ACCESSIBILITY OF ADOLESCENT CARE IN THE CONTEXT OF PRIMARY CARE REFORMS:

A population-based retrospective cohort study in Québec, Canada

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TABLE OF CONTENTS

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ABSTRACT

Introduction: Family medicine groups (FMGs) were implemented in Québec over a decade ago as a new model of multidisciplinary primary care intended to improve the medical home. Primary care is crucial for adolescents, since unhealthy behaviours such as smoking, alcohol abuse, and physical inactivity that arise during this period translate into risk factors for chronic diseases in adulthood. Proper access to primary care may help adolescents maintain health, modify unhealthy behaviors, and receive timely treatments. In Québec, adolescents primarily receive primary care from family physicians (FMG and non-FMG) or pediatricians. No published studies have investigated the impact of the new reform models on adolescent access to care.

Objectives: To assess the extent to which FMGs are associated with increased access to care and decreased health inequalities for adolescents.

Methods: Population-based retrospective cohort study linking province-wide health administrative data in Québec for adolescents between 2010-2013 (n=574,964). Multivariate regression analyses were performed to test associations between 4 primary care models (FMGs, family physicians not part of FMGs, pediatricians, or no primary care) and two outcomes: emergency department (ED) visits (main outcome; proxy for primary care accessibility) and primary care visits (secondary outcome). Models were adjusted for confounders: age, sex, co-morbidities, rurality, socioeconomic status (SES), and previous ED visits. Reasons for ED visits was examined through the ICD-9CA diagnostic codes on physician claims. Secondary analysis assessed for effect modification, testing the interaction between SES and primary care model.

Results: The distribution of adolescents across primary care models was the following: 19.7% in FMGs, 13.7% in pediatric care, 10.1% in non-FMGs, and 56.5% in no primary care. Compared to adolescents receiving care from FMGs, fewer ED visits were made when receiving care from pediatricians (incidence rate ratio [IRR] 0.90, 95% CI 0.87-0.93) or with no primary care (IRR 0.89, 95% CI 0.87-0.91). No significant differences in rates of ED use were found between FMGs and non-FMGs (IRR 0.98, 95% CI 0.95-1.02). Adolescents in pediatric (RR 1.29, 95% CI 1.28-1.31) and non-FMG models (RR 1.12, 95% CI 1.11-1.13) were more likely to receive a primary care visit than those in FMGs. The interaction term between SES and primary care model was only significant for the secondary outcome. Non-FMGs had the greatest gap in

access to primary care visits between the lowest and the highest SES groups, whereas the pediatric and FMG models had comparable gradients.

Conclusion: The majority of adolescents did not utilize primary care and FMGs were not associated with improved access for adolescents. Although FMGs did not significantly impact health inequalities for ED visits, FMGs reduced inequality in primary care visits between the lowest and highest SES groups compared to non-FMGs. Among adults, FMGs have been linked to minor improvements in access. Our findings suggest the same benefit does not extend to the adolescent population. The current study identifies gaps in adolescent primary care – future studies should ascertain and address the barriers and enablers of primary care accessibility.

RÉSUMÉ

Introduction: Les groupes de médecine de famille (GMF) ont été mis en place au Québec il y a plus de dix ans. Ce nouveau modèle de soins primaires multidisciplinaires vise à améliorer le milieu médical. Les soins primaires sont essentiels pour les adolescents, car les comportements malsains tels que le tabagisme, l'abus d'alcool et l'inactivité physique qui sont adoptés pendant cette période deviennent des facteurs de risque des maladies chroniques à l'âge adulte. Un accès facilité aux soins primaires peut aider les adolescents à maintenir leur état de santé, à modifier les comportements malsains et à recevoir des traitements au temps opportun. Au Québec, les adolescents reçoivent principalement des soins primaires de la part des médecins de famille (GMF et non-GMF) ou des pédiatres. Aucune étude publiée n'a étudié l'impact des nouveaux modèles de réforme de soins primaires sur l'accès des adolescents aux soins.

Objectifs: Évaluer si les GMF sont associés à un accès accru aux soins et à une diminution des inégalités de santé chez les adolescents.

Méthodes: Étude de cohorte populationnelle rétrospective utilisant les données administratives de santé au Québec pour les adolescents entre 2010-2013 (n = 574 964). Nous avons effectué des analyses de régression multivariée pour examiner les associations entre 4 modèles de soins primaires (GMF, médecins de famille non-GMF, pédiatres ou sans soins primaires) et deux résultats: visites à l'urgence (résultat principal), et visites de soins primaires (résultat secondaire). Les modèles ont été ajustés pour les facteurs de confusion: âge, sexe, co-morbidités, ruralité, statut socioéconomique (SSE). Les raisons des visites aux urgences ont été examinées à l'aide des codes de diagnostic de la CIM-9CA selon les facturations des médecins. L'analyse secondaire a évalué la modification des effets, examinant l'interaction entre le SSE et le modèle de soins primaires.

Résultats: La répartition des adolescents selon les modèles de soins primaires était la suivante: 19,7% dans les GMF, 13,7% dans les soins pédiatriques, 10,1% dans les non-GMF et 56,5% dans les soins primaires. Comparativement aux adolescents recevant des soins de FMG, moins de visites ont été effectuées lors de la prise en charge de pédiatres (rapport de taux d'incidence, RTI 0,90, IC 95% 0,87-0,93) ou sans soins primaires (RTI 0,89, IC 95%: 0,87-0,91). Aucune différence significative dans les taux d'utilisation de l'urgence n'a été remarquée entre GMF et non GMF (RTI 0,98, IC 95% 0,95-1,02). Les adolescents en milieu pédiatrique (rapport

de taux 1,29, IC 95% 1,28-1,31) et les modèles non GMF (rapport de taux 1,12, IC 95% 1,11-1,13) étaient plus susceptibles de recevoir une visite de soins primaires que ceux des GMF. Le terme d'interaction entre le SSE et le modèle de soins primaires n'a été significatif que pour le résultat secondaire. Les non-GMF ont le plus grand écart dans l'accès aux visites de soins primaires entre les groupes SES les plus bas et les plus élevés, tandis que les modèles pédiatriques et GMF ont des gradients comparables.

Conclusion: La majorité des adolescents n'utilisaient pas les soins primaires et les GMF n'étaient pas associés à un meilleur accès pour les adolescents. Bien que les GMF n'aient pas eu d'incidence significative sur les inégalités en santé pour les visites aux urgences, les GMF ont réduit l'inégalité des visites de soins primaires entre les groupes SES les plus bas et les plus élevés par rapport aux non GMF. Chez les adultes, les GMF ont été liés à des améliorations mineures dans l'accès. Nos résultats suggèrent que le même avantage ne s'étend pas à la population adolescent. La présente étude identifie les lacunes dans les soins primaires chez les adolescents - les études futures devraient déterminer et éliminer les obstacles et les facilitateurs de l'accessibilité des soins primaires.

LIST OF FIGURES, TABLES, & GRAPHS

CHAPTER 1: INTRODUCTION

Canadian provinces and territories have been undergoing primary care reform since the early 2000s. The specific objectives of reform differ for each province and territory. In those jurisdictions where primary health care transformation has resulted in a system-wide restructuring of health care services (e.g. Ontario, Alberta, and Québec), reform initiatives have focused on the establishment of multidisciplinary team-based models of care with extended clinical hours to improve access, continuity of care, as well as care coordination and integration (1-3). These goals are in line with the ideals of the primary care medical home, a framework for primary care to which many health systems aspire (4, 5).

In Québec, Family Medicine Groups (FMGs) were implemented in 2002 as one of two reformed models of care. FMGs consist of six to 10 physicians working with nurses to provide primary care to registered patients on the basis of contractual arrangements with the provincial government (1). With the goal of increasing access, FMGs provide patients with limited walk-in services during holidays and weekends, and some FMGs offer an on-call telephone service that is accessible at all hours of the day to enrolled patients (6). The compensation model for FMGs is primarily fee-for-service, but there are financial incentives for registering vulnerable patients, and other administrative work (7). As of March 2014, 258 FMGs have been accredited; Québec plans to increase this to 300 FMGs and register at least 75% of the population with an FMG (8).

Published evaluations of FMGs on attributes of primary care such as access, quality, and patient-centeredness have primarily focused on adults (7, 9, 10), with no studies focusing on children or adolescent subpopulations. This trend is not surprising, since the impetus for reform was to prepare the existing health care system for an increasingly aging population (1). However, evaluations on the impact of FMGs on adolescent primary care must also be conducted. Adolescence is a period in which risk factors for adult health are established. For example, it is estimated that 90% of adult smokers started smoking before the age of 20 and 50% of mental health disorders present by 14 years of age (11). Primary care remains a crucial platform through which health promotion and prevention messages can be delivered to adolescents, thereby decreasing the burden of chronic illnesses among adult populations (12-14).

The current thesis is the first to present an empirical assessment of Québec's recent primary care reform and its effect on accessibility of primary care for adolescents by comparing

FMGs to three other models of care: pediatric care, care from family physicians (FPs) in non-FMG practices, and no primary care. Emergency department (ED) visits and primary care visits with a usual provider of primary care were the outcome measures of choice. These endpoints were selected as complementary indicators of access to primary care.

Our primary research question was:

- Among Québec adolescents (aged 10-16 years old on January 1, 2012), what is the extent to which the FMG model of primary care is associated with improved primary care accessibility, as measured by 1) emergency department (ED) use, and 2) receipt of at least one primary care visit with the same provider, compared to the pediatric, non-FMG, or no primary care models?

Our secondary research questions were:

1. Among Québec adolescents enrolled in FMGs, what are the main conditions for which they present at EDs in comparison to adolescents seen within pediatric, non-FMG, or no primary care models?
2. Among Québec adolescents, what is the extent to which the FMG model of primary care is associated with lower inequalities in primary care accessibility, as measured by ED use and primary care visits with the same provider, compared to the pediatric, non-FMG, or no primary care models?

The findings from this thesis have relevance to researchers, clinicians, and policy-makers. As the first research study conducted in Québec to investigate the state of primary care for adolescents, our study identifies gaps in care for adolescents. Moving forward, preliminary evidence from our study can act as a basis for researchers to conduct other studies investigating the barriers and enablers of primary care accessibility for adolescents in Québec. Our findings also identify the need for an increased interest among clinicians and policy-makers on improving adolescent health care in Québec.

CHAPTER 2: BACKGROUND

2.1 Introduction to Primary Care

The National Academy of Sciences in the United States (U.S.) defines primary care as "the provision of integrated, accessible health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community" (15). Health care services provided in the primary care setting fulfills one or more of the following three elements: health promotion, illness and injury prevention, and diagnosis and treatment of illness and injury (16). Within the context of a trusting, long-term relationship between the patient and health care provider, primary care provides patients with prevention strategies to impede the development of disease, screening for early detection and management of disease, and care management for all health needs, sometimes in conjunction with specialty care (17). As the entry point into the health care system, primary care in Canada is most often delivered by family or general practitioners, general internists, or general pediatricians (18). In certain settings, nurses also play important roles in the provision of primary care (7).

Primary care contributes to health systems sustainability by lowering total costs of health services (18, 19). Several possible mechanisms explain this phenomenon. First, primary care improves overall population health. For example, states in the U.S. with higher ratios of primary care physicians to the population had better health outcomes, lower mortality, increased life span, and reduced low birth-weight rates (20-22). At an individual level, patients with primary care physicians as their usual source of care have been shown to be healthier, regardless of their initial health or other demographic characteristics (19). Second, care for common illnesses provided in primary care settings is as effective, yet cheaper, than care provided by specialists or EDs. A study by Whittle *et al.*, for example, showed that care for community-acquired pneumonia was more expensive if provided by specialists than if it was provided by generalists, with no difference in outcomes (23). In Canada, children living in counties with high primary care provider supply had higher rates of primary care visits, and lower rates of emergency department (ED) visits and hospital admissions compared to children living in counties with low primary care provider supply (24).

Primary care has also been identified by the World Health Organization as a promising strategy to reduce population health inequalities. A strong evidence base supports the link between social and material disadvantage and poor health over the life course (25-27). Starfield maintained that investment into health care services that focus on early detection and prevention of disease has the most impact on reducing these health inequalities because socioeconomic status (SES) is more strongly associated with mortality for more preventable causes of death than with less preventable causes of death (28). Correspondingly, a strong primary care infrastructure has been associated with greater health equality. In the United States, people living in areas with greater income inequality and few primary care resources were 33% more likely to report fair or poor health as opposed to good or excellent health compared to those living in areas with high income inequality and abundant primary care resources (29). Furthermore, strategies to improve primary care have been shown to mitigate gaps in health outcomes across the socioeconomic gradient. Following the implementation of a comprehensive primary care program in Columbia, there was a reduction in health inequalities for several child health outcomes, including diphtheria, pertussis, and tetanus (DPT) vaccination coverage, infant mortality rate, and acute malnutrition (30). Similarly in Mexico, primary care programs with a focus on addressing social determinants of health were successful in narrowing health gaps between the populations of high and low SES (31).

2.2 Primary Care and Adolescent Health

Health-related behaviours such as smoking, alcohol abuse, physical inactivity, and unhealthy diets often first arise during adolescence. These behaviours negatively affect development, but more importantly, onset of these behaviours during adolescence predicts persistence during adulthood, translating into risk factors for non-communicable diseases such as cancer, diabetes, heart disease, and stroke (32-36). Ninety percent of adult smokers started smoking before the age of 20 (37), obesity in adolescence confers very high risk for obesity in adulthood (32, 38), and alcohol use in adolescence predicts use in adulthood (34, 35). Unprotected sex leading to unplanned pregnancy in adolescence has the capacity to alter the life course of the individual in addition to that of his or her offspring (39). Furthermore, 50% of mental health problems including anxiety, depression, and eating disorders present by 14 years

of age, but usually go unrecognized and untreated, resulting in more severe clinical outcomes in adulthood (40, 41).

The propensity to engage in risky health behaviors by adolescents in part stems from the neurodevelopmental, psychological, and social changes that occur during this stage of life (32). Neural development in two key areas, the limbic system and the prefrontal cortex, begins in early adolescence but does not complete maturation until early adulthood (42). The limbic system is the brain region responsible for pleasure seeking, reward processing, and emotional responses (32, 43). The prefrontal cortex, on the other hand, coordinates executive functions such as decision-making, planning for the future, organization, and impulse control (32, 44). The delayed maturation of these areas, in combination with an intensifying need to develop independence, are thought to underlie the increased risk-taking, sensation seeking, and impulsivity that drive reckless adolescent behavior, like drunk driving and sex without contraception (44-46). The stress of changing social roles, responsibilities, relationships, and expectations from external environments also confer risk for the emergence of health problems (32).

Studies suggest that carefully designed preventive interventions implemented in the primary care setting can be effective in managing mental health issues and reducing specific risk behaviors. For example, Van Voorhees and colleagues conducted a randomized clinical trial of an Internet-based depression prevention program for adolescents (Project CATCH-IT), and showed that the intervention was associated with declines in depressed mood and likelihood of having clinical depression symptom levels. After 12 weeks of receiving the Internet program in addition to a motivational interview from a primary care physician, the intervention group exhibited a decline in overall measures of depressed mood (Center for Epidemiologic Studies Depression Scale [CES-D] total score) from 24.0 to 17.0 ($p<0.001$) (47). Interventions designed to educate and create awareness about HIV/sexually transmitted diseases (STDs) and to encourage lifestyle changes in order to prevent type II diabetes have shown similar positive results (48, 49). Adequate and timely access to primary care for adolescents allows for reinforcement of health promotion messages, early screening for potential health problems, as well as counselling and early intervention services for those who have initiated risk behaviours to occur. The Canadian Institute of Health Information and the World Health Organization state that improving the provision of primary preventive care services aimed at children and

adolescents will be an investment in the future, resulting in long-term savings in both direct medical and indirect social costs (12, 14, 50, 51).

2.3 Conceptualizing Health Care Accessibility

Access to health care services is central to the performance of health systems, because delivery of health interventions to individuals in need is a critical pathway through which health service provision can contribute to improving population health and reducing health inequalities (52). As a result, a large volume of health policy literature consists of studies measuring utilization and access (52, 53). Access has been defined by Lévesque *et al.* as the "opportunity to identify healthcare needs, to seek healthcare services, to reach, to obtain, or use health care services, and to actually have a need for services fulfilled" (53). Accessibility consists of five dimensions (approachability, acceptability, availability and accommodation, affordability, appropriateness) that interact with five corresponding abilities of the population (ability to perceive, ability to seek, ability to reach, ability to pay, ability to engage) to generate access (53). Numerous other conceptualizations of accessibility exist (54-56), but this definition was chosen for the purposes of this thesis because it was the most comprehensive of those reviewed. The outcome measures of 1) ED visits and 2) primary care visits with the usual provider of primary care addresses the availability and accommodation dimension within the Lévesque definition of accessibility. Specifically, availability and accommodation refers to whether health services can be reached physically and in a timely manner (53).

Primary health care experts across Canada agree that accessibility is a key attribute of primary care that needs to be evaluated (57). Due to the many dimensions of the concept, numerous methods to measure primary care accessibility exist. Some of these measures include: rates of health services utilization, distance from nearest primary care facility, patient perception of need as evaluated through surveys, proportion of population with usual primary care provider, ratio of primary care provider to population (20, 24, 54, 58, 59). A proxy measure for primary care accessibility that has been widely used in the literature for both children and adults is the rate of non-urgent ED visits (60-62). High rates of ED use have been attributed to patients turning to EDs for primary care because they do not have access to a regular FP or have trouble accessing the FP when needed (63). Use of an emergency department for non-urgent cases is

generally considered medically inappropriate and costlier than care in non-emergency settings (64). Non-urgent ED visits have been shown to be prevalent not just in the U.S. but also in Canada, despite all residents having universal access to primary care at no cost (65, 66). The health administrative data used in the current study does not allow for differentiation between urgent and non-urgent ED visits. However, we will examine the main conditions for which adolescents present to EDs, to help interpret the urgency of these visits.

2.4 Adolescent Access to Primary Care: Room for Improvement

Despite the importance of primary care and early treatment of health and mental health problems for adolescents, we are unaware of any studies focusing on access to primary care for Canadian adolescents. The following section reviews research examining adolescent access to primary care that has been conducted in the U.S. The results are not directly transferrable to the Canadian context, however, since Canada offers access to universal healthcare to all its citizens whereas the U.S. does not guarantee publicly funded healthcare to everyone (67, 68).

There is a gap in primary care accessibility for adolescents in the U.S. compared to that of other age groups. One-third of adolescents report having no regular preventive care visits and thus having unmet health needs (69, 70). A study conducted by the U.S. Congress demonstrated that adolescents use the mainstream model of healthcare delivery (i.e. provision of care by private office-based physicians) less than any other age group, and when they sought care, they received shorter consultations than all other patients (71, 72). Relative to younger children, they are 64% more likely to have no usual source of care and 25% more likely to have had no health care visits in the prior year (73). Lack of regular health visits lead to limited delivery of preventive care, as adolescents who do not have a regular source of care were almost 4 times less likely to have received preventive care than those who reported having a regular source of care for both preventive and acute health problems (OR, 0.26, 95% CI 0.17-0.38) (74).

Sociodemographic factors have been shown to be significant predictors of health care access in the U.S. According to Lieu *et al.,* among adolescents 10 to 17 years of age, non-white teens had significantly fewer visits for both acute and routine preventive care than white teens. Among those without health care coverage, a disproportionate number were minority youth (28% Hispanic and 16% African-American vs. 11% white) (75). Similarly, adolescents living in

poverty were half as likely to identify a regular source of health care services (76). The extent of these inequalities in health care is grave. Results of a national household survey conducted in the U.S. revealed statistically significant health inequalities between low-income adolescents and their middle- and higher-income counterparts for 3 out of 4 health status measures; 6 out of 8 measures of access to and satisfaction with care; and 6 out of 9 indicators of access to and use of medical care, dental care, and mental health care (77). These sociodemographic differences seem to go beyond financial coverage (i.e. insurance vs. no insurance), since similar inequalities in health care access have been observed among adult Canadian populations despite universal healthcare (59).

Adolescents encountered a significant number of barriers when attempting to access health services. Barriers that have been identified include: lack of knowledge of services offered, lack of relevant services, and inconvenient service locations (78-80). A major point of concern regarded confidentiality and communication with health workers. Specifically, adolescents were afraid that the details of their consultations would be revealed to their parents (81, 82) and that health providers would scold or ask difficult questions instead of providing guidance and reassurance (83, 84).

Adolescents rely heavily on EDs for the primary care needs because of these barriers. One study involving 426 adolescents in an urban pediatric emergency department in the U.S. found that only 18% of cases presented with true emergencies, whereas 27% presented for issues that could have been managed at the primary care level (85). The ED, however, is an acute care setting, and is thus inappropriate for comprehensive delivery of preventive services. Compared to adolescents who have a regular source of care, adolescents who primarily use EDs for primary care are less likely to have had regular preventive visits (75.0% vs. 86.3%; p=0.07) and more likely to report that they had not received medical attention when they felt they needed it (31.7% vs. 21.1%, p =0.04) (86).

The relationship between primary care access and ED visits seems inversely proportional. Primary care access for low-income children in North Carolina was improved by enrolling them into a new Medicaid care plan that assigned recipients to a single primary care provider. The assigned provider was responsible for providing all necessary preventive care, and patients had access to a telephone line twenty-four hours a day, seven days a week. A before-and-after comparison showed that the ED rates per 1000 children with Medicaid decreased by 24%

(p<0.001) (87). Continuity of primary care providers is also associated with a decreased likelihood of ED use. Adolescents who report having different sources of care for preventive and acute care were 1.8 times more likely to have received care in the emergency setting than those with a consistent source of health care for preventive and acute needs (74).

2.5 Primary Care Reform in Canada

Several government-commissioned reports in the early 2000s indicated that the existing primary care system was unable to cater to the health needs of the Canadian population. With health care spending mounting and public dissatisfaction with health care rising by the year, the government recognized the need to re-structure the health care system into one that could cut back on costs while providing more efficient and effective health care (1, 3, 6, 88).

Following those reports, Canada has been ensnared in a battle to reform the primary health care system. The federal government invested close to $17 billion into the Primary Care Transition Fund, and later the Health Reform Fund, to assist provinces and territories in reform efforts (6). The goals and objectives of reform are numerous, and vary for each province and territory. However, a primary theme among reform initiatives has been to increase accessibility, coordination, and integration of health care services by establishing inter-professional group practices and networks with extended clinical hours (6). In those jurisdictions where primary health care transformation has been the most far-reaching (for example, Ontario, Alberta, and Québec), system-wide implementation of such team-based models of care have already occurred.

Reform goals are in line with attributes of the primary care medical home, a vision for primary health care organizations that is being adopted internationally. The medical home is defined as a care setting where: 1) patients have a personal family physician who will be responsible for his or her care; 2) patients are offered a broad scope of services carried out by teams of inter-professional health care providers working together; 3) have access to timely appointments with family physician and with medical services needed outside of primary family practice; 4) the family practice is well supported through information technology like electronic medical records; 5) physician remuneration supports the model of care, and 6) the practice conducts ongoing quality evaluation to maintain a high level of care (4).

Primary care organization in Québec was traditionally dominated by solo and small group clinics, with little involvement of other health care professionals and large variation in opening

hours (89). In 2000, the Clair Commission painted a portrait of a fragmented and inaccessible primary health care system, and advocated for the reform of primary care with an impetus on preparing Québec's health care system for the increasingly aging population (1). Thirty-six recommendations and 59 proposals emerged from the report. Unfortunately, none of the recommendations focused on improving health care for adolescents, even though evidence suggests adolescents have different health care needs and wants compared to adults or children (32, 79). One of the major recommendations from the report was to reorganize the delivery of care by encouraging the formation of group family practices (1). This was well-received by the government and key stakeholders, and in response, the Family Medicine Group (FMG) model of primary care delivery was adopted (7).

FMGs consist of a group of six to10 FPs who practice in collaboration with nurses to provide care to registered patients, a model similar to that of Family Health Teams in Ontario and Primary Care Networks in Alberta (6). Since the primary rationale for creating FMGs was to increase the proportion of the Québec population with access to a FP, each physician is required to roster at least 1300 patients (7). In traditional health care models physicians were remunerated exclusively through fee-for-service; in contrast, FMGs employ a blended payment scheme that combines fee-for-service and capitation methods, with incentives for registering vulnerable patients (7). Adoption of an inter-professional team-based approach to care would allow improved coordination of services, reduced delays in appointments, extended hours, walk-in services available 365 days a year, on-call availability for complex and chronic disease cases, and increased availability for vulnerable patients (7). FMGs have been widely adopted throughout Québec, with 258 accredited clinics as of March 2014. The cost associated with FMG implementation is approximately $85 million (8). Considerable investment has been made, yet evaluations of the reformed model seem to suggest only minor improvements in primary care accessibility.

As aforementioned, primary care is primarily delivered by FPs, general internists, general pediatricians, and nurses. In Québec, different venues are available through which adolescents can obtain needed care. These include, but are not limited to: pediatric clinics, FMGs, non-FMGs, local community service centres (CLSCs), and school-based health centres. It is challenging to account for the care adolescents receive from CLSCs and school health professionals through billings data. Some FPs and nurses working in CLSCs and nurses

providing care in school settings are salaried and are not reimbursed through fee-for-service. Therefore, our study will focus on only four models of primary care: pediatricians, FPs in FMGs, FPs not in FMGs, and no primary care.

CHAPTER 3: LITERATURE REVIEW

3.1 Review Question

The quantitative literature review aims to answer the following question: what is the impact of primary health care reform on the accessibility of health care, as defined by emergency department visits, for Canadians?

3.2 Methods

The health-related database PubMed was searched to identify and retrieve relevant articles. The search strategy for PubMed was developed in partnership with a librarian. Initially, the search strategy employed four concepts: 1) primary health care, 2) health care reform, 3) accessibility, and 4) Canada. Search terms appropriate for each concept were developed and applied. This search strategy was too restrictive and retrieved only 16 articles Therefore, the search strategy was modified to encompass only two of the four concepts: 1) health care reform, and 2) Canada. Keyword search terms (primary care networks, family health teams, family medicine groups etc.) specific to Ontario, Québec, and Alberta where system-wide reform initiatives have been widely implemented were included in the health care reform concept.

The specific search terms used in the final search strategy can be found outlined in Appendix A. The search was limited to literature published from January 2000 to December 2016, to select for articles pertinent to the health care reform that was initiated in the early 2000s. Only primary research papers focusing on Canadian health care reform, and published in English or French, were included. Research protocols, policy briefs, and commentaries were excluded from the final analysis. Studies were excluded if they did not focus on a system-wide reform initiative. Pilot projects of organizational reforms were also excluded. Since our current study employed a quantitative design with ED visits as the primary outcome, only quantitative articles using ED visits as a proxy for accessibility were included. Studies also needed to contain appropriate control groups to allow for comparisons between reform intervention and the old model of care. No methodological limits were used during the searches.

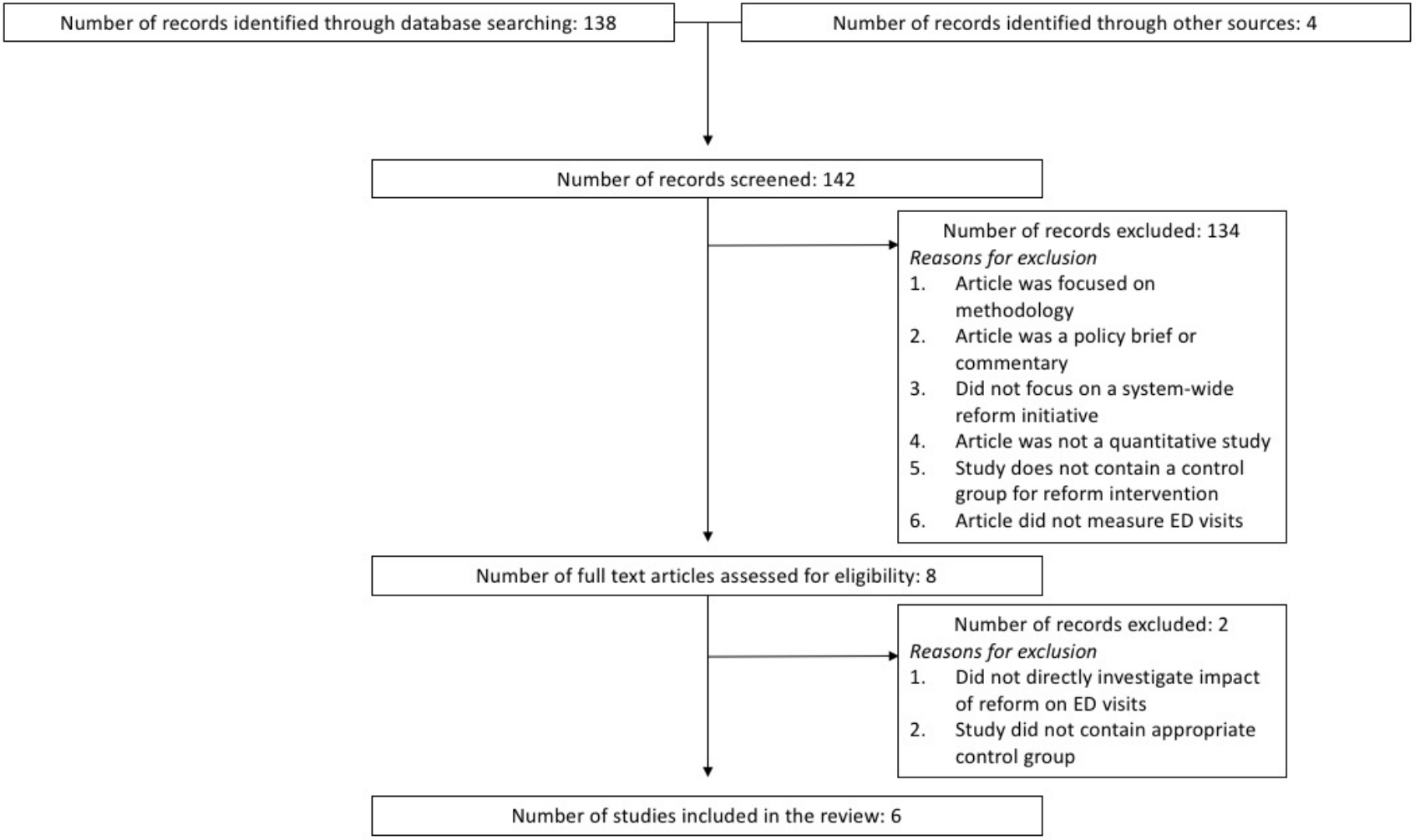
The results were imported into a bibliographic management software program (EndNote X7.5.3) to remove duplicates and keep track of the selection process. The search strategy executed in PubMed retrieved a total of 138 articles (Figure 1). An additional four articles were

identified through forward citation tracking of articles that met the eligibility criteria. The title and abstracts of these papers were initially screened to retain only empirical research investigating the impact of primary care reform in Canada on the accessibility of health care. Articles meeting any one of the exclusion criteria were removed, resulting in a total of eight articles. Full-text screening was performed, and two articles were disqualified because they did not directly link the reform to ED visits, and did not contain a control group that would allow for comparisons between the reform intervention and the previous model of care. Six articles were eligible to be included in the final stages of data extraction and synthesis. Information on the characteristics of the studies, as well as their key findings were extracted and recorded in an Excel file.

The initial goal of this quantitative review was to perform a meta-analysis using ED visits as the outcome measure of choice. After data extraction, however, it was apparent that the included studies were too heterogeneous in terms of the study design, the patient subpopulations included in analysis, as well as the reporting of the outcome measure to be able to combine the data to estimate a common effect.

Since synthesizing the included studies through a meta-analysis would not have led to any meaningful results, the main findings from the four articles were summarized through narrative synthesis. A narrative synthesis is an approach to the synthesis of findings from multiple studies relying primarily on the use of words and text to summarise and explain the findings of the synthesis. The narrative synthesis method has been previously used for reviews assessing the effects of interventions, and was thus determined to be an appropriate method for this quantitative review as well (90).

Figure 1 Flow Diagram of Study Selection Process



3.3 Results

Of the six included studies, two focused on the Primary Care Network (PCN) model of care implemented in Alberta, and the remaining four focused on the FMG model of care implemented in Québec. No studies of the impact of Family Health Team (FHT) model of care on ED utilization were found. The publication dates spanned 2012-2016. In all six of the studies, specific sub-populations of patients were studied. These included four studies of individuals with diabetes and two studies of patients with chronic conditions in general. All studies assessed independent associations between primary care reform models and the outcome of interest, and compared the defined intervention to a control group. See Table 1 for detailed study characteristics.

Enrolment in a Primary Care Network (PCN) in Alberta was associated with statistically significant decreases in ED visits. Campbell et al. used administrative data of Alberta residents with diabetes, to measure the association of PCN enrolment with ED visits for diabetes-specific conditions for two socioeconomically disadvantaged sub-populations and a First Nations sub-population (91). The study found that receiving care in a primary care network was associated with significantly lower rates of ED visits for diabetes-specific ambulatory care sensitive-conditions (ACSCs) for one of the socioeconomically disadvantaged groups (RR 0.71, 95% CI 0.54-0.94), the First Nations group (RR 0.74, 95% CI 0.59-0.93), as well as the general population (RR 0.75, 95% CI 0.67-0.85). Similarly, Manns et al. investigated the impact of enrolment in PCN on ED visits for diabetes-specific conditions. The results showed that patients affiliated with Primary Care Networks had a 18% reduction in the rate of avoidable ED visits compared to patients not enrolled in a PCN (RR 0.82, 95% CI 0.76-0.88) (92).

FMGs, on the other hand, seem to produce more modest reductions in ED visits than PCNs. Héroux et al. found enrolment in a FMG was associated with a decrease in the rate of visits to the ED among vulnerable patients defined by chronic disease or older age (RR 0.93, 95% CI 0.90-0.95) (93). Carter et al. showed that for every 10-percentage point increase in the population enrolled with an FMG in the year prior to an event, there was a 3% reduction among diabetic patients who had at most 1 visit to the ED per year (RR 0.97, 95% CI 0.95-0.99) (10). A second study by Carter et al. reported that the rate of avoidable visits to the ED per 10 000 diabetic patients per week decreased by 1% (RR = 0.99; 95 % CI = 0.98, 0.99) following FMG implementation (94). Finally, Strumpf et al. found that over a five-year follow-up period, the

number of ED visits did not significantly decline (2% reduction, $p>0.05$) among elderly and chronically ill patients enrolled in FMGs compared to those not enrolled in FMGs (95).

3.4 Conclusions

Overall, PCNs in Alberta were associated with decreases in ED visits among adult populations with chronic illnesses, but more modest decreases in ED visits were seen with FMGs. Studies investigating the impact of reform initiatives on adolescent patients, either with or without chronic illnesses, were not available.

Table 1 Characteristics of studies included in the literature review

Study				**Population**		**Method Details**			
Authors	*Year*	*Design*	*Province*	*Patient Population*	*N*	*Data Source*	*Study Follow-Up*	*Intervention Group*	*Outcome(s)*
Campbell et al.	2012	Population-Based Cohort study	Alberta	Low-income and First Nations diabetic patients	106,653	Administrative data from Alberta Health & Wellness	1 year	Individuals in the subpopulation of interest and enrolled in a Primary Care Network	ED visits for diabetes-specific ACSCs
Carter et al.	2016	Population-Based Before and after	Québec	Diabetic patients	336,052 in 2003-2004; 533,438 in 2011-2012	Administrative data from Québec Integrated Chronic Disease Surveillance System, Direction de l'organisation des services de première ligne intégrés, Institut de la statistique du Québec	8 years	Outcome measures in seven fiscal years following 2003-2004 (after Family Medicine Groups became more widespread)	Avoidable ED visits for diabetes
Héroux et al.	2014	Population-Based Cohort study	Québec	Vulnerable patients	231,938	Administrative data from Régie de l'assurance maladie du Québec	3 years	Individuals involved in a Family Medicine Group	General ED visits
Manns et al.	2012	Population-Based Cohort study	Alberta	Diabetic patients	154,928	Administrative data from Alberta Health & Wellness	1 year	Individuals involved in a Primary Care Network	ED visits for diabetes-specific ACSCs

Carter et al.	2016	Population-Based Before and After	Québec	Diabetic Patients	275,728 in 2000; 533,438 in 2011	Administrative data from Québec Integrated Chronic Disease Surveillance System	9 years	Outcome measures in the nine fiscal years following 2000-2002 (after implementation of Family Medicine Groups)	Avoidable ED visits for diabetes
Strumpf et al.	2016	Population-Based Before and After	Québec	Vulnerable Patients	797,248	Administrative data from Régie de l'assurance maladie du Québec	5 years	Individuals involved in a Family Medicine Group	General ED visits

CHAPTER 4: THESIS RATIONALE & OBJECTIVES

4.1 Rationale and Relevance of Study

There is growing international interest in the health of adolescents, as demonstrated by the 2014 report released by the World Health Organization describing why adolescents need tailored health care services, distinct from children and adults (32). All studies evaluating the impact of Québec primary care reform on the accessibility of care, as measured by ED visits, consisted solely of adult participants with chronic illnesses. Findings from adult populations cannot be directly translated to the adolescent sub-population since adolescents exhibit different health service use behaviors compared to adults or children (69, 70, 72, 73, 85, 96, 97). Evidence from studies conducted in the U.S. suggest adolescents have suboptimal access to primary care (69, 70, 72, 73, 78, 79, 85, 96, 97). Research must be conducted to see whether the same is true in Québec, and whether access to care differs among adolescents from different socioeconomic backgrounds. I aim to address these gaps in knowledge by examining whether the reformed FMG model of primary care is associated with decrease in ED use, an increase in primary care visits, and a decrease in health inequalities among adolescents compared to other models of care.

4.2 Objectives

The overall objective was to determine the extent to which the FMG model of primary care was associated with improved primary care accessibility, as measured by 1) emergency department visits and 2) primary care visits with the usual provider of primary care, among Québec adolescents aged 10-16 years old.

The specific aims of this thesis include:

1. Determine the proportion of adolescents seen within FMG, pediatric, non-FMG, or no primary care models.
2. Identify and quantify the main conditions for which adolescents enrolled in FMGs present at EDs, in comparison to pediatric, non-FMG, or no primary care models.

3. Determine the association between FMGs and accessibility of primary care, as measured by 1) ED visits, and 2) primary care visits with the same provider, in comparison to pediatric, non-FMG, or no primary care models.
4. Determine whether FMGs have reduced health inequalities in 1) ED visits and 2) primary care visits with the same provider between adolescents of high and low socioeconomic status in comparison to pediatric, non-FMG, or no primary care models.

CHAPTER 5: MANUSCRIPT

Accessibility of adolescent care in the context of primary care reforms in Québec, Canada

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5.1 Introduction

A strong primary care infrastructure promotes overall population health, resulting in lower mortality, healthier patients, and more equitable distribution of health (18, 98). For adolescent patients, who are undergoing a period of development in which risk factors for adult health are established, primary care remains a crucial platform through which health promotion and prevention messages can be delivered (11, 78). Access to effective primary care during this life stage may help to decrease the burden of chronic illnesses in adulthood (12-14). Among adolescents with lower socioeconomic backgrounds, primary care also presents an opportunity to mitigate the links between social and material deprivation and negative health outcomes (28). However, individuals of lower socioeconomic status (SES) consistently obtain fewer family physician (FP) visits than those of higher SES in Canada (99).

The medical home is seen as a promising way to improve primary care (4). Core features of the medical home include the delivery of patient-centered care through multidisciplinary teams, enhanced access for patients, care coordination, comprehensive services, and a focus on care quality (4). Widespread implementation of the medical home is underway in both the United States and Canada (4, 5).

Family Medicine Groups (FMGs) was a model of the medical home introduced in Québec in 2002 as a strategy to improve delivery of primary health care. They function through contractual agreement with Québec's regional health authorities (6, 7, 100). Six to 10 FPs work alongside nurses and administrative staff to provide multidisciplinary team-based care to registered patients (6). With the goal of increasing access, FMGs may offer enrolled patients on-call telephone services and even provide limited walk-in services to patients during holidays and weekends (100). The compensation model for FMGs is primarily fee-for-service, but places an emphasis on continuity of care and availability to vulnerable patients through supplementary per capita payments and incentive payments for registering vulnerable patients (7). As of March 2014, there were 258 accredited FMGs. The objective at the onset of the reform was to implement 300 FMGs and register at least 75% of the population with an FMG, although it is unclear when this target will be attained (8).

Early evaluations of the FMG model of care suggest modest improvements in the accessibility of primary health care services among adults (10, 93, 101). Visits to the emergency

department (ED) are often used as a proxy measure for access to health care (10, 91, 92). High rates of ED use have been attributed to patients turning to EDs for primary care because they do not have access to a regular FP or have trouble accessing them when needed (63). In Québec, lack of a primary care provider has been identified as a strong predictor of ED visits; elderly patients who receive a physical exam each year are less likely to visit the ED than those who do not (62). Among adults of older age or with chronic illnesses, enrollment in an FMG is associated with statistically significant decreases in ED use (10, 93, 94). Little is known, however, about the impact of FMGs on primary care experiences among adolescent populations. The primary objective of this study was to determine the association between the new medical home model and accessibility of primary care, as measured by 1) ED visits and 2) primary care visit with the same provider, among Québec adolescents aged 10-16 years old in comparison to traditional models of health care delivery (pediatricians or FPs practicing in non-FMGs). Secondary objectives included describing patient characteristics and the main conditions for which adolescent patients present to EDs, as well as determining whether enrollment in FMGs reduced health inequalities between adolescents of high and low SES.

5.2 Methods

Setting

Québec is the second most populated province in Canada with a population of approximately 8.3 million in 2016. All permanent residents have access to the Régie de l'assurance maladie de Québec (RAMQ), which covers a wide range of medical services that are rendered by a family physician (FP) or a medical specialist, including examinations, consultations, laboratory tests, and diagnostic procedures (102).

In Québec, adolescents may receive primary health care through a variety of venues, including but not limited to FPs practicing in FMGs, FPs practicing in non-FMGs, pediatricians, school health clinics, local community health services centres (CLSCs), walk-in clinics, or other public health venues. A core facet of the medical home model is to provide patients with continuity of care through the fostering of long-term relationships between patients and their health care provider (4). Sources of continuity of care for primary care services include pediatricians and FPs. School-based health clinics or CLSCs are unlikely to provide continuity of

primary care, because they rarely follow patients (89). Moreover, health services rendered in these venues cannot be measured by billing data since health care professionals working in these settings are not remunerated through fee-for-service. Therefore, only four sources of primary care were compared in this study: FPs in FMGs (intervention group), pediatric care, FPs in non-FMGs, and no primary care (control groups).

Study Design and Data Sources

We conducted a population-based, retrospective cohort study linking province-wide Québec health administration data for adolescents from 2010-2013. Health administrative data on patient's characteristics, visits to emergency departments, and use of physician services was obtained from the RAMQ and linked using an encrypted patient health identification number. RAMQ is the government body responsible for the administration of the provincial health insurance program, and reimburses physicians for services covered in the program. These include services provided in hospitals, medical offices, health centres, and the patient's home.

Study Population

We selected a cohort of adolescents 10 to 16 years of age on January 1, 2012 with valid Québec healthcare insurance for the study period of 2010 to 2013. All adolescents with administratively defined asthma, diabetes, and complex chronic diseases were selected. These three conditions account for a large proportion of common childhood chronic illnesses, and are associated with high health care utilization (103). Complex chronic diseases were defined as "any medical condition that can be reasonably expected to last at least 12 months (unless death intervenes) and to involve either several different organ systems or one organ system severely enough to require specialty pediatric care and probably some period of hospitalization in a tertiary care center" (104). We also included a random sample of adolescents without these conditions, characterized as "other".

Main Exposure

Individuals were assigned to one of four primary care models (no primary care, pediatricians, FPs in FMGs, and FPs not in FMGs) based on their Usual Provider of Primary Care (UPPC). To determine the UPPC, we retrieved all physician claims filed in the baseline

two-year period of January 1, 2010 to December 31, 2011 and examined them for billing codes identifying either a FP or pediatrician as a UPPC for each patient. If these codes were not found, we assigned the UPPC based on the provider who gave the most primary health care visits. If neither one of these two methods identified a UPPC, the patient was deemed to have no primary care. FPs practicing in FMGs were differentiated from those practicing in non-FMGs based on supplementary codes on physician claims identifying a medical clinic as an FMG. The detailed algorithm can be found in Appendix B. The algorithm used in this study is an adaptation of a validated version developed by the Institut national de santé publique du Québec (INSPQ) to identify patient attachment to a family physician in adults (105).

Outcomes

The primary outcome was emergency department (ED) visits made by a patient in the two-year outcome period of January 1, 2012 to December 31, 2013. We measured ED visits as a binary and continuous outcome. The binary outcome accounted for the probability of obtaining at least one ED visit, and the continuous outcome accounted for the rate of ED visits. The ICD-9 Québec diagnoses codes of all ED visits were retrieved to examine the reasons for ED use.

For those adolescents assigned to a pediatrician, FPs in FMGs, or FPs in non-FMGs, we also accounted for access to the UPPC through our secondary outcome of primary care visits with the UPPC. Primary care visits were administratively defined according to the algorithm presented in Appendix B. A binary outcome measured the probability of receiving at least one primary care visit in the outcome period. For pediatrician and non-FMG groups, only those primary health care visits with the UPPC were considered. For those enrolled in FMGs, primary care visits occurring in the same establishment were included since FPs in the same FMG may share patients.

Co-variables

We obtained sociodemographic data on age, sex, SES, rurality and health status. SES was measured with the Pampalon index, a validated ecologic measure of material and social deprivation that divides the population into quintiles (Q5 to Q1, most deprived to least deprived). The method matches the patient's postal code with census data on six indicators of deprivation (education, employment, income, marital status, single parenting and living alone) to create an

aggregate measure (106). To determine rurality, postal codes were linked to census data from Statistics Canada. Geographical areas were divided into urban, rural or intermediate zones. Intermediate zones were further divided into strong, moderate, or weak metropolitan influenced zones (MIZ), depending on the degree of influence from surrounding urban areas (107). Patients were classified into four different health status groups to account for any co-morbidities: asthma, diabetes, complex chronic diseases, or other. Not all co-morbidities are captured through this classification, but these RAMQ identifiable chronic conditions accounts for a large proportion of common chronic illnesses seen in childhood and are associated with high health care utilization (103). We also included previous ED visits as a co-variate, as an additional measure of high health care utilization.

Statistical Analysis

The individual patient was our unit of analysis. All data are presented and statistical analyses were performed with a weight that adjusted for design effects related to differential sampling of adolescents with or without comorbidities. The weight was calculated based on 2011 Québec population estimates to adjust the sample by health status to the Québec population. All adolescents in Québec with administratively defined asthma, diabetes, and complex chronic diseases were included. Therefore, a weight of 1 was added to these groups. Since a random sample of 256 942 patients characterized as "other" was received from a population total of 545 294, we assigned a weight value of 2.1231 (545 294/ 256 942) to these individuals.

We described variables and outcomes using proportions for counts, and means or medians (as appropriate for the distribution of the continuous data). ICD-9 diagnoses of all ED visits made in the 2012-2013 outcome period were obtained. ICD-9 codes occurring at a frequency of greater than or equal to 0.05% were selected and grouped using the PECARN tool into 21 major categories (see Appendix C for detailed methods). PECARN is a validated and clinically-relevant method for describing pediatric ED visits (108).

We tested the association between binary ED and primary care visit outcomes and primary care models using multivariable logistic regression analysis, from which we report the risk ratios and 95% confidence intervals (109). When outcomes are common and occur in greater than 10% of the unexposed population, as is the case with this study, the odds ratios are no longer a reasonable approximation of the risk ratios (110). To ease interpretation of results, we

opted to report the risk ratios rather than the odds ratios (111). Models were adjusted for the variables age, sex, health status, rurality, SES, and previous ED visits.

We initially used a multivariable zero-inflated Poisson regression model to test associations between the rate of ED visits with our primary exposure variable. The multivariable zero-inflated Poisson model was chosen because it is thought to be superior to the Poisson model when modeling for count data with excess zeroes (112). Comparison of the means and variance of the continuous outcome indicated the possibility of overdispersion. We used the Vuong statistic to examine whether the multivariable zero-inflated negative binomial model would be more appropriate than the zero-inflated Poisson (113, 114). In the end, the multivariable zero-inflated negative binomial model was chosen because it had superior fit over the zero-inflated Poisson. Results are reported in adjusted and unadjusted incidence rate ratios and 95% confidence intervals. Models were adjusted for the variables age, sex, health status, rurality, SES, and previous ED visits.

We also tested for the interaction between SES and primary care models. If the interaction term was significant at $p < 0.05$, we reran the multivariable models stratified by primary care models to explore in greater detail the effect of primary care models on health inequalities.

All statistical analyses were performed in SAS 9.4 (SAS Institute Inc., North Carolina).

5.3 Results

Descriptive analyses and identification of main reasons for ED use

Our study sample included 286 612 individuals. The weighted population totaled 574 964. All results presented in this manuscript are derived from weighted calculations. Table 2 displays the total patient characteristics, as well as patient characteristics within each primary care model. As of January 1, 2012, 43.5% of Québec adolescents had a primary care provider. The majority were enrolled in an FMG, followed by pediatric care, and then non-FMG. The "no primary care" group had a slightly higher percentage of adolescents without asthma, diabetes, or complex chronic diseases co-morbidities compared to adolescents in FMGs, pediatric care, or non-FMGs. Of the four models of care, pediatricians had the highest proportion of adolescents with co-morbidities. Within the pediatric model of care, a higher percentage of patients were from high socioeconomic backgrounds in comparison to FMG, no primary care, or non-FMG models. Across the four models, pediatricians had the highest percentage of patients from urban areas, whereas FMGs had a lower percentage of patients from urban backgrounds.

Table 3 displays the results of ED diagnoses categorized into PECARN categories. The top three common categories for adolescent use of ED were: 1) trauma, 2) gastrointestinal complaints, and 3) ear, nose, throat, dental, and mouth diseases. These three categories were the primary reasons for ED use across all four primary care models. Major diagnoses categorized under trauma include fractions or dislocations of any of the external limbs. Common gastrointestinal complaints include nausea, vomiting, or gastroenteritis. Conditions such as otitis media, laryngitis, or pharyngitis were categorized under ear, nose, throat, dental, and mouth diseases.

Table 2 Baseline characteristics of patients by primary care models

Characteristics	Primary care model				**All (n, %)** N = 574964 (100)
	FMG (n, %)	**No Primary Care (n, %)**	**Pediatrician (n, %)**	**Non-FMG (n, %)**	
	N = 113450 (19.7)	N = 324704 (56.5)	N = 78629 (13.7)	N = 58182 (10.1)	
Female (n, %)	59632 (52.3)	155940 (48.0)	36279 (46.1)	30142 (51.8)	281993 (49.1)
Age in years					
Mean	13.74	13.73	13.16	13.78	13.66
SD	2.91	2.87	2.75	2.90	2.03
Health status (n, %)					
Asthma	3625 (3.3)	2629 (2.3)	2954 (4.6)	2014 (3.6)	11222 (2.0)
Diabetes	295 (3.2)	754 (0.8)	284 (3.8)	245 (3.5)	1578 (0.3)
Complex chronic diseases	3783 (0.3)	7427 (0.2)	3593 (0.4)	2067 (0.4)	16870 (2.9)
Other	105747 (93.2)	313893 (96.7)	71798 (91.3)	53856 (92.6)	545294 (94.8)
Income quintile (n, %)					
Q5 (most deprived)	14391 (12.7)	59138 (18.2)	9740 (12.4)	10366 (17.8)	93636 (16.3)
Q4	18149 (16.0)	56012 (17.3)	11010 (14.0)	9609 (16.5)	94780 (16.5)
Q3	18852 (16.6)	49917 (15.4)	10047 (12.8)	8662 (14.9)	87479 (15.2)
Q2	26242 (23.1)	63347 (19.5)	15920 (20.3)	11518 (19.8)	117026 (20.4)
Q1 (least deprived)	26331 (23.2)	68125 (21.0)	25777 (32.8)	13374 (23.0)	133607 (23.2)
Missing	9485 (8.4)	6134 (8.7)	28164 (7.8)	4654 (8.0)	48436 (8.4)
Rurality (n, %)					
Urban	71068 (62.6)	235074 (72.4)	68639 (87.3)	44680 (76.8)	419461 (73.0)
Strong MIZ	12700 (11.2)	26780 (8.3)	3478 (4.4)	3530 (6.1)	46488 (8.1)
Moderate MIZ	8800 (7.8)	19302 (5.9)	3457 (4.4)	3856 (6.6)	35415 (6.2)
Weak MIZ	16284 (14.4)	29256 (9.01)	2540 (3.2)	4358 (7.5)	52438 (9.1)
Rural	4449 (3.9)	13808 (4.3)	438 (0.6)	1683 (2.9)	20378 (3.5)
Missing	150 (0.13)	483 (0.15)	77 (0.10)	74 (0.1)	784 (0.1)
Previous ED Visits					
Median	0.00	0.00	0.00	0.00	0.00
IQR*	0.00-1.00	0.00-0.00	0.00-1.00	0.00-1.00	0.00-1.00

* IQR = inter-quartile range

Table 3 ED diagnoses categorized into PECARN Major Groups

PECARN Major Group	FMGs (frequency, %)	No Primary Care (frequency, %)	Pediatrician (frequency, %)	Non-FMGs (frequency, %)	Total (frequency, %)
Trauma	11498 (32.6)	24107 (34.5)	6647 (37.23)	5607 (30.37)	47859 (33.80)
Gastrointestinal Diseases	4251 (12.04)	7357 (10.52)	2126 (11.91)	2419 (13.10)	16153 (11.41)
ENT, Dental & Mouth Diseases	3778 (10.7)	6622 (9.47)	997 (5.58)	1586 (8.59)	12983 (9.17)
Musculoskeletal & Connective Tissue Diseases	2222 (6.29)	4819 (6.89)	1074 (6.01)	1235 (6.69)	9350 (6.60)
Psychiatric and Behavioral Diseases & Substance Abuse	2118 (6.00)	4294 (6.14)	1313 (7.35)	1293 (7.00)	9018 (6.37)
Systemic States	2003 (5.67)	3543 (5.06)	682 (3.82)	908 (4.92)	7136 (5.04)
Absent Diagnosis	1488 (4.22)	3402 (4.86)	755 (4.23)	913 (4.94)	6558 (4.63)
Respiratory Diseases	1484 (4.20)	2884 (4.12)	968 (5.42)	927 (5.02)	6263 (4.42)
Skin, Dermatologic & Soft Tissue Diseases	1447 (4.10)	3258 (4.66)	626 (3.51)	645 (3.49)	5976 (4.22)
Neurologic Diseases	1355 (3.84)	2702 (3.86)	957 (5.36)	858 (4.65)	5872 (4.15)
Urinary Tract Diseases	1318 (3.73)	2201 (3.15)	381 (2.13)	690 (3.74)	4590 (3.24)
Other	499 (1.41)	1027 (1.47)	334 (1.87)	270 (1.46)	2130 (1.50)
Genital & Reproductive Diseases	496 (1.41)	1023 (1.46)	185 (1.04)	316 (1.71)	2020 (1.43)
Allergic, Immunologic &	497 (1.41)	918 (1.31)	291 (1.63)	285 (1.54)	1991 (1.41)

Rheumatologic Diseases					
Toxicologic Emergencies (including Environment)	293 (0.83)	707 (1.01)	231 (1.29)	213 (1.15)	1444 (1.02)
Endocrine, Metabolic & Nutritional Diseases	113 (0.32)	330 (0.47)	122 (0.68)	101 (0.55)	666 (0.47)
Diseases of the Eye	223 (0.63)	244 (0.35)	76 (0.43)	79 (0.43)	622 (0.44)
Circulatory & Cardiovascular Diseases	129 (0.37)	263 (0.38)	64 (0.36)	83 (0.45)	539 (0.38)
Hematologic Diseases	62 (0.18)	259 (0.37)	27 (0.15)	24 (0.13)	372 (0.26)
Fluid & Electrolyte Disorders	25 (0.07)	0 (0.00)	0 (0.00)	12 (0.06)	37 (0.03)

Associations between ED visits and primary care models

Table 4 describes the distribution of ED visits among adolescents across the four models of primary care. Less than 30% of Québec adolescents had at least one ED visit from 2012-2013. FMGs and non-FMGs had the highest percentage of adolescents with ED visits, whereas the no primary care and pediatric models had lower percentages of adolescents with ED visits. The mean and median number of ED visits across the four models of care were similar.

The multivariable logistic regression analysis showed that adolescents who received primary care from pediatricians or received no primary care were less likely to have at least one visit to an ED compared to those receiving care from an FMG. There was no significant difference in the risk of having at least one visit to an ED between FMGs and non-FMGs (Table 5). Males were more likely to have a visit to the ED than females. Compared to the most deprived (Q5) adolescents, those who were of higher SES (Q1, Q2, Q3, or Q4) were less likely to have a visit to the ED. Adolescents living in less urban areas (strong MIZ, moderate MIZ, weak MIZ, or rural) were more likely to have a visit to the ED than those living in urban areas. Adolescents were also more likely to have a visit to the ED if they had asthma, diabetes, or complex chronic diseases.

Similarly, the multivariable zero-inflated negative binomial regression analysis showed that adolescents who received primary care from pediatricians or received no primary care had lower rates of visits to an ED compared to those receiving care from an FMG (Table 6). However, there were no significant differences between FMGs and non-FMGs. Interestingly, in contrast to the trend observed in the logistic regression, males exhibited lower rates of ED use than females. With rurality and health status co-variates, the same pattern in the rates of ED visits was observed as with the binary ED outcome. Adolescents from less urban areas had higher rates of ED visits than those from urban areas. Patients with asthma, diabetes, or complex chronic diseases had higher rates of ED visits than those categorized as other. In terms of material and social deprivation, adolescents in Q4, Q3, Q2, and Q1 had statistically lower rates of visits to the ED compared to those in Q5. The interaction term between SES and primary care models was not significant at $p > 0.05$ for both logistic and zero-inflated negative binomial regression models.

Table 4 Emergency department visits by primary care model

	Primary Care Model				**Total**
	FMG (N=113450)	**No Primary Care** (N=324703)	**Pediatrician** (N= 78629)	**Non-FMG** (N=58182)	
% Yes	33.33	26.83	26.37	32.18	28.59
Median	0.00	0.00	0.00	0.00	0.00
IQR*	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00

*IQR = inter-quartile range

Table 5 Multivariable logistic regression testing association between primary care model and ED visits (yes/no)

Independent Variable	Levels	Risk Ratio (unadjusted)	Risk Ratio (adjusted)	95% Confidence Interval
Intercept			0.148	0.141, 0.155
Primary Care Models	FMGs	Reference	Reference	Reference
	No Primary Care	0.807	0.872	0.858, 0.886
	Pediatrician	0.789	0.936	0.916, 0.957
	Non-FMG	0.964	1.011	0.984, 1.038
Age		1.049	1.043	1.039, 1.047
Gender	Female	Reference	Reference	Reference
	Male	1.018	1.023	1.010, 1.036
Material & Social Deprivation	Q5 (most deprived)	Reference	Reference	Reference
	Q4	0.996	0.973	0.954, 0.992
	Q3	1.014	0.956	0.937, 0.975
	Q2	0.918	0.935	0.917, 0.953
	Q1 (least deprived)	0.809	0.889	0.871, 0.906
Rurality	Urban	Reference	Reference	Reference
	Strong MIZ	1.606	1.531	1.501, 1.561
	Moderate MIZ	1.197	1.171	1.142, 1.201
	Weak MIZ	1.581	1.491	1.462, 1.521
	Rural	2.066	1.847	1.795, 1.900
Health Status	Other	Reference	Reference	Reference
	Asthma	1.536	1.314	1.253, 1.379
	Diabetes	1.777	1.571	1.487, 1.658
	Complex chronic diseases	1.469	1.271	1.225, 1.319
Previous ED Visits		1.073	1.065	1.057, 1.074

Table 6 **Zero-inflated negative binomial regression testing association between primary care model and rate of ED visits (count)**

Independent Variable	Levels	Incidence rate ratio (unadjusted)	Incidence rate ratio (adjusted)	95% Confidence Interval
Intercept			0.348	0.324, 0.374
Primary Care Models	FMGs	Reference	Reference	Reference
	No Primary Care	0.735	0.893	0.874, 0.913
	Pediatrician	0.669	0.900	0.872, 0.928
	Non-FMG	0.937	0.984	0.954, 1.016
Age		1.092	1.063	1.058, 1.067
Gender	Female	Reference	Reference	Reference
	Male	0.710	0.799	0.784, 0.813
Material & Social Deprivation	Q5 (most deprived)	Reference	Reference	Reference
	Q4	0.971	0.960	0.933, 0.988
	Q3	0.980	0.929	0.902, 0.956
	Q2	0.830	0.883	0.859, 0.908
	Q1 (least deprived)	0.736	0.851	0.827, 0.875
Rurality	Urban	Reference	Reference	Reference
	Strong MIZ	1.363	1.329	1.292, 1.368
	Moderate MIZ	1.061	1.079	1.039, 1.120
	Weak MIZ	1.474	1.409	1.371, 1.448
	Rural	2.160	1.519	1.494, 1.544
Health Status	Other	Reference	Reference	Reference
	Asthma	1.268	1.768	1.705, 1.833
	Diabetes	1.513	1.315	1.201, 1.440
	Complex chronic diseases	1.299	1.216	1.173, 1.260
Previous ED Visits		1.144	1.119	1.115, 1.123

Associations between primary care visits and primary care models

Only FMG, non-FMG, and pediatrician models of care were considered in analyses of primary care visits. Table 7 describes the distribution of adolescents with primary care visits across the four models of primary care. The pediatric model had the highest percentage of patients with at least one primary care visit, whereas the FMG model had the lowest.

Table 8 displays the multivariable logistic regression analysis testing associations between primary care models and having at least one primary care visit. Patients receiving care from FMGs were less likely to have a primary care visit compared to those receiving care from pediatricians or non-FMGs. Male patients were less likely to receive a primary care visit than female patients. Compared to the most deprived adolescents (Q5), those of higher SES (Q4, Q3, Q2, Q1) had a statistically higher likelihood of obtaining a primary care visit. Adolescents residing in weak MIZ or rural areas had lower rates of primary care visits than adolescents residing in urban areas, but those living in strong MIZ and moderate MIZ areas exhibited slightly higher rates of primary care visits than adolescents from urban areas. Adolescents with asthma or complex chronic diseases were more likely to have primary care visits than adolescents characterized as other. However, diabetic patients displayed the opposite; they were less likely to obtain primary care visits than adolescents in the "other" category.

The interaction term between SES and primary care models was significant at $p < 0.05$. Results from stratified analyses of the multivariable model is displayed in Table 9. A gradient was observed across all primary care models, wherein those who were least socially and materially deprived were more likely to receive primary care compared to those who were most deprived. Gaps in access to care across SES quintiles were comparable between FMG and pediatric models (Graph 1). Compared to non-FMGs, FMGs reduced health inequalities between the lowest (Q5) and highest (Q1) SES groups. There were no significant differences in health inequalities between Q5 and other income quintiles (Q2, Q3, Q4) in the FMG versus the non-FMG model (Graph 1).

Table 7 Primary care visits by primary care model

	Primary Care Model			**Total**
	FMG (N=113450)	**Pediatrician** (N= 78629)	**Non-FMG** (N=58182)	
Visit with UPPC (n, %)	61526 (54.23)	55345 (70.39)	35613 (61.21)	152483 (60.93)

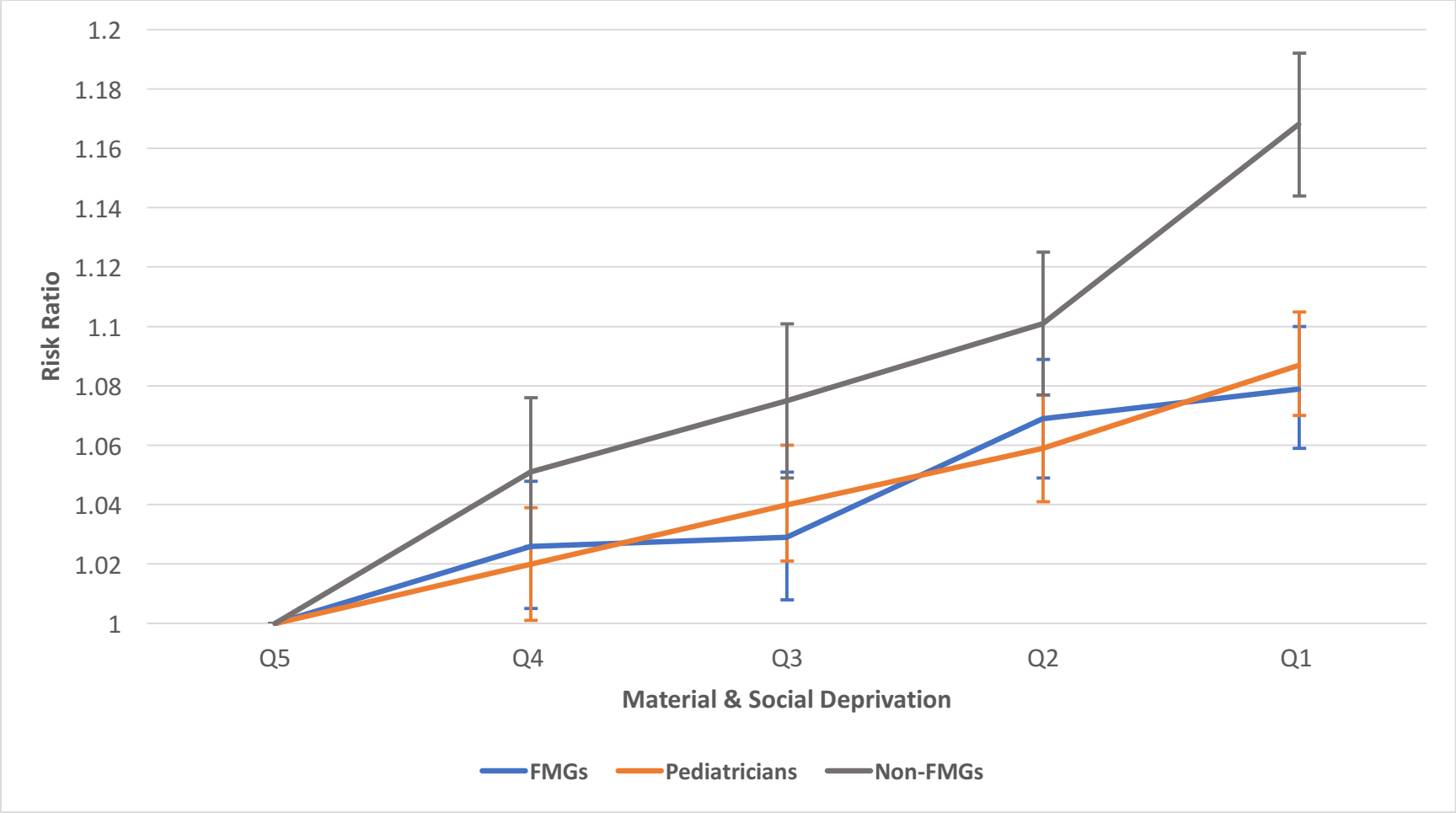
Table 8 **Multivariable logistic regression testing association between primary care model and primary care visits (yes/no)**

Independent Variable	Levels	Risk Ratio (unadjusted)	Risk Ratio (adjusted)	95% Confidence Interval
Intercept			0.583	0.569, 0.596
Primary Care Models	FMGs	Reference	Reference	Reference
	Pediatrician	1.298	1.294	1.281, 1.308
	Non-FMG	1.128	1.117	1.105, 1.129
Age		0.991	0.994	0.992, 0.996
Gender	Female	Reference	Reference	Reference
	Male	0.920	0.921	0.915, 0.927
Material & Social Deprivation	Q5 (most deprived)	Reference	Reference	Reference
	Q4	1.025	1.023	1.009, 1.036
	Q3	1.033	1.029	1.012, 1.045
	Q2	1.075	1.066	1.042, 1.090
	Q1 (least deprived)	1.131	1.005	1.002, 1.008
Interaction between Primary Care Models, Material & Social Deprivation			1.005	1.002, 1.008
Rurality	Urban	Reference	Reference	Reference
	Strong MIZ	0.972	1.034	1.021, 1.046
	Moderate MIZ	1.013	1.060	1.047, 1.073
	Weak MIZ	0.859	0.940	0.928, 0.953
	Rural	0.768	0.853	0.830, 0.876
Health Status	Other	Reference	Reference	Reference
	Asthma	1.101	1.093	1.077, 1.110
	Diabetes	0.796	0.787	0.731, 0.846
	Complex chronic diseases	1.039	1.023	1.007, 1.039
Previous ED Visits		0.992	0.996	0.994, 0.997

Table 9 **Multivariable logistic regression testing association between primary care model and primary care visits (yes/no), stratified by primary care models**

	FMGs		Pediatricians		Non-FMGs	
	RR	95% CI	RR	95% CI	RR	95% CI
Q5	Reference	Reference	Reference	Reference	Reference	Reference
Q4	1.026	1.005, 1.048	1.020	1.001, 1.039	1.051	1.026, 1.076
Q3	1.029	1.008, 1.051	1.040	1.021, 1.060	1.075	1.049, 1.101
Q2	1.069	1.049, 1.089	1.059	1.041, 1.077	1.101	1.077, 1.125
Q1 (least deprived)	1.079	1.059, 1.100	1.087	1.070, 1.105	1.168	1.144, 1.192

Graph 1 **Primary care visits across material & social deprivation quintiles, stratified by primary care models**



5.4 Discussion

Main Findings

We observed that 56.5% of Québec adolescents did not have a usual provider of primary care. Most adolescents were enrolled in FMGs, then with pediatricians, and then in non-FMGs. Patients across all models of care mainly frequented the ED for conditions related to trauma, gastrointestinal complaints, or ear, nose, throat, dental, and mouth diseases. Overall, FMGs were not associated with increased accessibility. ED visits between adolescents enrolled in FMGs compared to those in non-FMGs did not significantly differ, but adolescents seen within pediatric models of care had fewer ED visits than those in FMGs. Adolescents enrolled in FMGs were also less likely to obtain a primary care visit compared to those receiving care from pediatricians or non-FMGs. Gradients in primary care visits across SES quintiles were observed across all models of care: the most deprived adolescents had a lower likelihood of receiving a primary care visit compared to adolescents of higher SES. Non-FMGs had the greatest gap in access to primary care visits between the lowest and the highest SES groups, whereas the pediatric and FMG models had comparable gradients.

Interpretation

More than half of Québec adolescents did not have a usual provider of primary care. Suboptimal access to primary care for adolescents has been noted in numerous studies published in international contexts (69-74). Despite a universal healthcare system, Canadian adolescents seem to experience similar difficulties in gaining access to a regular source of primary care. A lack of focus among Canadian health policies and reform initiatives on improving health care for adolescent populations may explain these issues (1, 3). Failure to provide primary care in adolescence is a missed opportunity to better overall population health. Risk factors for adult health are established in adolescence (11, 32). Delivery of effective and timely primary care with a focus on health promotion and prevention has the potential to positively impact the life trajectories of patients, leading to improved health care outcomes in adulthood (12-14).

FMGs were not associated with reductions in ED visits compared to pediatric, non-FMGs, or no primary care models. Previous literature investigating the impact of FMGs showed

minor reductions in ED visits for ambulatory care sensitive conditions (ACSCs) among adult populations defined by older age or chronic illnesses (10, 93, 94). The same improvement was not seen in our study. This discrepancy may be explained by the relatively healthy morbidity profile of adolescent populations compared to that of adults. FMGs are a team-based medical home model with a focus on chronic illness management (1). Among adolescent patients with low burden of chronic illnesses, the FMG model may provide little benefit in primary care accessibility compared to traditional models of care. Future work should aim to identify facets of current Québec primary care delivery that hinders adolescents from obtaining timely access to primary care.

We observed that adolescents primarily visited the ED for reasons related to trauma, gastrointestinal complaints, or ear, nose, throat, dental, and mouth diseases. Although we were not able to differentiate between urgent and non-urgent ED visits in our data, some of the common diagnoses under these categories included otitis media, gastroenteritis, and infectious diseases of the upper respiratory tract, which are potentially treatable in the primary care setting (115-117). Compared to treatment by a primary care provider, the cost of treating these conditions is higher if administered in the ED (23). Diverting the care of these conditions to urgent care walk-in clinics in FMGs is a potential strategy to reduce at least a portion of adolescent visits to the ED and thereby decrease the cost incurred on the health care system.

Similarly, FMGs were not associated with improved likelihood of obtaining primary care visits compared to traditional models of care. Despite the recommendation for one preventive visit every one to two years for children and adolescents aged six to 17 years old by the Canadian Paediatric Society, our study showed that for FMGs, pediatric, and non-FMG models, almost 40% of adolescent patients did not receive primary care visits with their usual provider of care (118). Regular preventive care has been linked to decreased ED use in previous studies (64, 87). It is possible that we underestimated the proportion of adolescents with primary care visits in FMGs, since nurse practitioners have a larger role in FMGs compared to traditional models of care and may provide a portion of primary care alongside FPs (6, 7). We were unable to account for all visits with nurse practitioners in the health administrative billing data. Despite this limitation, FMGs were not associated with improvements in access in terms of reduced ED visits.

FMGs reduced the gap in access to primary care visits between the lowest and highest SES groups compared to non-FMGs, but did not have an impact on health inequalities for ED visits. Although FMG physicians were offered incentives for registering vulnerable patients, SES was not considered a criterion for vulnerability by the Québec health care system administrative guidelines (89). Implementing measures to favor the enrollment of, and provision of services to, socioeconomically disadvantaged individuals could lead to a more profound impact of the new medical home model in reducing gaps in access across the SES gradient.

In the United States, medical homes for children with special needs has been associated with lower odds of ED use, higher likelihood of annual preventive care visits, and a reduction in health care inequalities compared to having neither a medical home or usual source of care (119, 120). In international contexts, the medical home model has been linked to more widespread benefits in improving quality of primary care for adolescents compared to what we have observed with a similar model implemented in Québec. It is outside the scope of our study to hypothesize why this discrepancy exists. Our study explores only a partial picture of accessibility through the measurement of health services use. Accessibility is a complex construct, with many dimensions and factors that interact to influence whether health services can be reached physically and in a timely manner. Some of these include: characteristics of facilities, characteristics of providers, as well as the degree of health literacy and knowledge of health services among adolescent patients (53). These other facets of accessibility need to be studied to understand exactly why FMGs were not associated with improvements in primary care receipt and ED use compared to other models of care.

Limitations

Assessing the effectiveness of interventions is best done using randomized controlled trials. The retrospective population-based cohort study design prevents us from establishing causality, but the large sample size suggests our findings are likely to capture associations seen in the actual population. We only accounted for primary care services obtained through pediatricians or FPs; it is possible that adolescents received continuity of primary care through other sources such as school health clinics, CLSCs, or pharmacies. We could not obtain this information through our administrative data. Physician demographic information such as age, sex, years since graduation, and whether they are internationally trained have been previously

shown to be predictors of physicians joining an FMG (121). These characteristics may influence the quality of primary care services, and the degree to which the services are adolescent-friendly. Physician co-variates were not included in our models because the data was unavailable. Although there are many other co-morbidities in adolescence, we only accounted for asthma, diabetes, and complex chronic diseases because they are identifiable in health administrative data through validated algorithms and account for significant morbidity and costs. The health administrative data did not allow for differentiation between urgent and non-urgent ED visits. However, we examined the main conditions for which adolescents present to EDs, to help interpret the urgency of these visits. The algorithm we used to administratively assign patients into primary care models has not yet been validated. However, it was created in conjunction with clinicians and is an adaptation of an algorithm developed by the INSPQ to identify patient attachment to a family physician in adults (105). Lastly, the algorithm assigned a usual provider of primary care based on the concept that this physician is someone who routinely provided primary care and played a role in the primary care medical home of the adolescent. Therefore, if an adolescent had a primary care provider but did not visit their provider during the 2-year exposure period, they would have been categorized in the "no primary care" group. Despite these limitations, our population-based study provides novel insight into experience with a new medical home model implemented in a large area served by a universal health care system.

5.5 Conclusions

The FMG model of care was not associated with decreased ED visits and increased likelihood of obtaining primary health care visits. Compared to non-FMGs, FMGs reduced inequalities in primary care visits between adolescents of the highest and lowest SES, but had no impact on inequalities in ED visits. Although FMGs have been linked to minor improvements in access among adults, the same benefit was not seen with the adolescent population. The current study identifies gaps in accessibility of adolescent primary care. Future studies should ascertain and address the barriers and enablers of adolescent primary care accessibility.

CHAPTER 6: RECOMMENDATIONS

1. Approximately 57% of Québec adolescents did not have a usual source of primary care. The model of pediatrics developed by the Canadian Paediatric Society states that all children and adolescents must have a primary care provider (122). The proportion of adolescents with a primary care provider, ideally within a medical home, must be increased.
2. Two of the three most common conditions related to ED use was gastrointestinal complaints and ear, nose, throat, dental, and mouth diseases. Some common diagnoses under these categories, including gastroenteritis and otitis media, were primary care treatable conditions (116, 117). Effective and timely health care in the primary care setting could prevent at least a portion of adolescent visits to the ED.
3. The FMG model of care was not associated with decreased ED visits among adolescent patients, which is contrary to the reductions in ED visits found among adult patients defined by chronic illness or older age (10, 93, 94). Strategies to improve primary care for vulnerable adult patients may not benefit relatively healthy adolescent patients. Existing models of care need to be equipped with strategies to make primary health care services adolescent-friendly and more accessible to adolescent patients.
4. The FMG model of care was not associated with improved likelihood of obtaining primary care visits. Compared to traditional models of care, FMGs had the lowest percentage (54%) of adolescents receiving a primary care visit within a two-year period. The Canadian Paediatric Society recommends children receive one preventive visit every one to two years until 17 years of age (118). All models of care, but FMGs especially, need to improve on the delivery of preventive care for adolescent patients.
5. FMGs only slightly reduced inequalities in access compared to non-FMGs. FMGs had no impact on reducing inequalities in ED visits, and for primary care visits, reduced the gap between the most (Q5) and the least (Q1) deprived groups but not with other income quintiles. Implementing incentives in FMGs models of care for rostering disadvantaged adolescent patients could lead to a more profound reduction in inequalities in access across the SES gradient.

6. Further research needs to be done to obtain a more complete understanding of the accessibility of primary care for adolescents in Québec. Survey or qualitative data could shed insight into the following: 1) role of nurses and virtual consultations in FMGs, 2) health literacy of adolescents, 3) perceived need for health care among adolescents, and 4) perspectives of adolescents on the quality and accessibility of primary care.

APPENDIX A: LITERATURE REVIEW

A.1 Eligibility Criteria

Inclusion criteria

1. Articles are empirical (original research)
2. Study focuses on the Canadian primary health care reform
3. Study assesses impact of reform on accessibility, as defined by emergency department visits
4. Article was quantitative

Exclusion criteria

1. Articles are methodological papers or protocols
2. Articles are policy briefs, editorials/commentaries
3. Study did not focus on a system-wide reform initiative
4. Article focused on pilot projects of organizational reforms
5. Study did not contain an appropriate control group for the reform intervention
6. Article was not quantitative
7. Article did not employ ED visits as a proxy for accessibility
8. Not published in English or French

A.2 Search Strategy

1. Care, primary health [Mesh] OR health care reform[Mesh] OR family medicine group* [Title/Abstract] OR groupe de médecine familiale [Title/Abstract] OR network clinic* [Title/Abstract] OR integrated network clinic* [Title/Abstract] OR clinique* réseau* intégrée* [Title/Abstract] clinique* réseau*[Title/Abstract] OR family health team* [Title/Abstract] OR family health organization* [Title/Abstract] OR family health group*[Title/Abstract] OR primary care network* [Title/Abstract]
2. Canada [Mesh] OR Canad*[Title/Abstract]
Complete search strategy: 1 and 2

APPENDIX B: DETAILED METHODS

B.1 Data Sources

Information from three RAMQ databases were obtained:

1. Registered persons database
    a. Contains the encrypted health identification number, age, sex, postal code, and healthcare region of residence for all insured patients in Québec
2. Physician claims database
    a. Contains information for every remunerated medical service or "claim" provided by a physician
    b. Includes information on the patient (health identification number, age, sex, postal code, healthcare region of residence) and the service delivered (date, physician specialty, diagnostic codes, billing codes, establishment, region of establishment, role during execution of service, and documents any referring professionals)
3. Hospital discharge summary database (Maintenance et exploitation des données pour l'étude de la clientèle hospitalière, Med-Echo)
    a. Contains information on all hospitalizations in acute care institutions within the province of Québec since 1980 (123)
    b. Each record includes patient information (health identification number, age, sex, postal code), dates of admission and discharge, length of stay, and diagnosis as coded by the International Classification of Diseases, Ninth Revision, Québec (CIM-9)

The data from the three databases was linked by the RAMQ for each patient using the encrypted patient health identification numbers.

B.2 Study population

The study population is a combination of two separate sub-cohorts:

1. Sub-cohort 1: All Québec adolescents with a valid Québec healthcare card from 2010-2013 and aged 10-16 on January 1st, 2012 with asthma, diabetes, or complex chronic diseases.
2. Sub-cohort 2: A random sample of adolescents with a valid Québec healthcare card from 2010-2013 and aged 10-16 on January 1st, 2012 without asthma, diabetes, or complex chronic diseases.

Any adolescents with at least two medical services or at least one hospitalization during the baseline period (2010-2011) with a diagnosis or intervention related to asthma, diabetes, or complex chronic diseases were defined as having these conditions. All the ICD-9 Québec diagnosis codes used to identify asthma, diabetes, or complex chronic diseases are outlined in Table B.2.1. Codes for interventions related to complex chronic diseases are listed in Table B.2.2. and Table B.2.3. We adjusted for the differential sampling of individuals in sub-cohort 1 and sub-cohort 2 by calculating a weight based on 2011 Québec population estimates. On application of the weight, our study sample reflected the actual Québec population distribution of morbidities. Since all adolescents in Québec with administratively defined asthma, diabetes, and complex chronic diseases were included, a weight of 1 was added to this group. Since a sample of 256 942 patients with "other" health status was received from a population of 545 294 patients, a weight value of 2.1231 (545 294/ 256 942) was assigned to sub-cohort 2.

Table B.2.1 ICD-9 Québec diagnostic codes to identify asthma, diabetes, or complex chronic diseases

Code	Description
ASTHMA	
493x	Asthma
COMPLEX CHRONIC DISEASES	
042x	HIV
043x	HIV
044x	HIV
2594	Dwarfism
270x	Metabolism troubles
271x	Metabolism troubles
272x	Metabolism troubles
277x	Metabolism troubles
279x	Immune troubles
319x	Mental Retardation
330x	Cerebral Degeneration
331x	Cerebral Degeneration
332x	Parkinson
333x	Extrapyramidal movement disorders
334x	Hereditary ataxia
335x	Spinal muscular atrophy and related syndromes
336x	Other diseases of spinal cord
337x	Other disorders of nervous system in diseases classified elsewhere
343x	Infant Cerebral Palsy
344x	Other paralytic syndromes
345x	Epilepsy
426x	Conduction disorders
555x	Regional enteritis
556x	Ulcerative colitis
585x	Chronic renal failure
740x	Anencephaly and similar malformations
741x	Spina bifida
742x	Encephalocele
745x	Congenital malformations of cardiac chambers and connections
746x	Congenital malformations of pulmonary and tricuspid valves
748x	Congenital malformations of nose
7503	Atresia of esophagus without fistula
751x	Other congenital malformations of intestine
753x	Renal agenesis and other reduction defects of kidney
758x	Down's syndrome
770x	Congenital pneumonia
140x to 239x	Neoplasms

2750 to 2753	Disorders of mineral metabolism
2772 to 2776	Disorders of purine and pyrimidine metabolism
2778	Disorders of porphyrin and bilirubin metabolism
2779	Other metabolic disorders
2820 to 2824	Other hereditary haemolytic anaemias
2826	Sickle-cell disorders
2881 to 2882	Functional disorders of polymorphonuclear neutrophils
318x	Mental retardation
3488	Other affections of the encephalon
3489	Affection of the encephalon, not otherwise specified
3590 to 3593	Other diseases of blood and blood-forming organs
4250 to 4254	Myocarditis and cardiomyopathy
4259	Cardiomyopathy due to drugs and other external agents
4270 to 4274	Cardiac arrythmias
4276	Atrial premature depolarization
4278	Sick sinus syndrome
4279	Cardiac arrhythmia, unspecified
4291	Myocardial degeneration
5513	Diaphragmatic hernia
5523	Diaphragmatic hernia
5533	Diaphragmatic hernia
5714 to 5719	Chronic hepatitis, cirrhosis and fibrosis of liver
7373	Scoliosis
7470 to 7474	Congenital malformation of great arteries and veins
7560 to 7567	Other congenital malformations of skeletal system
7597 to 7599	Other congenital malformations, not elsewhere classified
5696	Enterostomy malfunction
5190	Tracheostomy malfuntion
V539	Device adjustment, not otherwise specified
V550	Trancheostomy surveillance
V551	Gastrostomy surveillance
V552	Ileostomy surveillance
V553	Colostomy surveillance
V555	Cystostomy surveillance
V556	Surveillance of other artificial orifices (urinary tract)
V560	Surveillance of dialysis (outside body)
V568	Surveillance of intermittent dialysis
V451	Kidney dialysis
V535	Ileostomy adjustment
V450	In situ pacemaker
V435	Bladder replacement, not otherwise specified
V431	Crystalline replacement, not otherwise specified
V438	Organs/tissue replacement, not otherwise specified
V436	Joint replacement, not otherwise specified

9961	Mechanical complication of prosthesis, implant, or vascular graft, not otherwise specified
V440	Tracheostomy
V441	Gastrostomy
V442	Ileostomy
V443	Colostomy
V445	Cystostomy
V446	Opening of artificial urinary tract, not otherwise specified
V450	In situ pacemaker
V451	Kidney dialysis
V530	Placing / adjusting other apparatuses, appar. with nerve and sensory organs
V535	Ileostomy adjustment /disp.intest.
V550	Trancheostomy surveillance
V551	Gastrostomy surveillance
V552	Ileostomy surveillance
V553	Colostomy surveillance
V555	Cystostomy surveillance
V556	Surveillance of artificial orifice, urinary tract, not otherwise specified
V560	Surveillance of dialysis (outside body)
V568	Surveillance of intermittent dialysis
9961	Mechanical complication of prosthesis, implant, or vascular graft, not otherwise specified
DIABETES	
250x	Diabetes

Table B.2.2 CCA-Québec codes to identify interventions for complex chronic diseases

Code	Description
5519 5529	Temporary gastrostomy Permanent gastrostomy
5839	Enterostomy, not otherwise specified
1036	Irrigation of gastrostomy/enterostomy
5652	Closure of gastrostomy
1151	Tube extraction of gastrostomy
1152	Extraction of tube in small intestine
4319	Temporary tracheostomy
4329	Permanent tracheostomy
1123	Tracheostomy tube replacement
1139	Extraction of therapeutic apparatus in head/neck, not otherwise specified
4339	Incision of larynx/trachea
1531	Ventricular derivation to the head/neck
1532	Ventricular derivation to the circulatory system
1533	Ventricular derivation to the thoracic cavity
1534	Ventricular derivation to the intra-abdominal cavity
1539	Establishment of ventricular derivation
1541	Ventricular shunt irrigation
1542	Ventricular shunt replacement
1543	Removal of ventricular shunt
1694	Removal of neurostimulator
1698	Removal of device from meninges
1699	Therapeutic intervention for central nervous system
1661	Lumbar peritoneal shunt
1669	Pleuro-thecal shunt
1690	Implantation of catheter in spinal canal/meninges
1693	Implantation of nuerostimulator in spinal canal/meninges
1697	Management of an internal device
5811	Colostomy SAI
5823	Permanent ileostomy
5127	Arteriovenostomy for dialysis
1052	Nephrostomy/pyelostomy
5195	Hemodialysis
6698	Peritoneal dialysis
6693	Implantation of catheter in abdominal cavity
1053	Ureterostomy irrigation
7199	Operation on urinary apparatus, not otherwise specified
5142	Arteriovenous shunt for dialysis
1161	Removal of pyelostomy/nephrostomy tube
4971	Pacemaker implant, not otherwise specified
49743	Cardiovascular/total system defibrillator implant
4983	Pulse generator replacement

4986	Endocardial electrode ablation
4987	Pacemaker ablation without replacement
9805	Insertion of infusion pump

Table B.2.3 CCI codes to identify interventions for complex chronic diseases

Code	Description
1NF53HATS	Temporary gastrostomy
1NF53LAQB	Permanent gastrostomy
1NF53LATS	Permanent gastrostomy
1NF53BTQB	Permanent gastrostomy
1NF53BTTS	Permanent gastrostomy
1NF53DAQB	Permanent gastrostomy
1NF53DATS	Temporary gastrostomy
1NK53BTTS	Enterostomy, not otherwise specified
1NK53DATS	Enterostomy, not otherwise specified
1NK53HATS	Enterostomy, not otherwise specified
1NK53LAQB	Enterostomy, not otherwise specified
1NK53LATS	Enterostomy, not otherwise specified
1NK53TGTS	Enterostomy, not otherwise specified
1NK77EM	Enterostomy, not otherwise specified
1NK77RQ	Enterostomy, not otherwise specified
1OW12ZZ	Irrigation of gastrostomy/enterostomy
1OW35CAD1	Irrigation of gastrostomy/enterostomy
1OW35CAD2	Irrigation of gastrostomy/enterostomy
1OW35CAD3	Irrigation of gastrostomy/enterostomy
1OW35HAD1	Irrigation of gastrostomy/enterostomy
1OW35HAD2	Irrigation of gastrostomy/enterostomy
1OW35HAD3	Irrigation of gastrostomy/enterostomy
1NF54HAFA	Irrigation of gastrostomy/enterostomy
1NF54HAQB	Irrigation of gastrostomy/enterostomy
1NF54HATS	Irrigation of gastrostomy/enterostomy
1NF80DA	Closing of gastrostomy
1NF55HATS	Extraction of gastrostomy tube
1NF55JATS	Extraction of gastrostomy tube
1NK54HAQB	Extraction of small intestine tube
1NK54HATS	Extraction of small intestine tube
1NK55BATS	Extraction of small intestine tube
1NK55CATS	Extraction of small intestine tube
1NK55DATS	Extraction of small intestine tube
1GJ77LALG	Temporary tracheostomy
1GJ77LA	Permanent tracheostomy
1GJ77QB	Temporary tracheostomy
1GJ77HA	Permanent tracheostomy
1GJ54CANR	Tracheostomy tube replacement

1GJ54JATS	Tracheostomy tube replacement
1GJ54JANG	Tracheostomy tube replacement
1GJ77HA	Permanent tracheostomy, not otherwise specified
1GJ77LA	Permanent tracheostomy, not otherwise specified
1GJ77LALG	Temporary tracheostomy
1GJ77QB	Permanent tracheostomy, not otherwise specified
1GJ55BAEB	Removal of apparatus from head/neck
1GJ55BANR	Removal of apparatus from head/neck
1GJ55CAEB	Removal of apparatus from head/neck
1GJ55CANG	Removal of apparatus from head/neck
1GJ55CANR	Removal of apparatus from head/neck
1GJ55CATS	Removal of apparatus from head/neck
1GJ55JAEB	Removal of apparatus from head/neck
1GJ55LAEB	Incision of larynx/trachea
1GJ55LANR	Incision of larynx/trachea
1GJ55LAPM	Incision of larynx/trachea
1AP52MJSJ	Ventricular derivation to the head/neck
1AC52MFSJ	Ventricular derivation to the circulatory system
1AP52MFSJ	Ventricular derivation to the circulatory system
1AB52GISJ	Ventricular derivation to the circulatory system
1AB52MFSJ	Ventricular derivation to the circulatory system
1AC52GISJ	Ventricular derivation to the circulatory system
1AC52MQSJ	Ventricular derivation to the thoracic cavity
1AP52MQSJ	Ventricular derivation to the thoracic cavity
1AB52GJSJ	Ventricular derivation to the thoracic cavity
1AB52MQSJ	Ventricular derivation to the thoracic cavity
1AC52GJSJ	Ventricular derivation to the thoracic cavity
1AC52MESJ	Ventricular derivation to the intra-abdominal cavity
1AC52SESJ	Ventricular derivation to the intra-abdominal cavity
1AB52GNSJ	Ventricular derivation to the intra-abdominal cavity
1AB52MESJ	Ventricular derivation to the intra-abdominal cavity
1AC52GNSJ	Ventricular derivation to the intra-abdominal cavity
1AC52MPSJ	Operation prior to establishment of ventricular drain
1AC52GKSJ	Operation prior to establishment of ventricular drain
1AC54HATS	Irrigation of ventricular shunt
1AC54MESJ	Ventricular shunt replacement
1AP54MQSJ	Ventricular shunt replacement
1AP54MJSJ	Ventricular shunt replacement
1AP54MFSJ	Ventricular shunt replacement
1AP54MESJ	Ventricular shunt replacement
1AC54MQSJ	Ventricular shunt replacement

1AC54MPSJ	Ventricular shunt replacement
1AC54MJSJ	Ventricular shunt replacement
1AC54MFSJ	Ventricular shunt replacement
1AB54HATS	Ventricular shunt replacement
1AB54MESJ	Ventricular shunt replacement
1AB54MFSJ	Ventricular shunt replacement
1AB54MQSJ	Ventricular shunt replacement
1AA55SETS	Excision of ventricular shunt
1AC55SZSJ	Excision of ventricular shunt
1AC55DANR	Excision of ventricular shunt
1AC55SENR	Excision of ventricular shunt
1AA55SZSJ	Excision of ventricular shunt
1AB55SETS	Excision of ventricular shunt
1AB55SZSJ	Excision of ventricular shunt
1AX55LADV	Excision of neurostimulator in spinal canal
1AX55LASJ	Excision of monitoring device from spinal canal
1AX55LAQK	Operation on marrow
1AX55LAFT	Operation on marrow
1AX52MESJ	Lumbar-peritoneal shunt
1AX52MBSJ	Lumbar-peritoneal shunt
1AX52MQSJ	Lumbar-peritoneal shunt
1AX53DAFT	Insertion of catheter in spinal canal
1AX53LAFT	Insertion of catheter in spinal canal
1AX53HHFT	Insertion of catheter in spinal canal
1AX53DADV	Insertion of neurostimulator in spinal canal
1AX53LADV	Insertion of neurostimulator in spinal canal
1AX54HASJ	Management of device in spinal canal
1NM77EP	Colostomy, not otherwise specified
1NM77RS	Colostomy, not otherwise specified
1NM77RSXXG	Colostomy, not otherwise specified
1NK77EN	Permanent ileostomy
1NK84RRXXG	Permanent ileostomy
1NK77RR	Permanent ileostomy
1NK77RRXXG	Permanent ileostomy
1KY76LA	Arteriovenostomy for dialysis
1KY76LAXXN	Arteriovenostomy for dialysis
1KY76LAXXL	Arteriovenostomy for dialysis
1KY76LAXXA	Arteriovenostomy for dialysis
1KY76LASJ	Arteriovenostomy for dialysis
1PE54JATS	Irrigation of nephrostomy/pyelostomy
1PZ21HQBR	Hemodialysis

1PZ21HPD4	Hemodialysis
1OT53DATS	Cuteaneous-peritoneal incision
1OT53HATS	Cuteaneous-peritoneal incision
1OT53LATS	Abdominal wall incision
1PE54BANR	Irrigation of ureterostomy
1PE54DANR	Irrigation of ureterostomy
1PE54LANR	Irrigation of ureterostomy
1PV50BABJ	Operation of urinary device
1PV50BABM	Operation of urinary device
1PV50BABP	Operation of urinary device
1PV57BAAM	Operation of urinary device
1PV57BAGX	Operation of urinary device
1PV57LAGX	Operation of urinary device
1PV59BAAG	Operation of urinary device
1PV59BAAS	Operation of urinary device
1PV59BAAT	Operation of urinary device
1PV59BAAZ	Operation of urinary device
1PV59BAGX	Operation of urinary device
1PV59BAX7	Operation of urinary device
1PV59LAGX	Operation of urinary device
1PZ94BA	Operation of urinary device
1PZ94DA	Operation of urinary device
1PZ94HA	Operation of urinary device
1PZ94LA	Operation of urinary device
1KY80LA	Repair of shunt for dialysis
1KY80LAXXA	Repair of shunt for dialysis
1KY80LAXXK	Repair of shunt for dialysis
1KY80LAXXN	Repair of shunt for dialysis
1PE55CATS	Extraction of pyelostomy/nephrostomy tube
1PE55JATS	Extraction of pyelostomy/nephrostomy tube
1HB53LAJA	Implant of permanent myocardial electrodes
1HD53GRJA	Implant of permanent pericardial electrodes
1HZ53QANM	Pacemaker implantation, not otherwise specified
1HZ53QANL	Pacemaker implantation, not otherwise specified
1HZ53QANK	Pacemaker implantation, not otherwise specified
1HZ53LANN	Pacemaker implantation, not otherwise specified
1HZ53LANM	Pacemaker implantation, not otherwise specified
1HZ53LANL	Pacemaker implantation, not otherwise specified
1HZ53LANK	Pacemaker implantation, not otherwise specified
1HZ53GRNN	Pacemaker implantation, not otherwise specified
1HZ53GRNM	Pacemaker implantation, not otherwise specified

1HZ53GRNL	Pacemaker implantation, not otherwise specified
1HZ53GRNK	Pacemaker implantation, not otherwise specified
1HZ53GRFR	Pacemaker implantation, not otherwise specified
1HZ53LAFR	Pacemaker implantation, not otherwise specified
1HZ53SYFR	Pacemaker implantation, not otherwise specified
1HZ53GRFS	Implantation of cardiovascular defibrillator
1HZ53LAFS	Implantation of cardiovascular defibrillator
1HZ53HAFS	Implantation of cardiovascular defibrillator
1HZ53SYFS	Implantation of cardiovascular defibrillator
1HZ55QANM	Pulse generator replacement
1HZ55QANL	Pulse generator replacement
1HZ55QANK	Pulse generator replacement
1HZ55QAFS	Pulse generator replacement
1HZ55LANM	Pulse generator replacement
1HZ55LANL	Pulse generator replacement
1HZ55LANK	Pulse generator replacement
1HZ55LAKP	Pulse generator replacement
1HZ55LAFS	Pulse generator replacement
1HZ55GPNM	Pulse generator replacement
1HZ55GPNL	Pulse generator replacement
1HZ55GPNK	Pulse generator replacement
1HZ55GPFS	Pulse generator replacement
1HB55LAJA	Ablation of endocardial electrodes
1HB55LAJB	Ablation of endocardial electrodes
1HD55GPJB	Ablation of endocardial electrodes
1HD55GRJA	Ablation of endocardial electrodes
1HZ38GRNN	Ablation of endocardial electrodes
1YY55LANJ	Ablation of systemic pacemaker
1AX53LAQK	Insertion of infusion pump
1OA53LAQK	Insertion of infusion pump
1YS53LAQK	Insertion of infusion pump
1YY53LAQK	Insertion of infusion pump

B.3 Primary Exposure

The primary exposure of interest was primary care model. Adolescents were assigned into one of four possible models (pediatrician, FPs in FMGs, FPs in non-FMGs, or no primary care) based on the model of care in which the associated UPPC practices. We used RAMQ data elements from the exposure period 2010-2011 to assign a UPPC to each adolescent. The algorithm presented in Table B.3.1. details the steps to identify 1) the presence of a UPPC, and 2) whether the UPPC was a FP or pediatrician.

Table B.3.1 Algorithm to identify the UPPC

STEP 1	Identify codes for "enrollment" under a FP. If subject has one of the following codes, then "primary care model" is a FP practicing in either an FMG or non-FMG: – 08875, 08877, 15144, 15145, 00059, 15158, 15159, 15148, 15169, 15170, 15171, 19952, 19951, 19954, 19955, 15156, 15157, 15189, 19074 The UPPC is the family physician who billed any of the above codes, except for the code 19074.
STEP 2	If subjects do not have a code identifying a FP, search for enrollment by a pediatrician using the 09194 code. This code is not specific to "enrollment" of patients under a pediatrician but it is used by pediatricians for follow-up or growth and development milestones. If this code is found, the "primary care model" is pediatrician; the UPPC is the pediatrician who has billed the most 09194 codes.
STEP 3	If a subject does not have a code identifying a FP or pediatrician, calculate the number of visits by a FP using the following codes: – 09092, 08870 (00005), 08871 (00056), 08872 (00097), 08901 (08807), 08902 (08809), 15161, 15230, 00474, 00002, 08873, 08874, 08855, 00007, 00075 – NOTE: brackets indicate these codes are billed by CHSGS/CLSC* outpatient clinic Also, calculate the number of visits by a pediatrician using the following codes: – 09129, 09127, 09171, 09172 – These codes must be ALL billed by a pediatrician and not any other specialist Only one act per day per doctor can be included when calculating number of visits. Only physicians with at least 2 visits can be considered for STEP 3. The following are ways that a usual provider of care can be assigned in STEP 3: a. FP (FMG or non-FMG) is assigned for the "primary care model": if the number of visits by the **same** FP > the number of visits by the **same** pediatrician. The "usual provider of care" in this case is the FP with the most complete major exams (00872 or 00097). If there are no complete major exams, select the FP with the most visits.

	b. Pediatrician is assigned for the "primary care model": if the number of visits by the **same** pediatrician > the number of visits by the **same** FP. The "usual provider of care" is the pediatrician with the most visits. c. For the "primary care model" if the number of visits (>=2) by the **same** pediatrician equals number of visits (>=2) by the **same** FP, then FP (FMG or non-FMG) is assigned if there are at least 2 complete major exams (00872, 00097) by the same FP. Otherwise, Pediatrician is assigned. For the "usual provider of care", if FP is assigned as the "primary care model", select the FP with the most complete major exams (00872 or 00097). If there are no complete major exams, select the FP with the most visits. If the "primary care model" is Pediatrician, the "usual provider of care" is the pediatrician with the most visits.
STEP 4	If no UPPC is identified through steps 1 through 3, then the subject does not have a UPPC and is classified as "no primary care"

* CHSGS = centre hospitalier de soins généraleaux et spécialisés
CLSC = centre locales de services communautaires

If the UPPC was a FP, we used the codes displayed in Table B.3.2 to differentiate FPs practicing in FMGs from those practicing in non-FMGs. The codes were applied in an hierarchy; in other words, looked for code d'acte 08875 first, then code d'acte 19074, and finally code d'établissement 54x.

Table B.3.2 Codes to Identify FPs in FMGs

Code	Coding	Description
Code d'acte 08875 (for any visits)	FMG	Inscription of patients in FMG
Code d'acte 19074 (for any visits)	FMG	Temporary inscription of pregnant patient in FMG (followed by another FP in the same FMG)
Code d'établissement 54x: look specifically for 54x for visits made with the "usual provider of care"	FMG	Medical clinic coded for FMGs or as a Network Clinic

The primary exposure variable was coded as displayed in Table B.3.3.

Table B.3.3 Primary Exposure Variable

Variable Description	Variable Name	Coding	Type
Primary care models	pcm_cat	0 = no primary care 1 = pediatrician 2 = FMGs 3 = non-FMGs	Categorical

B.4 Co-Variates

Age and sex of the patient was obtained from the RAMQ records. SES was determined using the Pampalon index, which is an ecologic measure of material and social deprivation that divides the population into quintiles (Q1 = most privileged, Q5 = most deprived) (106, 124). Québec is divided into spatial units of 400-700 people called dissemination areas (DA), and an index value is assigned to each DA based on six indicators: education, employment, income, marital status, single parenting and living alone. Using data from the *2011 Census,* individual postal codes were linked to a DA to determine the neighbourhood SES. The linkage was performed by RAMQ.

Rurality was determined by referencing the Statistical Area Classification system developed by Statistics Canada (125). This classification system divides geographical areas in Canada into either census metropolitan areas (CMAs), census agglomerations (CAs), or metropolitan influenced zones (MIZs). Urban centers are labeled CMAs or CAs depending on population density. Municipalities outside of CMAs or CAs are assigned one of three MIZ depending on the percentage of the employed labor force that commutes to the nearest CMA or CA for work: strong, moderate, or weak. Patient postal codes were linked to geographical areas categorized as urban (CMA or CA), strong MIZ, moderate MIZ, weak MIZ, or rural (no CMA, CA or MIZ).

We accounted for whether adolescents were from sub-cohort 1 or 2 by including the co-variate health status. Adolescents were categorized into one of four categories: asthma, diabetes, complex chronic diseases, or other. All co-variates were determined on January 1, 2012. Coding information for co-variates are displayed in Table B.4.1.

Table B.4.1. Co-Variates

Variable Description	Database Name	Coding	Type
Health status	health_status_cat	0 = no co-morbidity 1 = asthma 2 = diabetes 3 = complex chronic diseases	Categorical
Age	age_c	Age in years	Continuous
Sex	gender	0 = female 1 = male	Dichotomous
Material & Social Deprivation (SES)	ses_combined	0 = Q5 1 = Q4 2 = Q3 3 = Q2 4 = Q1	Categorical
SES (social deprivation index, Pampalon)	ses_soc_cat	0 = Q5 1 = Q4 2 = Q3 3 = Q2 4 = Q1	Categorical
Rurality	sgc_cat	0 = urban 1 = strong MIZ 2 = moderate MIZ 3 = weak MIZ 4 = rural	Categorical
Previous hospital admissions	prev_adm	Number of hospital admissions	Continuous

B.5 Outcomes

ED Visits

The establishment code 0X7 was used to identify ED visits. The number of ED visits that occurred from the outcome period of January 1, 2012 to December 31, 2013 was counted and created into a continuous variable. A binary variable separating adolescents who had at least one ED visit from those with no ED visits was also created. For each ED visit, the reason for ED use was obtained by retrieving the ICD-9 Québec diagnosis code on the physician claims.

Primary Care visits

We counted the number of visits made in the same establishment as the UPPC (FP or pediatrician). When no establishment code was available, we counted the number of visits made by the same UPPC.

When the UPPC was a FP (FMG or non-FMG), we counted the number of physician claims on different dates from January 1, 2012 to December 31, 2013, with the codes listed in Table B.5.1.

Table B.5.1. Codes Identifying Primary Care Visits for FPs

Cabinet, CLSC, UMF-CH	CHSGS (clinique externe)	Description
08870	00005	Patient ordinary exam <60 years
08871	00056	Patient complete exam <60 years
08872	00097	Patient major complete exam <60 years
00002	Same (home)	Home visit <70 years, first patient, non-urgent
08873	Same (home)	Home visit, additional patients, ordinary exam
08874	Same (home)	Home visit, additional patients, complete exam
08855	Same (home)	Home visit, additional patients, complete psychiatric exam
00007		Home visit, loss of autonomy, first patient, all other times than 0-7h
00075		Home visit, loss of autonomy, additional patients
00059	00059	Exam/Pregnancy “prise en charge”
08901	08807	Psychiatric complete
08902	08809	Psychiatric complete major

When the UPPC was a pediatrician, we counted the number of physician claims on different dates from January 1, 2012 to December 31, 2013, with the codes listed in Table B.5.2.

Table B.5.2 Codes Identifying Primary Care Visits for Pediatricians

Code	Description
09194	General exam in office by pediatrician
09127	Main (non-consultative) visit in office by pediatrician
09129	Follow-up visit by pediatrician (office)
15164	Multidisciplinary or parent meeting in regards to a complex pathology (office)
09171	Main visit by pediatrician (home)
09172	Follow-up visit by pediatrician (home)
15552	Palliative care visit by pediatrician (home)

The coding for ED and primary care outcome variables are presented in Table B.5.1.

Table B. 5.1. Outcome Variables

Variable Description	Database Name	Coding	Type
Rate of ED visits	ED_visits_c	Number of ED visits	Continuous
ED visits yes/no	ED_visits_b	0 = no 1 = yes	Binary
Reasons for ED use	ED_reasons	ICD-9 Québec diagnostic codes	Categorical
Rate of primary care visits	pc_visits_c	Number of primary care visits	Continuous
Primary care visits yes/no	pc_visits_b	0 = no 1= yes	Binary

The statistical analysis was as described in the manuscript section.

APPENDIX C: PECARN CODING OF ED DIAGNOSES

PECARN has created a SAS utility program for the Diagnosis Grouping System (DGS) that groups diagnoses commonly found in pediatric emergency medicine into 21 major groups and 77 subgroups. The program contains two main files. First, an ICD9_Master.sas7bdat that contains a complete list of the 2002 International Classification of Diseases, 9th Revision (ICD-9CM) codes in the DGS (2 688 codes) and their associated DGS categories. Second, it contains the SAS DGS program that allows for mapping of diagnosis codes in individual datasets into the DGS categories and the generation of frequency reports for each DGS major group and subgroup. The PECARN tool can be found here: http://www.pecarn.org/tools/.

Prior to using the DGS program to group the ED diagnosis codes in our dataset, we had to check for congruency between the way the codes were formatted in our dataset versus the DGS program. Major sources of discrepancy between the two were the following:

1. The diagnoses codes in our dataset were 2009 International Classification of Disease, 9th Revision, Québec version (CIM-9), whereas the codes in the DGS program were based on 2002 ICD9-CM codes. Codes that were exclusive to CIM-9 was not categorized and read by the DGS program as "ICD-9 code not found".
2. Codes in our dataset had a maximum of four alphanumerical digits, whereas most of the valid codes in the DGS program had five digits. The additional fifth digit confers specificity of the diagnoses; for example, a four-digit numerical code may code for an elbow fracture, but the addition of a fifth digit would specify whether it was an elbow fracture with complications. In the DGS, the four-digit code was considered "invalid" and not categorized into appropriate DGS groups, while the five-digit code was read and categorized.

If there were any codes in our dataset that would not be read by the DGS program for the above reasons, changes to the existing ICD9_Master.sas7bdat file was made so that all the codes in our dataset could be read and categorized into logical PECARN major groups and subgroups. Since sifting through the entire 2432 different CIM-9 codes in our dataset would have been too time consuming, only the diagnoses codes occurring at a frequency of 0.05% or greater were included in the final analysis.

Changes made to the ICD9_Master.sas7bdat file consists of three types:

1. An “invalid” four-digit code changed to “valid”. DGS major group and subgroup assignation mirrored the categorization of the five-digit codes.
2. Code not one of the 2688 codes categorized in the DGS because it was not a common diagnosis seen within pediatric emergency care. These codes were manually categorized into appropriate categories based on how they are categorized in other literature.
3. Code exists in CIM-9 (Québec) but not in ICD-9CM. For these codes, the corresponding ICD-9CM codes for the same diagnosis was found and altered to mirror the CIM-9 format.

The complete list of changes made to the ICD9_Master.sas7bdat file is detailed in Table C.1.

Table C.1 List of changes made to the PECARN ICD-9 codes in the SAS analysis program

ED Diagnosis Code	Change to DGS ICD-9 Master document
V999	– Added new row – "Not categorized".
7865	– Invalid code changed to "Chest Pain" – Groups: Musculoskeletal & Connective Tissue Diseases → Chest Pain
4939	– Invalid code changed to "Asthma" – Groups: Respiratory Diseases → Asthma
8450	– Invalid code changed to "Ankle strain & sprain" – Groups: Trauma → Strains and Sprains (extremities)
8540	– Invalid code changed to "Intracranial injury" – Groups: Trauma → Brain and Skull Trauma
7809	– Invalid code changed to "General symptoms" – Groups: Systemic States → Acute Systemic States
8140	– Invalid code changed to "Closed fractures of carpal bones" – Groups: Trauma → Fractions and Dislocations (extremities)
3119	– Code 311 (ICD 9-CM) changed to 3119 (corresponding to ICD9-Quebec), signifying "Depressive disorder" – Groups: Psychiatric and Behavioral Diseases and Substance Abuse → Psychiatric and Behavioral Diseases and Substance Abuse
3000	– Invalid code changed to "Anxiety States" – Groups: Psychiatric and Behavioral Diseases and Substance Abuse → Psychiatric and Behavioral Diseases and Substance Abuse
3469	– Invalid code changed to "Unspecified migraine" – Groups: Neurologic diseases → Headache
4629	– Code 462 (ICD 9-CM) changed to 4629 (corresponding to ICD9-Quebec), signifying "Acute pharyngitis" – Groups: ENT, Dental & Mouth Diseases → Infectious Mouth & Throat Disorders
8130	– Invalid code changed to "Closed fracture of upper end of radius and ulna" – Groups: Trauma → Fractures & Dislocations (extremities)
8160	– Invalid code changed to "Closed fracture of one or more phalanges of hand – Groups: Trauma → Fractures & Dislocations (extremities)
4639	– Code 463 (ICD 9-CM) changed to 4639 (corresponding to ICD9-Quebec), signifying "Acute tonsillitis" – Groups: ENT, Dental & Mouth Diseases → Infectious Nose & Sinus Disorders
7803	– Invalid code changed to "Convulsions" – Groups: Neurologic Diseases → Seizures

8100	– Invalid code changed to “Closed fracture of clavicle” – Groups: Trauma → Chest Trauma
5640	– Invalid code changed to “Constipation” – Groups: Gastrointestinal Diseases → Other Gastrointestinal Diseases
9232	– Invalid code changed to “Contusion of wrist and hand(s), except finger(s) alone” – Groups: Trauma → Contusions & Abrasions (external, of any body part)
8734	– Invalid code changed to “Open wound of face, without any complications” – Groups: Trauma → Lacerations, Amputations & Uninfected Foreign Bodies (external)
8299	– Code 829 (ICD 9-CM) changed to 8299 (corresponding to ICD9-Quebec), signifying “Fracture in one or more bones, not specified” – Code originally not categorized, manually categorized – Groups: Trauma → Fractures & Dislocations.
7807	– Invalid code changed to “Malaise and fatigue” – Groups: Systemic States → Acute Systemic States
8420	– Invalid code changed to “Wrist sprain and strain” – Groups: Trauma → Strains and Sprains (extremities)
5355	– Invalid code changed to “Unspecified gastritis and gastroduodenitis” – Groups: Gastrointestinal Diseases → Gastroenteritis
3801	– Invalid code changed to “Infective otitis externa” – Groups: ENT, Dental & Mouth Diseases → Infectious Ear Disorders
7860	– Invalid code changed to “Dyspnea and respiratory abnormalities” – Groups: Respiratory Diseases → Other Respiratory Diseases
5419	– Code 541 (ICD 9-CM) changed to 5419 (corresponding to ICD9-Quebec), signifying “Appendicitis, unqualified” – Groups: Gastrointestinal Diseases → Appendicitis
4869	– Code 486 (ICD 9-CM) changed to 4869 (corresponding to ICD9-Quebec), signifying “Pneumonia, organism unspecified” – Groups: Respiratory Diseases → Infectious Respiratory Diseases
5901	– Invalid code changed to “Acute pyelonephritis” – Groups: Urinary Tract Diseases → Infectious Urinary Tract Diseases
9241	– Invalid code changed to “Contusion of knee and lower leg” – Groups: Trauma → Contusions & Abrasions (external, of any body part)
8139	– Invalid code changed to “Open fracture of unspecified part of radius with ulna” – Groups: Trauma → Fractures & Dislocations (extremities)
9242	– Invalid code changed to “Contusion of ankle and foot, excluding toe(s)” – Groups: Trauma → Contusions & Abrasions (external, of any body part)

8252	– Invalid code changed to "Closed fracture of other tarsal and metatarsal bones" – Groups: Trauma →Fractures and Dislocations (extremities).
7870	– Invalid code changed to "Nausea and vomiting" – Groups: Gastrointestinal Diseases → Vomiting
8421	– Invalid code changed to "Hand sprain & Strain" – Groups: Trauma → Strains & Sprains (extremities)
8150	– Invalid code changed to "Closed fracture of metacarpal bones – Groups: Trauma → Strains & Sprains (extremities)
4909	– Code 490 (ICD 9-CM) changed to 4909 (corresponding to ICD9-Quebec), signifying "Bronchitis, not specified as acute or chronic" – Groups: Respiratory Diseases → Infectious Respiratory Diseases
7331	– Invalid code changed to "Pathologic fracture" – Groups: Trauma → Fractures & Dislocations (extremities)
3723	– Invalid code changed to "Other and unspecified conjunctivitis" – Groups: Diseases of the Eye → Infectious Diseases of the Eye
7269	– Invalid code changed to "Unspecified enthesopathy" – Groups: Musculoskeletal & Connective Tissue Diseases → Musculoskeletal Pain
6161	– Invalid code changed to "Vaginitis and vulvovaginitis" – Groups: Genital & Reproductive Diseases → Infectious Genital & Reproductive Diseases
0799	– Invalid code changed to "Unspecified viral and chlamydial infections, in conditions classified elsewhere and of unspecified site" – Groups: Other → Other Infectious Diseases
3459	– Invalid code changed to "Unspecified epilepsy" – Groups: Neurologic Diseases → Seizures
8124	– Invalid code changed to "Closed fracture of lower end of humerus" – Groups: Trauma →Fractures and Dislocations (extremities).
2500	– Invalid code changed to "Diabetes mellitus without mention of complication" – Groups: Endocrine, Metabolic & Nutritional Diseases → Diabetes mellitus
3810	– Invalid code changed to "Acute nonsuppurative otitis media" – Groups: ENT, Dental & Mouth Diseases → Infectious Ear Disorders
9230	– Invalid code changed to "Contusion of shoulder and upper arm" – Groups: Trauma → Contusions & Abrasions (external, of any body part).
9590	– Invalid code changed to "Injury, other and unspecified, head, face, and neck" – Groups: Trauma → Other Trauma
8230	– Invalid code changed to "Closed fracture of upper end of tibia and fibula" – Groups: Trauma → Fractures & Dislocations (extremities).

0781	– Invalid code changed to "Viral warts" – Groups: Skin, Dermatologic & Soft Tissue Diseases → Infectious Skin, Dermatologic, & Soft Tissue Diseases
0759	– Code 075 (ICD 9-CM) changed to 0759 (corresponding to ICD9-Quebec), signifying "Infectious mononucleosis" – Groups: Systemic States → Viral Illnesses
4782	– Invalid code changed to "Other diseases of pharynx, not elsewhere classified" – Groups: ENT, Dental, & Mouth Diseases → Infectious Mouth & Throat Disorders
9231	– Invalid code changed to "Contusion of elbow and forearm" – Groups: Trauma → Contusions & Abrasions (external, of any body part).
3887	– Invalid code changed to "Otalgia" – Groups: ENT, Dental, & Mouth Diseases → Non-Infectious Mouth & Throat Disorders
7339	– Invalid code changed to "Other and unspecified disorder of bone and cartilage" – Groups: Musculoskeletal & Connective Tissue Diseases → Non-Infectious Musculoskeletal & Connective Tissue Disease
8310	– Invalid code changed to "Closed dislocation of shoulder, unspecified" – Groups: Trauma → Fractures & Dislocations (extremities).
8451	– Invalid code changed "Foot strain and sprain" – Groups: Trauma → Strains & Sprains (extremities).
3050	– Invalid code changed to "Nondependent alcohol abuse" – Groups: Psychiatric and Behavioral Diseases and Substance Abuse → Psychiatric and Behavioral Diseases and Substance Abuse
7909	– Invalid code changed to "Other nonspecific findings on examination of blood" – Groups: Other → Screening Exams, Labs & administrative Issues.
5908	– Invalid code changed to "Other pyelonephritis or pyonephrosis, not specified as acute or chronic" – Groups: Urinary Tract Diseases → Infectious Urinary Tract Diseases
7199	– Invalid code changed to "Unspecified disorder of joint" – Groups: Musculoskeletal and Connective Tissue Diseases → Non-Infectious Musculoskeletal and Connective Tissue Disease
3820	– Invalid code changed to "Acute suppurative otitis media" – Groups: ENT, Dental & Mouth Diseases → Infectious Ear Disorders
8459	– 845 (ICD-9 CM) changed to 8459 signifying "Sprains and strains of ankle and foot" – Groups: Trauma → Strains & Sprains (extremities)
7800	– Invalid code changed to "Alteration of consciousness" – Groups: Neurologic Diseases → Other Neurologic Diseases

8949	– Code 894 (ICD 9-CM) changed to 8949 (corresponding to ICD9-Quebec), signifying "Multiple and unspecified open wound of lower limb" – Groups: Trauma → Lacerations, Amputations, & Uninfected Foreign Bodies (external)
5350	– Invalid code changed to "Acute gastritis" – Groups: Gastrointestinal Diseases → Gastroenteritis
4640	– Invalid code changed to "Acute laryngitis" – Groups: ENT, Dental & Mouth Diseases → Infectious Mouth & Throat Disorders
7879	– Invalid code changed to "Other symptoms involving digestive system" – Groups: Gastrointestinal Diseases → Other Gastrointestinal Diseases
8134	– Invalid code changed to "Closed fracture of lower end of radius and ulna" – Groups: Trauma → Fractures & Dislocations (extremities).
6049	– Invalid code changed to "Other orchitis, epididymitis, and epididymo-orchitis, without mention of abscess" – Groups: Genital & Reproductive Diseases → Infectious Genital & Reproductive Diseases
8340	– Invalid code changed to "Closed dislocation of finger" – Groups: Trauma → Fractures & Dislocations (extremities)
5301	– Invalid code changed to "Esophagitis" – Groups: Gastrointestinal Diseases → Other Gastrointestinal Diseases
8159	– Code 815 (ICD 9-CM) changed to 8159 (corresponding to ICD9-Quebec), signifying "Fracture of metacarpal bone(s)" – Groups: Trauma →Fractures & Dislocations (extremities)
8239	– Invalid code changed to "Open fracture of unspecified part of tibia and fibula" – Groups: Trauma →Fractures & Dislocations (extremities)
7309	– Invalid code changed to "Unspecified infection of bone" – Groups: Musculoskeletal and Connective Tissue Diseases → Infectious Musculoskeletal and Connective Tissue Disease
3140	– Invalid code changed to "Attention deficit disorder of childhood" – Groups: Psychiatric and Behavioral Diseases & Substance Abuse → Psychiatric and Behavioral Diseases & Substance Abuse
9591	– Invalid code changed to "Injury, other and unspecified, trunk" – Groups: Trauma → Other Trauma
7194	– Invalid code changed to "Pain in joint" – Groups: Musculoskeletal and Connective Tissue Diseases → Musculoskeletal Pain
7169	– Invalid code changed to "Unspecified anthropathy" – Groups: Musculoskeletal and Connective Tissue Diseases → Non-Infectious Musculoskeletal and Connective Tissue Disease
5354	– Invalid code changed to "Other specified gastritis"

	– Groups: Gastrointestinal Diseases → Other Gastrointestinal Diseases
8122	– Invalid code changed to "Closed fracture of shaft or unspecified part of humerus" – Groups: Trauma →Fractures & Dislocations (extremities).
8120	– Invalid code changed to "Closed fracture of upper end of humerus" – Groups: Trauma →Fractures & Dislocations (extremities).
3039	– Invalid code changed to "Other and unspecified alcohol dependence" – Groups: Psychiatric and Behavioral Diseases & Substance Abuse → Psychiatric and Behavioral Diseases & Substance Abuse
9223	– Invalid code changed to "Contusion of trunk" – Groups: Trauma → Contusions & Abrasions (external, of any body part)
8109	– Code 810 (ICD 9-CM) changed to 8109 (corresponding to ICD9-Quebec), signifying "Fracture of clavicle" – Groups: Trauma → Chest Trauma
9240	– Invalid code changed to "Contusion of hip and thigh" – Groups: Trauma → Contusions & Abrasions (external, of any body part)
3802	– Invalid code changed to "Other otitis externa" – Groups: ENT, Dental & Mouth Diseases → Infectious Ear Disorders
7855	– Invalid code changed to "Shock without mention of trauma" – Groups: Systemic states → Acute Systemic States
8319	– Code 831 (ICD 9-CM) changed to 8319 (corresponding to ICD9-Quebec), signifying "Dislocation of shoulder" – Groups: Trauma → Fractures & Dislocations (extremities)
8839	– Code 883 (ICD 9-CM) changed to 8839 (corresponding to ICD9-Quebec), signifying "Open wound of finger(s)" – Groups: Trauma → Lacerations, Amputations & Uninfected Foreign Bodies (external)
4740	– Invalid code changed to "Chronic tonsillitis and adenoiditis" – Groups: ENT, Dental & Mouth Diseases → Infectious Mouth & Throat Disorders
9499	– Code 949 (ICD 9-CM) changed to 9499 (corresponding to ICD9-Quebec), signifying "Burn, unspecified site, unspecified degree" – Groups: Trauma → Burns (external, of any body part)
6909	– Code 690 (ICD 9-CM) changed to 6909 (ICD9-Quebec) "Erythematosquamous dematosis" – Groups: Skin, Dermatologic & Soft Tissue Diseases → Non-infectious Skin, Dermatologic & Soft Tissue Diseases
4609	– Code 460 (ICD 9-CM) changed to 4609 (ICD9-Quebec) "Acute nasopharyngitis" – Groups: ENT, Dental & Mouth Diseases → Infectious Nose & Sinus Disorders, including URI

8169	– Code 816 (ICD 9-CM) changed to 8169 (ICD9-Quebec) "Closed fracture of one or more phalanges of hand" – Groups: Trauma → Fractures & Dislocations (extremities).
8129	– Code 812 (ICD 9-CM) changed to 8129 (ICD9-Quebec) "Fracture of humerus" – Groups: Trauma → Fractures & Dislocations (extremities).
8810	– Invalid code changed to "Open wound of elbow, forearm, and wrist, without mention of complication" – Groups: Trauma → Lacerations, Amputations & Uninfected Foreign Bodies (external)
7270	– Invalid code changed to "Synovitis and tenosynovitis" – Groups: Musculoskeletal and Connective Tissue Diseases → Non-Infectious Musculoskeletal and Connective Tissue Disease
2960	– Invalid code changed to "Manic disorder, single episode" – Groups: Psychiatric and Behavioral Diseases & Substance Abuse → Psychiatric and Behavioral Diseases & Substance Abuse
3049	– Invalid code changed to "Unspecified drug dependence" – Groups: Psychiatric and Behavioral Diseases & Substance Abuse → Psychiatric and Behavioral Diseases & Substance Abuse
9209	– Code 920 (ICD 9-CM) changed to 9209 (ICD9-Quebec) "Contusion of face, scalp, and neck except eye(s)" – Groups: Trauma → Contusions & Abrasions (external, of any body part)
5742	– Invalid code changed to "Calculus of gallbladder without mention of cholecystitis" – Groups: Gastrointestinal Diseases → Other Gastrointestinal Diseases
8320	– Invalid code changed to "Closed dislocation of elbow" – Groups: Trauma → Fractures & Dislocations (extremities)
3731	– Invalid code changed to "Hordeolum and other deep inflammation of eyelid" – Groups: Diseases of the Eye → Infectious Diseases of the Eye
8429	– Code 842 (ICD 9-CM) changed to 8429 (ICD9-Quebec) "Sprains and strains of wrist and hand" – Groups: Trauma → Strains & Sprains (extremities)
3720	– Invalid code changed to "Acute conjunctivitis" – Groups: Diseases of the Eye → Infectious Diseases of the Eye
6849	– Code 684 (ICD 9-CM) changed to 6849 (ICD9-Quebec) "Impetigo" – Groups: Skin, Dermatologic & Soft Tissue Diseases → Infectious Skin, Dermatologic & Soft Tissue Diseases
0850	– Code originally not categorized, manually categorized – Code signifies "Visceral leishmaniasis" – Groups: Systemic States → Bacterial & Fungal Illnesses
2919	– Code originally not categorized, manually categorized – Code signifies "Alcohol Psychosis"

	– Groups: Psychiatric and Behavioral Diseases & Substance Abuse → Psychiatric and Behavioral Diseases & Substance Abuse
4650	– Code originally not categorized, manually categorized – Code signifies "Acute laryngopharyngitis" – Groups: ENT, Dental & Mouth Diseases → Infectious Nose & Sinus Disorders, including URI
7239	– Code originally not categorized, manually categorized – Code signifies "Unspecified musculoskeletal disorders and symptoms referable to neck" – Groups: Musculoskeletal and Connective Tissue Diseases → Non-Infectious Musculoskeletal and Connective Tissue Disease
7279	– Code originally not categorized, manually categorized – Code signifies "Unspecified disorder of synovium, tendon, and bursa" – Groups: Musculoskeletal and Connective Tissue Diseases → Non-Infectious Musculoskeletal and Connective Tissue Disease
8690	– Code originally not categorized, manually categorized – Code signifies "Internal injury to organs without mention of open wound into cavity" – Groups: Trauma → Abdominal Trauma
9492	– Code originally not categorized, manually categorized – Code signifies "Blisters with epidermal loss due to burn (second degree), unspecified site" – Groups: Trauma → Burns (external, of any body part)
V403	– Code originally not categorized, manually categorized – Code signifies "Other behavioral problems" – Groups: Psychiatric and Behavioral Diseases & Substance Abuse → Psychiatric and Behavioral Diseases & Substance Abuse
V709	– Code originally not categorized, manually categorized – Code signifies "Unspecified general medical examination" – Groups: Other → Screening Exams, Labs & Administrative Issues
V729	– Code originally not categorized, manually categorized – Code signifies "Unspecified examination" – Groups: Other → Screening Exams, Labs & Administrative Issues
0099	– Code 009 (ICD 9-CM) changed to 0099 (ICD9-Quebec) signifying "Ill-defined Intestinal Infections" – Groups: Gastrointestinal Diseases → Gastroenteritis
2501	– Invalid code changed to "Diabetes with ketoacidosis" – Groups: Endocrine, Metabolic & Nutritional Diseases → Diabetes Mellitus
2990	– Invalid code changed to "Infantile autism" – Groups: Neurologic Diseases → Developmental Disorders
3723	– Invalid code changed to "Other and unspecified conjunctivitis" – Groups: Diseases of the Eye → Infectious Diseases of the Eye

2770	– Invalid code changed to “Cystic fibrosis” – Groups: Respiratory Diseases → Other Respiratory Diseases
2829	– Code originally not categorized. manually categorized – Code signifies “Unspecified hereditary hemolytic anemia.” – Groups: Hematologic Diseases → Other Hematologic Diseases
V259	– Code originally not categorized. Manually categorized. “Unspecified contraceptive management”.
2280	– Invalid code changed to “Hemangioma, any site” – Groups: Skin, Dermatologic & Soft Tissue Diseases → Non-Infectious Skin, Dermatologic & Soft Tissue Diseases
2509	– Invalid code changed to “Diabetes with unspecified complication” – Groups: Endocrine, Metabolic & Nutritional Diseases → Diabetes Mellitus
2966	– Invalid code changed to “Bipolar affective disorder, mixed” – Groups: Psychiatric and Behavioral Diseases & Substance Abuse → Psychiatric and Behavioral Diseases & Substance Abuse
3018	– Invalid code changed to “Other personality disorders” – Groups: Psychiatric and Behavioral Diseases & Substance Abuse → Psychiatric and Behavioral Diseases & Substance Abuse
3075	– Invalid code changed to “Other and unspecified disorders of eating” – Groups: Psychiatric and Behavioral Diseases & Substance Abuse → Psychiatric and Behavioral Diseases & Substance Abuse
3092	– Invalid code changed to “Predominant disturbance of other emotions as adjustment reaction” – Groups: Psychiatric and Behavioral Diseases & Substance Abuse → Psychiatric and Behavioral Diseases & Substance Abuse
3098	– Invalid code changed to “Other specified adjustment reactions” – Groups: Psychiatric and Behavioral Diseases & Substance Abuse → Psychiatric and Behavioral Diseases & Substance Abuse
3719	– Code originally not categorized. manually categorized – Code signifies “Unspecified corneal disorder” – Groups: Diseases of the Eye → Non-Infectious Diseases of the Eye
3799	– Invalid code changed to “Unspecified disorder of eye and adnexa” – Groups: Diseases of the Eye → Non-Infectious Diseases of the Eye
4661	– Invalid code changed to “Acute bronchiolitis” – Groups: Respiratory Diseases → Infectious Respiratory Diseases
4759	– Code 475 (ICD 9-CM) changed to 4759 (ICD9-Quebec) signifying “Peritonsillar abscess” – Groups: ENT, Dental & Mouth Diseases → Infectious Mouth & Throat Disorders
8210	– Invalid code changed to “Closed fracture of shaft or unspecified part of femur” – Groups: Trauma → Fractures & Dislocations (extremities)
0462	– Code originally not categorized, manually categorized

	– Code signifies “Subacute sclerosing panencephalitis” – Groups: Neurologic Diseases → Infectious Neurologic Diseases
8398	– Code originally not categorized, manually categorized – Code signifies “Closed dislocation, multiple and ill-defined sites” – Groups: Trauma → Fractures & Dislocations (extremities)
9569	– Code originally not categorized. manually categorized – Code signifies “Injury to unspecified nerve of pelvic girdle and lower limb” – Groups: Trauma → Other Extremity Trauma
V629	– Code originally not categorized, manually categorized – Code signifies “Unspecified psychosocial circumstance” – Groups: Other → Screening Exams, Labs & Administrative Issues
0789	– Code 078 (ICD 9-CM) changed to 0789 (ICD9-Quebec) signifying “Other diseases due to viruses and Chlamydiae” – Groups: Systemic States → Viral Illnesses
3460	– Invalid code changed to “Classical migraine” – Groups: Neurological Diseases → Headache
3714	– Invalid code changed to “Corneal degenerations” – Groups: Dieseases of the Eye → Non-Infectious Diseases of the Eye
5694	– Invalid code changed to “Other specified disorders of rectum and anus” – Groups: Gastrointestinal Diseases → Other Gastrointestinal Diseases
7373	– Invalid code changed to “Kyphoscoliosis and scoliosis” – Groups: Musculoskeletal & Connective Tissue Diseases → Non-Infectious Musculoskeletal & Connective Tissue Disease
8232	– Invalid code changed to “Closed fracture of shaft of tibia and fibula” – Groups: Trauma → Fractures & Dislocations (extremities)
8549	– Code 854 (ICD 9-CM) changed to 8549 (ICD9-Quebec) signifying “Intracranial injury of other and unspecified nature” – Groups: Trauma → Brain & Skull Trauma
0541	– Invalid code changed to “Genital herpes” – Groups: Genital & Reproductive Diseases → Infectious Genital & Reproductive Diseases
4209	– Invalid code changed to “Other and unspecified acute pericarditis” – Groups: Circulatory & Cardiovascular Diseases → Other Circulatory & Cardiovascular Diseases
4930	– Invalid code changed to “Extrinsic asthma” – Groups: Respiratory Diseases → Asthma
6469	– Invalid code changed to “Unspecified complication of pregnancy” – Groups: Genital & Reproductive Diseases → Pregnancy
5909	– Code originally not categorized, manually categorized – Code signifies “Unspecified infection of kidney” – Groups: Urinary Tract Diseases → Infectious Urinary Tract Diseases

Table C.2 Frequency of ED diagnoses categorized into PECARN Major Groups and Sub Groups, stratified by primary care models

PECARN Major Group	PECARN Subgroup	FMGs (frequency, %)	No Primary Care (frequency, %)	Pediatrician (frequency, %)	Non-FMGs (frequency, %)	Total (frequency, %)
Trauma	Fractures & Dislocations (extremities)	2881 (8.16)	6067 (8.67)	1763 (9.87)	1365 (7.39)	12076 (8.53)
	Strains & Sprains (extremities)	2398 (6.79)	4465 (6.38)	1011 (5.66)	1107 (6.00)	8981 (6.34)
	Contusions & Abrasions (external, of any body part)	1798 (5.09)	3416 (4.88)	851 (4.77)	743 (4.02)	6808 (4.81)
	Other Trauma	1726 (4.89)	3888 (5.56)	1144 (6.41)	996 (5.39)	7754 (5.48)
	Lacerations, Amputations & Uninfected Foreign Bodies (external)	1220 (3.46)	2738 (3.91)	705 (3.95)	536 (2.90)	5199 (3.67)
	Lacerations, Amputations & Uninfected Foreign Bodies (external)	1220 (3.46)	2738 (3.91)	705 (3.95)	536 (2.90)	5199 (3.67)
	Brain & Skull Trauma	897 (2.54)	1967 (2.81)	769 (4.31)	547 (2.96)	4180 (2.95)
	Burns (external, of any body part)	104 (0.29)	200 (0.29)	22 (0.12)	34 (0.18)	360 (0.25)
	Chest Trauma	172 (0.49)	625 (0.89)	122 (0.68)	105 (0.57)	1024 (0.72)

	Other Extremity Trauma	133 (0.38)	427 (0.61)	194 (1.09)	113 (0.61)	867 (0.61)
	Face, Dental, Mouth & Eye Trauma	134 (0.38)	249 (0.36)	55 (0.31)	49 (0.27)	487 (0.34)
	Abdominal Trauma	35 (0.10)	65 (0.09)	11 (0.06)	12 (0.06)	123 (0.09)
Gastrointestinal Diseases	Abdominal Pain	2440 (6.91)	4042 (5.78)	1105 (6.19)	1291 (6.99)	8878 (6.27)
	Gastroenteritis	823 (2.33)	1400 (2.00)	416 (2.33)	488 (2.64)	3127 (2.21)
	Other Gastrointestinal Diseases	573 (1.62)	1029 (1.47)	352 (1.97)	383 (2.07)	2337 (1.65)
	Appendicitis	292 (0.83)	626 (0.89)	157 (0.88)	155 (0.84)	1230 (0.87)
	Vomiting	123 (0.35)	260 (0.37)	81 (0.45)	102 (0.55)	566 (0.40)
ENT, Dental & Mouth Diseases	Infectious Nose & Sinus Disorders, including URI	1579 (24.47)	2478 (3.54)	357 (2.00)	682 (3.69)	5096 (3.60)
	Infectious Ear Disorders	864 (2.45)	1697 (2.43)	313 (1.75)	372 (2.01)	3246 (2.29)
	Infectious Mouth & Throat Disorders	966 (2.74)	1691 (2.42)	199 (1.11)	349 (1.89)	3205 (2.26)
	Non-Infectious ENT, Dental, & Mouth Diseases	324 (0.92)	633 (0.90)	110 (0.62)	159 (0.86)	1226 (0.87)
	Infectious Dental Disorders	45 (0.13)	123 (0.18)	18 (0.10)	24 (0.13)	210 (0.15)
	Musculoskeletal Pain	1362 (3.86)	3063 (4.38)	614 (3.44)	733 (3.97)	5772 (4.08)

Musculoskeletal & Connective Tissue Diseases	Chest Pain	414 (1.17)	921 (1.32)	240 (1.34)	259 (1.40)	1834 (1.30)
	Non-Infectious Musculoskeletal & Connective Tissue Disease	406 (1.15)	761 (1.09)	191 (1.07)	224 (1.21)	1582 (1.12)
	Infectious Musculoskeletal & Connective Tissue Disease	40 (0.11)	74 (0.11)	29 (0.16)	19 (0.10)	162 (0.11)
Psychiatric and Behavioral Diseases & Substance Abuse		2118 (6.00)	4294 (6.14)	1313 (7.35)	1293 (7.00)	9018 (6.37)
Systemic States	Acute Systemic States	1178 (3.34)	2023 (2.89)	373 (2.09)	516 (2.79)	4090 (2.89)
	Viral Illnesses	429 (1.22)	730 (1.04)	113 (0.63)	193 (1.05)	1465 (1.03)
	Fever	264 (0.75)	572 (0.82)	148 (0.83)	150 (0.81)	1134 (0.80)
	Bacterial & Fungal Illnesses	50 (0.14)	95 (0.14)	23 (0.13)	18 (0.10)	186 (0.13)
	Chronic Systemic States	82 (0.23)	123 (0.18)	25 (0.14)	31 (0.17)	261 (0.18)
Absent Diagnosis		1488 (4.22)	3402 (4.86)	755 (4.23)	913 (4.94)	6558 (4.63)
Respiratory Diseases	Asthma	434 (1.23)	979 (1.40)	532 (2.98)	447 (2.42)	2392 (1.69)
	Other Respiratory Diseases	468 (1.33)	893 (1.28)	226 (1.27)	196 (1.06)	1783 (1.26)
	Infectious Respiratory Diseases	425 (1.20)	777 (1.11)	132 (0.74)	188 (1.02)	1522 (1.08)
	Bronchospasm & Wheezing	157 (0.44)	235 (0.34)	78 (0.44)	96 (0.52)	566 (0.40)
	Non-Infectious Skin,	775 (2.20)	1730 (2.47)	339 (1.90)	366 (1.98)	3210 (2.27)

Skin, Dermatologic & Soft Tissue Diseases	Dermatologic & Soft Tissue Diseases					
	Infectious Skin, Dermatologic & Soft Tissue Diseases	672 (1.90)	1528 (2.18)	287 (1.61)	279 (1.51)	2766 (1.95)
Neurologic Diseases	Headache	919 (2.60)	1578 (2.26)	574 (3.21)	556 (3.01)	3627 (2.56)
	Seizures	287 (0.81)	723 (1.03)	256 (1.43)	194 (1.05)	1460 (1.03)
	Other Neurologic Diseases	149 (0.42)	302 (0.43)	71 (0.40)	77 (0.42)	599 (0.42)
	Developmental Disorders	0 (0.00)	48 (0.07)	31 (0.17)	15 (0.08)	94 (0.07)
	Infectious Neurologic Diseases	0 (0.00)	51 (0.07)	25 (0.14)	16 (0.09)	92 (0.06)
Urinary Tract Diseases	Infectious Urinary Tract Diseases	1217 (3.45)	1983 (2.83)	346 (1.94)	631 (3.42)	4177 (2.95)
	Other Non-Infectious Urinary Tract Diseases	101 (0.29)	213 (0.31)	35 (0.20)	59 (0.32)	413 (0.29)
	Screening Exams, Labs & Administrative Issues	405 (1.15)	669 (0.96)	176 (0.99)	144 (0.78)	1394 (0.98)
	Other Infectious Diseases	94 (0.27)	358 (0.51)	158 (0.88)	126 (0.68)	736 (0.52)

Genital & Reproductive Diseases	Other Genital & Reproductive Diseases	280 (0.79)	544 (0.78)	121 (0.68)	154 (0.83)	1099 (0.78)
	Infectious Genital & Reproductive Diseases	191 (0.54)	432 (0.62)	64 (0.36)	127 (0.69)	814 (0.57)
	Pregnancy	25 (0.07)	47 (0.07)	0 (0.00)	35 (0.19)	107 (0.08)
Allergic, Immunologic & Rheumatologic Diseases		497 (1.41)	918 (1.31)	291 (1.63)	285 (1.54)	1991 (1.41)
Toxicologic Emergencies (including Environment)		293 (0.83)	707 (1.01)	231 (1.29)	213 (1.15)	1444 (1.02)
Endocrine, Metabolic & Nutritional Diseases	Diabetes Mellitus	70 0(.20)	244 (0.35)	95 (0.53)	88 (0.48)	497 (0.35)
	Other Endocrine, Metabolic & Nutritional Diseases	43 ()0.12	86 (0.12)	27 (0.15)	13 (0.07)	169 (0.12)
Diseases of the Eye	Infectious Diseases of the Eye	174 (0.49)	244 (0.35)	47 (0.26)	66 (0.36)	531 (0.38)
	Non-Infectious Diseases of the Eye	49 (0.14)	0 (0.00)	0 (0.00)	13 (0.07)	91 (0.06)
Circulatory & Cardiovascular Diseases	Dysrhythmias	108 (0.31)	214 (0.31)	53 (0.30)	72 (0.39)	447 (0.32)
	Other Circulatory &	21 (0.06)	49 (0.07)	11 (0.06)	11 (0.06)	92 (0.06)

	Cardiovascular Diseases					
Hematologic Diseases	Other (non-sickle cell anemia) Hematologic Diseases	62 (0.18)	259 (0.37)	27 (0.15)	24 (0.13)	372 (0.26)
Fluid & Electrolyte Disorders	Oher (non-dehydration) Fluid & Electrolyte Disorders	25 (0.07)	0 (0.00)	0 (0.00)	12 (0.06)	37 (0.03)

REFERENCES

1. Clair M. Emerging solutions: Report and recommendations: [Québec]: The Commission; 2001.
2. Fyke KJ. Caring for Medicare: sustaining a quality system: Regina: The Commission; 2001.
3. Mazankowski D. A framework for reform. Edmonton: Premier's Advisory Council on Health. 2001.
4. Canada CoFPo. A Vision for Canada: Family Practice, the Patient's Medical Home: College of Family Physicians of Canada; 2011.
5. Pediatrics AAo. The Medical Home. Pediatrics. 2002;110(1):184-6.
6. Hutchison B, LEVESQUE JF, Strumpf E, Coyle N. Primary health care in Canada: systems in motion. Milbank Quarterly. 2011;89(2):256-88.
7. Lévesque J-F, Pineault R, Grimard D, Burge F, Haggerty J, Hogg W, et al. Looking backward to move forward: A synthesis of primary health care reform evaluations in Canadian provinces: Équipe santé des populations et Services de santé, Secteur Services préventifs en milieu clinique, Direction de santé publique, Agence de la santé et des Services sociaux de Montréal; 2012.
8. Québec VGd. Goupes de médecine de famille et cliniques-réseau. Rapport du Vérificateur général du Québec à l'Assemblée nationale pour l'année 2015-2016. 2015;2016.
9. Tourigny A, Aubin M, Haggerty J, Bonin L, Morin D, Reinharz D, et al. Patients' perceptions of the quality of care after primary care reform Family medicine groups in Quebec. Canadian Family Physician. 2010;56(7):e273-e82.
10. Carter R, Levesque JF, Harper S, Quesnel-Vallee A. Measuring the effect of Family Medicine Group enrolment on avoidable visits to emergency departments by patients with diabetes in Quebec, Canada. Journal of evaluation in clinical practice. 2016.
11. Sawyer SM, Afifi RA, Bearinger LH, Blakemore S-J, Dick B, Ezeh AC, et al. Adolescence: a foundation for future health. The Lancet. 2012;379(9826):1630-40.
12. Brindis C, Park MJ, Ozer EM, Irwin CE. Adolescents' access to health services and clinical preventive health care: crossing the great divide. Pediatric annals. 2002;31(9):575-81.
13. Roberts J, Sanci L, Haller D. Global adolescent health: is there a role for general practice? Br J Gen Pract. 2012;62(604):608-10.
14. Roberts G, Grimes K. Return on investment: Mental health promotion and mental illness prevention: Canadian Institute for Health Information Ottawa, ON; 2011.
15. Scheffler RM, Weisfeld N, Ruby G, Estes EH. A manpower policy for primary health care. New England Journal of Medicine. 1978;298(19):1058-62.
16. Muldoon LK, Hogg WE, Levitt M. Primary care (PC) and primary health care (PHC). What is the difference? Canadian journal of public health = Revue canadienne de sante publique. 2006;97(5):409-11.
17. Health JHBSoP. What is primary care? [Available from: http://www.jhsph.edu/research/centers-and-institutes/johns-hopkins-primary-care-policy-center/definitions.html.
18. Starfield B, Shi L, Macinko J. Contribution of primary care to health systems and health. Milbank quarterly. 2005;83(3):457-502.

19. Franks P, Fiscella K. Primary care physicians and specialists as personal physicians: health care expenditures and mortality experience. Journal of Family Practice. 1998;47(2):105-10.
20. Vogel RL, Ackermann RJ. Is primary care physician supply correlated with health outcomes? International journal of health services. 1998;28(1):183-96.
21. Shi L. Primary care, specialty care, and life chances. International Journal of Health Services. 1994;24(3):431-58.
22. Shi L. The relationship between primary care and life chances. Journal of health care for the poor and underserved. 1992;3(2):321-35.
23. Whittle J, Lin CJ, Lave JR, Fine MJ, Delaney KM, Joyce DZ, et al. Relationship of provider characteristics to outcomes, process, and costs of care for community-acquired pneumonia. Medical care. 1998;36(7):977-87.
24. Guttmann A, Shipman SA, Lam K, Goodman DC, Stukel TA. Primary Care Physician Supply and Children's Health Care Use, Access, and Outcomes: Findings From Canada. Pediatrics. 2010;125(6):1119-26.
25. Lloyd JEV, Li L, Hertzman C. Early experiences matter: Lasting effect of concentrated disadvantage on children's language and cognitive outcomes. Health & Place. 2010;16(2):371-80.
26. Shonkoff JP, Boyce WT, McEwen BS. Neuroscience, molecular biology, and the childhood roots of health disparities: building a new framework for health promotion and disease prevention. Jama. 2009;301(21):2252-9.
27. Stansfeld SA, Clark C, Rodgers B, Caldwell T, Power C. Repeated exposure to socioeconomic disadvantage and health selection as life course pathways to mid-life depressive and anxiety disorders. Social psychiatry and psychiatric epidemiology. 2011;46(7):549-58.
28. Starfield B. State of the art in research on equity in health. Journal of health politics, policy and law. 2006;31(1):11-32.
29. Shi L, Starfield B. Primary care, income inequality, and self-rated health in the United States: a mixed-level analysis. International Journal of Health Services. 2000;30(3):541-55.
30. Mosquera PA, Hernández J, Vega R, Martínez J, Labonte R, Sanders D, et al. The impact of primary healthcare in reducing inequalities in child health outcomes, Bogotá–Colombia: an ecological analysis. International journal for equity in health. 2012;11(1):66.
31. Hortensia R, Perez-Cuevas R, Salmeron J, Tome P, Guiscafre H, Gutierrez G. Infant mortality due to acute respiratory infections: the influence of primary care processes. Health policy and planning. 1997;12(3):214-30.
32. Organization WH. Health for the world's adolescents: a second chance in the second decade: summary. 2014.
33. Gore FM, Bloem PJ, Patton GC, Ferguson J, Joseph V, Coffey C, et al. Global burden of disease in young people aged 10–24 years: a systematic analysis. The Lancet. 2011;377(9783):2093-102.
34. Masten AS, Faden VB, Zucker RA, Spear LP. Underage drinking: A developmental framework. Pediatrics. 2008;121(Supplement 4):S235-S51.
35. Grant BF, Dawson DA. Age at onset of alcohol use and its association with DSM-IV alcohol abuse and dependence: results from the National Longitudinal Alcohol Epidemiologic Survey. Journal of substance abuse. 1997;9:103-10.

36. Singh AS, Mulder C, Twisk JW, Van Mechelen W, Chinapaw MJ. Tracking of childhood overweight into adulthood: a systematic review of the literature. Obesity reviews. 2008;9(5):474-88.
37. Warren C, Jones N, Eriksen M, Asma S, group GTSSc. Patterns of global tobacco use in young people and implications for future chronic disease burden in adults. The lancet. 2006;367(9512):749-53.
38. Patton GC, Coffey C, Carlin JB, Sawyer SM, Williams J, Olsson CA, et al. Overweight and obesity between adolescence and young adulthood: a 10-year prospective cohort study. Journal of adolescent health. 2011;48(3):275-80.
39. Organization WH. Preconception care to reduce maternal and childhood mortality and morbidity. Geneva (CH): World Health Organization. 2012.
40. Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. Archives of general psychiatry. 2005;62(6):593-602.
41. Patton GC, Coffey C, Romaniuk H, Mackinnon A, Carlin JB, Degenhardt L, et al. The prognosis of common mental disorders in adolescents: a 14-year prospective cohort study. The Lancet. 2014;383(9926):1404-11.
42. Giedd JN. The teen brain: insights from neuroimaging. Journal of Adolescent Health. 2008;42(4):335-43.
43. Spear LP. Adolescent neurodevelopment. Journal of Adolescent Health. 2013;52(2):S7-S13.
44. Romer D. Adolescent risk taking, impulsivity, and brain development: Implications for prevention. Developmental psychobiology. 2010;52(3):263-76.
45. Arnett J. Drunk driving, sensation seeking, and egocentrism among adolescents. Personality and Individual Differences. 1990;11(6):541-6.
46. Arnett J. Reckless behavior in adolescence: A developmental perspective. Developmental review. 1992;12(4):339-73.
47. Van Voorhees BW, Fogel J, Reinecke MA, Gladstone T, Stuart S, Gollan J, et al. Randomized clinical trial of an Internet-based depression prevention program for adolescents (Project CATCH-IT) in primary care: 12-week outcomes. Journal of Developmental & Behavioral Pediatrics. 2009;30(1):23-37.
48. Jemmott LS, Jemmott III JB, O'Leary A. Effects on sexual risk behavior and STD rate of brief HIV/STD prevention interventions for African American women in primary care settings. American Journal of Public Health. 2007;97(6):1034-40.
49. Laatikainen T, Dunbar JA, Chapman A, Kilkkinen A, Vartiainen E, Heistaro S, et al. Prevention of type 2 diabetes by lifestyle intervention in an Australian primary health care setting: Greater Green Triangle (GGT) Diabetes Prevention Project. BMC public health. 2007;7(1):1.
50. Park M, Macdonald T, Ozer E, Burg S, Millstein S. Investing in clinical preventive health services for adolescents. 2001.
51. Rosen DS, Elster A, Hedberg V, Paperny D. Clinical preventive services for adolescents: position paper of the Society for Adolescent Medicine. Journal of adolescent health. 1997;21(3):203-14.
52. Shengelia B, Murray CJ, Adams OB. Beyond access and utilization: defining and measuring health system coverage. Health systems performance assessment: debates, methods and empiricism Geneva: World Health Organization. 2003:221-34.

53. Levesque J-F, Harris MF, Russell G. Patient-centred access to health care: conceptualising access at the interface of health systems and populations. International journal for equity in health. 2013;12(1):1.
54. Andersen RM. Revisiting the behavioral model and access to medical care: does it matter? Journal of health and social behavior. 1995:1-10.
55. Berk ML, Schur CL. Measuring access to care: improving information for policymakers. Health Affairs. 1998;17(1):180.
56. Gulliford M, Figueroa-Munoz J, Morgan M, Hughes D, Gibson B, Beech R, et al. What does access to health care mean? Journal of health services research & policy. 2002;7(3):186-8.
57. Haggerty J, Burge F, Lévesque J, Gass D, Pineault R, Beaulieu MD, et al. Operational Definitions of Attributes of Primary Health Care: Consensus Among Canadian Experts. Annals of Family Medicine. 2007;5(4):336-44.
58. Quality AfHRa. Access to Health Care 2011 [Available from: https://www.ahrq.gov/research/findings/nhqrdr/nhqr11/chap9.html.
59. Wilson K, Rosenberg MW. Accessibility and the Canadian health care system: squaring perceptions and realities. Health policy (Amsterdam, Netherlands). 2004;67(2):137-48.
60. Lombrail P, Vitoux-Brot C, Bourrillon A, Brodin M, Pouvourville Gd. Another Look at Emergency Room Overcrowding: Accessibility of the Health Services and Quality of Care. International Journal for Quality in Health Care. 1997;9(3):225-35.
61. Cecil E, Bottle A, Cowling TE, Majeed A, Wolfe I, Saxena S. Primary Care Access, Emergency Department Visits, and Unplanned Short Hospitalizations in the UK. Pediatrics. 2016;137(2):e20151492.
62. McCusker J, Roberge D, Tousignant P, Lévesque J, Vadeboncoeur A, Ciampi A, et al. Closer Than You Think: Linking Primary Care to Emergency Department Use in Quebec. Montreal, QC: St Mary's Research Centre. 2013.
63. Mian O, Pong R. Does better access to FPs decrease the likelihood of emergency department use? Results from the Primary Care Access Survey. Canadian Family Physician. 2012;58(11):e658-e66.
64. Guttman N, Zimmerman DR, Nelson MS. The many faces of access: reasons for medically nonurgent emergency department visits. Journal of Health Politics, Policy and Law. 2003;28(6):1089-120.
65. Béland F, Lemay A, Boucher M. Patterns of visits to hospital-based emergency rooms. Social Science & Medicine. 1998;47(2):165-79.
66. Boushy D, Dubinsky I. Primary care physician and patient factors that result in patients seeking emergency care in a hospital setting: the patient's perspective. The Journal of Emergency Medicine. 1999;17(3):405-12.
67. Woolhandler S, Campbell T, Himmelstein DU. Costs of health care administration in the United States and Canada. New England Journal of Medicine. 2003;349(8):768-75.
68. Obama B. United states health care reform: Progress to date and next steps. JAMA. 2016;316(5):525-32.
69. Zimmer-Gembeck MJ, Alexander T, Nystrom RJ. Adolescents report their need for and use of health care services. Journal of Adolescent Health. 1997;21(6):388-99.
70. Nordin JD, Solberg LI, Parker ED. Adolescent primary care visit patterns. The Annals of Family Medicine. 2010;8(6):511-6.
71. Congress U. Adolescent health: Volume II. Background and the effectiveness of selected prevention and treatment services. Washington, DC: Office of Technology Assessment; 1991.

72. Ziv A, Boulet JR, Slap GB. Utilization of physician offices by adolescents in the United States. Pediatrics. 1999;104(1):35-42.
73. Burns ME, Leininger LJ. Understanding the gap in primary care access and use between teens and younger children. Medical care research and review. 2012;69(5):581-601.
74. Ryan S, Riley A, Kang M, Starfield B. The effects of regular source of care and health need on medical care use among rural adolescents. Archives of pediatrics & adolescent medicine. 2001;155(2):184-90.
75. Lieu TA, Newacheck PW, McManus MA. Race, ethnicity, and access to ambulatory care among US adolescents. American Journal of Public Health. 1993;83(7):960-5.
76. Gans JE, McManus MA, Newacheck PW. Adolescent health care: use, costs and problems of access. 1991.
77. Newacheck PW, Hung YY, Jane Park M, Brindis CD, Irwin CE. Disparities in adolescent health and health care: does socioeconomic status matter? Health services research. 2003;38(5):1235-52.
78. Booth ML, Bernard D, Quine S, Kang MS, Usherwood T, Alperstein G, et al. Access to health care among Australian adolescents young people's perspectives and their sociodemographic distribution. Journal of Adolescent Health. 2004;34(1):97-103.
79. Tylee A, Haller DM, Graham T, Churchill R, Sanci LA. Youth-friendly primary-care services: how are we doing and what more needs to be done? The Lancet. 2007;369(9572):1565-73.
80. Richter S. Accessibility of adolescent health services. Curationis. 2000;23(2):76-82.
81. Klein JD, McNulty M, Flatau CN. Adolescents access to care: teenagers self-reported use of services and perceived access to confidential care. Archives of Pediatrics & Adolescent Medicine. 1998;152(7):676-82.
82. Gleeson CR, Robinson MB, Neal RD. A review of teenagers' perceived needs and access to primary health care: implications for health services. Primary Health Care Research and Development. 2002;3(03):184-93.
83. Curtis K, Liabo K, Roberts H, Barker M. Consulted but not heard: a qualitative study of young people's views of their local health service. Health Expectations. 2004;7(2):149-56.
84. Haller DM, Sanci LA, Patton GC, Sawyer SM. Toward youth friendly services: a survey of young people in primary care. Journal of general internal medicine. 2007;22(6):775-81.
85. Lehmann CU, Barr J, Kelly PJ. Emergency department utilization by adolescents. Journal of adolescent health. 1994;15(6):485-90.
86. Wilson KM, Klein JD. Adolescents who use the emergency department as their usual source of care. Archives of pediatrics & adolescent medicine. 2000;154(4):361-5.
87. Piehl MD, Clemens CJ, Joines JD. Narrowing the gap: decreasing emergency department use by children enrolled in the Medicaid program by improving access to primary care. Archives of pediatrics & adolescent medicine. 2000;154(8):791-5.
88. Aggarwal M, Hutchison BG. Toward a primary care strategy for Canada: Canadian Foundation for Healthcare Improvement; 2012.
89. Ouimet MJ, Pineault R, Prud'homme A, Provost S, Fournier M, Levesque JF. The impact of primary healthcare reform on equity of utilization of services in the province of Quebec: a 2003-2010 follow-up. International journal for equity in health. 2015;14:139.
90. Popay J, Roberts H, Sowden A, Petticrew M, Arai L, Rodgers M, et al. Guidance on the conduct of narrative synthesis in systematic reviews. A product from the ESRC methods programme Version. 2006;1:b92.

91. Campbell DJ, Ronksley PE, Hemmelgarn BR, Zhang J, Barnabe C, Tonelli M, et al. Association of enrolment in primary care networks with diabetes care and outcomes among First Nations and low-income Albertans. Open medicine : a peer-reviewed, independent, open-access journal. 2012;6(4):e155-65.
92. Manns BJ, Tonelli M, Zhang J, Campbell DJ, Sargious P, Ayyalasomayajula B, et al. Enrolment in primary care networks: impact on outcomes and processes of care for patients with diabetes. CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne. 2012;184(2):E144-52.
93. Heroux J, Moodie EE, Strumpf E, Coyle N, Tousignant P, Diop M. Marginal structural models for skewed outcomes: identifying causal relationships in health care utilization. Statistics in medicine. 2014;33(7):1205-21.
94. Carter R, Quesnel-Vallée A, Plante C, Gamache P, Lévesque J-F. Effect of family medicine groups on visits to the emergency department among diabetic patients in Quebec between 2000 and 2011: a population-based segmented regression analysis. BMC family practice. 2016;17(1):23.
95. Strumpf E, Ammi M, Diop M, Fiset-Laniel J, Tousignant P. The Impact of Team-Based Primary Care on Health Care Services Utilization and Costs: Quebec's Family Medicine Groups. 2016.
96. Jacobson L, Kinnersley P. Teenagers in primary care--continuing the new direction. Br J Gen Pract. 2000;50(461):947-8.
97. Oberg C, Hogan M, Bertrand J, Juve C. Health care access, sexually transmitted diseases, and adolescents: identifying barriers and creating solutions. Current problems in pediatric and adolescent health care. 2002;32(9):320-39.
98. Macinko J, Starfield B, Shi L. The contribution of primary care systems to health outcomes within Organization for Economic Cooperation and Development (OECD) countries, 1970–1998. Health services research. 2003;38(3):831-65.
99. Van Doorslaer E, Masseria C, Koolman X, Group OHER. Inequalities in access to medical care by income in developed countries. Canadian medical association journal. 2006;174(2):177-83.
100. Canada A. Family Medicine Groups 2013 [Available from: https://accreditation.ca/family-medicine-groups.
101. Haggerty JL, Pineault R, Beaulieu M-D, Brunelle Y, Gauthier J, Goulet F, et al. Practice features associated with patient-reported accessibility, continuity, and coordination of primary health care. The Annals of Family Medicine. 2008;6(2):116-23.
102. Québec Rdlamd. Health Insurance: Medical Services [Available from: http://www.ramq.gouv.qc.ca/en/citizens/health-insurance/healthcare/Pages/medical-services.aspx.
103. Cohen E, Berry JG, Camacho X, Anderson G, Wodchis W, Guttmann A. Patterns and costs of health care use of children with medical complexity. Pediatrics. 2012:peds. 2012-0175.
104. Feudtner C, Hays RM, Haynes G, Geyer JR, Neff JM, Koepsell TD. Deaths attributed to pediatric complex chronic conditions: national trends and implications for supportive care services. Pediatrics. 2001;107(6):e99-e.
105. Provost S, Pérez J, Pineault R, Borgès Da Silva R, Tousignant P. An algorithm using administrative data to identify patient attachment to a family physician. International journal of family medicine. 2015;2015.

106. Pampalon R, Raymond G. A deprivation index for health and welfare planning in Quebec. Chronic Diseases and Injuries in Canada. 2000;21(3):104.
107. Canada S. Census metropolitan influenced zone (MIZ) 2011 [Available from: https://www12.statcan.gc.ca/census-recensement/2011/ref/dict/geo010-eng.cfm.
108. Alessandrini EA, Alpern ER, Chamberlain JM, Shea JA, Gorelick MH. A new diagnosis grouping system for child emergency department visits. Academic emergency medicine : official journal of the Society for Academic Emergency Medicine. 2010;17(2):204-13.
109. Hosmer DW, Lemeshow S. Introduction to the logistic regression model. Applied Logistic Regression, Second Edition. 2000:1-30.
110. Viera AJ. Odds ratios and risk ratios: what's the difference and why does it matter? Southern medical journal. 2008;101(7):730-4.
111. Shrier I, Steele R. Understanding the relationship between risks and odds ratios. Clinical journal of sport medicine : official journal of the Canadian Academy of Sport Medicine. 2006;16(2):107-10.
112. Lambert D. Zero-inflated Poisson regression, with an application to defects in manufacturing. Technometrics. 1992;34(1):1-14.
113. Ridout M, Hinde J, DeméAtrio CG. A Score Test for Testing a Zero-Inflated Poisson Regression Model Against Zero-Inflated Negative Binomial Alternatives. Biometrics. 2001;57(1):219-23.
114. Atkins DC, Gallop RJ. Rethinking how family researchers model infrequent outcomes: a tutorial on count regression and zero-inflated models. Journal of Family Psychology. 2007;21(4):726.
115. Albert RH, Skolnik NS. Essential infectious disease topics for primary care: Springer Science & Business Media; 2008.
116. Cripps AW, Otczyk DC, Kyd JM. Bacterial otitis media: a vaccine preventable disease? Vaccine. 2005;23(17):2304-10.
117. Tate JE, Curns AT, Cortese MM, Weintraub ES, Hambidge S, Zangwill KM, et al. Burden of acute gastroenteritis hospitalizations and emergency department visits in US children that is potentially preventable by rotavirus vaccination: a probe study using the now-withdrawn RotaShield vaccine. Pediatrics. 2009;123(3):744-9.
118. Greig A, Constantin E, Carsley S, Cummings C. Preventive health care visits for children and adolescents aged six to 17 years: The Greig Health Record–Executive Summary. Paediatrics & Child Health. 2010;15(3):157.
119. Raphael JL, Zhang Y, Liu H, Tapia CD, Giardino AP. Association of Medical Home Care and Disparities in Emergency Care Utilization Among Children With Special Health Care Needs. Academic Pediatrics. 2009;9(4):242-8.
120. Strickland BB, Jones JR, Ghandour RM, Kogan MD, Newacheck PW. The medical home: health care access and impact for children and youth in the United States. Pediatrics. 2011;127(4):604-11.
121. Coyle N, Strumpf E, Fiset-Laniel J, Tousignant P, Roy Y. Characteristics of physicians and patients who join team-based primary care practices: evidence from Quebec's Family Medicine Groups. Health policy (Amsterdam, Netherlands). 2014;116(2-3):264-72.
122. Embree J, Henderson KJ, Hilliard RI, Pekeles G, Abelson B, George P, et al. A model of paediatrics: Rethinking health care for children and youth. PULSUS GROUP INC 2902 S SHERIDAN WAY, OAKVILLE, ONTARIO L6J 7L6, CANADA; 2009.

123. Monfared AAT, LeLorier J. Accuracy and validity of using medical claims data to identify episodes of hospitalizations in patients with COPD. Pharmacoepidemiology and Drug Safety. 2006;15(1):19-29.
124. Coyle N, Strumpf E, Tousignant P, Roy Y, Fiset-Laniel J. Primary health care reform: Who joins a family medicine group. American Journal of Epidemiology. 2011;173:S103.
125. Canada S. Statistical Area Classification (SAC) 2011 [updated November 27, 2015.