCare intervention for its participants. In this study, avoidable or non-urgent ED visits were selected as the primary outcome as a proxy for unmet need and access to primary health care. However, other types of utilization such as urgent ED visits, ambulatory care-sensitive condition (ACSC) ED visits, and ACSC hospitalizations may also capture use of acute care services reflective of needs not addressed through primary health care. Additionally, an examination of ED visits and hospitalizations specifically related to mental health could shine light on the ability of the TeamCare program to address mental health concerns. These outcomes could be explored in future analyses.

The results of the first study of this thesis demonstrate that TeamCare was able to reach its intended patient population; patients accessing the program were complex in terms of their sociodemographic and health characteristics and patterns of health care utilization. (122). It is likely that TeamCare was meeting unmet needs in this patient population because the most complex patients were being referred. However, though the program did target and reach patients with complex needs, the results of the second study indicate that it did not have a significant impact on either acute care utilization or primary or secondary care utilization. It is possible that the length of follow-up was too short to allow for the observation of significant differences; this impact may translate to a slowing of the increase in other health care utilization rather than an immediate reduction.

Utilization outcomes are only one aspect of the Quadruple Aim and not enough on their own to capture the full impact of the program. For example, patient-reported experience and quality of life are intermediate outcomes that are likely to be meaningful to patients and impacted by TeamCare. Further analyses should examine the impact of TeamCare on these outcomes and other aspects of the Quadruple Aim (population health, patient experience, provider experience, and cost) (122) and data sources beyond administrative databases, such as patient surveys and interviews.

TeamCare is an innovative program that continues to expand across the province and evolve beyond a referral model to improve communication between primary care providers and improve care for patients. Unless and until further large-scale or provincial-level reforms and innovations are implemented that would equitably deliver team-based care to those who need it, the TeamCare model may be a solution that can fill a significant access gap in Ontario.

Despite its limitations, this study was the first to examine the impact of TeamCare on health care utilization and provides evidence for the effectiveness of a referral-based model that links non-team physicians to a community-based interprofessional team. This evidence combined with further research to examine how TeamCare impacts patterns of utilization as well as patient experience and health outcomes will inform future efforts to expand the TeamCare program model across the province of Ontario, as well as the implementation of other voluntary referral-based interprofessional primary care programs.

Chapter 6
Conclusion

6 Conclusion

Patients with complex needs represent a significant concern for policy makers and health care professionals. Though evidence suggests that interprofessional team-based care is an effective model of primary care service delivery, current interprofessional team-based care models in Ontario serve only approximately 30% of the population and do not reach many individuals with complex needs who could benefit from team-based care. TeamCare represents a program that can improve access to interprofessional team-based care for these patients and impact health systems outcomes. The results of this thesis demonstrate that TeamCare is reaching a patient population representing those individuals with complex needs in the health system. It is likely that TeamCare is meeting unmet needs in this patient population because the most complex patients are being referred. However, this impact may translate to a slowing of the increase in other health care utilization, but likely not an immediately reduction; in the short-term, the results of this study indicate that TeamCare did not have significant impacts on ED utilization or physician visits. Future research should examine the impact of TeamCare on intermediate outcomes such as health outcomes, patient-reported experience, and quality of life. Unless and until further large-scale or provincial-level reforms and innovations are implemented that would equitably deliver team-based care to those who need it, the TeamCare model may be a solution that can fill a significant access gap in Ontario.

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