

A population-based evaluation of the delivery of care for people living with
HIV in Ontario

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Abstract

Background: Health care needs to evolve to meet the needs of people living with HIV as they age and become a more diverse population. For HIV and other conditions, physician specialty and experience are often positively associated with disease-specific outcomes but negatively associated with primary care outcomes. The objectives of this thesis were to: 1) assess comorbidity prevalence among people living with HIV in Ontario; 2) describe the type and extent of care by physician specialty; 3) use a theoretical shared primary/specialist care typology to characterize this care; 4) measure the quality of care delivered related to this typology; and 5) assess the independent effect of family physician HIV experience.

Methods: Population-based data were used to describe a cohort of 14,282 individuals living with HIV in Ontario. Health care visits to this cohort were categorized by physician specialty, physician HIV experience, and HIV-related versus HIV-unrelated care. A theoretically-based typology of care was developed by linking patients to usual family physicians and to HIV specialists with 5 possible patterns of care. Prevention and chronic disease management adherence, antiretroviral (ART) prescribing, and health care utilization were compared across typology models using multivariable hierarchical logistic regression analyses. The independent effect of family physician experience was also examined.

Results: People with HIV had significant comorbidity. Family physicians provided the majority of care. Five patterns of care were described: exclusively primary care (45.4%); specialist-dominated co-management (30.7%); family physician-dominated co-management (10.1%); low engagement (8.6%); and exclusively specialist care (5.3%). After adjustment, HIV patients in exclusively specialist care had lower odds of colorectal cancer screening but higher odds of receiving ART. Odds of having an emergency

department visit did not differ among models. Among HIV patients seeing only family physicians, those linked to family physicians with high HIV experience were significantly more likely to receive ART than those with lower HIV experience.

Discussion: People with HIV in Ontario have substantial comorbidity. A typology of shared care between family physicians and HIV specialists had a strong influence on the quality of care delivered. These findings have important policy and practice implications and support emerging evidence that multi-specialty expertise is required to address the care needs of this population.

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Chapter 1

Preface

1.1 Overview and objectives

The accumulation of chronic conditions over the lifespan is a significant and rising burden on individuals and healthcare systems. There is strong evidence that the management of chronic diseases is most effectively and economically provided in well-supported primary care settings(1–4). With this awareness, the past decade has seen a period of rapid and substantial investment in primary care transformation in Ontario and across Canada(5–7). This transformation was viewed as necessary for decreasing existing barriers to access, improving coordination, enhancing community integration, and improving quality of care in order to reduce persistent disparities in health. Researchers and policy makers have sought to measure how the organization of care impacts the quality of primary care delivered.

Despite investments in primary care delivery, patients, especially those with chronic disease, struggle within fragmented systems(3,8–11). Much of this fragmentation can be attributed to inadequate coordination of care within and among levels of the health care system. The breakdown of communication at the interface between providers, such as between specialists and family physicians, calls for systems to strengthen(12) and measure(13) the quality of this interface. Finally, there is a need to measure how the organizational structure of this interface impacts actual outcomes for complex patients.

Given the successes of antiretroviral therapy (ART), HIV has become a chronic condition well-suited to defining this specialist-primary care interface. Certainly in the early-ART era, HIV was a complicated, life-threatening disease requiring significant specialist expertise for treatment. However, as longevity for people with HIV has increased, HIV patients must now contend with the mental and physical comorbidity that increasingly defines this population(14–18). As with other chronic conditions, there is increasing evidence that

traditional specialist expertise alone may no longer be enough to meet the comprehensive care needs of this complex population(19–27). In addition, patients with HIV continue to be disproportionately disadvantaged by socioeconomic inequities that hinder their linkage to and retention in care.

Stemming from this literature, the two grounding hypotheses of this thesis are: that the care for people living with HIV can be defined within a typology that is distinguished by discrete patterns of outpatient visits to HIV specialists and family physicians; and that patients with HIV who receive the majority of their health care from a usual family physician will have improved quality of primary care compared to those in other models of care, measured as health services utilization outcomes and technical quality of primary clinical care measures.

In response to these hypotheses, the objectives of this thesis are iterative, with each objective building upon the findings of the previous studies. These are:

- (1) To describe the prevalence of comorbidities for people living with HIV and to compare this prevalence to an age and sex adjusted general population.
- (2) To describe the individual and practice characteristics of physicians who provide outpatient care to patients living with HIV in Ontario.
- (3) To determine the proportion of physician care provided to patients with HIV in Ontario by physician specialty (family physicians, infectious disease specialists, general internists, and others), and to describe the amount and type of care by physician specialty.
- (4) To develop a theoretically-defined typology of shared care using administrative data, with people living with HIV in Ontario as a population of focus.

(5) To describe and compare the quality of primary care provided to people with HIV in Ontario assigned to the different care models of this typology.

(6) Related to this typology of shared care, to explore whether family physician HIV experience contributes independently to the quality of care for people living with HIV in Ontario.

1.2 Studies emerging from this thesis

These objectives are met through five chapters of this thesis representing the scientific articles that have been published or submitted for publication. In brief, the sequence of these chapters is:

Chapter 5 addresses Objective 1: Kendall, C., Wong, J., Taljaard, M., Glazier, R. H., Hogg, W., Younger, J., & Manuel, D. G. (2014). A cross-sectional, population-based study measuring comorbidity among people living with HIV in Ontario. BMC Public Health, 14(161).

This chapter consists of a study that used validated chronic disease algorithms to quantify the burden of comorbidities for people living with HIV and to compare this burden to an age and sex adjusted general Ontario population. This study found that one third of people with HIV have at least one other physical condition and 38.6% have a mental health diagnosis. Multimorbidity, especially combined physical-mental health multimorbidity, was significantly higher among people with HIV than in the general Ontario population.

Chapter 6 addresses Objective 2 and 3: Kendall, C., Wong, J., Taljaard, M., Glazier, R. H., Hogg, W. E., Younger, J., & Manuel, D. G. A cross-sectional, population-based study of HIV

physicians and outpatient health care use by people with HIV in Ontario. Submitted to BMC Health Services Research October 2013.

This chapter consists of a study that characterizes the physician care for people living with HIV in Ontario. This study quantified for the first time the substantial amount of care being provided by family physicians; the majority of HIV-related and non-HIV related outpatient visits were to family physicians, and most of these family physicians had fewer than 5 HIV patients under their care. Almost one third of visits were to physicians in specialties outside of family medicine, infectious diseases, and general internal medicine, and one third of these are to psychiatrists.

Chapter 7 addresses Objective 4: Kendall, C. E., Younger, J., Manuel, D. G., Glazier, R. H., Hogg, W. E., & Taljaard, M. The derivation and validation of a typology of care for patients with chronic disease using administrative data. Submitted to Journal of Clinical Epidemiology September 2014.

This chapter consists of the study in which I developed and characterized a theoretically-derived typology of care for people living with HIV in Ontario. Five possible patterns of care were described as low engagement (8.6%), exclusively primary care (52.7%); family physician-dominated co-management (10.0%), specialist-dominated co-management (30.5%); and exclusively specialist care (5.2%). Sensitivity analyses were performed using variations in definitions for the usual provider of primary care and demonstrated robustness of typology assignments. Visit patterns were used to characterize the typology categories.

Chapter 8 addresses Objective 5: Kendall, C. E., Taljaard, M., Younger, J., Hogg, W. E., Glazier, R. H., & Manuel, D. G. A population-based study comparing patterns of care delivery on the quality of care for persons living with HIV in Ontario. Submitted to BMJ Open December 2014.

The specific objective of this study was to describe the quality of primary care among the typology of care categories derived in Study 3. Using hierarchical multivariable regression

analysis, this study found that how care is provided and shared between specialist and primary care physicians had a strong influence on the quality of care delivered. In particular, family physician dominant models provided better preventative care, and specialist-dominant models had improved adherence to ART prescribing.

Chapter 9 addresses Objective 6: Kendall, C. E., Manuel, D. G., Younger, J., Glazier, R. H., Hogg, W. E., & Taljaard, M. The impact of primary care on the quality of primary care for people living with HIV in Ontario. Submitted to Annals of Family Medicine January 2015.

This study built upon Study 4 to find that, within models in which patients have a usual family physician, family physician HIV experience is strongly associated with certain outcomes. HIV experience was especially important for adherence to ART prescribing among patients cared for in primary care dominant models. In addition, lower HIV experience was associated with increased hospitalization rates.

This body of work represents a contribution to the literature in several ways. To my knowledge, it is the first population-based work evaluating HIV care in a population of socioeconomically diverse adults. Our administrative data sources arise from a publicly-funded system in which the vast majority of physician billing is captured, allowing us to describe actual patterns of care. Within, I address quality of care from both disease-specific and general primary care perspectives, which broadens the impact of this work beyond the HIV clinic to the entire health care delivery system. Importantly, this work provides essential insight into the respective contributions of both physician specialty and physician experience to the care of people living with HIV in Ontario. Finally, the typology and its use in characterizing patterns of care may be extended to other chronic conditions requiring a primary care lens with specialist input and expertise.

1.3 Contribution of authors

Dr. Kendall led the conception, design, analysis and interpretation of all studies within this thesis. Drs. Manuel, Hogg, Taljaard and Glazier contributed their insight and expertise at

each of these stages through regular meetings. Jenna Wong contributed to data extraction for Study 1, and Jaime Younger for Studies 2-5. Dr. Kendall was responsible for the first complete draft of each study, and all other authors contributed to drafts of the articles and approved the final draft prior to submission.

Chapter 2 Background

2.1 The rising burden of chronic disease in Canada

The accumulation of chronic conditions over the lifespan is a significant and rising burden. In Canada, 33% of community dwelling individuals report having at least one of seven common chronic conditions(28). Furthermore, 11.6% of adults in the Canadian general population and 32.3% of adults in primary care practice have multimorbidity, that is, the presence of two or more such chronic conditions(29).

The outpatient management of these conditions consumes substantial healthcare resources(30–32). Canadians with one or more chronic diseases report using 51% of all family physician consultations and 55% of all specialist consultations(13). Administrative data from Ontario demonstrate an increasing number of health care visits associated with increasing chronic disease count, with, on average, twice as many visits to family physicians compared to specialists(32,33). With advancing age, patients with multiple conditions tend to increase their number of primary care visits while decreasing their visits to specialists(33). Similar patterns were seen for younger patients with chronic disease in the United States; primary care visits exceeded specialist visits for all but those with the most uncommon conditions (34). In contrast, elderly patients with higher comorbidity in the United States had more visits to specialists than to primary care providers, even when the management of these comorbidities was within the scope of primary care practice(35). These differing patterns of care delivery for people with chronic disease speaks to the high utilization by this population across settings, and raises questions around the optimal care delivery models for patients with chronic disease over time.

2.2 Health systems remain fragmented despite investments in primary care

Despite these different patterns of specialist and primary care use, it is well established that the prevention and management of chronic diseases (and their multimorbidity) is most effectively, equitably and economically provided in well-supported primary care settings(1–4). With this recognition, the last decade has seen a substantial transformation of the primary care landscape in Ontario. The aim of these reforms was to decrease barriers to access, improve comprehensiveness and coordination of care, enhance community integration, and improve quality of care while mitigating persistent disparities in health. System and practice level changes focused on capitation-based remuneration and patient rostering, quality improvement incentives for disease prevention, health promotion, chronic disease management, and complex care, enhancing within-practice interdisciplinary team-based care, and implementing electronic health records(7,36,37).

Overall, despite some modest advances, these new models have not substantially improved performance indicators of prevention, health promotion, or chronic disease management, nor enhanced the overall access to and equity of care delivered(2,36,38–43). One potential explanation is that these incentives focused on improving operations at the level of the primary care clinic but did not explicitly address the integration between primary care teams and specialists or tertiary care settings.

Despite frequent contact with the health care system, patients with chronic disease struggle within a system that is often disease-focused and fragmented (3,8–11). Much of this fragmentation arises from poor coordination at the interface between primary care practices and other specialists within the system. Across several developed countries, including Canada, one fifth to one half of adults with chronic disease reported coordination gaps in their care, including poor transition of medical tests and lack of communication between providers(44). These gaps have consequences for patients with

chronic disease, including delays in diagnosis and treatment, medical errors, and ineffective care.

This suboptimal coordination arises in large part from lack of delineation and communication regarding the respective roles of primary care physicians and specialists in the care of individual patients (45,46). The role of the primary care provider is to establish a medical home for coordinated and comprehensive care(47,48). By virtue of their training and practice environments, generalists have a different approach to care than specialists(8,47,49). Generalists embrace a symptom-based approach, using established relationships to navigate the patient's illness experience towards a management plan over time. Even when multiple physicians are involved in their care, this continuity with a trusted physician matters to patients(50) and this trust is eroded when communication between providers is inadequate(45).

The role of the specialist physician is less clearly defined. Specialists are primarily trained in hospitals and referral clinics, not community settings(8). Disease prevalence in their practices is high, leading to a more disease-focused approach to diagnosis and management. The delineation of roles of primary care providers and specialists may become increasingly blurred for complex patients, such as those undergoing cancer care(51) and for those at the end of life(52). Even though physicians tend to favour co-management for issues related to the reason for referral(53), specialists and primary care providers interpret their roles in sharing care differently (54,55).

2.3 Challenges in measuring primary care, specialist care, and shared care

There are several challenges to measuring quality of care for complex patients. Vertical quality, that is, measuring the specific tasks of primary care providers and specialists within their respective roles, is relatively straightforward. It is more difficult, however, to

measure the horizontal aspects of care, such as personalization, prioritization, and integration of care across several conditions and domains of care(56).

Most existing literature exploring the performance of specialist and primary care has used a dichotomous approach, ignoring the reality that more than one provider is often involved in the care of patients over time. Many patients with chronic disease do not have one discrete condition – they present with overlapping physical and mental health conditions as well as variations in their social contexts that impact their health behaviours, health care use and health outcomes(57). Yet most randomized control trials, clinical guidelines and measures of quality of care are disease-specific, thus disregarding the complexity of the illness experience(3,58,59).

On the one hand, it is established that primary care leads to better outcomes for whole person care than does specialist care(49). Among patients with chronic conditions, those who do not report having a regular doctor, those with fewer than three medical visits over two years, and those with poor continuity of care are more likely to use the emergency department and to have a medical non-elective hospital admission(60).

On the other hand, there is certainly a role for the specialist physician, especially in the management of patients whose needs are defined by a single or less common condition. Smetana et. al.(61) conducted a systematic review of studies that compared specialist versus generalist care for patients with a single discrete medical condition. Of the 49 studies, 24 found that specialists provided better care within their area of expertise, while only four studies favoured generalist care.

However, some of these studies (and more of those favouring specialist care) inadequately controlled for practice environment, physician experience, and patient complexity. In one study, patients with cardiac disease cared for by generalists were older and more frail than those in specialist care(62). Provider experience (patient volume or

caseload) also results in improved outcomes for discrete conditions, although, again, this relationship is less clear when factoring in differences in patient complexity (63). Furthermore, while within-specialty care may be superior, subspecialists provide lower quality care compared to primary care physicians when managing issues outside of their specialty area(64).

Despite the potential benefits of both specialists and primary care, it is less clear how care shared between them influences outcomes for patients. Smith et al.(65) conducted a systematic review to synthesize the effectiveness of shared care interventions for patients with chronic disease. The included randomized controlled trials had wide variations in the definitions of shared care, multifaceted interventions, differences between their target diseases, and were often of inadequate quality. Despite the “intuition” that shared care should lead to improved outcomes, evidence of its effectiveness was lacking for all physical, mental health, and patient evaluated outcomes save for medication prescribing. Furthermore, there is no clear evidence that sharing care reduces the use of health care resources. In fact, when a patient sees any one specialist in addition to a family physician, their total number of visits per year doubles, and continues to increase with every additional specialist seen(31). There is, however, consensus that sharing care may mitigate gaps from seeing either physician alone, and that primary care is preferred foundation upon which to effectively and economically liaise with specialist expertise(62,66,67).

2.4 Measuring the performance of shared care using health administrative data

Provincial administrative data have been used to measure care for several populations in Ontario, including the relative amounts of specialist and primary care for patients with chronic conditions (33,60,68). These data have facilitated the evaluation of quality of care

among several populations and conditions. In recent years, much of this work has evaluated the impact of primary care reform and new, primarily capitation-based, models of primary care on health services delivery and the quality of care.

To date, however, there has been limited research using health administrative data to explore how primary care providers and specialists share care for the same patients.

Barnett et al. (69) sought to determine whether relationships between physicians identified as sharing care based on administrative data (Medicare billings) corresponded to perceived physician relationships obtained through physician surveys. The likelihood of physicians reporting a shared care relationship increased with the number of patients shared, with a plateau observed at 9-10 shared patients (AUC or c-statistic 0.73, 95% confidence interval: 0.70 – 0.75). Primary care physicians were more likely than surgical or medical specialists to recognize these relationships, especially with fewer shared patients, likely reflecting their role in coordinating specialist referrals(4). This study thus identifies that administrative data may be a useful tool in defining how physicians actually share care.

In a particularly salient study, Lafata et al.(70) recognized that the specialist versus primary care dichotomy adopted by previous performance studies does not adequately represent that physicians often share care for the same conditions. In addition, these authors noted that previous studies typically only evaluated outcomes related to the specialist's area of expertise, such as glycosylated hemoglobin testing by endocrinologists, but neglected to include care needs such as the prevention and management of comorbidities. To explore this further, they conducted a study to evaluate the contribution of provider type on both diabetes-related and general preventative care. Using clinical records and administrative billing data, they generated a cohort of 10,991 patients, all whom had at least 1 visit to either a primary care provider or an endocrinologist for diabetes care. The authors found that patients receiving shared care were more likely to receive both recommended diabetes-related and general preventative care. Those seeing only an endocrinologist were more likely to receive a

retinal exam and a composite of all 3 diabetes measures, but less likely to receive a pap test. Overall, there was little impact of receiving care from additional specialists, or of more than one endocrinologist or more than one primary care provider on the receipt of diabetes-related services.

Katz et al. used cluster analysis to empirically assign patients in Manitoba, Canada, based on their patterns of ambulatory visits. Eleven clusters emerged for patients without chronic conditions compared to 15 quite varied clusters for those with at least one chronic condition. The majority (84%) of Manitobans with chronic disease fell into a cluster where most visits were provided by their usual family physician. On average, these patients had 13 visits to their usual primary care provider and 2 visits to specialists over 3 years. No clear cluster emerged as clearly associated with better or worse quality of care. However, several patients had patterns that reflected low continuity of care, very high ambulatory care use, or in which specialists were the main provider; these clusters performed less well on a number of indicators. While this study had an empirical advantage, the large number and variation of clusters made it difficult to interpret their impact on quality of care.

2.5 Human immunodeficiency syndrome (HIV) is a complex chronic condition well-suited to defining and measuring the primary care – specialist interface

2.5.1 HIV is a chronic condition rising in both prevalence and complexity

The prevalence of HIV continues to increase in Canada; in 2011, an estimated 71,300 individuals were living with HIV, increased 11.7% from 64,000 in 2008(71). Ontario is the province with the largest number of HIV positive residents. This rising prevalence reflects the medical success of combination antiretroviral therapy (cART) on longevity. In the developed world, mortality from non-AIDS events, including chronic diseases, substance abuse and non–AIDS- defining cancers, now exceeds that of AIDS-defining opportunistic

diseases in individuals receiving ART.(17,16) With this increased longevity, HIV has become a complex chronic condition. As people with HIV on combination ART age, they are likely to acquire additional chronic conditions related to normal aging as well as from the effects of HIV and its treatment, including renal failure, hypertension and diabetes, and are likely to have multimorbidity of these conditions(17,16,14,15,18)

2.5.2 Little is known about who is providing care to people with HIV

Little is known about who is actually providing care for people with HIV, and much of what is known is outdated, reflecting care in the early ART era(72). One challenge has been lack of standardization of provider terminology in the literature(73). A “primary care provider” may be defined based on role (i.e. first point source of care or physician responsible for coordination of care) or based on accredited specialty training (i.e. certified family medicine). An HIV “specialist” may be accredited as such through residency training or further accreditation, or self-defined based on volume of HIV care or years of experience. This ambiguity has made it difficult to distinguish the respective contributions of physician qualification versus provider experience to the effectiveness of HIV care(74).

In the United States, the majority of accredited HIV “specialists” are male, specialty trained, 79% have an annual caseload of over 200 HIV patients, and about 40% are over 50 years of age(75,76). A survey of United States primary care providers found that only 54% report treating HIV patients(76). Most of these primary care providers were female, family medicine trained, urban practicing, and 36% reported an annual caseload of over 200 HIV patients(77). There is particularly limited information on HIV providers in Canada. In a dated survey of Canadian family physicians, only 33.4% of respondents reported providing any level of care to people with HIV in 2001(78). Another study within a tertiary HIV clinic found that even when patients had an assigned family physician at the time of specialist referral, many did no longer identified or sought care from that physician(20).

2.5.3 The extent to which patterns of care relate to outcomes for people with HIV requires further exploration

As described, specialist care may be best for those with rare conditions or requiring complex procedures, or patients whose health care needs are mostly defined by one condition. Although many studies were performed before or early in the era of modern antiretroviral therapy (ART), when HIV was still considered a fatal condition within years of diagnosis, there is evidence that HIV specialists (versus generalists) and those with greater HIV experience provide higher quality of care as measured by disease-specific indicators(79,80,74,81–83).

At the same time, there is increasing recognition that a primary care approach is warranted for people living with longstanding HIV(20,19,21–24). Specialist HIV providers are less comfortable managing the common comorbidities associated with chronic HIV infection(19) resulting in increased referrals(25). They are also less likely to provide HIV-related risk reduction counseling (25) and non-HIV related age and sex-specific preventative care for this population(26,27).

There is limited work exploring how patterns of specialist and primary care impact the quality of care for people living with HIV. Chu et al. (84) demonstrated no difference in HIV treatment outcomes (virologic suppression and immunologic success) among patients presenting to care to non-experts at a community-based program with collaborative HIV specialist support versus a hospital-based specialist-run clinic. Koethe et al.(85) found no significant difference in prevention measures between generalists and specialists providing care at one HIV-focused clinic, although some maneuvers were quite low in both physician groups. Both of these studies adjusted for patient complexity, but neither adjusted for physician HIV experience, which varied between comparison groups.

These studies adopted a dichotomous approach to compare specialty care with primary care rather than considering the impact of shared care between providers. In one study, Rodriguez and colleagues(86) hypothesized that the impact of HIV care team composition would differ for complex tasks, such as ART (in the early ART era) versus those amenable to routinization, such as cervical screening. They then interviewed patients with HIV regarding the clinicians involved in their care and their settings of care. After adjusting for patient factors, teams with more clinicians had improved HIV-specific outcomes such as opportunistic infection prophylaxis. Those without an identified usual provider were least likely to receive ART, but ART prescribing did not differ between the other team composition groups. However, after adjusting for patient factors, patients with more providers had higher rates of cervical screening, but poorer patient-reported care coordination and higher inappropriate emergency department use. These findings highlight the advantages and disadvantages of having multiple clinicians involved in the care of the same patients.

Early in the ART-era, Page et al. interviewed HIV patients and identified five patterns of care: 42% saw a general practitioner exclusively, 31% received care at a specialist outpatient clinic, 8% were in shared care, 10% changed health-care model during the study period, and 9% were lost to follow-up. Demographic, psychosocial and clinical characteristics were similar among the groups. They found no differences in viral suppression, ART prescribing, and ART adherence between those in the specialist clinic exclusively, shared care, and general practitioner exclusively models. However, patients reported higher satisfaction in the general practitioner exclusively and shared care models. Those in general practitioner exclusively (vs. specialist clinic exclusively) reported greater perceived provider competence, visit satisfaction, personal continuity, receipt of information, interpersonal communication, provider trust, and access outside of regular hours. All general practitioners surveyed had at least five HIV patients in their care in the previous 12 months, with most having more than 20 HIV patients(87).

2.6 Conclusion of background section

There are two key themes arising from this review: first, people living with HIV have complex care needs that reflect both HIV-specific care and the prevention and management of comorbid conditions; and second, there is wide variation in those providing care to people with HIV, including specialists and generalists and those with higher and lower experience. With the evolution of HIV to a chronic disease and the option of simpler ART regimens, we know very little about how HIV is managed in the primary care setting or the best way to integrate “HIV-specific expertise [with] comprehensiveness, continuity, coordination and accessibility – four key aspects of primary care” for this aging and increasingly diverse HIV positive population(75,24). Several delivery system strategies have been proposed to improve access to comprehensive HIV care, including task-shifting, co-management, and coordination of care within primary care medical homes(88). These strategies generally house the bulk of care within the primary care setting, although different models of specialist collaboration are possible. The evaluation of these models has important policy, practice and patient implications.

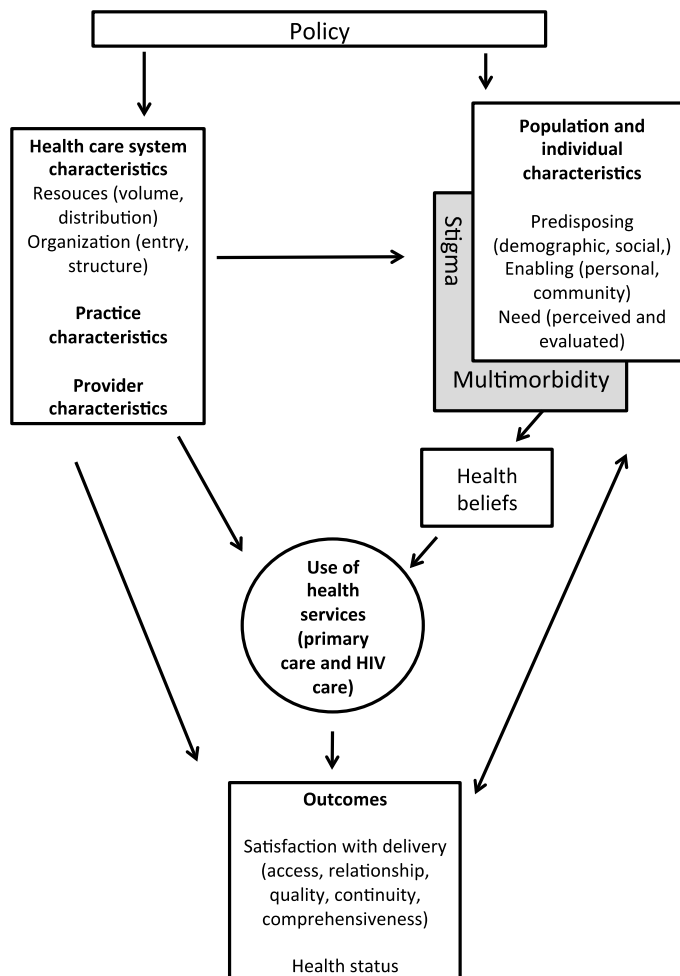
Chapter 3

Theoretical underpinnings of this thesis

This thesis builds upon four established theoretical frameworks:

- 1) A typology of the roles of specialists relative to primary care providers in the referral process
- 2) An adapted Andersen behavioural model of health care use by people living with HIV
- 3) A socioecologic model of influences on health care engagement by people living with HIV
- 4) A conceptual framework for primary care performance measurement

Figure 1: Model of health service delivery for people living with HIV



The overlap of these frameworks, and their application to the projects within this thesis, are presented in Figure 1. This model of health services delivery for people living with HIV demonstrates the how policy, health system, and population and patient factors collide to engage and retain patients in care, and a strategy for measuring the receipt of primary care services to this population.

3.1 Forrest's typology of specialist's clinical roles

In order to give structure to the specialist-primary care interface, Forrest outlined a typology of roles and responsibilities for specialists representing a continuum of shared care with primary care providers (47) (Text box 1). One key feature of this typology is that it defines the role of the specialist *relative* to a referring primary care provider. Primary care is not one of silos of the health care system; it is the foundation that, if supported from a systems approach, will enhance the effectiveness and efficiency of other health care services(46). Primary care is undoubtedly the best setting for routine care(89–91), and there is increasing attention being given to primary care, patient-centred medical homes which foster timely access to clinicians who know patients' medical histories and can coordinate care with other areas of the health care system(48). Across several different health systems, patients who identified having a primary care medical home, reported better satisfaction with care, fewer gaps in care coordination, and fewer medical errors(44).

Text box 1: Typology of Specialist roles and responsibilities(47)

1. Cognitive consultant - e.g. provides diagnostic or therapeutic advice
2. Procedural consultant - e.g. evaluates and performs a procedure
3. Co-manager sharing care of a specific problem with the primary care provider
4. Co-manager when the specialist becomes the principal caregiver for a specific problem
5. Co- manager when the specialist provides a new medical home for the patient

This primary care foundation is critical to the hypotheses of this thesis. Building on the Forrest typology, text box 2 depicts a theoretically-defined typology of shared care for

one condition in a way that permits delineation using administrative data. This typology has the following key features: a) patient assignment to a defined, usual primary care physician, b) the identification of levels of care assumed by the specialist physician, and c) the ability to isolate disease-specific specialist visits from other visits.

Text box 2: Typology of shared care using administrative data

Primary care dominant models	<p>1. Exclusively primary care – patient is assigned to a regular family physician who provides most primary care and most HIV-related care, no infectious disease or internal medicine physician provides any HIV care</p> <p>2. Family physician dominant co-management– patient is assigned to a regular family physician who provides majority of HIV-related care, specialist physician provides some HIV care</p>
Specialist dominant models	<p>3. Specialist dominant co-management– patient is assigned to a regular family physician, but specialist physician provides majority of HIV-related care</p> <p>4. Specialist care only – patient is not assigned to a regular family physician, specialist physician provides all HIV-related care</p>
	<p>5. Low engagement– patient is not assigned to a regular family physician and has no specialist physician providing HIV care</p>

3.2 A behavioural model of health care use by people living with HIV

Figure 2(92): Adaptation of the behavioural model of health services utilization to provide a conceptual framework to evaluate the relationships between patient characteristics and their contextual health care environment factors in contributing to health behaviours. (Copied for purposes of this thesis with permission from Liebert Publishing)

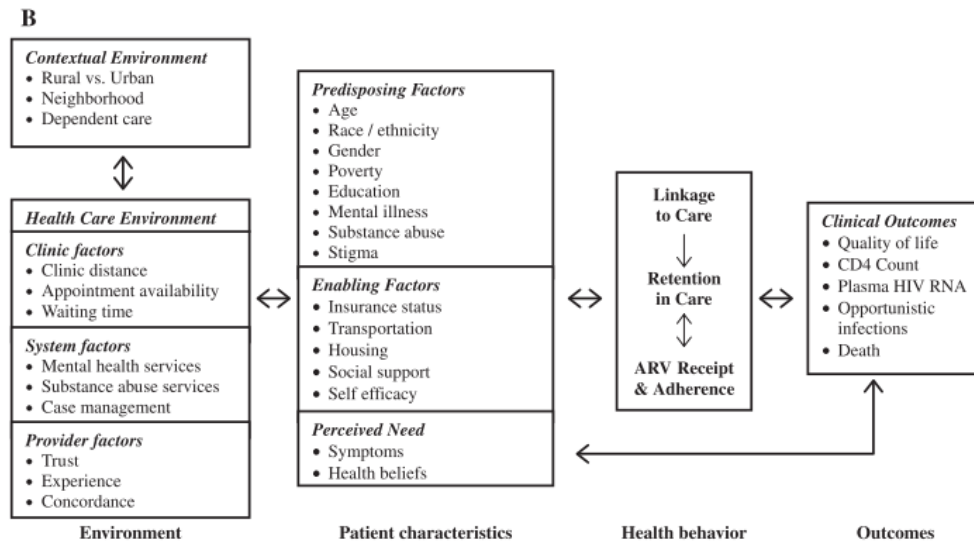


FIG. 1. A: Blueprint for HIV treatment success: requisite processes from initial diagnosis to long-term clinical outcomes. (adapted from Giordano *et al.*¹ and Samet *et al.*³). B: Adaptation of the behavioral model of health services utilization to provide a conceptual framework to evaluate the relationships between patient characteristics and health care environmental factors in contributing to health behaviors outlined in the “blueprint for HIV treatment success” that ultimately influence clinical outcomes.

Ulett et al. have developed a framework of HIV care engagement based on the foundational behavioural model of health service use(93). Their framework respects the evolution of Andersen’s original behavioural model of health services use with respect to identifying an individual’s predisposing factors (more intrinsic features, such as demographic characteristics, social structure, and health beliefs, that contribute to one’s propensity to seek care), enabling factors (an individual’s means by which they can seek care related to social status), and their care needs (both perceived and evaluated)(57,94). In addition, Ulett reflects the expansion and elaboration this model has adopted over time. Within the individual domain, for example, psychological factors are included as predisposing factors, reflecting the burden of mental health disorders, including addiction, known to affect people living with HIV. Stigma is also included here as a unique predisposing factor.

In Ulett's model, health behaviours focus on HIV-specific care utilization and adherence to ART and the role behavior plays in HIV-specific outcomes. Care utilization could be further expanded to identify the types, sites, purposes and timing of utilization, including for more comprehensive care. Furthermore, health care delivery system factors are explicitly delineated within the framework, reflecting the contribution of structures and resources of health systems and practices to health care utilization. However, health system organizational features and the role of policy decisions are underrepresented. Finally, outcomes are limited to disease measures and do not incorporate measures of consumer satisfaction, of which quality of care is one aspect.

I will incorporate this framework into the overall thesis model by delineating individual characteristics that contribute to patterns of health care use by people with HIV. In particular, I will quantify comorbidity and multimorbidity as important predisposing factors for health care use. Furthermore, the studies within this dissertation will describe how system factors, in particular the distribution of specialist and family physician care, as well as the individual and practice characteristics of these physicians, contribute to the health care use and quality of care for people with HIV.

3.3 A socio-ecological model of influences on health care engagement by people living with HIV

Figure 3: Socio-ecological perspective of factors that influence the process of engagement in care (95) (Copied for purposes of this thesis with permission from Oxford University Press)

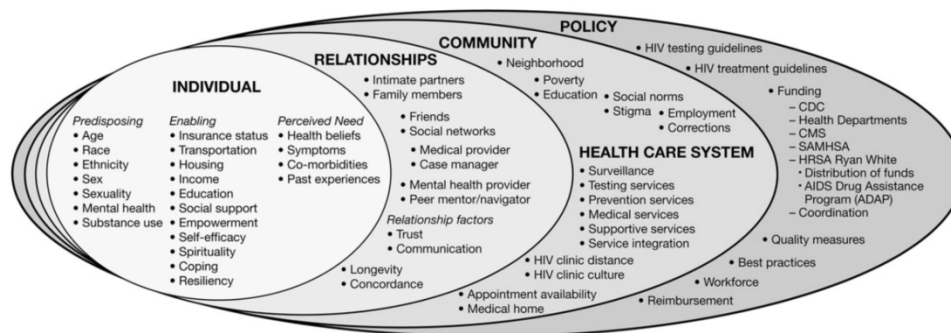


Figure 3. A social-ecological perspective, which provides the framework for this article's arguments, serves as a road map outlining the complex interplay of individual, relationship, community, health care system, and policy factors that influence the processes of engagement in care. CDC, Centers for Disease Control and Prevention; CMS, Center for Medicare and Medicaid Services; HIV, human immunodeficiency virus; HRSA, Health Resources and Services Administration; SAMHSA, Substance Abuse and Mental Health Services Administration.

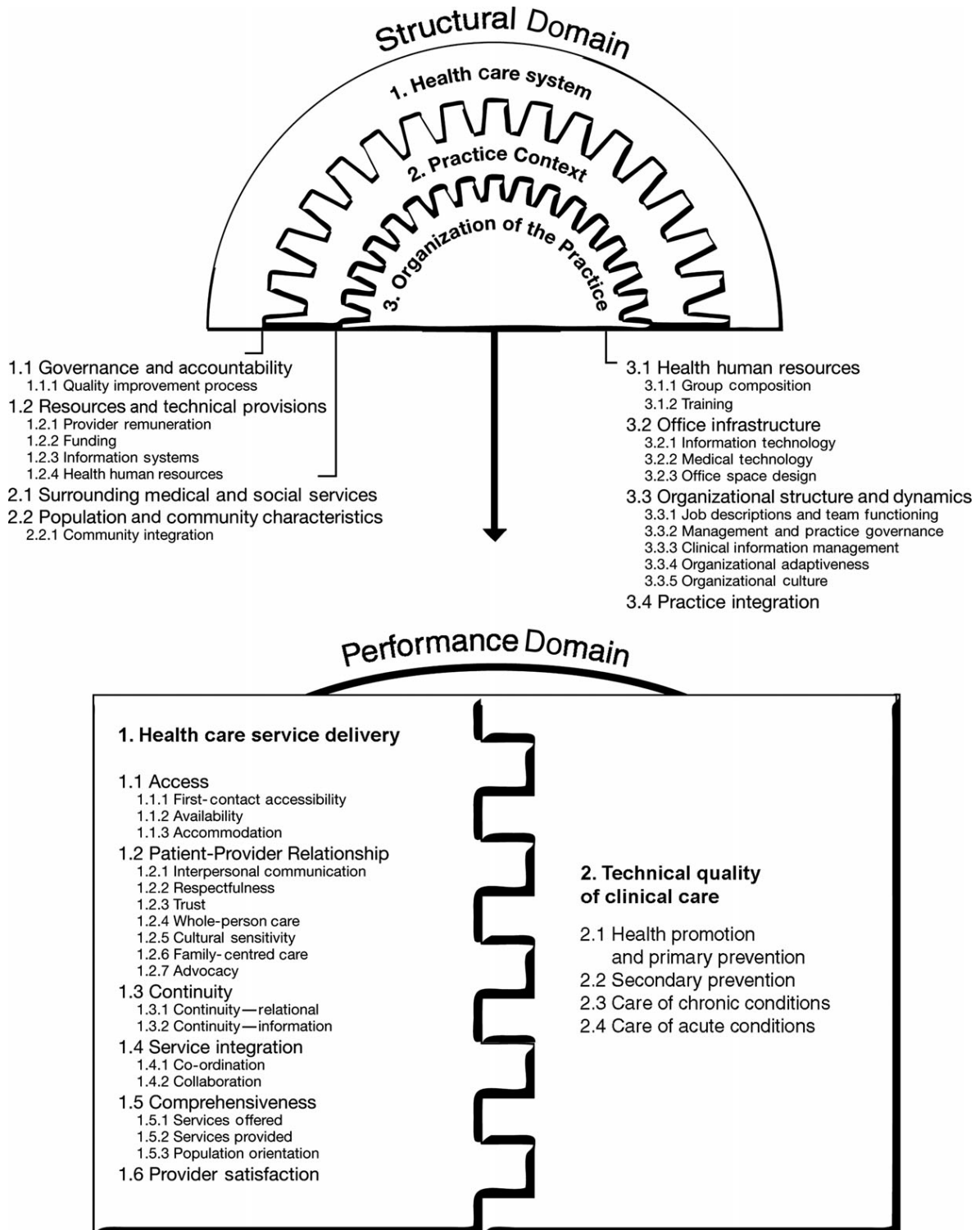
Mugavero et al(95) have presented a frequently-cited socio-ecological framework demonstrating the depth and overlap of layers, from the individual to healthcare policy domains, that may contribute to care engagement for people with HIV. This framework is comprehensive in scope and highlights the intersecting disparities faced by this population. They also clearly identify stigma as a community factor rather than an individual-level characteristic. Stigma is pervasive driver and fundamental cause of health inequities that influences multiple predisposing factors, enabling factors, health behaviours, and, ultimately, health utilization and experience of care(96). In the health care utilization of people with HIV, stigma plays an especially important role, exacerbating existing inequality drivers such as class, ethnicity, gender, and sexuality(97).

While Mugavero's framework is comprehensive, I interpret two issues with its use. First, this framework is less clear regarding the mechanisms by which health care delivery system structure and organization relate to health care utilization and outcomes. Second, as with Ulett's model, this framework focuses on a specialist model of care rather than a primary care approach. I will expand my framework to explore both primary care and specialist care, as well as their interface. Finally, this framework highlights key drivers of care that can not be measured by the methodology used within this thesis, thus remind us of important social and environmental determinants of health and health care use that have particular relevance for people living with HIV.

3.4 A conceptual framework for primary care performance measurement

There has been growing emphasis on the need to measure the impact of the organizational features of primary care on the delivery of care. A conceptual framework of primary care has been derived explicitly to guide the measurement of primary care performance in Ontario (98) (Figure 4). This framework contains two domains: The structural domain includes ingredients of the way primary care is delivered, such as the features of health care system, the context of the primary care practice, and the organization of the practice. The performance domain encompasses two main attributes: the health care service delivery measures the key attributes of primary care delivery, such as access and the physician-patient relationship; and the technical quality of clinical care measures the quality of care across the disease spectrum.

Figure 4: Conceptual framework for primary care performance measurement (Copied for purposes of this thesis with permission from Oxford University Press)



I incorporated this framework in two ways. First, it allowed me to expand the health care environment component of the health care utilization model to more deliberately identify the health care system resources and organization, practice context, practice factors, and provider factors that contribute to health care utilization behaviours. For example, the typology of shared care as described is reliant on a health care system with a strong primary care foundation. It also relies on a primary care practice context in which there is the capacity and resources for family physicians and specialists to interact and share care.

Second, I selected study outcomes from the performance domain based on previously identified indicators of quality of care using administrative data in the primary care setting. For example, as a health care service delivery outcome, utilization of the emergency department is a proxy for access to care, as patients with chronic disease who last saw a physician in the emergency department, regardless of health status and socioeconomic status, are more likely to report unmet health needs and not have a regular physician(99–102). Technical quality of care domain indicators have been developed with a focus on preventative care, chronic disease management, and appropriate acute care (103). In addition, there are also disease-specific measures of quality of care for many discrete conditions(3,58), including HIV, such as viral load and CD4 cell counts. However, many HIV-specific indicators are not currently available within the Ontario administrative data holdings.

Chapter 4 Methodological overview

Study design

All of the studies within this thesis are retrospective, population-based longitudinal observational studies with an observation period from April 1, 2009 to March 31, 2012.

Data sources

This thesis relied on the administrative databases held at the Institute for Clinical Evaluative Sciences (ICES). ICES is an independent, non-profit organization comprising data on over 13 million individuals from the province of Ontario. These databases are made available to accredited researchers through a data sharing agreement with the Ontario Ministry of Health and Long Term Care and are linked using unique, encoded identifiers and analyzed at ICES in accordance with the provincial Personal Health Information Protection Act. Please refer to Appendix 1 for a summary of these databases. Ontario has a single-payer health care system administered by the provincial government, thus physician services are collected for administrative and remuneration purposes.

There are two key strengths of the ICES databases. The first is their capture of over 95% of physician services in the province. The second is the linkage of this individual-level health services data to other ICES-held health and social service data using unique, encoded identifiers. Such additional datasets include other health and social demographic information, such as neighborhood residence (as a proxy of socioeconomic

position), and immigration data, as well as national survey data from the Canadian Community Health Survey, which enhance health services analyses.

While the general limitations of using administrative data are elaborated upon in Chapter 10, readers should keep several thesis-specific limitations of ICES data in mind. First, these databases rely on physician billing, thus only capture individuals who are receiving care. Second, physician services in certain care settings, such as community health centres and aboriginal health centres, are remunerated by different means, thus do not routinely contribute to these data; these care locations may more commonly serve those living with HIV. Third, despite the variation in the different ICES datasets, these data can not illuminate the individual-, system- and societal-level drivers of health care utilization that may contribute to quality of care.

In accordance with ICES policies, all studies within this thesis were approved by the Ottawa Hospital and Sunnybrook Health Sciences Centre Research Ethics Boards.

Study population

HIV Patient cohort (Figure 5)

The overall flow diagram of this thesis is shown in Figure 5. I used ICES administrative databases to create a cohort of people living with HIV in Ontario. Eligible Ontarians were identified from the Registered Persons Database (RPDB). To obtain a cohort of people with HIV in the province, I used data from the Ontario Health Insurance Program (OHIP) billing claims system, which records claims for approximately 95% of physician services conducted in the province. To these data, I applied a previously validated algorithm to people 18 years of age and older and living in Ontario between April 1, 1992 and March

31, 2012 to identify those with HIV (104). Briefly, this algorithm requires at least 3 physician claims (International Classification of Diseases, Ninth Revision (ICD-9) code for HIV infection (042, 043, 044)) over a 3-year period. It has a sensitivity of 96.2% (95% CI 95.2% - 97.9%) and specificity 99.6% (95% CI 99.1% - 99.8%) for identifying people with HIV and receiving care in Ontario. I then excluded those who were less than 18 years, those with no valid OHIP card, and those no longer alive on April 1, 2009 to obtain a provincial cohort of those living with HIV.

Ascertainment of patient characteristics is described in detail in the thesis manuscripts.

Physician cohort

To create a cohort of physicians providing outpatient care to patients with HIV, I used the OHIP database to identify all outpatient health care visits made to physicians by patients in our HIV cohort between April 1, 2009 and March 31, 2012. (Physician specialty was categorized into four groups: as “Family Medicine” (comprising the specialties of family medicine, family medicine/emergency medicine, general practice, or community medicine, all of whom may be licensed to practice family medicine/general practice in Ontario), “Internal Medicine”, “Infectious Diseases” or “Other”). Ascertainment of physician characteristics is described in detail in the respective chapters.

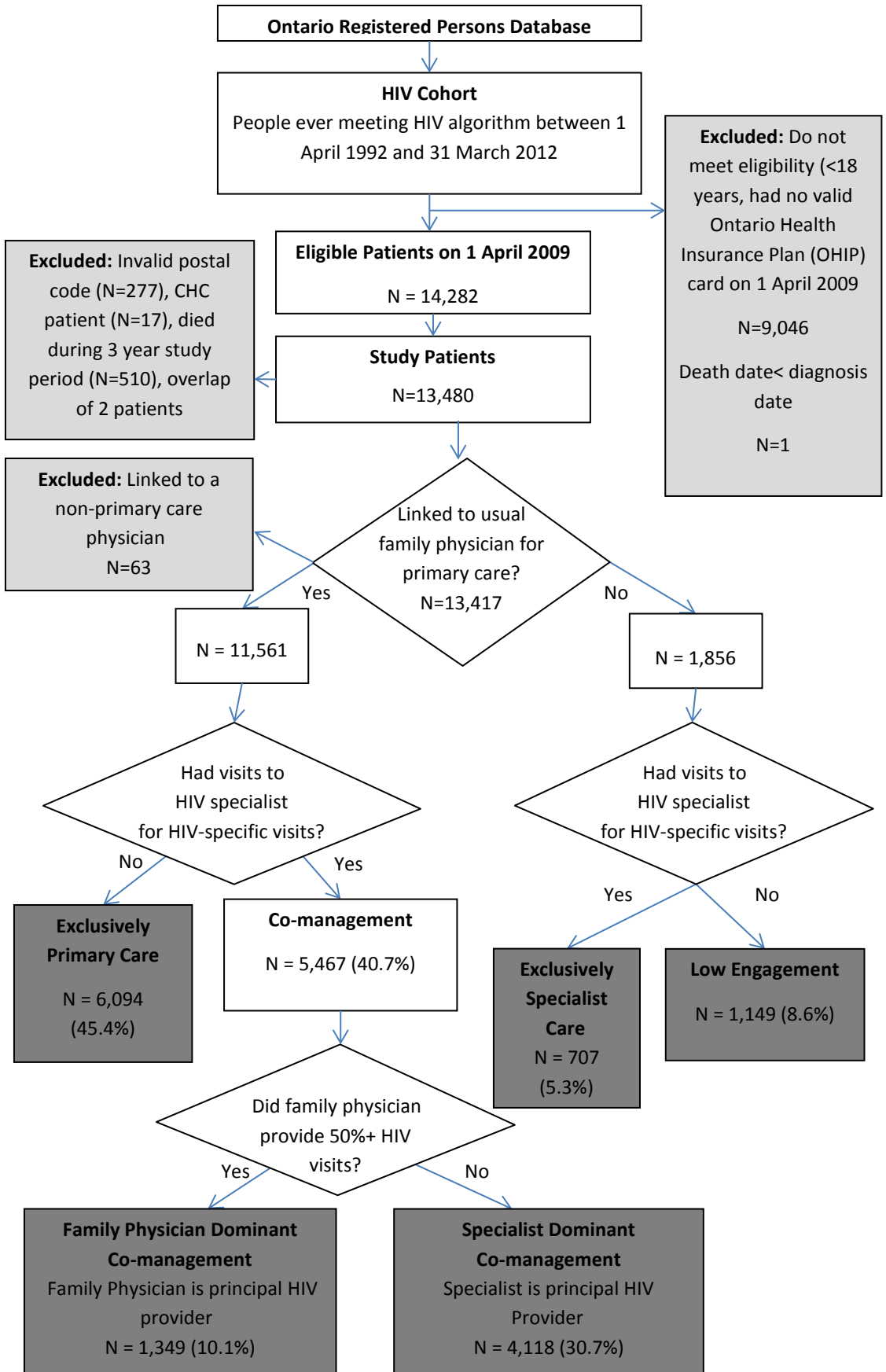
Health care visits

Using OHIP billing diagnoses, I classified each visit as either an HIV visit (any diagnosis code of ‘042’, ‘043’, or ‘044’) or non-HIV visit (any non-HIV diagnostic code). In Ontario, only a single diagnostic code can be billed per visit.

Typology assignment

I used these data to assigned patients in our cohort to a typology based on their pattern of care between April 1, 2009 to March 31, 2012, as shown in Figure 5.

Figure 5: Flow diagram of study participants and typology assignments



Performance measures

Performance measures were selected using the conceptual framework for primary care performance described in section 3.4 (98). Two primary outcomes were selected. For a health services utilization outcome, emergency department visits were selected as a measure of primary care access. For a technical quality of primary care outcome, colorectal cancer screening was selected as, unlike cervical cancer, colon cancer is not significantly increased among people with HIV, the screening interval is the same as those without HIV and applies to both genders, and had the largest target population (ages 50-74years) in our cohort (n=2,829)(105). Additional outcomes are outlined in Text box 3.

Text box 3: Administrative data performance measures for people living with HIV

Health care services delivery outcomes	
Access	Emergency department visits (all and low acuity (Canadian Triage and Acuity Scale 4 and 5))
	Hospital admissions (all and HIV-specific)
Technical quality of clinical care outcomes	
Disease prevention	Cervical cancer screening (pap testing)
	Breast cancer screening (mammography)
	Colorectal cancer screening
Chronic disease management	Eye exam in patients with comorbid diabetes over age 40 years
HIV specific outcome	
Antiretroviral therapy	Receipt of at least one prescription for ART during the study period to patients known to be eligible for Ontario Drug Benefits (age \geq 65 years or received any ODB prescription)

Statistical analyses

Detailed analyses are outlined in each paper. All statistical analyses were performed using SAS version 9.3 (SAS Institute, Cary, North Carolina). A 4-way categorical variable (exclusively primary care, family physician dominant co-management, specialist dominant

co-management, exclusively specialist care) was the main exposure of interest in most analyses.

Privacy and ethics

Data at the Institute for Clinical Evaluative Sciences are securely housed at the ICES Central Facility at Sunnybrook Health Sciences Centre. Individual personal identifiers are coded into unique identification number (ICES Key Number (IKN)), which allows linkage of patient level data across multiple databases in accordance with the provincial Personal Health Information Protection Act. These data are made available to accredited researchers through a data sharing agreement with the Ontario Ministry of Health and Long Term Care. This project was approved by The Ottawa Hospital and Sunnybrook Health Sciences Centre Research Ethics Boards and the ICES uOttawa Privacy Officer. Study results were only reported in aggregate form, and small cell sizes (≤ 5) are not reported.

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Chapter 5

A cross-sectional, population-based study measuring comorbidity among people living with HIV in Ontario

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Abstract

Background: As people diagnosed with HIV and receiving combination antiretroviral therapy are now living longer, they are likely to acquire chronic conditions related to normal ageing and the effects of HIV and its treatment. Comorbidities for people with HIV have not previously been described from a representative population perspective.

Methods: We used linked health administrative data from Ontario, Canada. We applied a validated algorithm to identify people with HIV among all residents aged 18 years or older between April 1, 1992 and March 31, 2009. We randomly selected 5 Ontario adults who were not identified with HIV for each person with HIV for comparison. Previously validated case definitions were used to identify persons with mental health disorders and any of the following physical chronic diseases: diabetes, congestive heart failure, acute myocardial infarction, stroke, hypertension, asthma, chronic obstructive lung disease, peripheral vascular disease and end-stage renal failure. We examined multimorbidity prevalence as the presence of at least two physical chronic conditions, or as combined physical-mental health multimorbidity. Direct age-sex standardized rates were calculated for both cohorts for comparison.

Results: 34.4% (95% confidence interval (CI) 33.6% to 35.2%) of people with HIV had at least one other physical condition. Prevalence was especially high for mental health conditions (38.6%), hypertension (14.9%) and asthma (12.7%). After accounting for age and sex differences, people with HIV had significantly higher prevalence of all chronic conditions except myocardial infarction and hypertension, as well as substantially higher multimorbidity (prevalence ratio 1.30, 95% CI 1.18 to 1.44) and combined physical-mental health multimorbidity (1.79, 95% CI 1.65 to 1.94). Prevalence of multimorbidity among people with HIV increased with age. The difference in prevalence of multimorbidity between the two cohorts was more pronounced among women.

Conclusion: People living with HIV in Ontario, especially women, had higher prevalence of comorbidity and multimorbidity than the general population. Quantifying this morbidity at the population level can help inform healthcare delivery requirements for this complex population.

Background

The accumulation of chronic conditions over the lifespan is a significant and rising burden on individuals and healthcare systems. In Canada, 33% of community dwelling individuals report having at least one of 7 common chronic conditions(1). There is strong evidence that the management of chronic diseases is most effectively and economically provided in well-supported primary care settings(2,3). The outpatient management of these chronic conditions consumes substantial healthcare resources (4), the bulk of which is managed in primary care(5,6).

As people with Human immunodeficiency syndrome (HIV) on combination antiretroviral therapy (ART) are now living longer, they are likely to acquire additional chronic conditions related to normal aging as well as from the effects of HIV and its treatment (7,8). While the literature regarding what factors contribute to the prevalence of specific conditions is evolving, it is clear that multimorbidity, the presence of several of these conditions, is increasingly the norm for people with HIV(9). Early in the era of HIV, it was considered a deadly, acute condition, requiring a specialist focus on care(10–12). However, with ART HIV becomes a chronic condition, and a generalist perspective may now have a more major role as comorbidities increase (13–17). In order to determine the best way to integrate primary and specialist care(18), we require a full understanding of the complex health needs of this population.

The specific objectives of this study are to describe the prevalence of comorbidities and their multimorbidity for people living with HIV and to compare this prevalence to an age and sex adjusted general population. In Ontario, Canada, administrative data for over 13 million multiethnic residents is routinely collected at the time of care in a single-payer health system. These data can be used to measure the prevalence of chronic disease (19). To our knowledge, this is the first study to use a population-based approach to measure

the types and numbers of chronic diseases associated with HIV. As a result, this study will inform the complex healthcare needs of this population.

Methods

Study Design: We conducted a retrospective observational study to examine the demographic and clinical characteristics of people living with HIV in Ontario compared with those in the general Ontario population. We analyzed the administrative databases held at the Institute for Clinical Evaluative Sciences (ICES) from the province of Ontario, Canada comprising data on almost 13 million individuals (2008). These data are made available to accredited researchers through a data sharing agreement with the Ontario Ministry of Health and Long-Term Care and are individually linked using an anonymous identification number in accordance with the provincial Personal Health Information Protection Act. The study was approved by the Ottawa Hospital Research Ethics Board and the Sunnybrook Health Sciences Centre Research Ethics Board.

Study population (see flow diagram Figure 1): We identified eligible individuals from the Registered Persons Database (RPDB), an electronic registry of all Ontarians eligible for health coverage that captures patient demographic information, including age, sex, postal code and mortality data. We used data from the Ontario Health Insurance Plan (OHIP) billing claims system, which records claims for about 95% of physician services conducted in the province, to obtain an HIV cohort. We applied a previously validated algorithm to people 18 years of age and older and living in Ontario between April 1, 1992 and April 1, 2009(20). Briefly, this algorithm requires 3 physician claims (International Classification of Diseases, Ninth Revision (ICD-9) code for HIV infection (042, 043, 044)) over a 3-year period and has a sensitivity and specificity of 96.2% (95% CI 95.2% - 97.9%) and 99.6% (95% CI 99.1% - 99.8%), respectively for identifying people living with HIV and receiving HIV care. As a comparison, a cohort of individuals 18 years or older, living in Ontario on

April 1, 2009, and not in the HIV cohort was created using a computerized random number generator in a 5:1 ratio to the HIV cohort. For both cohorts, individuals without a valid health card, age or sex value and those without valid postal codes were excluded.

Variables: All variables for patients in the HIV and Ontario cohorts were captured using identical methods. Age, sex and postal code on April 1, 2009 were obtained from the RPDB. To broadly describe the populations, we used postal codes at the neighborhood level linked to 2006 Statistics Canada census data to assign income quintiles, marginalization quintiles and rurality scores. We used Matheson's Canadian Marginalization Index(21) to assign marginalization quintiles for four components of marginalization (1 lowest to 5 highest): dependency, residential instability, material deprivation, and ethnic concentration and present these as a summary score. Rurality was assigned categorically into major urban areas (score 0 to 9), non-major urban areas (10 to 44), and rural areas (45 or higher) according to the Rurality Index of Ontario(22).

Using OHIP billing claims data, the Canadian Institute for Health Information (CIHI) Discharge Abstract Database, which supplies information on acute care hospitalizations and the CIHI National Ambulatory Care Reporting System, which captures information on visits to emergency departments, we applied additional previously validated algorithms in both cohorts to identify the status (i.e. presence or absence) of the following physical comorbidities on April 1, 2009: diabetes, congestive heart failure, acute myocardial infarction, hypertension, asthma, chronic obstructive lung disease, stroke, end stage renal disease and peripheral vascular disease(19,23–26). People with mental health conditions between April 1, 2007 and April 1, 2009 were broadly captured using an algorithm previously validated to identify people receiving mental health services in the primary care setting(27).

Disease count was used to measure the prevalence of multimorbidity(28). Physical multimorbidity was defined as the presence of two or more listed physical chronic

conditions, and physical-mental health multimorbidity was defined as a combination of mental health condition and any physical chronic health condition. In patients in the HIV cohort, this multimorbidity is in addition to HIV as their index condition.

We used the Ontario Drug Benefits claims database to identify individuals in the cohorts who were prescribed drugs paid for by the public system which covers those aged 65 and older and those receiving social assistance (Ontario Works, Ontario Disability Support Program, or the subsidized Trillium program).

Statistical analysis: We used descriptive statistics to describe the demographic characteristics of the two cohorts. For our descriptive analyses, age was treated as both a continuous variable and a categorical variable. Sex, age group, income quintiles, rurality categories and use of Ontario Drug Benefits were described as categorical variables, and the marginalization composite score as a continuous variable. These characteristics were compared between the cohorts using two-sample t-tests for continuous variables and chi-squared tests for categorical variables. We calculated the prevalence of individual physical and mental health comorbidities, physical multimorbidity, and physical-mental health multimorbidity in the HIV cohort, together with 95% confidence intervals (CI).

We used direct standardization to calculate age and sex standardized prevalence rates for both populations. The Canadian 1991 population was used as the reference standard (29). We present the comparative ratio of these rates together with 95% confidence interval, calculated using the formula provided by Breslow and Day(30). We also compare the prevalence of at least one chronic condition and at least two chronic conditions (multimorbidity) with age between the HIV and Ontario cohorts for both men and women. All statistical analyses were performed using SAS version 9.2 (SAS Institute, Cary, North Carolina).

Results

Table 1 provides for descriptive purposes the demographic characteristics of people in the HIV cohort compared to the Ontario cohort. The sex and age distributions differed substantially between the HIV and Ontario populations; people with HIV were more often male (80.5% vs. 48.8%, $p < 0.001$) and less likely to be in the youngest (18-35 years) or oldest (>65 years) age groups (16.8% vs. 30.2% and 4.1% vs. 15.9% respectively, $p < 0.001$). Overall, people with HIV were poorer (lowest income quintile 31.7% vs 19.5%, $p < 0.001$), lived in more marginalized neighborhoods (marginalization index 3.35 (SD 0.74) vs. 2.97 (SD 0.7), $p < 0.001$), were more likely to live in urban settings (89.7% vs. 72.8%, $p < 0.001$) and were more likely to have obtained provincial drug benefits than those in the Ontario cohort (62.8% vs. 30.1%, $p < 0.001$).

The prevalence of individual comorbidities and of multimorbidity among individuals in the HIV cohort are presented in Table 2. More than one-third (38.6%, 95% CI 37.8% to 39.4%) of people with HIV had a mental health condition diagnosed within the previous 2 years. One-third (34.4%, 95% CI 33.6% to 35.2%) had at least one physical chronic condition in addition to their HIV. Comorbidities with especially high prevalence included hypertension (14.9%), asthma (12.7%), diabetes (8.3%) and chronic obstructive pulmonary disease (7.9%). The prevalence of physical multimorbidity (at least two physical conditions) was 10.8% (95% CI 10.3% to 11.3%); 15.5% (95% CI 14.9% to 16.1%) had both a mental health and at least one other physical condition.

Table 3 presents the age and sex standardized prevalence rates for the two cohorts (standardized to the 1991 Canadian population), along with the prevalence rate ratios and 95% confidence intervals. After accounting for age and sex differences, people in the HIV cohort were more likely to have at least one chronic condition than those in the Ontario cohort (prevalence ratio 1.13, 95% CI 1.07 to 1.20). People with HIV had significantly higher prevalence of all chronic conditions except myocardial infarction and hypertension,

which were not significantly different from the general population. Individuals with HIV had substantially higher physical multimorbidity (prevalence ratio 1.30, 95% CI 1.18 to 1.44) and physical-mental health multimorbidity (1.79, 95% CI 1.65 to 1.94) than the Ontario population.

Figure 2 shows the burden of comorbidity measured as having at least one chronic condition or at least two chronic conditions (multimorbidity), for men and women respectively, by age group for the HIV and Ontario cohorts. Prevalence of multimorbidity increased with age in all groups. Women had higher multimorbidity than men across all groups. Men in the HIV cohort only had higher prevalence of at least one chronic condition and multimorbidity than men in the Ontario cohort in the younger age groups. In contrast, multimorbidity prevalence among women with HIV was consistently higher than among Ontario women in all age groups, and this gap appeared to widen slightly with age.

Discussion

Our study quantifies the substantial comorbidity prevalence among people living with HIV in Ontario. Mental health conditions and individual physical comorbidities were more prevalent among people with HIV than among the general population, as were physical and physical-mental health multimorbidity. In addition, as is seen in the general population, our study confirms the accumulation of multiple chronic conditions with age for both men and women with HIV. Women had higher multimorbidity than men across all groups, which is consistent with the Canadian general population(1). Furthermore, while men with HIV had slightly lower single comorbidity and multimorbidity than Ontario men in most age groups, women with HIV had consistently higher single comorbidity and multimorbidity prevalence than women without HIV.

To our knowledge, this is the first study to use a population-based approach to measure the types and numbers of chronic diseases associated with HIV; most studies have been conducted in clinical cohorts of people living with HIV. While the prevalence of comorbidity in people with HIV is clearly high, there have been inconsistencies regarding which conditions are more or less common in people with HIV. For instance, Butt et al(31) found that HIV was associated with a decreased risk of diabetes, but that increasing age had a greater effect on diabetes rates in those with HIV than in the general population. Crothers et al(32) found HIV to be an independent risk factor for COPD even after adjusting for smoking status and other risk factors. In their very large, almost exclusively male study comparing HIV positive with non HIV positive veterans, Goulet et al(33) found that those with HIV had lower risk of hypertension, diabetes, vascular disease and psychiatric disorders, and higher rates of renal and liver disease than their HIV negative cohort. In their study of ART-experienced patients, Guaraldi et al(8) found that those who were HIV positive had higher rates of diabetes, bone fracture and renal failure, but no difference in cardiovascular disease and hypertension. It is likely that the prevalence of individual comorbidities is a result of the complex interplay of aging, behavioral risk factors such as smoking (known to be higher among those with HIV), genetic risk factors, HIV severity, and ART history(8,9,34–36).

This study offers the unique strength of presenting the multimorbidity of people with HIV from a broad, multiethnic population of men and women from a variety of socioeconomic groups. Our findings are consistent with the literature highlighting that multimorbidity is common for people with HIV(7,8,33,34). However, previously published prevalences of multimorbidity vary depending on the population base of the study, as clinical cohorts of people with HIV are often limited to certain demographic populations or at-risk groups. For example, our study showed that women with HIV have excess multimorbidity, which is consistent with Salter's study of HIV positive injection drug users, but not with Guaraldi's study of polypathology in ART-experienced people with HIV enrolled in a metabolic clinic. As men have historically represented a larger but decreasing proportion

of people living with HIV, it is possible that Ontario men who were infected earlier in the epidemic were sicker and had higher mortality, resulting in a healthier cohort of older HIV-positive men within our population. However, because our population base isn't limited by the definition of any high risk cohort and presents the clinical experience of people currently living with HIV our data is likely to be a robust estimate of the prevalence of comorbidities in the population.

In addition, previous studies have varied with respect to definitions for multimorbidity, such as specific diseases included, methods of clustering conditions, and numbers of conditions required to meet multimorbidity criteria (5,37–40). It is likely that broadening our comorbidity measures would have resulted in higher prevalence of multimorbidity(7,33).

There are several limitations to our study. First, we did not identify those who were unaware of their HIV status, estimated to be 26% of prevalent infections in Canada(41), or those not accessing health care. Furthermore, there are some settings in Ontario, most notably community health centres, that are not included in administrative data and so HIV patients in these setting were not included in the study. Community health centres are estimated to provide primary care for about 1% of the Ontario population (42), thus our findings are unlikely to be substantially affected by missing these individuals. Second, we were initially concerned that providers, especially those who have high-volume HIV practices or those who receive incentives for providing HIV care, would have preferentially identified HIV diagnosis codes for services received over other codes for chronic conditions. This potential bias would result in under ascertainment of chronic conditions in the HIV population compared to the general population. In light of this ascertainment issue, we are confident in our finding that, compared to the general Ontario population, the prevalence of almost all chronic conditions among those with HIV is higher.

Conclusion

This population-based study quantifies the substantially higher comorbidity and multimorbidity prevalence among people living with HIV relative to the general population. This additional burden of disease increasingly defines the care needs of this population(43,44). Strategies for chronic disease management, including for people with HIV, must be expanded with a view to multimorbidity(18,37,43,45,46). Particular attention should be paid to the complex care needs defined by the comorbidity burden on women with HIV. By contributing to quantifying this increasing burden with age, our results can inform policy direction around HIV health services delivery. Future work will be directed at understanding how these complex patients access the healthcare system, and how providers are meeting the healthcare needs of this population.

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Table 1: Demographic characteristics of HIV and Ontario cohorts (April 1, 2009)

		HIV cohort n=14,005	Ontario cohort n=71410	p-value
Age (years)	Mean (SD)	45.4 (10.8)	46.7 (17.9)	<.001
Age group (n, %)	18-35 years	2,355 (16.8%)	21,600 (30.2%)	<.001
	36-50 years	7,798 (55.7%)	21,895 (30.7%)	
	51-65 years	3,283 (23.4%)	16,575 (23.2%)	
	>65 years	569 (4.1%)	11,340 (15.9%)	
Sex (n, %)	Male	11,270 (80.5%)	34,862 (48.8%)	<.001
Income quintile (1 lowest, 5 highest)	missing	131 (0.9%)	302 (0.4%)	<.001
	1	4,441 (31.7%)	13,918 (19.5%)	
	2	2,875 (20.5%)	14,224 (19.9%)	
	3	2,280 (16.3%)	14,053 (19.7%)	
	4	2,085 (14.9%)	14,554 (20.4%)	
	5	2,193 (15.7%)	14,359 (20.1%)	
Marginalization index	Mean (SD)	3.4 (0.74)	3.0 (0.78)	<.001
Rurality group	missing	41 (0.3%)	596 (0.8%)	<.001
	Major urban	12,563 (89.7%)	52,020 (72.8%)	
	Non-major urban	1,006 (7.2%)	13,341 (18.7%)	
	Rural	395 (2.8%)	5,453 (7.6%)	
ODB Claim	Yes	8,789 (62.8%)	21,509 (30.1%)	<.001

Table 2: Comorbidities and multimorbidity burden of people living with HIV in Ontario (April 1, 2009)

Comorbidity N=14,005	Prevalence		
	(n)	(%)	95% CI
Mental health condition	5,401	38.6%	(37.8% to 39.4%)
Physical conditions:			
Myocardial infarction	174	1.2%	(1.1% to 1.4%)
Congestive heart disease	233	1.7%	(1.5% to 1.9%)
Chronic obstructive pulmonary disease	1,106	7.9%	(7.5% to 8.3%)
End stage renal disease	223	1.6%	(1.4% to 1.8%)
Peripheral vascular disease	72	0.5%	(0.4% to 0.6%)
Asthma	1,780	12.7%	(12.2% to 13.3%)
Diabetes	1,167	8.3%	(7.9% to 8.8%)
Hypertension	2,093	14.9%	(14.4% to 15.5%)
Stroke	173	1.2%	(1.1% to 1.4%)
At least one physical condition	4820	34.4%	(33.6% to 35.2%)
Physical-mental health multimorbidity	2,174	15.5%	(14.9% to 16.1%)
Multimorbidity (at least two physical conditions)	1,508	10.8%	(10.3% to 11.3%)

Table 3: Comparison of comorbidities and multimorbidity burden between HIV and Ontario cohorts (standardized by age and sex to Canadian 1991 population)

	HIV cohort N=14,005		Ontario cohort N=71,410		HIV:ON	
	n	prevalence (%)	n	prevalence (%)	prevalence ratio	(95% CI)
Mental health condition	5,401	40.6	15935	22.0	1.84	(1.75,1.94)
Physical conditions:						
Acute myocardial infarction	174	1.2	949	1.1	1.12	(0.78,1.60)
Congestive heart failure	233	3.4	1,428	1.5	2.26	(1.74,2.92)
Chronic obstructive lung disease	1,106	8.3	4,621	5.3	1.56	(1.39,1.76)
End stage renal disease	223	1.9	631	0.8	2.57	(1.92,3.44)
Peripheral vascular disease	72	0.6	248	0.3	2.15	(1.35,3.40)
Asthma	1,780	15.9	8,448	12.1	1.31	(1.20,1.43)
Diabetes	1,167	9.7	6,730	8.1	1.19	(1.06,1.33)
Hypertension	2,093	19.3	16,886	20.3	0.95	(0.88,1.04)
Stroke	173	1.6	891	1.0	1.53	(1.15,2.03)
At least one physical condition	4,820	38.7	26,907	34.2	1.13	(1.07,1.20)
Physical-mental health multimorbidity	2,174	17.0	7,443	9.5	1.79	(1.65,1.94)
Multimorbidity (at least two physical conditions)	1,508	14.5	9,417	11.1	1.30	(1.18,1.44)

Figure 1: Flow diagram for study cohorts

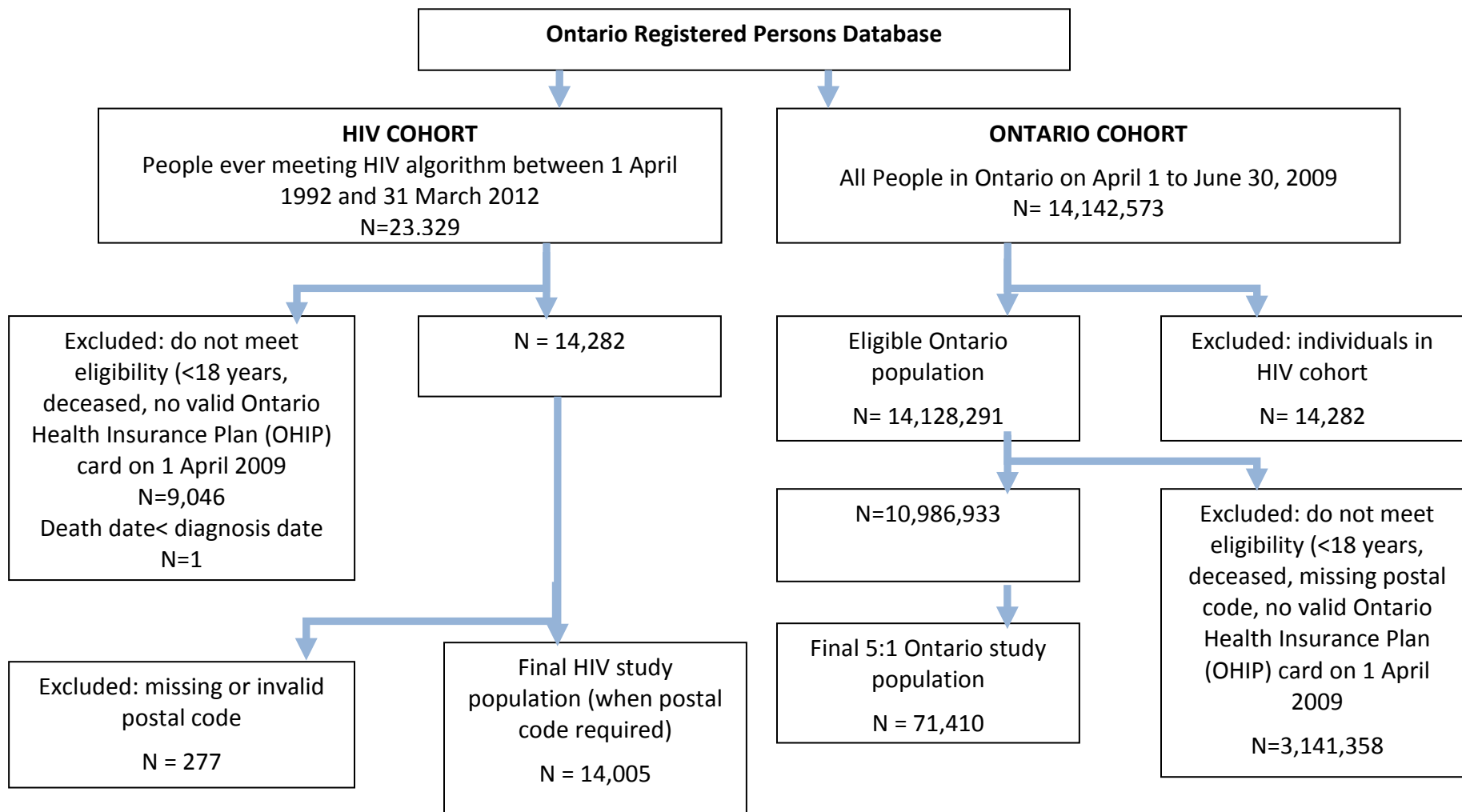
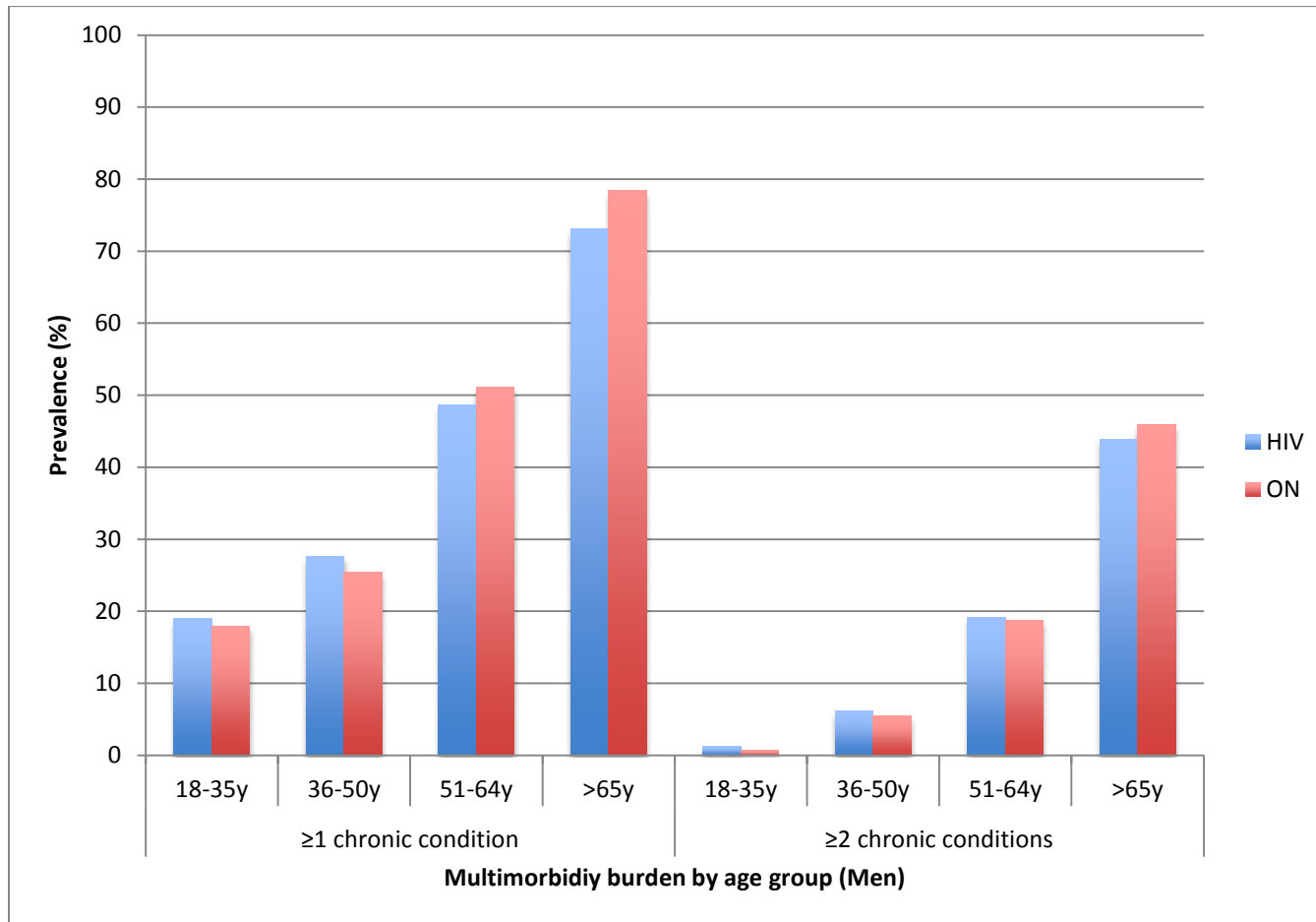
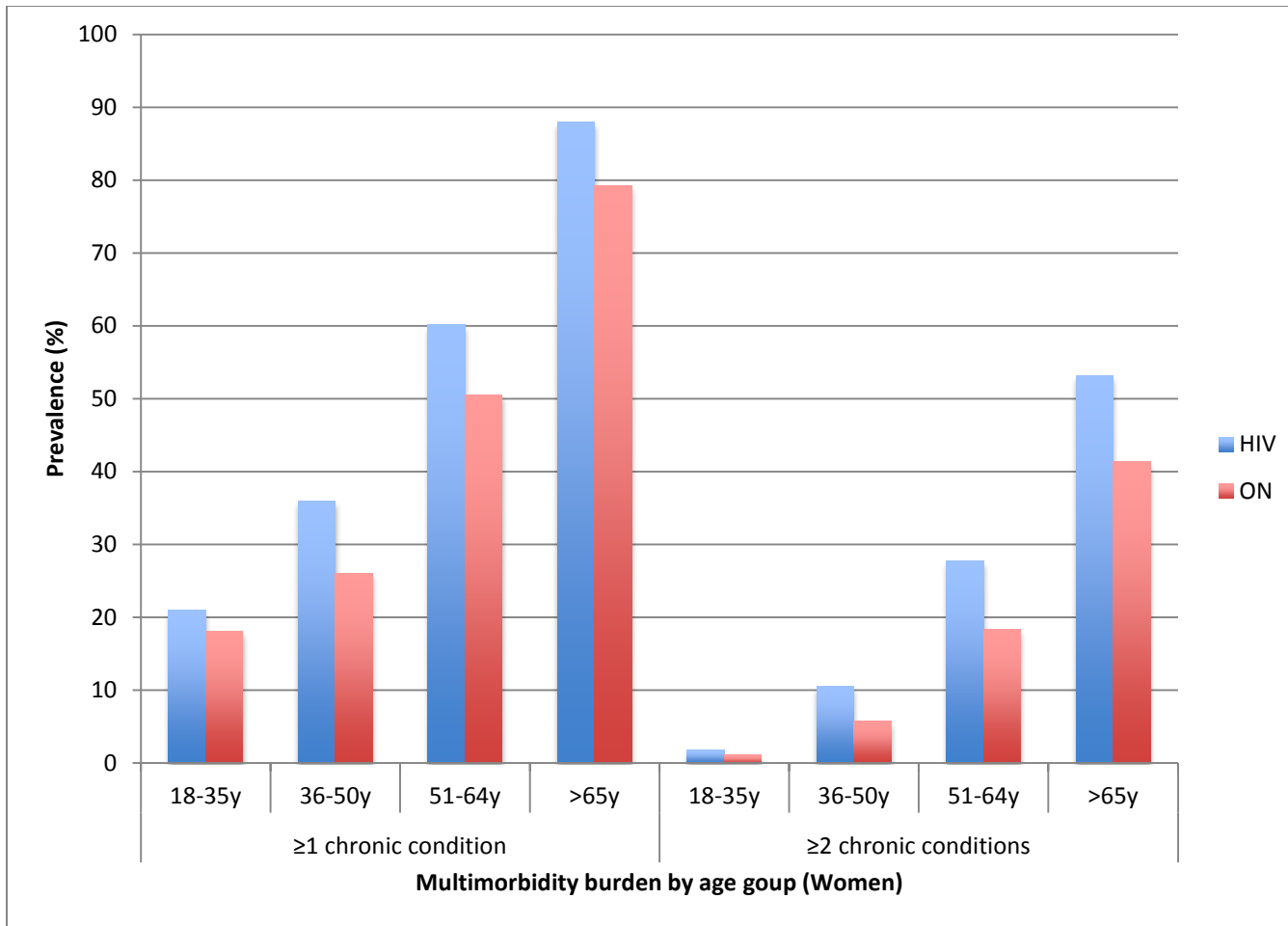


Figure 2: Multimorbidity prevalence by age group among men and women with HIV versus the Ontario general population





Chapter 6

A cross-sectional, population-based study of HIV physicians and outpatient health care use by people with HIV in Ontario

Submitted in manuscript form as Kendall, C., Wong, J., Taljaard, M., Glazier, R. H., Hogg, W. E., Younger, J., & Manuel, D. G. A cross-sectional, population-based study of HIV physicians and outpatient health care use by people with HIV in Ontario. Submitted to BMC Health Services Research October 2013.

Abstract:

Background: People with HIV are living longer and their care has shifted towards the prevention and management of comorbidities. However, little is known about who is providing their care. Our objective was to characterize the provision of HIV care in Ontario by physician specialty.

Methods: Retrospective population-based observational study using linked administrative databases in Ontario, Canada, a single payer health care system. All Ontarians with HIV were identified using a validated case ascertainment algorithm. We examined office-based health care visits for this cohort between April 1, 2009 and March 31, 2012.

Physician characteristics were compared between specialty groups. We stratified the frequency and distribution of physician care into three categories: (a) care by physician specialty (family physicians, internal medicine specialists, infectious disease specialists, and other specialists), (b) care based on physician caseload (low, medium or high categorized as ≤ 5 , 6-49 or ≥ 50 HIV patients per physician), and (c) care that is related to HIV versus unrelated to HIV.

Results: Family physicians were older, graduated earlier, were more often female, and were the only group practicing in rural settings. Unlike other specialists, most family physicians (76.8%) had low-volume caseloads. There were 406,411 outpatient visits made by individuals with HIV; one-third were for HIV care. Family physicians provided the majority of care (53.6% of all visits and 53.9% of HIV visits). Internal medicine specialists provided 4.9% of all visits and 9.6% of HIV visits. Infectious disease specialists provided 12.5% of all visits and 32.7% of HIV visits. Other specialties provided 29.0% of visits; most of these (33.0%) were to psychiatrists.

Conclusions: The distribution of visits to physicians caring for HIV patients reveals different patterns of health care delivery by specialty and HIV caseload. Further research should delineate how specialties share care for this population and how different patterns relate to quality of care.

Background

People with HIV on combination antiretroviral therapy (ART) are now living longer. This increase in HIV survival rates means there is a growing prevalence of people with longstanding HIV in Canada and other high-income countries. With this increased survival, people with HIV are likely to acquire additional chronic conditions due to normal aging as well as the effects of HIV and its treatment (1–3). In prioritizing care for HIV patients, this has led to a shift away from a specialist focus and towards the prevention and management of comorbidities.

This shift raises questions about how to provide the best care for this diverse and complex population. These questions are particularly relevant in the United States, where the Affordable Care Act has the potential to extend health care coverage for a large number of people living with HIV(4,5). In the early ART-era, a high-volume specialist approach was the main source of care of this population and resulted in improved HIV-specific outcomes(6–8). However, there is increasing recognition that specialty HIV providers and those with high HIV caseloads are less comfortable preventing and managing the comorbidities associated with chronic HIV infection(9–13). A new medical home model consistent with chronic disease management of other conditions that bridges both primary and specialty care is likely required(4,14–16).

Little is known about who is actually providing care for people with HIV. One challenge has been lack of standardization of provider terminology in the literature. A “primary care provider” may be defined based on role (i.e. first point source of care or physician responsible for coordination of care) or based on accredited specialty training (i.e. certified family medicine or general medicine specialist). An HIV “specialist” may be accredited as such through residency training or further accreditation, or self-defined based on volume of HIV care or experience. More information about HIV providers and their provision of care to people with HIV is required for health services planning.

In the US, the majority of accredited HIV “specialists” are male, specialty trained, 79% have an annual caseload of over 200 HIV patients, and about 40% are over 50 years of age(14,15). A survey of U.S. primary care providers found that only 54% report treating HIV patients(14). Most of these primary care providers were female, family medicine trained, urban practicing, and 36% reported an annual caseload of over 200 HIV patients(5). Similar ambiguity exists in Canada, where little is known about who is providing HIV care. In a survey of Canadian family physicians, only 33.4% of respondents reported providing any level of care to people with HIV in 2001(17). Another study found that even when patients with HIV had a previously identified family physician, many did not identify with and seek care from that provider(13).

The objectives of this study were to (1) determine the proportion of physician care provided to patients with HIV in Ontario by physician specialty (primary care physicians, infectious disease specialists, general internists, and others), (2) describe the amount and type of care by physician specialty. The study includes virtually all HIV patients receiving care in Ontario, an ethnically diverse industrialized setting with HIV patients from a range of sociodemographic backgrounds and disease risk factors.. The Ontario health care system is a single payer system for physician services, and to our knowledge, this is the first such population-based study.

Methods

Study Design:

We conducted a retrospective observational study to examine the characteristics of and health care visits to physicians caring for people living with HIV in Ontario, Canada. To do this, we analyzed the administrative databases held at the Institute for Clinical Evaluative Sciences (ICES) comprising data on over 13 million individuals from the province of Ontario. These databases are made available to accredited researchers through a data sharing agreement with the Ontario Ministry of Health and Long Term Care and are individually linked using an anonymous identification number in accordance with the

provincial Personal Health Information Protection Act. This study was approved by the Ottawa Hospital and Sunnybrook Health Sciences Centre Research Ethics Boards.

Participants:

We identified eligible individuals in Ontario from the Registered Persons Database (RPDB), an electronic registry that contains patient demographic information, including age, sex, postal code and mortality data on all Ontarians eligible for coverage under the provincial health insurance plan. To obtain a cohort of people with HIV in the province, we used data from the Ontario Health Insurance Program (OHIP) billing claims system, which records claims for approximately 95% of physician services conducted in the province. To these data, we applied a previously validated algorithm to people 18 years of age and older and living in Ontario between April 1, 1992 and March 31, 2012 to identify those with HIV (18). Briefly, this algorithm requires at least 3 physician claims (International Classification of Diseases, Ninth Revision (ICD-9) code for HIV infection (042, 043, 044)) over a 3-year period. It has a sensitivity of 96.2% (95% CI 95.2% - 97.9%) and specificity 99.6% (95% CI 99.1% - 99.8%) for identifying people with HIV and receiving care in Ontario.

We then used the OHIP database to identify all outpatient health care visits made to physicians by patients in our HIV cohort between April 1, 2009 and March 31, 2012 to derive our physician cohort.

Main measures:

We obtained information about physicians in the cohort (including age, sex, and year of graduation from medical school) from the ICES Physician Database (IPDB). This database comprises information from the Ontario Health Insurance Plan (OHIP) Corporate Provider Database (CPDB), the Ontario Physician Human Resource Data Centre (OPHRDC) database and the OHIP database of physician billings. The CPDB contains information about physician demographics, specialty training and certification, and practice location. This information is validated against the OPHRDC database, which verifies this information through telephone interviews with all physicians practicing in Ontario.

To assign physicians to a rurality category, we used the postal code of the physician's main practice venue along with the Rurality Index of Ontario(19). Physicians were categorized as practicing in major urban areas (score 0 to 9), non-major urban areas (10 to 44), or rural areas (45 or higher). We used the number of unique patients in the HIV cohort that a physician billed for at least once during the 3-year study period to determine the physician's HIV caseload, categorized as low (≤ 5), medium (6-49), or high-volume (≥ 50) practice, as 6-49 patients is a HIV volume threshold that may lead to improved care(7). As patients may have seen more than one physician, the HIV patient population of each physician was not mutually exclusive. If physician specialty was not available in the IPDB database, then we used the most common specialty code among the physician's office billings in the OHIP database. Specialty was categorized into four groups: as "Family Medicine/General Practice" (comprising the specialties of family medicine, family medicine/emergency medicine, general practice or community medicine, all of whom may be licensed to practice family medicine/general practice in Ontario), "Internal Medicine", "Infectious Diseases" or "Other". Finally, using billing diagnoses, we classified each visit as either an HIV visit (any diagnosis code of '042', '043', or '044') or non-HIV visit (any non-HIV diagnostic code). In Ontario, only a single diagnostic code can be billed per visit.

Statistical analysis:

We used descriptive statistics to compare the characteristics of providers across the specialty categories using two-sample t-tests (for continuous variables) and chi-squared tests (for categorical variables). We stratified the frequency and proportion of physician care into three categories: (a) care by physician specialty, (b) care based on physician caseload, i.e. the number of HIV patients per physician, and (c) care that is related to HIV versus unrelated to HIV. Frequencies less than or equal to 5 were excluded from analysis by collapsing them with the closest variable category.

All statistical analyses were performed using SAS version 9.2 (SAS Institute, Cary, North Carolina).

Results

After excluding individuals who were under 18 years, not alive on or not diagnosed with HIV by April 1, 2009, and those who had an invalid OHIP number (n=9,046), as well as those with an HIV diagnosis date after their date of death (n=1), there remained 14,282 individuals aged 18 years or older in our HIV cohort. Their characteristics are described in more detail previously(3).

There were 4,756 physicians who provided care to people in the HIV cohort, defined as having submitted at least one claim within the study period for a patient in the HIV cohort: 3,699 (77.8%) family physicians, 55 (1.6%) infectious disease specialists, 70 (1.5%) internal medicine specialists, 895 (18.8%) other specialists, and 30 (0.6%) physicians with no identified specialty.

Table 1 presents the characteristics of physicians by specialty. The 'other' specialty physicians represented a diverse group of specialists (Appendix 1), and were therefore excluded from this comparison of demographic characteristics. There were several demographic differences between the specialties. The mean ages of the internal medicine and infectious disease specialists were lower than that of family physicians (47.0 years and 47.4 years vs. 49.8 years). Family physicians had a higher proportion of female physicians than the other specialty groups (30.8% of family physicians vs. 20.0% of internal medicine specialists and 23.6% of infectious disease specialists, although this difference was not statistically significant. There were also differences in the time since graduation between specialties; 58.2% of family physicians graduated prior to 1990, compared with 38.6% of internal medicine specialists and 47.3% of infectious disease specialists.

There were differences in practice location between specialties. In particular, all infectious disease specialists and 92.9% of internal medicine specialists practiced in major urban settings. In contrast, 16.6% of family physicians had practices in rural or non-major urban settings.

There were substantial differences between specialties in the distributions of low, medium and high-volume physicians based on their HIV caseloads. The majority of family

physicians (76.8%) had low-volume caseloads. Only 2.1% of family physicians had high-volume caseloads. In contrast, the majority of infectious disease specialists (63.6%) had high-volume caseloads. Internal medicine specialists were more evenly distributed, with 50.0% having medium-volume caseloads.

The distribution and proportion of outpatient health care visits for our HIV cohort (total visits, HIV visits and non-HIV visits) by specialty category is presented in Table 2, Figure 1 and Figure 2. One third of all visits were for HIV care (33.6% or 136,590 of a total of 406,411 outpatient health care visits).

Family physicians provided the majority of outpatient visits for HIV patients in Ontario (217,850 visits, or 53.6% of all visits and 53.9% of HIV visits). Family physicians in low- and medium-volume practice provided 28.9% of all visits, most of which were for non-HIV care (95.7%). In contrast, family physicians in high-volume practice provided 24.8% of all visits, most of which were for HIV care (68.1%).

Internal medicine specialists provided 20,088 visits for HIV patients in Ontario (4.9% of all visits and 9.6% of HIV visits). Most visits were to specialists in high-volume practice (70.2%). For those in low- and medium-volume practice, only 3.6% and 26.0% of visits were HIV visits, respectively. However, for those in high-volume practice, 85.5% of visits were HIV visits.

Infectious disease specialists provided 50,788 visits for HIV patients in Ontario (12.5% of all visits and 32.7% of HIV visits). Again, most visits were to specialists in high-volume practice (96.6%). For those in low-volume practice, only 30.5% of visits were HIV visits. However, for those in medium and high-volume practice, 78.2% and 88.3% were HIV visits.

Other specialties provided 117,685 visits to people with HIV in Ontario (29.0% of all visits and 3.8% of HIV visits); only 4.4% of these visits were billed for HIV care. Psychiatrists provided the majority of these visits (33.0% of other specialist visits and 9.6% of all visits). Figure 3 shows the number of visits provided by those specialties for which the proportion of visits exceeded 2% of the total. A complete distribution of the proportions of visits to other specialties is presented in Appendix 1.

Discussion

Our study describes two key aspects of HIV care in Ontario. First, we found that family physicians providing care to people with HIV are, on average, more often female, older and graduated longer ago than internal medicine and infectious disease specialists caring for these patients. Family physicians were the only specialty with a presence in rural settings.

Second, our study describes how these physicians are providing care. Family physicians, most of whom have low- or medium- HIV caseloads, were by far the most common specialty providing care to people with HIV in Ontario. Furthermore, family physicians provided the majority of both HIV and non-HIV care. Internal medicine and infectious disease specialists with lower HIV caseloads provided fewer and mostly non-HIV visits, but higher caseload specialists provided mostly HIV visits. These findings may speak to patterns of consultation or shared care at lower caseloads versus a specialist acting as the 'primary care provider', measured as the provision of high proportions of all care, at higher HIV caseloads. Finally, other specialties provide a large proportion of care. Psychiatrists provided an amount of care to people with HIV that approaches HIV specialists (9.6 versus 12.5% of all visits).

This study adds to understanding how volume of care and provider specialty are reflected in the actual health care utilization of people living with HIV. Historically, specialty physicians with high HIV caseloads have been required to manage the complexities of HIV care. However, we know that for many complex chronic conditions specialty care may improve disease-specific indicators while strong primary care is required for improved whole-person care for those with multiple conditions(20). Our findings are consistent with previous work demonstrating a decrease in ambulatory visits to infectious disease specialists in with a concomitant visits to other specialties(21), but primary care visits have not been explored. The number of family physicians providing care to any patients with HIV is not greatly changed from a 2001 survey(17). However, the proportion of care this represents for this population is surprisingly substantial. Questions remain regarding

the best ways to merge HIV expertise and generalist knowledge to meet the needs of this increasingly diverse population(15,22).

Our findings have implications for health care planning, especially given that the Affordable Care Act may substantially increase the number of people with HIV eligible for health care insurance in the United States. Family physicians caring for people with HIV are older and graduated many years ago, yet are the only group practicing in rural settings. These results reflect concerns in the United States of an aging HIV workforce and the need for community-based care(15,22). In addition, our results highlight the substantial mental health resources required for people with HIV, consistent with the observed high mental health burden in this population.

There are several limitations to our study. First, although we used a highly validated algorithm to identify people with HIV, the algorithm only identified patients who were being cared for by physicians. We were not able to identify those who were unaware of their HIV status (estimated to be 26% of prevalent infections in Canada(23)), or those not accessing health care, who may differ from those in care(24). As the focus of our study was to describe who is actively providing care to people with HIV, this constraint is appropriate to the research question. Furthermore, there are some practice settings in Ontario (most notably community health centres) whose data were not included in the administrative databases; thus, HIV patients seeking care in these settings could not be included in the study. However, since community health centres are estimated to serve only 0.9% of the Ontario population (25), our findings are unlikely to be substantially affected by missing these individuals. Second, we are unable to measure the contribution of care provided by other health care providers who do not bill the provincial insurance system or the care provided by community based HIV/AIDS agencies. Third, in Canada, family physicians are primary care providers whereas internal medicine physicians act as consultant specialists. This differs from the United States where general medicine specialists may also provide primary care. However, the analysis of ambulatory visits by both physician specialty and HIV caseload allows generalization across settings. Finally,

these data do not allow us a deeper understanding of how different specialties share care for the same patients.

Conclusions

Our study demonstrates that differences exist between specialists caring for people with HIV in Ontario. Further, the distribution of visits unveils patterns of health care delivery by physicians depending on their specialty and their HIV caseloads. Family physicians with high and low caseloads provide substantial proportions of care for this population, as do psychiatrists. Further research should delineate the ways these specialty groups share care for this complex, chronic population and how different provider patterns relate to quality of care.

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Figure 1: Number of visits to physicians by physician HIV caseload volume and specialty. Caseload volume categories by number of patients in HIV cohort seen during study period: low (≤ 5 patients), medium (6-49 patients) and high (50+ patients)

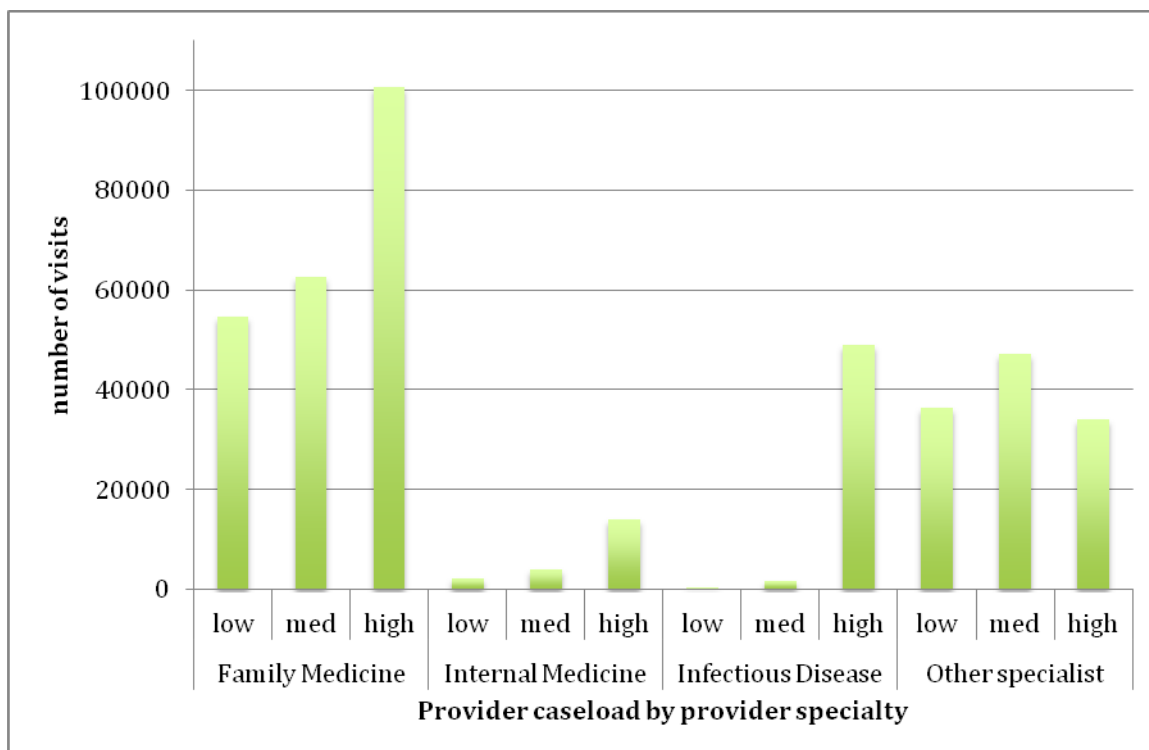


Figure 2: Proportion of all visits to physicians that are HIV visits by physician HIV caseload volume and specialty. Caseload volume categories by number of patients in HIV cohort seen during study period: low (≤ 5 patients), medium (6-49 patients) and high (50+ patients)

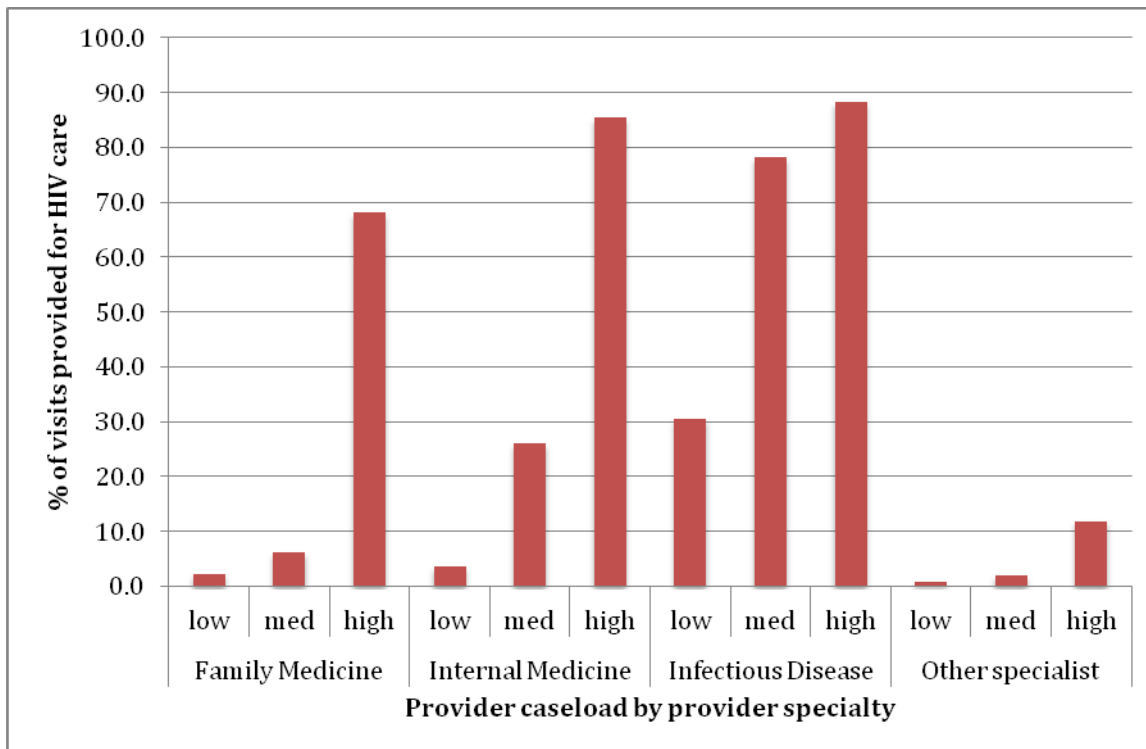


Figure 3: Distribution of visits by other specialists

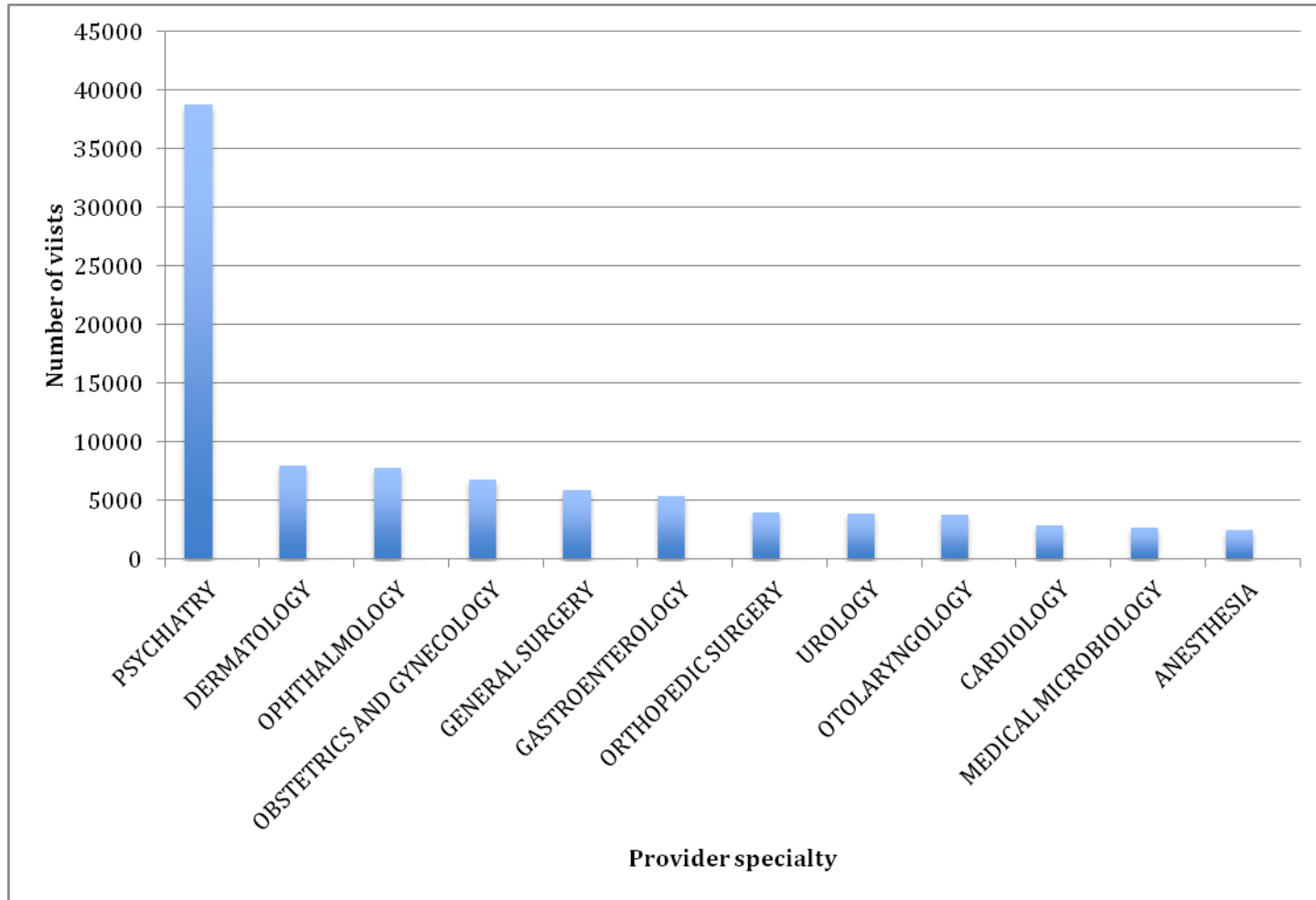


Table 1: Characteristics of physicians by specialist category

Variable		All N=3,824	Family Medicine N=3,699	Internal Medicine Specialist N=70	Infectious Disease Specialist N=55	p-value
Age (years)	Mean ± SD	49.7 ± 11.2	49.8 ± 11.1	47.0 ± 14.1	47.4 ± 9.2	0.033
Age category (years)	<40	1,711 (44.7%)	732 (19.8%)	29 (41.4%)	12 (21.8%)	<0.001
	40-54	986 (25.8%)	1,660 (44.9%)	19 (27.1%)	32 (58.2%)	
	55-64	773 (20.2%)	966 (26.1%)	12 (17.1%)	11 (20%)*	
	>64	347 (9.1%)	334 (9.0%)	10 (14.3%)		
Sex	F	1,165 (30.5%)	1,138 (30.8%)	14 (20.0%)	13 (23.6%)	0.276
Year of graduation	missing	320 (8.4%)	307 (8.3%)	7 (10.0%)	6 (10.9%)	<0.001
	>2000s	363 (9.5%)	471 (12.7%)	18 (25.7%)	23 (41.8%)*	
	1990s	829 (21.7%)	765 (20.7%)	18 (25.7%)		
	1980s	1,017 (26.6%)	992 (26.8%)	10 (14.3%)	15 (27.3%)	
	1970s	801 (20.9%)	815 (22.0%)	6 (8.6%)	11 (20.0%)*	
	pre-1970	494 (12.9%)	349 (9.4%)	11 (15.7%)		
Rural status of physician	missing	114 (3.0%)	112 (3.0%)	<=5	0	0.002
	major urban	3,092 (80.9%)	2,972 (80.3%)	65 (92.9%)	55 (100.0%)	
	non-major urban	451 (11.8%)	448 (12.1%)	<=5	0	
	rural	167 (4.4%)	167 (4.5%)	<=5	0	
Caseload volume	<=5	2,870 (75.1%)	2,841 (76.8%)	25 (35.7%)	20 (36.4%)*	<0.001
	6-49	830 (21.7%)	779 (21.1%)	35 (50.0%)		
	>=50	124 (3.2%)	79 (2.1%)	10 (14.3%)	35 (63.6%)	

*Some categories are collapsed to avoid reporting cell sizes <=5

Table 2: Distribution and proportion of outpatient health care visits between April 1, 2009 and March 31, 2012 (all visits, HIV visits and non-HIV visits) by specialist category and HIV caseload

Physician specialty	Physician HIV caseload	All visits		HIV visits		non-HIV visits		Proportion HIV visits/all visits (%)
		(n)	(%)	(n)	(%)	(n)	(%)	
Family Medicine	low	54,712	13.5%	1,246	0.9%	53,466	19.8%	2.3%
	medium	62,541	15.4%	3,841	2.8%	58,700	21.8%	6.1%
	high	100,597	24.8%	68,503	50.2%	32,094	11.9%	68.1%
	All	217,850	53.6%	73,590	53.9%	144,260	53.5%	33.8%
Internal Medicine	low	2,106	0.5%	75	0.1%	2,031	0.8%	3.6%
	medium	3,872	1.0%	1,007	0.7%	2,865	1.1%	26.0%
	high	14,110	3.5%	12,060	8.8%	2,050	0.8%	85.5%
	all	20,088	4.9%	13,142	9.6%	6,946	2.6%	65.4%
Infectious Disease	low	118	0.03%	36	0.03%	82	0.03%	30.5%
	medium	1,632	0.4%	1,276	0.9%	356	0.1%	78.2%
	high	49,038	12.1%	43,316	31.7%	5,722	2.1%	88.3%
	all	50,788	12.5%	44,628	32.7%	6,160	2.3%	87.9%
Other specialist	low	36,465	9.0%	293	0.2%	36,172	13.4%	0.8%
	medium	47,239	11.6%	894	0.7%	46,345	17.2%	1.9%
	high	33,981	8.4%	4,043	3.0%	29,938	11.1%	11.9%
	all	117,685	29.0%	5,230	3.8%	112,455	41.7%	4.4%
Total		406,411	100%	136,590	100%	269,821	100%	33.6%

Caseload volume categories by number of patients in HIV cohort seen during the 3-year study period: low (≤ 5 patients), medium (6-49 patients) and high (50+ patients)

Appendix 1: Distribution of visits by other specialists

Provider specialty	visits (n)	visits (%)
PSYCHIATRY	38,830	33.0
DERMATOLOGY	8,015	6.8
OPHTHALMOLOGY	7,756	6.6
OBSTETRICS AND GYNECOLOGY	6,823	5.8
GENERAL SURGERY	5,919	5.0
GASTROENTEROLOGY	5,434	4.6
ORTHOPEDIC SURGERY	3,982	3.4
UROLOGY	3,881	3.3
OTOLARYNGOLOGY	3,785	3.2
CARDIOLOGY	2,868	2.4
MEDICAL MICROBIOLOGY	2,708	2.3
ANESTHESIA	2,500	2.1
PLASTIC SURGERY	2,318	2.0
HEMATOLOGY	2,247	1.9
RADIATION ONCOLOGY	2,213	1.9
NEUROLOGY	2,205	1.9
ENDOCRINOLOGY	2,166	1.8
RESPIROLOGY	2,021	1.7
PEDIATRICS	1,844	1.6
NEPHROLOGY	1,842	1.6
MEDICAL ONCOLOGY	1,415	1.2
RHEUMATOLOGY	1,400	1.2
PHYSICAL MEDICINE AND REHAB.	1,100	0.9
EMERGENCY MEDICINE	1,004	0.9
VASCULAR SURGERY	717	0.6
CLINICAL IMMUNOLOGY	625	0.5
GERIATRIC MEDICINE	416	0.4
THORACIC SURGERY	327	0.3
NEUROSURGERY	320	0.3
DIAGNOSTIC RADIOLOGY	290	0.2
HEMATOLOGICAL PATHOLOGY	176	0.1
ANATOMICAL PATHOLOGY	173	0.1
CARDIO. AND THORACIC SURGERY	168	0.1
GENERAL PATHOLOGY	86	0.1
MEDICAL BIOCHEMISTRY	35	0.0
MEDICAL GENETICS	27	0.0
OCCUPATIONAL MEDICINE	22	0.0

THERAPEUTIC RADIOLOGY	13	0.0
PEDIATRIC CARDIOLOGY	9	0.0
NUCLEAR MEDICINE	5	0.0
TOTAL	117685	

Chapter 7

The derivation and validation of a typology of care for patients with chronic disease using administrative data

Submitted in manuscript form as The derivation and validation of a typology of care for patients with chronic disease using administrative data. Kendall, C. E., Younger, J., Manuel, D. G., Glazier, R. H., Hogg, W. E., & Taljaard, M. Submitted to Journal of Clinical Epidemiology September 2014.

Abstract

Background: Building upon an existing theoretical shared primary care/specialist care framework, to a) develop a unique typology of care for people living with HIV in Ontario; b) assess sensitivity of the typology by varying typology definitions, and; c) describe characteristics of typology categories.

Methods: Retrospective population-based observational study from 1 April 2009 to 31 March 2012. 13,480 eligible patients with HIV and receiving publicly-funded health care in Ontario. We derived a typology of care by linking patients to usual family physicians and to HIV specialists with 5 possible patterns of care. Patient and physician characteristics and outpatient visits for HIV related and non-HIV related care were used to assess the robustness and characteristics of the typology.

Results: Five possible patterns of care were described as: low engagement (8.6%); exclusively primary care (45.4%); family physician-dominated co-management (10.1%); specialist-dominated co-management (30.7%); and exclusively specialist care (5.3%). Sensitivity analyses demonstrated robustness of typology assignments. Visit patterns varied in ways that conform to typology assignments.

Conclusion: We anticipate this typology can be used to assess the impact of care patterns on the quality of primary care for individuals with various complex conditions.

Background:

Patients with chronic conditions that are less commonly seen in primary care practice benefit from specialist expertise (1). As a good example, there is evidence that HIV specialists and more experienced HIV practitioners provide higher quality of care as measured by disease-specific indicators (2–7). However, as people with HIV on combination antiretroviral therapy (ART) are now living substantially longer, they are likely to acquire comorbidities related to aging as well as from the effects of HIV and its treatment (8–12). As with other chronic conditions, there is increasing recognition that people with HIV require primary care approaches to health promotion and comorbid disease management (13–21). This balance of care needs makes HIV an ideal condition to study the interface of shared care between primary care physicians and specialists.

Research using health administrative data provides an opportunity to explore how primary care physicians and specialists share care for patients with HIV. Lafata et al. (22) used a simple categorization of patients with diabetes according to whether they saw exclusively endocrinologists, exclusively primary care providers, or had shared care by both specialties. Patients seeing only endocrinologists were less likely to receive preventative care, and those receiving shared care were more likely to receive a full complement of disease-specific and primary care. Katz et al. (23) used cluster analysis to categorize patients with chronic disease based on their patterns of ambulatory visits. 84% of patients fell into a cluster where most care was provided by their usual family physician. However, several had patterns that reflected low continuity of care, unusually high ambulatory care use, or in which specialists (rather than family physicians) were the patient's main provider; these clusters overall performed less well. This empirical approach to categorizing shared care elicited 15 quite varied categories, making it difficult to understand their impact on quality of care.

Ontario is the Canadian province with the highest number of people living with HIV. We have a single payer health care system in which the majority of physician billing claims are captured in provincial administrative databases. We previously used administrative databases to demonstrate large variability in the provision of HIV care by physician specialty and HIV experience (24). In this article, our objectives are to a) explore a unique, administratively-defined typology of shared care (Text box 1); b) assess the sensitivity of this typology by performing sensitivity analyses of our typology definitions, and; c) describe the characteristics of this typology by examining the patients, physicians, and patterns of health care use among the typology categories. Our typology builds on a theoretical framework of the roles of specialists and the level of responsibility they assume for care of the index condition compared to a referring family physician (25). This framework can be used to develop and evaluate strategies to improve the quality of the specialist-primary care interface (26).

Text box 1: Typology of shared care for patients with HIV using administrative data

<p>Primary care dominant models</p>	<p>1. Exclusively primary care – patient is assigned to a regular family physician who provides most primary care and most HIV-related care, no infectious disease or internal medicine physician provides any HIV care</p> <p>2. Family physician dominant co-management – patient is assigned to a regular family physician who provides majority of HIV-related care, specialist physician provides some HIV care</p>
<p>Specialist dominant models</p>	<p>3. Specialist dominant co-management – patient is assigned to a regular family physician, but specialist physician provides majority of HIV-related care</p> <p>4. Specialist care only – patient is not assigned to a regular family</p>

physician, specialist physician provides all HIV-related care
5. Low engagement – patient is not assigned to a regular family physician and has no specialist physician providing HIV care

Methods:

Data sources:

We used the administrative databases held at the Institute for Clinical Evaluative Sciences (ICES) to abstract all data for this study. These databases are made available to accredited researchers through a data sharing agreement with the Ontario Ministry of Health and Long Term Care and are individually linked using a coded identification number in accordance with the provincial Personal Health Information Protection Act. The databases used include the Registered Persons Database (RPDB), which includes demographic and mortality data for all individuals eligible for provincial health care, the Ontario Health Insurance Program (OHIP) billing claims system, which records claims for approximately 95% of physician services conducted in the province, the Discharge Abstract Database (DAD) which contains all provincial hospital discharge data, the National Ambulatory Care Reporting System (NACRS), which captures information on visits to emergency departments, Citizen and Immigration Canada data, which contains demographic and socioeconomic information on all individuals granted permanent residency in Canada, the Client Agency Program Enrolment (CAPE) registry, which tracks patient enrolment to individual family physicians, and the ICES Physician Database (IPDB), which contains information on physician demographics, training, and practice setting.

Eligible population:

We identified eligible individuals in Ontario from the Registered Persons Database. To obtain a cohort of people with HIV in the province, we used data from the OHIP billing claims system. To these data, we applied a previously validated algorithm to people 18 years of age and older and living in Ontario between April 1, 1992 and March 31, 2012 to identify those with HIV (27). Briefly, this algorithm requires at least 3 physician claims (International Classification of Diseases, Ninth Revision (ICD-9) code for HIV infection (042, 043, 044)) over a 3-year period. It has a sensitivity of 96.2% (95% CI 95.2% - 97.9%) and specificity 99.6% (95% CI 99.1% - 99.8%) for identifying people with HIV and receiving care in Ontario.

We excluded patients with an invalid or out-of-province residence on July 1, 2009 (n=277). As physicians in community health centres (CHCs) do not provide billing to OHIP, we excluded those patients within our cohort who were known to be receiving care in CHCs between 2008-2010 (n=17) (28). Furthermore, to avoid misclassifying patients with incomplete follow up, we excluded patients who died during the 3-year study period (n=510).

Assignment of patients to a typology category (model):

Patients in our HIV cohort were assigned to one of five typologies based on their outpatient health care visits, including the specialty of the physician seen and billing codes submitted by these physicians between the study period of April 1, 2009 to March 31, 2012. The identified typologies are: exclusively primary care, family physician dominant co-management, specialist dominant co-management, exclusively specialist care, and low engagement. The method used to derive the typologies is summarized in Figure 1 and described below.

Step 1. Linkage of patients to a usual provider of primary care:

First, patients were assigned to a single family physician if they were contractually rostered with a family practice (defined using the Client Agency Program Enrolment registry) at the midpoint of the study period (October 1, 2010) (29). In Ontario, approximately 75% of the population is rostered to one of several primary care models (30). For patients who could not be assigned using this method, we obtained all of their core primary care services (Appendix A) over the 3-year study window. Patients were “virtually rostered” to a usual provider of primary care if at least 50% of their primary care billings were to the same family physician. We excluded patients for whom their virtually rostered physician was not a primary care provider (specialties other than general/family practice, community medicine, or family medicine/emergency medicine).

Step 2. Linkage of patients to an HIV specialist provider:

This step determined whether patients had any billings specifically for HIV care (any ICD-9 diagnosis code of 042, 043, 044) to an infectious disease or internal medicine specialist. In Ontario, only a single ICD-9 diagnostic code is recorded in administrative claims databases per patient visit.

Step 3. Ascertaining degree of co-management between family physicians and specialists:

Patients receiving care only from a family physician were assigned to “exclusively primary care”. Patients receiving care only from a specialist were assigned to “exclusively specialist care”. Patients who were assigned to a usual source of primary care in step 1 and had visits to an infectious disease/internal medicine specialist for HIV care in step 2 were categorized to “co-management”. These patients were further classified based on whether the family physician (family physician dominant co-management) or the specialist physician(s) (specialist dominant co-management) billed most of the HIV visits. Patients who did not have a usual source of primary care and did not see an infectious disease or internal medicine specialist for HIV care were assigned to “low engagement”.

Sensitivity analysis to assess the robustness of typology algorithm:

Researchers have used a variety of ways to assign patients to family physicians using claims data. We performed the following sensitivity analyses to assess the robustness of our assignment methodology. The algorithm we used for assigning patients to a typology category defined the threshold for a usual source of primary care as having a family physician that provided at least 50% of all core primary care services, with no required threshold number of visits per year. We compared the results of this approach with the alternate definitions in Table 1. After reassignment, we compared the proportions of patients in each typology category and the proportion of patients who are assigned to the same usual provider of primary care to those in the reference algorithm.

Comparison of patient characteristics, physician characteristics, and health care use between typology categories:

Patient and physician variables were collected for comparison between typology categories.

HIV patient variables:

Age, sex and postal code on April 1, 2009 were obtained from the RPDB. We used postal codes at the neighborhood level linked to 2006 Statistics Canada census data to assign income quintiles and rurality scores. Rurality was assigned categorically into major urban areas (score 0 to 9), non-major urban areas (10 to 39), and rural areas (40 or higher) according to the Rurality Index of Ontario (31).

We used two measures of case mix to describe disease burden among people with HIV. First, we used the Johns Hopkins Adjusted Clinical Group System to measure morbidity by assigning patients to up to 32 distinct Aggregated Diagnosis Groups (ADGs), and categorized the number of ADGs into low (<5 ADGs), medium (6-9 ADGs) and high (≥ 10 ADGs) (32,33). Second, we used chronic disease count to measure disease burden. We applied additional previously validated algorithms to identify the status (i.e. presence or absence) of the following physical comorbidities on April 1, 2009: diabetes, congestive

heart failure, acute myocardial infarction, hypertension, asthma, chronic obstructive lung disease, stroke, end stage renal disease and peripheral vascular disease (34–38). People with mental health conditions between April 1, 2007 and April 1, 2009 were broadly captured using an algorithm previously validated to identify people receiving mental health services in the primary care setting (39).

We used data from Citizenship and Immigration Canada to identify recent immigrants as well immigrants from HIV-endemic regions of Africa and the Caribbean. This group represents a growing proportion of new and prevalent HIV infections in Canada, are often demographically different from other groups, and have health outcomes that differ from other groups living with HIV (40–44).

Physician variables:

We used the OHIP database to identify all outpatient health care visits made to physicians by patients in our HIV cohort between April 1, 2009 and March 31, 2012 to derive our physician cohort.

We obtained information about these physicians (including age, sex, and year of graduation from medical school, and self-designated and functional specialty) from the ICES Physician Database, which contains information on physician demographics, training, and practice setting. Specialty was categorized into four groups: as “Family Medicine” (comprising the specialties of family medicine, family medicine/emergency medicine, general practice or community medicine, all of whom may be licensed to practice family medicine/general practice in Ontario), “Internal Medicine”, “Infectious Diseases” or “Other”. In contrast to the United States, where internal medicine specialists may act as primary care providers, Canadian internal medicine specialists are primarily consultants.

To assign physicians to a rurality category, we used the postal code of the physician's main practice venue by the same method as for patients, above (31).

We used the number of unique patients in the HIV cohort that a physician billed for at least once during the 3-year study period to determine the physician's HIV patient caseload, categorized as low (≤ 5), medium (6-49), or high-volume (≥ 50) practice, as 6-49 patients is a HIV volume threshold that may lead to improved care and decreased mortality (3). As patients may have seen more than one physician, the HIV patient population of each physician was not mutually exclusive. As a measure of comprehensiveness of primary care provided, we calculated the mean number and proportion of 20 primary care services provided by family physicians to all of their patients between October 1, 2010 to March 31, 2012 (Appendix A).

Finally, we used the provincial Client Agency Program Enrolment (CAPE) registry to identify family physician remuneration models. Fee-for-service (FFS) models primarily reimburse physicians based on a per-visit fee schedule. Capitation models are those that primarily reimburse physicians based on age and sex based capitation rates for rostered patients. Family Health Teams (FHTs) are specific capitation models that include additional funding for primary care teams, including some allied health support.

Health care use:

We examined patterns of health care visits to physicians in the typology category (usual provider of primary care, HIV specialist(s), or both) by assigning visits as for HIV-related care (ICD-9 diagnosis code for visit was 042, 043, or 044) or non-HIV-related care. We also looked at the number of family physicians seen during the study period, as well as the number of visits to all family physicians. Finally, we determined whether patients had seen an obstetrician gynecologist for non-maternity care during the study period.

Statistical analysis:

For our sensitivity analysis, we used descriptive statistics to compare the proportion of patients who remained in each typology model as well as the proportion who remained assigned to the same family physician after applying changes to our typology assignment. Descriptive statistics were generated to compare the patient characteristics, physician characteristics and health care use across the typology categories. Cell sizes with fewer than 6 individuals were suppressed. For this descriptive study, we did not conduct any statistical significance testing of differences in characteristics across the typologies. A future study will examine the statistical significance of differences in quality of care outcomes across the typologies.

All statistical analyses were performed using SAS version 9.3 (SAS Institute, Cary, North Carolina).

Ethics approval:

This study was approved by the Ottawa Hospital and Sunnybrook Health Sciences Centre Research Ethics Boards.

Results:

Assignment of patients to a typology model:

13,480 individuals were eligible for our study on April 1, 2009 (Figure 1); 11,624 (86.2%) were linked to a usual source of primary care: 9,680 (83.3%) of these through contractual rostering and 1881 (16.2%) through virtual rostering to the physician with at least 50% of all primary care billings. 63 (0.5%) of these patients were linked to physicians from specialties other than general/family practice, community medicine, or family medicine/emergency medicine, thus were excluded from further analyses (2 of these patients were virtually rostered to internal medicine physicians, none to infectious disease specialists). Of the 11,561 patients linked to a family physician as usual source of

primary care, 5,467 (47.3%) also had specialist care for HIV specific visits, thus were assigned to co-management, and 6,094 (52.7%) did not, thus were assigned to exclusively primary care. Of the 1,856 patients not linked to a usual source of primary care, 707 (38.1%) had specialist care for HIV specific visits and were assigned to exclusively specialist care. The 1,149 patients (8.6%) without either a usual source of primary care or specialist care for HIV specific visits were assigned to low engagement. Of those patients in co-management, 1,349 (24.7%) had most of their HIV visits from their family physician (Family physician dominant co-management) and 4,118 (74.3%) had most of their HIV visits from specialists (Specialist dominant co-management).

Sensitivity analysis to assess the robustness of typology algorithm:

The typology remained robust with 90 to 96 % of patients remaining in the same typology category for alternative ascertainment methods (Table 1). When we adjusted the number of visits thresholds for assigning the usual source of primary care, most patients (93-96%) remained assigned to the same family physician. However, when we ignored contractual rostering and assigned patients to the family physician based only on visit frequency, only about 80% remained assigned to the same family physician.

Characteristics of HIV patients

The characteristics of HIV patients differed among the care models, as shown in Table 2. Patients in low engagement had substantially fewer visits, thus are not directly compared to other groups. Both specialist dominant models (exclusively specialist care and specialist dominant co-management) had higher proportions of female patients. Patients receiving exclusively specialist care were on average younger than those in other models. Both specialist dominant models (exclusively specialist care and specialist dominant co-management) had higher proportions of patients in the lowest income quintiles, living rurally, and who were non-Canadian born, including those who immigrated recently and originated from Africa and the Caribbean.

Comorbid illness varied among HIV patients in the typology models. Patients with HIV in specialist dominant co-management had higher prevalence of diabetes and hypertension, and those in exclusively specialist care had lower prevalence of diabetes, congestive heart failure, acute myocardial infarction, hypertension, asthma, and a mental health diagnosis. Patients across models had similar prevalence of stroke, peripheral vascular disease, and end stage renal disease. These findings were further delineated through composite scores, with patients receiving exclusively specialist care having the lowest total chronic disease count and mean ADG score.

Characteristics of typology physicians

Physicians could have provided care for patients in one or more typology models. Appendix B depicts the degree of overlap, which is greater for HIV specialists than for family physicians. Table 3 describes the characteristics of family physicians and HIV specialists between the models (noting that overlap of physicians may make differences less pronounced). There were no meaningful differences of family physician age, sex, or rurality of practice among the typology models. HIV caseloads are depicted in Figure 2a and were substantially higher among family physicians in family physician dominant co-management. The majority of family physicians in exclusively primary care and specialist dominant co-management had low HIV patient caseloads. The largest proportion of family physicians in all typology models were in fee-for-service practice, however, those in family physician dominant co-management had the largest proportions of family physicians in both capitation and family health team models. Finally, family physician comprehensiveness scores did not vary among the models.

HIV specialist physician characteristics showed less variation among typology models. The vast majority of HIV specialists practiced in urban settings and most had high HIV volume practices (Figure 2b). Fewer HIV specialists in family physician dominant co-management were infectious disease trained.

Characterization of physician visits

Numbers of physician visits and physician billing patterns help characterize differences between the typology models (Figure 3). Patients in family physician dominant co-management had by far the highest number of visits and number of HIV visits to typology physicians, and those in exclusively specialist care the lowest. Patients in both co-management models had, on average, approximately twice as many visits over the 3 year study period as patients in their respective single physician models (mean 13.6 (standard deviation (SD 13.4)) visits in exclusively primary care vs. 24.5 (16.9) visits in family physician dominant co-management, and 8.2 (6.9) visits in exclusively specialist care vs. 17.6 (17.5) visits in specialist dominant co-management). While visits to HIV specialists were almost always billed as HIV care, visits to the usual source of primary care varied substantially. Family physicians billed HIV care differentially based on whether they or the HIV specialist was the principal HIV physician.

Aside from low engagement, the number of family physicians seen (approximately 2.5) and number of HIV specialists (approximately 1) seen did not vary across models. HIV patients showed high visit fidelity to their HIV specialists with the vast majority of all visits to the HIV specialist they saw most often (mean 1.0 (SD 0.1)). However, visit fidelity to the usual source of primary care varied from 0.7 (0.3) to 0.9 (0.2), and was highest for those in the primary care dominant models (primary care only and family physician dominant co-management). Finally, patients in specialist models (specialist only and specialist co-management) were more likely to have seen an obstetrician gynecologist for non-maternity care during the study period (13.2%) and those in exclusively primary care the least (6.1%).

Conclusions

Using routinely collected administrative data, we developed and characterized a theoretically-defined typology of how care is shared between family physicians and specialists for people living with HIV. Our typology models were robust to variations in definitions, had distinct populations of patients and physicians and distinct patterns of outpatient visits. About half of HIV patients saw only a family physician for both their primary health care and HIV care. Furthermore, the majority of patients could be assigned to a usual provider of primary care. Only a small proportion saw a specialist exclusively. Almost 10% of HIV patients had a pattern of low engagement with no usual source of primary care, no specialist HIV care, and very few visits during the 3-year study period.

The patterns of visits conformed to typology categories, adding face validity to our typology. Our finding that the majority of patients receive most of their care from family physicians and few receive care exclusively from specialists aligns with other studies of patients with chronic disease in single payer systems (23,45). Second, as in previous work (46), visit rates approximately doubled in models in which patients see a specialist in addition to a family physician. Third, as with the empirically-derived clusters found by Katz et al. (23), most HIV patients had the majority visits to their own family physician, a smaller proportion to other family physicians, and a very small proportion of visits to specialist physicians. Fourth, we found that the HIV experience and HIV billing practices differ substantially for family physicians in different typology models. These differences may speak to whether family physicians perceive themselves or the HIV specialist as responsible for HIV-specific care (25). Fifth, fidelity to family physicians was higher in the primary care dominant models, which may highlight the importance of relational continuity (47). Finally, patients in specialist dominant models were more likely to see an obstetrician/gynecologist for non-maternity care during the study period, possibly as models with lower primary care intensity are less likely to provide these services in the main location of care (20).

As our data were collected within a single payer system, our study captured almost all physician/patient encounters for the province of Ontario. We could not measure care delivered outside of the provincial health insurance plan, such as in community health centres (where about 1% of the Ontario population receives primary care (28)), and to those federally insured such as refugee claimants and some Aboriginal populations. There are additional limitations to our work. First, we were not able to identify those who were unaware of their HIV status, estimated to be 26% of prevalent infections in Canada (40). Nor could we identify those not accessing health care. Second, while based on theory of physician roles, our categorizations may differ from patterns that emerge from empirical data or self-definition. However, previous work has shown that physician-reported shared care reflects administratively-obtained definitions (48). Third, it is possible that patients switched physicians or models of care during the 3-year study period, which has been estimated to occur in 10-15% of HIV patients over one to two year periods (49,50). Our sensitivity analysis demonstrated a high level of agreement in category classification, however, using some definitions, up to 20% of patients received most of their primary care from physicians to whom they weren't contractually rostered. We did not assess, however, whether these patients were seeing family physicians in the same practice as their rostered family physician. Finally, while we used several validated strategies to measure comorbidity, it is possible that specialist physicians would have preferentially billed HIV diagnosis codes over codes for other chronic conditions, resulting in under-ascertainment of comorbidity among patients in specialist models. Furthermore, key measures such as lower CD4 cell counts and/or viral load suppression are not captured within our routinely collected administrative data holdings. As such, while comprehensive, these comorbidity indicators do not necessarily reflect the severity of HIV disease.

In conclusion, we were able to develop and characterize a theoretically-based and administratively-defined typology of how care is shared between specialists and primary care physicians for people with HIV. Most HIV patients had access to a usual family physician. Few patients in our cohort saw only specialists or had patterns of care

reflecting low continuity. This work provides a platform for extending this algorithm to other chronic conditions. Future work will further validate this typology by examining how these models of care impact the quality of care for people living with HIV.

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Table 1: Sensitivity analysis of typology assignments.

		Same typology model	Same family physician	Exclusively primary care	Family physician dominant comanage.	Specialist dominant co-manage.	Exclusively specialist care	Low engagement
	N	n (%)	n/N (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Ref.	13,417			6,094 (45.4)	1,349 (10.1)	4,118 (30.7)	707 (5.3)	1,149 (8.6)
A	13,405	12,879 (96.0)	11,561/12,087 (95.6)	6,297 (47.0)	1,360 (10.1)	4,430 (33.0)	377 (2.8)	941 (7.0)
B	13,419	12,937 (96.4)	11,122/11,561 (96.2)	5,687 (42.4)	1,348 (10.1)	4,087 (30.4)	666 (5.0)	1,631 (12.2)
C	13,407	12,416 (92.5)	11,122/12,070 (92.2)	5,874 (43.8)	1,359 (10.1)	4,398 (32.8)	337 (2.5)	1,439 (10.7)
D	13,404	12,134 (90.4)	9,503/11,561 (82.2)	5,556 (41.5)	1,362 (10.2)	3,436 (25.6)	1,370 (10.2)	1,680 (12.5)
E	13,380	12,443 (92.7)	9,886/12,087 (81.8)	6,119 (45.7)	1,434 (10.7)	4,203 (31.4)	516 (3.9)	1,108 (8.3)

Reference - assign usual provider of primary care based on 1) contractual rostering and 2) 50%+ of core primary care services:

A) assign patient to a usual source of primary care defined first as the family physician to whom the patient was rostered, and second as the family physician who provided the largest proportion of core primary care services;

B) exclude patients with fewer than 4 physician visits during the 3 year study period as being in low engagement care first, then assign patient to a usual source of primary care defined first as the family physician to whom the patient was rostered, and second as the family physician who provided at least 50% of core primary care services;

C) exclude patients with fewer than 4 physician visits during the 3 year study window period as being in low engagement care first, then patient assigned to a usual source of primary care defined first as the family physician to whom the patient was rostered, and second as the family physician who provided the largest proportion of core primary care services;

D) assign patients to a usual source of primary care defined as the family physician who provided at least 50% of core primary care services, regardless of which physician to whom they were contractually rostered;

E) assign patients to a usual source of primary care defined as the family physician who provided the largest proportion of core primary care services, regardless of which physician to whom they were contractually rostered.

Table 2: Characteristics of HIV patients across typologies. Entries are frequency (%) unless otherwise indicated.

Patient Characteristic	Exclusively primary care N=6,094	Family physician dominant co-management N=1,349	Specialist dominant co-management N=4,118	Exclusively specialist care N=707	Low engagement N=1,149	Total N=13,417
Male sex	5,128 (84.1%)	1,194 (88.5%)	3,013 (73.2%)	525 (74.3%)	959 (83.5%)	10,819 (80.6%)
Age (years) (mean, (sd))	45.0 (10.7)	46.4 (9.7)	44.9 (10.4)	42.7 (9.9)	45.8 (10.7)	45.1 (10.5)
Neighborhood income quintile						
missing	57 (0.9%)	20 (1.5%)	25 (0.6%)	<6	19 (1.7%)	124 (0.9%)
1 (lowest)	1,623 (26.6%)	430 (31.9%)	1,538 (37.3%)	288 (40.7%)	373 (32.5%)	4,252 (31.7%)
2	1,236 (20.3%)	248 (18.4%)	881 (21.4%)	156 (22.1%)	218 (19.0%)	2,739 (20.4%)
3	1,025 (16.8%)	220 (16.3%)	638 (15.5%)	92 (13.0%)	206 (17.9%)	2,181 (16.3%)
4	1,024 (16.8%)	193 (14.3%)	526 (12.8%)	93 (13.2%)	174 (15.1%)	2,010 (15.0%)
5 (highest)	1,129 (18.5%)	238 (17.6%)	510 (12.4%)	75 (10.6%)	159 (13.8%)	2,111 (15.7%)
Lives Rurally	80 (1.3%)	20 (1.5%)	96 (2.3%)	16 (2.3%)	30 (2.6%)	242 (1.8%)
Immigrant to Canada			1,109 (26.9%)	202 (28.6%)	181 (15.8%)	2,646 (19.7%)
< 5 years in Canada	949 (15.6%)	205 (15.2%)	365 (8.9%)	98 (13.9%)	25 (2.2%)	800 (6.0%)
Region of origin is Africa or Caribbean	241 (4.0%)	71 (5.3%)	718 (17.4%)	153 (21.6%)	90 (7.8%)	1,487 (11.1%)

Comorbidity prevalence						
Diabetes	448 (7.4%)	96 (7.1%)	408 (9.9%)	46 (6.5%)	57 (5.0%)	1,055 (7.9%)
Congestive heart failure	89 (1.5%)	22 (1.6%)	62 (1.5%)	<6	10 (0.9%)	187 (1.4%)
Acute myocardial infarction	69 (1.1%)	23 (1.7%)	55 (1.3%)	<6	<6	156 (1.2%)
Hypertension	864 (14.2%)	185 (13.7%)	697 (16.9%)	57 (8.1%)	102 (8.9%)	1,905 (14.2%)
Asthma	836 (13.7%)	179 (13.3%)	520 (12.6%)	62 (8.8%)	90 (7.8%)	1,687 (12.6%)
Chronic obstructive lung disease	463 (7.6%)	116 (8.6%)	293 (7.1%)	44 (6.2%)	64 (5.6%)	980 (7.3%)
Stroke	67 (1.1%)	12 (0.9%)	39 (0.9%)	8 (1.1%)	16 (1.4%)	142 (1.1%)
Peripheral vascular diseases	26 (0.4%)	7 (0.5%)	15 (0.4%)	6 (0.8%)	<6	58 (0.4%)
End stage renal disease	89 (1.5%)	17 (1.3%)	68 (1.7%)	11 (1.6%)	14 (1.2%)	199 (1.5%)
Mental health diagnosis	2,384 (39.1%)	675 (50.0%)	1,688 (41.0%)	216 (30.6%)	160 (13.9%)	5,123 (38.2%)
Chronic disease count (mean, (sd))	0.5 (0.8)	0.5 (0.8)	0.5 (0.8)	0.3 (0.7)	0.3 (0.7)	0.5 (0.8)
Aggregated Diagnosis Groups (ADG) (mean, (sd))	6.2 (3.7)	8.3 (3.4)	7.4 (3.8)	5.8 (4.1)	1.7 (3.6)	6.3 (4.1)
ADG category						
High	1,167 (19.1%)	496 (36.8%)	1,121 (27.2%)	145 (20.5%)	76 (6.6%)	3,005 (22.4%)
Medium	1,968 (32.3%)	502 (37.2%)	1,547 (37.6%)	166 (23.5%)	66 (5.7%)	4,249 (31.7%)
Low	2,959 (48.6%)	351 (26.0%)	1,450 (35.2%)	396 (56.0%)	1,007 (87.6%)	6,163 (45.9%)

Table 3: Characteristics of family physicians and HIV specialists among typology models. Entries are frequency (%) unless otherwise indicated.

Physician characteristics	Exclusively primary care	Family physician dominant co-management	Specialist dominant co-management	Exclusively specialist care
FAMILY PHYSICIANS	N=1,474	N=138	N=2,037	
Male Sex	1,040 (70.6%)	101 (73.2%)	1,487 (73.0%)	
Age (years) (mean, (sd))	50.8 (10.8)	48.0 (10.1)	50.0 (10.8)	
Rurality of practice				
Urban	1,222 (82.9%)	114 (82.6%)	1,674 (82.2%)	
Non major-urban	170 (11.5%)	11 (8.0%)	224 (11.0%)	
Rural	51 (3.5%)	10 (7.2%)	89 (4.4%)	
Primary care model of family physician				
Capitation	338 (22.9%)	43 (31.2%)	504 (24.7%)	
Fee for service	822 (55.8%)	54 (39.1%)	1,158 (56.8%)	
Family Health Team	314 (21.3%)	41 (29.7%)	375 (18.4%)	
Comprehensiveness score (mean (sd))	0.7 (0.1)	0.7 (0.2)	0.6 (0.1)	
HIV SPECIALISTS		N=76	N=70	N=60
Male sex		58 (76.3%)	53 (75.7%)	47 (78.3%)
Age (years) (mean, (sd))		44.4 (10.4)	45.9 (9.9)	46.1 (9.5)
Urban location		73 (96.1%)	69 (98.6%)	60 (100.0%)
Infectious disease vs. internal medicine specialist		49 (64.5%)	55 (78.6%)	52 (86.7%)

Figure 1: Flow diagram of study participants and typology assignments

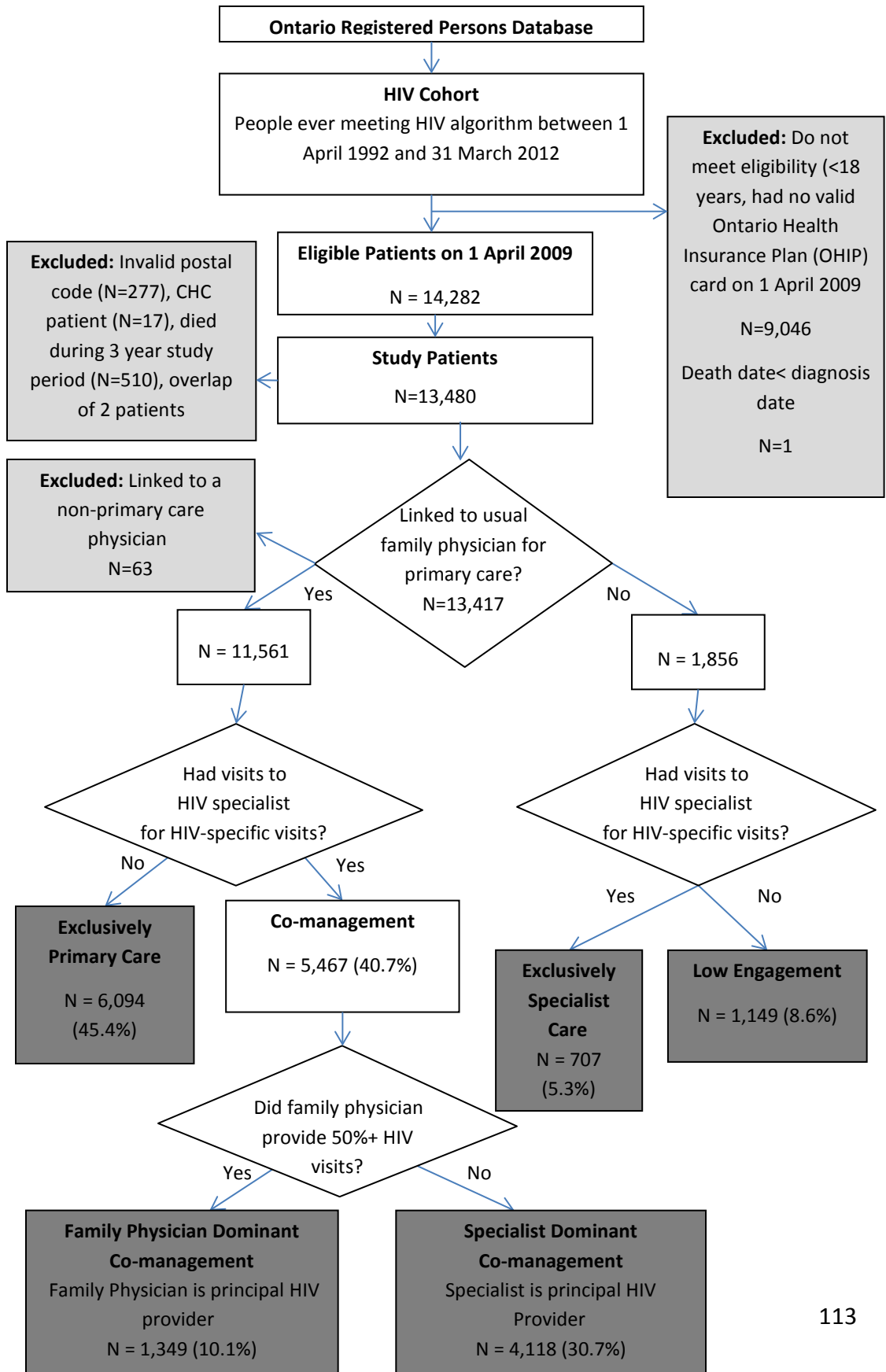
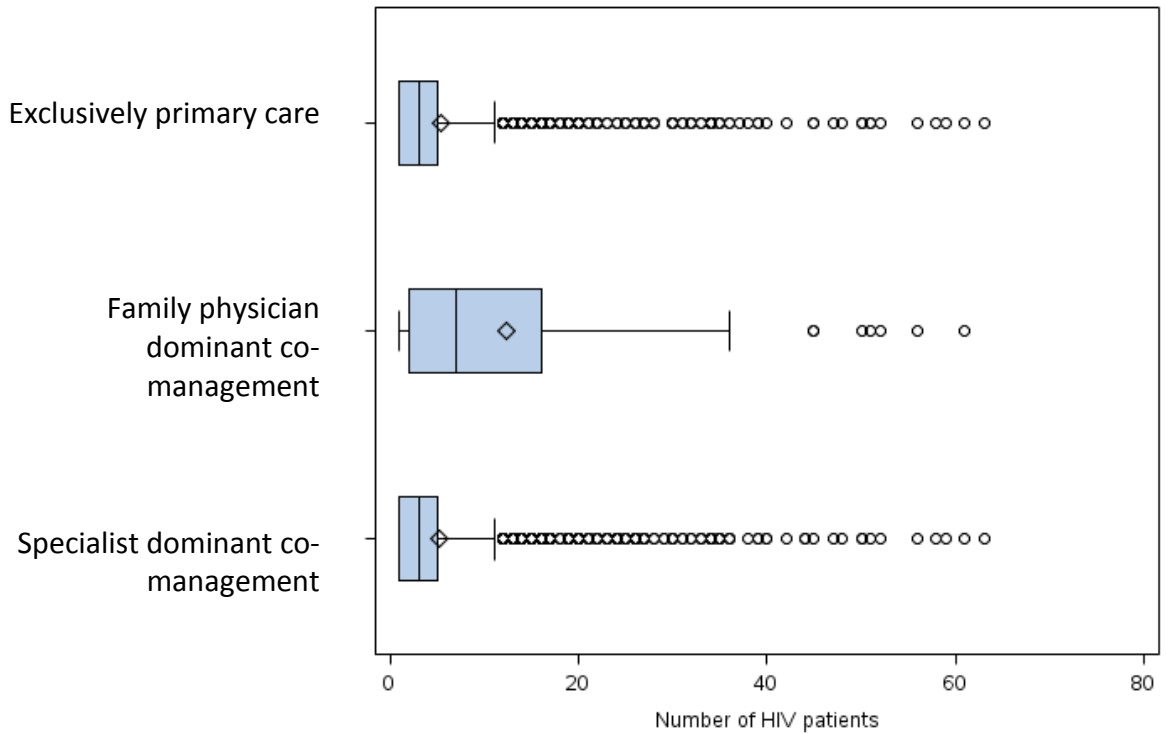


Figure 2: Boxplots of the distributions of family physician and HIV specialist HIV caseloads among typology models

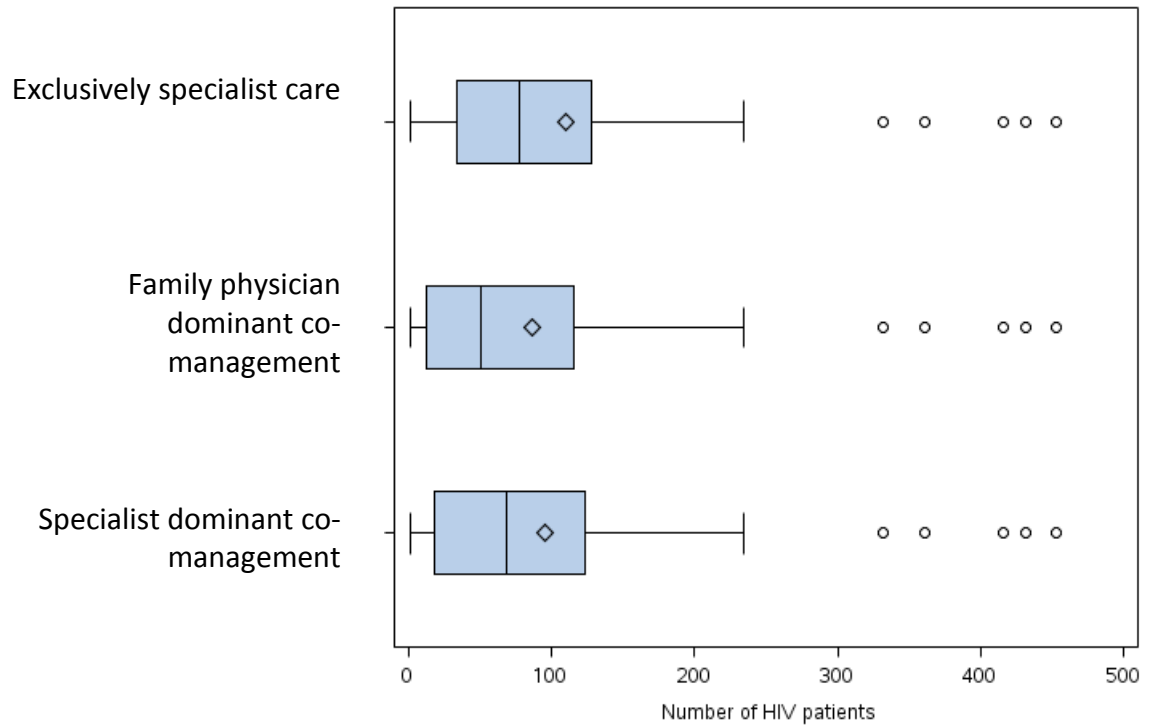
Figure 2a: Distribution of family physician HIV caseloads



Notes:

1. We excluded physicians with HIV caseloads above the 95th percentile (>63 HIV patients): 61, 47 and 66 physicians in exclusively primary care, family physician dominant co-management, and specialist dominant co-management respectively.
2. Physicians are not mutually exclusive across typology categories.
3. Despite having HIV patients rostered to them, 56 (3.8%) of family physicians in exclusively primary care and 74 (3.6%) of family physicians in specialist dominant co-management had no visits from HIV patients during the study period.

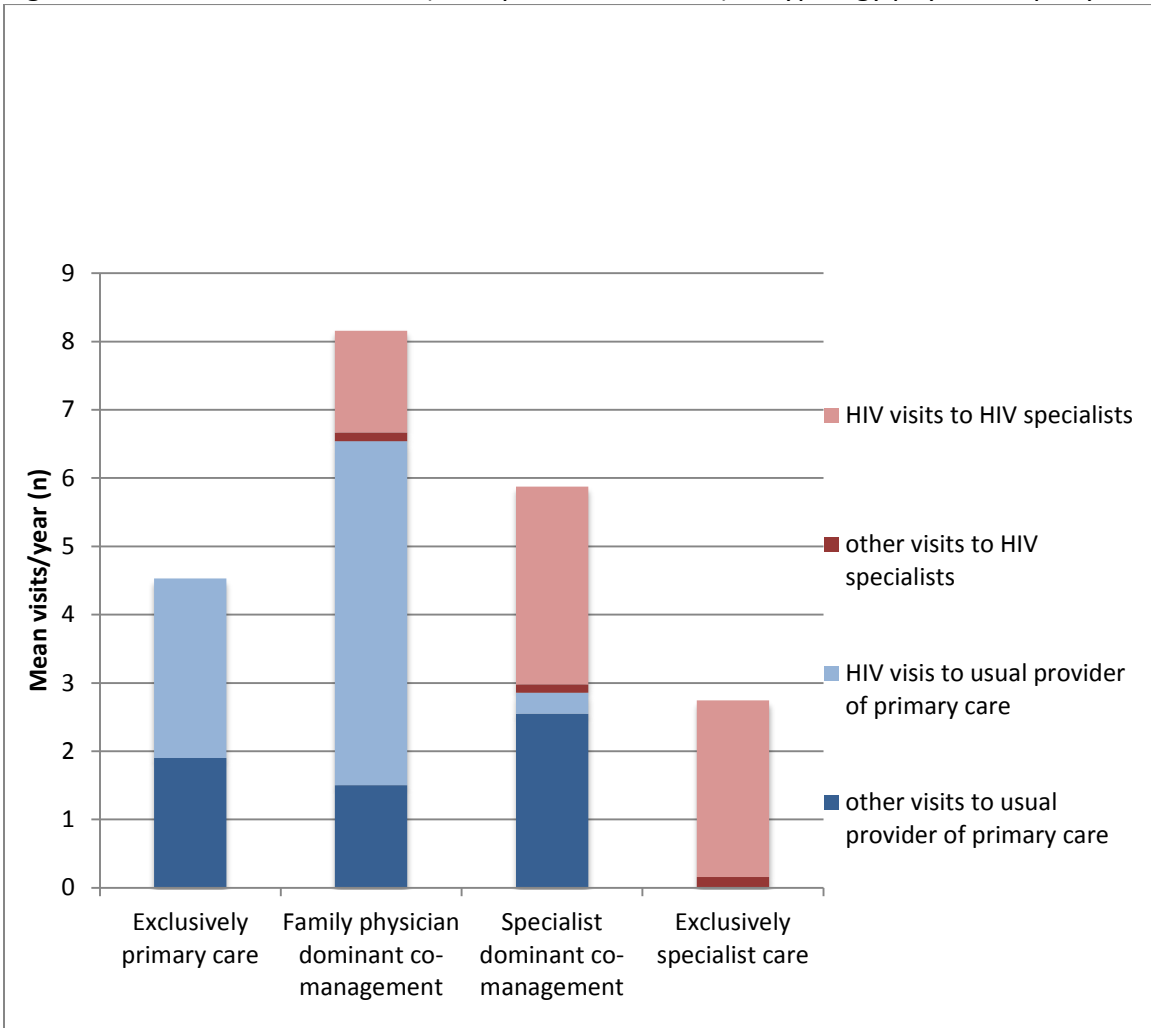
Figure 2b: Distribution of HIV specialist HIV caseloads



Notes:

1. We excluded physicians with HIV caseloads above the 95th percentile (>63 HIV patients): 3 physicians in each typology category.
2. Physicians are not mutually exclusive across typology categories.

Figure 3: Mean number of visits (HIV-specific and other) to typology physicians per year



Chapter 8

A population-based study comparing patterns of care delivery on the quality of care for persons living with HIV in Ontario

Submitted in manuscript form as A population-based study comparing patterns of care delivery on the quality of care for persons living with HIV in Ontario. Kendall, C. E., Taljaard, M., Younger, J., Hogg, W. E., Glazier, R. H., & Manuel, D. G. Submitted to BMJ Open December 2014.

Abstract

Background: Physician specialty is often positively associated with disease-specific outcomes and negatively associated primary care outcomes for people with chronic conditions. People with HIV have increasing comorbidity arising from the success of antiretroviral therapy (ART), making HIV a useful condition to examine shared care models. We used a previously described, theoretically-developed shared care framework to assess the impact of pattern of care delivery on the quality of care provided.

Methods: Retrospective population-based observational study from 1 April 2009 to 31 March 2012. 13,480 eligible patients with HIV and receiving publicly-funded health care in Ontario were assigned to one of 5 possible patterns of care. Prevention, ART prescribing, and health care utilization across typology models using multivariable hierarchical logistic regression analyses adjusted for patient characteristics.

Results: Models in which patients had an assigned family physician had higher odds of cancer screening compared to those in exclusively specialist care (colorectal cancer screening, exclusively primary care adjusted odds ratio (AOR) = 3.12, 95% confidence interval (CI) (1.90 to 5.13), family physician dominant co-management AOR = 3.39, 95% CI (1.94 to 5.93), specialist dominant co-management AOR = 2.01, 95% CI (1.23 to 3.26)). Odds of having one emergency department visit did not differ among models, although odds of hospitalization and HIV-specific hospitalization were lower among patients who saw exclusively family physicians (AOR = 0.23, 95% CI (0.14 to 0.35) and AOR = 0.15, 95%

CI (0.12 to 0.21), respectively). Odds of antiretroviral prescriptions were significantly lower among models in which patients' HIV care was provided predominantly by family physicians (exclusively primary care AOR = 0.15, 95% CI (0.12 to 0.21), family physician dominant co-management AOR = 0.45, 95% CI (0.32 to 0.64).

Conclusions: We found how care is provided and shared between specialist and primary care physicians had a strong influence on the quality of care delivered.

Background

Patients with chronic disease often see more than one physician for their care. Those with single conditions who receive care from specialist physicians typically have improved disease-specific outcomes(1). The proportion of patients with chronic disease with single conditions and those who are treated exclusively by a specialist is low(2,3), however, these patients are less likely to have needs outside of these specialist's scope of practice met (3,4). Despite the belief that shared care by both family physicians and specialists should lead to improved condition-specific and more general outcomes, evidence of this is lacking (5). Consensus remains, however, that sharing care may mitigate gaps from seeing either provider alone, and that a primary care foundation is required to effectively and economically balance specialist expertise (6–9).

As people with HIV on combination antiretroviral therapy (ART) are now living substantially longer, they are likely to acquire comorbidities related to aging as well as from the effects of HIV and its treatment (10–12). As with other chronic conditions, there is evidence that HIV specialists and those providers with more HIV experience provide higher quality of care as measured by HIV-specific indicators (13–15). However, there is increasing recognition that some care needed for people with HIV falls outside the scope and comfort of many HIV specialists (16–20). The literature also demonstrates that patients with chronic conditions who don't have a regular family physician are more likely to have emergency department visits and hospital admissions. As such, it is

essential that we study to what extent different patterns of care address the needs of this complex population.

Administrative data have been used to measure care for several populations in Ontario. For example, it has been used to study the relative extent to which patients with chronic conditions receive care from specialists and family physicians, as well as the quality of care provided (21,22). Building on a theoretical framework of the specialist-primary care physician interface (23), we have previously developed and characterized a typology of care for people with HIV based on actual patterns of care (24). We delineated the following care models: exclusively primary care, shared care with the family physician being the dominant HIV physician, shared care with the HIV specialist being the dominant HIV physician, exclusively specialist care, and low engagement. We found that most HIV patients were linked to a usual family physician, and few saw exclusively HIV specialists.

Most existing literature exploring outcomes for specialist versus generalist care has used a dichotomous approach, ignoring the reality that many patients with chronic disease require care from more than one physician to meet their varied needs. Furthermore, the lack of standardization of provider terminology in the HIV literature has complicated delineation of which physicians are currently providing care (25). For example, studies describe 'HIV primary care' regardless of the specialty of the physician. Our typology overcomes these issues by using a continuum of shared care provided by physician specialty. The main objective of this study is to assess the delivery of care as described

by this typology, in particular, to examine differences in health services delivery and adherence to primary care indicators among the main typology models. This evaluative approach allows for adjustment of factors known to affect the receipt of primary care services, including patient demographic and clinical characteristics, as well as the intensity of outpatient visits.

Methods

Data sources:

We used the administrative databases at the Institute for Clinical Evaluative Sciences (ICES) for this cross-sectional study. These databases are made available to accredited researchers through a data sharing agreement with the Ontario Ministry of Health and Long Term Care. These individual level-data are linked using a coded identification number in accordance with the provincial Personal Health Information Protection Act. The databases used include the Registered Persons Database, which includes mortality and demographic data for all residents eligible for provincial health care, the Ontario Health Insurance Program (OHIP) billing claims system, which contains 95% of physician services conducted in the province; the Discharge Abstract Database which captures all provincial hospital discharge data, the National Ambulatory Care Reporting System, which contains information on visits to emergency departments; Citizen and Immigration Canada data, which contains information on individuals granted permanent residency in Canada; the Client Agency Program Enrolment registry, which tracks patient enrolment to individual family physicians; the ICES Physician Database, which comprises

information from the Ontario Health Insurance Plan (OHIP) Corporate Provider Database (CPDB), the Ontario Physician Human Resource Data Centre (OPHRDC) database and the OHIP database of physician billings regarding physician demographics, training, and practice setting; and the Ontario Drug Benefits, claims database of prescriptions to individuals covered by the public system (those aged 65 and older and those receiving social assistance (Ontario Works, Ontario Disability Support Program, or the subsidized Trillium program)).

Eligible population:

We identified eligible individuals in Ontario from the Registered Persons Database. Using OHIP billing claims, we applied a previously-validated algorithm to people 18 years of age and older and living in Ontario between April 1, 1992 and March 31, 2012 (26). The algorithm has a sensitivity of 96.2% (95% CI 95.2% - 97.9%) and specificity of 99.6% (95% CI 99.1% - 99.8%) for identifying people with HIV and receiving care in Ontario. We excluded patients with an invalid or out-of-province residence on July 1, 2009 (n=277). As physicians in community health centres (CHCs) do not provide billing to OHIP, we excluded those patients within our cohort who were known to be receiving care in CHCs between 2008-2010 (n=17) (27). Furthermore, we excluded patients who died during the 3-year study period (n=510) to avoid misclassifying their typology of care based on censored visit pattern data.

Assignment of patients to a typology category:

We used the OHIP database to identify all outpatient health care visits made by cohort patients between April 1, 2009 and March 31, 2012. We then used a previously reported and validated approach to assign patients to one of 5 typology models (Text box 1) (24): exclusively primary care, family physician dominant co-management, specialist dominant co-management, exclusively specialist care, and low engagement. Briefly, patients were assigned based on their outpatient health care visits, including the specialty of the physician seen (primary care or HIV specialist) and their billing codes submitted (HIV related or not) for the study period of April 1, 2009 to March 31, 2012 (Figure 1). Patients were assigned to a usual provider of primary care if they were contractually rostered to a family physician, or if they had at least 50% of their primary care services provided by one individual family physician. In contrast to the United States, internal medicine specialists in Canada are primarily consultant physicians, and do not routinely provide ongoing primary care, thus both infectious disease and internal medicine specialists are included as HIV specialists in our models.

Text box 1: Typology of specialist-primary care physician interface

Primary care dominant models	<p>1. Exclusively primary care – patient is assigned to a regular family physician who provides most care, no infectious disease or internal medicine physician provides any HIV care</p>
	<p>2. Family physician dominant co-management – patient is assigned to a regular family physician who provides the majority (50% or more) of</p>

	HIV-related care, specialist physician provides some HIV care
Specialist dominant models	<p>3. Specialist dominant co-management – patient is assigned to a regular family physician, but specialist physician provides the majority (50% or more) of HIV-related care</p> <p>4. Specialist care only – patient is not assigned to a regular family physician, specialist physician provides all HIV-related care</p>
	5. Low engagement – patient is not assigned to a regular family physician and has no specialist physician providing HIV care

Patient characteristics:

Patient age, sex and postal code on April 1, 2009 were obtained from the RPDB. We used postal codes at the neighborhood level linked to 2006 Statistics Canada census data to assign income quintiles and rurality scores. Rurality was assigned categorically into major urban areas (score 0 to 9), non-major urban areas (10 to 39), and rural areas (40 or higher) according to the Rurality Index of Ontario(28).

We used data from Citizenship and Immigration Canada to identify recent immigrants as well as immigrants from HIV-endemic regions of Africa and the Caribbean. This group

represents a growing proportion of new and prevalent HIV infections in Canada, is often demographically different from other groups, and has health outcomes that differ from other groups living with HIV (29–32).

We used the Ontario Drug Benefits claims database to identify individuals who were eligible for public drug coverage.

The Johns Hopkins Adjusted Clinical Group System was used to ascertain comorbidity by assigning patients to up to 32 distinct Aggregated Diagnosis Groups (ADGs) (33). We assigned patients to low (<5 ADGs), medium (6-9 ADGs) and high (≥ 10 ADGs) comorbidity categories (33,34). People with mental health conditions between April 1, 2007 and April 1, 2009 were broadly captured using an algorithm previously validated to identify people receiving mental health services in the primary care setting (35).

We used OHIP billing claims to identify the number of outpatient visits patients made to the family physicians and HIV specialists to whom they were assigned during the study period.

Physician specialty:

We obtained information about self-designated physician specialty for fiscal year 2009 from the ICES Physician Database.

Outcome measures:

Outcomes were selected using pre-selected indicators of health services delivery and technical quality of primary care using administrative data in the primary care setting (36). Quality of primary care outcomes (cancer screening) included: adherence to colorectal cancer screening (ascertained as one screening test (fecal occult blood or colonoscopy) over 2 years for eligible individuals 50 – 74 years), adherence to breast cancer screening (ascertained as one mammography test over 2 years for eligible women aged 50-69 years), and adherence to cervical cancer screening (ascertained as one cervical screening test over 2 years in eligible women 21-69 years). Health service utilization outcomes were measured over the latter 18 months of the 3-year study period (October 1, 2010 to March 31, 2012) and included: any emergency department visits, any low acuity emergency department visits, any hospital admissions (excluding maternity and same day surgery), and any HIV specific hospitalizations. Finally, one HIV-specific outcome, the receipt of any ART prescription among those eligible for Ontario drug benefits, was included.

Statistical analysis:

Descriptive statistics were generated to compare patient demographic and clinical characteristics among the five typologies. Summary measures of the outcome measures (frequencies and proportions) were calculated for patients in each of the typologies.

We conducted multivariable hierarchical logistic regression analyses to examine the association between typology category and quality of care outcomes. We excluded patients in the low engagement category from this analysis, because their health care utilization and outcome patterns differed significantly from the other models. Family physicians and HIV specialists were modeled as random effects, where possible, to account for clustering of patients by providers. Typology category, modeled as a four-level categorical variable, was entered as the main effect of interest. We estimated both unadjusted and adjusted odds ratios for typology, together with 95% confidence intervals. We adjusted for the following patient covariates: age, sex, neighborhood income quintile, rurality, immigrant status, comorbidity, mental health comorbidity, as well as the number of outpatient visits. The method of pseudo-likelihood estimation was used to estimate the models. If a model adjusting for the two sources of clustering failed to converge, we specified only the family physician as a random effect. All statistical analyses used the SAS procedure GENMOD using SAS version 9.3 (SAS Institute, Cary, North Carolina).

Ethics approval

This study was approved by the Ottawa Hospital and Sunnybrook Health Sciences Centre Research Ethics Boards.

Results

A total of 13,480 individuals were eligible for our study on April 1, 2009 and were assigned to typology categories as described in Figure 1. The characteristics of HIV patients differed among the care models, as shown in Table 1. Both specialist dominant models (exclusively specialist care and specialist dominant co-management) had the highest proportions of female patients, those in younger age categories, those living in the lowest income neighborhoods and non-major urban settings, and non-Canadian born patients, in particular those originating from Africa and the Caribbean. The family physician dominant co-management model had the highest proportion of patients in the highest comorbidity category.

Prevalence of outcomes varied by patients among typology models (Table 2). Patients in exclusively specialist care the lowest observed proportions of all cancer screening maneuvers. Models with two providers (both family physician and HIV specialist) had the highest observed proportion of having an emergency department visit. Observed proportions of patients with any low acuity emergency department visit, hospital admission, and HIV-specific hospital admission were lowest among patients in exclusively primary care. The observed proportion of patients prescribed ART when eligible for public drug coverage were lowest among patients in exclusively primary care. Patients in low engagement primary care had uniformly poor quality of care on all measures, and were not compared to other care delivery models in further analyses.

Figure 2 summarizes the results of the hierarchical logistic regression analyses of all outcomes, adjusted for patient-level characteristics. The adjusted odds ratios for each typology category versus the reference category (exclusively specialist care) are displayed, together with 95% confidence intervals. Compared to those in exclusively specialist care, patients in all other typology categories had higher odds of adherence to preventative care maneuvers (colorectal cancer screening, cervical cancer screening, and mammography), although not all findings were statistically significant (colorectal cancer screening, exclusively primary care adjusted odds ratio (AOR) = 3.12, 95% confidence interval (CI) (1.90 to 5.13), family physician dominant co-management AOR = 3.39, 95% CI (1.94 to 5.93), specialist dominant co-management AOR = 2.01, 95% CI (1.23 to 3.26)).

There were no significant differences in the odds of any emergency department visit and any low-triage emergency department, but the odds of any hospital admission (AOR = 0.23, 95% CI (0.14 to 0.35)) and any HIV-specific hospital admission were significantly lower among patients in exclusively primary care (AOR = 0.15, 95% CI (0.12 to 0.21)).

The odds of receiving ART were significantly lower in the exclusively primary care and family physician dominant co-management (exclusively primary care AOR = 0.15, 95% CI (0.12 to 0.21), family physician dominant co-management AOR = 0.45, 95% CI (0.32 to 0.64), specialist dominant co-management AOR = 0.84, 95% CI (0.63 to 1.13)).

Discussion

Health care should evolve to meet the needs of people living with HIV as they increasingly age and become a more diverse population. Quality care is influenced by many patient, provider and system factors. Of factors that influenced care in our study, we found by far the most important influence on care was how care is provided and shared between specialist and primary care physicians. We found that people with HIV with more family physician care received better prevention and had lower odds of hospital admissions. In fact, patients in exclusively specialist care had colorectal cancer screening rates half that of those in primary care dominant models. Those with more HIV specialist care received better disease-specific care (both diabetes care and, importantly, antiretroviral therapy). Those identified as having low engagement in care, that is, no identified usual primary care provider and no HIV specialist, had very poor care. These findings highlight that there is no one current model of health care delivery for patients with HIV. However, it does confirm on a population level the need for both specialist and primary care expertise to cover the broad range of care needs for this increasingly complex population.

People with HIV are known to have lower rates of disease screening than their non-HIV counterparts (20,37). Compared with specialty care, primary care leads to better health promotion and disease prevention, even in areas of high inequality (9). As such, we accurately anticipated that patients in models that include a usual family physician would be more likely to have recommended prevention maneuvers, and that this would be most pronounced for models in which the family physician provided the majority of

care. This is consistent with some (17) but not all (38) research comparing prevention interventions between generalists and specialists for HIV patients, and as such we were surprised by the magnitude of this difference. In our study, improved prevention likely arises in part due to continuity of care with a prevention-oriented provider (39,40) who can adhere to prevention recommendations within their own clinical setting (41).

We found that HIV patients in models in which HIV care is provided predominantly by family physicians were less likely to receive prescriptions for ART. It is possible that there are differences in the patient characteristics pertaining to HIV stage or ODB eligibility that are not captured within our data. However, despite recent work demonstrating similar ART prescribing between generalists and specialists (42), it is most likely that this finding supports previous extensive literature demonstrating that specialist care is closely linked to adequate antiretroviral treatment (13,15).

People with chronic conditions who don't have a regular medical doctor have been shown to be more likely to have emergency department visits and hospital admissions (22,40,43). Surprisingly, we failed to observe significant differences in the frequency of emergency department visits (including low-acuity visits), although patients in exclusively specialist care were more likely to have had a hospital admission (including HIV-specific admissions). Inappropriate emergency department use among HIV patients has been previously attributed to both generalist care and to having multiple clinicians (44,45), but we saw no influence of these features on emergency department usage.

People with HIV in Ontario have higher rates of hospitalization than those in the general population, with rates higher among those of lower socioeconomic status(46). Thus our findings may reflect changes in HIV care and treatment over time, or may be affected by unmeasured indicators of disadvantage, such as HIV disease stage (47), housing status, or employment (48).

While this typology provides one theoretically-grounded and intuitive way to describe and measure how care is delivered, the delivery of primary care is complex. Thus, it is possible that the differences found (and not found) between typology models are influenced by organizational, practice and community factors that are not measured by an administrative definition of shared care (49). For example, quality of HIV care has been shown to be improved through case management, multidisciplinary and group practices, extended hours, decision support and clinical information systems, and collocation of clinic activity (13,41,44,50). In addition, extensive work has shown that physician experience has a strong impact on HIV specific-outcomes (13–15), whereas our study focused on the impact of physician specialization.

There are additional limitations to our work. While we used validated measures of comorbidity burden, there are measures of HIV-specific morbidity, such as CD4 counts and time since diagnosis, that are unmeasured in this study. Increased HIV severity may have led to less focus on preventative care and resultant higher hospitalizations among those in exclusively specialist care. Second, we were unable to measure care delivered

outside of the provincial health insurance plan, such as in community health centres (where about 1% of the Ontario population receives primary care (27)), and to those federally insured such as refugee claimants and some Aboriginal populations. Third, it is possible that a small proportion of patients switched physicians or models of care during the 3-year study period (51). Fourth ART prescribing only represents receipt of one prescription over 18 months and may not reflect actual medication adherence. Fifth, it is possible that residual confounding, such as by income or immigration, could have influenced these results. Finally, while our study provides insight into how patterns of care delivery influence general and disease-specific outcomes for people with HIV, it does not provide information regarding the quality of interaction between providers associated with improved patient outcomes (52) or measures of patient satisfaction associated with different care models (53).

This study found that a theoretically-based typology of how care is delivered had a strong relationship with the quality of care provided for people with HIV, even after adjustment for important patient characteristics such neighborhood income, rurality and number of comorbidities. This work confirms on a population level that neither exclusively primary care nor exclusively specialist care provide adequate comprehensive care for people living with HIV. Further work is required to understand how best to integrate specialist and primary care, and to evaluate how this typology relates to actual coordination between providers and patient satisfaction with care.

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Table 1: Patient characteristics among typology models

Patient characteristics	Exclusively primary care N=6,094	Family physician dominant co-management N=1,349	Specialist dominant co-management N=4,118	Exclusively specialist care N=707	Low engagement N=1,149
Male sex	5,128 (84.1%)	1,194 (88.5%)	3,013 (73.2%)	525 (74.3%)	959 (83.5%)
Age category (years)					
18-35	1,064 (17.5%)	169 (12.5%)	753 (18.3%)	161 (22.8%)	166 (14.4%)
36-49	3,265 (53.6%)	705 (52.3%)	2,136 (51.9%)	387 (54.7%)	617 (53.7%)
50-65	1,523 (25.0%)	439 (32.5%)	1,092 (26.5%)	149 (21.1%)	317 (27.6%)
>65	242 (4.0%)	36 (2.7%)	137 (3.3%)	10 (1.4%)	49 (4.3%)
Neighbourhood income quintile					
Quintile 1 (lowest)	1,623 (26.6%)	430 (31.9%)	1,538 (37.3%)	288 (40.7%)	373 (32.5%)
Quintile 2	1,236 (20.3%)	248 (18.4%)	881 (21.4%)	156 (22.1%)	218 (19.0%)
Quintile 3	1,025 (16.8%)	220 (16.3%)	638 (15.5%)	92 (13.0%)	206 (17.9%)
Quintile 4	1,024 (16.8%)	193 (14.3%)	526 (12.8%)	93 (13.2%)	174 (15.1%)
Quintile 5 (highest)	1,129 (18.5%)	238 (17.6%)	510 (12.4%)	75 (10.6%)	159 (13.8%)
Missing	57 (0.9%)	20 (1.5%)	25 (0.6%)	<=5	19 (1.7%)
Rurality index					
Major urban	5,553 (91.1%)	1,263 (93.6%)	3,596 (87.3%)	617 (87.3%)	1,030 (89.6%)
Non-major Urban	450 (7.4%)	61 (4.5%)	409 (9.9%)	73 (10.3%)	86 (7.5%)
Rural	80 (1.3%)	20 (1.5%)	96 (2.3%)	16 (2.3%)	30 (2.6%)
Missing	11 (0.2%)	<=5	17 (0.4%)	<=5	<=5
Immigrant Status					
Canadian Born	5,145 (84.4%)	1,144 (84.8%)	3,009 (73.1%)	505 (71.4%)	968 (84.2%)
Immigrant from Africa or Caribbean	413 (6.8%)	108 (8.0%)	718 (17.4%)	153 (21.6%)	90 (7.8%)

Immigrant from Europe and Western Nations	132 (2.2%)	22 (1.6%)	75 (1.8%)	13 (1.8%)	36 (3.1%)
Immigrant from other nations	404 (6.6%)	70 (5.2%)	315 (7.6%)	36 (5.1%)	
Mental health condition	2,384 (39.1%)	675 (50.0%)	1,688 (41.0%)	216 (30.6%)	160 (13.9%)
Number of ADGs*					
High	1,167 (19.1%)	496 (36.8%)	1,121 (27.2%)	145 (20.5%)	76 (6.6%)
Medium	1,968 (32.3%)	502 (37.2%)	1,547 (37.6%)	166 (23.5%)	66 (5.7%)
Low	2,959 (48.6%)	351 (26.0%)	1,450 (35.2%)	396 (56.0%)	1,007 (87.6%)

*aggregated diagnosis groups

Table 2: Prevalence of quality indicators among typology models

Prevalence of quality indicator (N reflects number eligible for outcome)	Exclusively primary care N=6,094	Family physician dominant co-management N=1,349	Specialist dominant co-management N=4,118	Exclusively specialist care N=707	Low engagement N=1,149
<i>Technical quality of primary care outcomes</i>					
Colorectal cancer screening (N=2,829)	478 (42.2%)	125 (48.1%)	306 (33.1%)	24 (16.2%)	12 (3.3%)
Cervical cancer screening (N=2,323)	421 (50.9%)	66 (45.8%)	464 (46.0%)	57 (33.7%)	33 (18.9%)
Mammography (N=591)	139 (55.4%)	26 (63.4%)	112 (48.7%)	10 (32.3%)	4 (10.5%)
<i>Health services delivery outcomes</i>					
Any emergency department visits	1,815 (29.8%)	483 (35.8%)	1,452 (35.3%)	221 (31.3%)	122 (10.6%)
Any low acuity emergency department visits	876 (14.4%)	233 (17.3%)	714 (17.3%)	119 (16.8%)	70 (6.1%)
Any hospital admissions	470 (7.7%)	226 (16.8%)	479 (11.6%)	82 (11.6%)	33 (2.9%)
Any HIV-specific hospital admissions	57 (0.9%)	76 (5.6%)	121 (2.9%)	25 (3.5%)	<=5
Number of specialist types seen >=2	3,630 (59.6%)	1,024 (75.9%)	2,712 (65.9%)	395 (55.9%)	150 (13.1%)
<i>HIV-specific outcome</i>					
Any receipt of ART among ODB* eligible patients(N=8,302)	2,271 (66.1%)	866 (85.7%)	2,683 (86.6%)	467 (87.3%)	72 (32.3%)

* OBB = Ontario Drug Benefits

Figure 1: Flow diagram of study participants and typology assignments

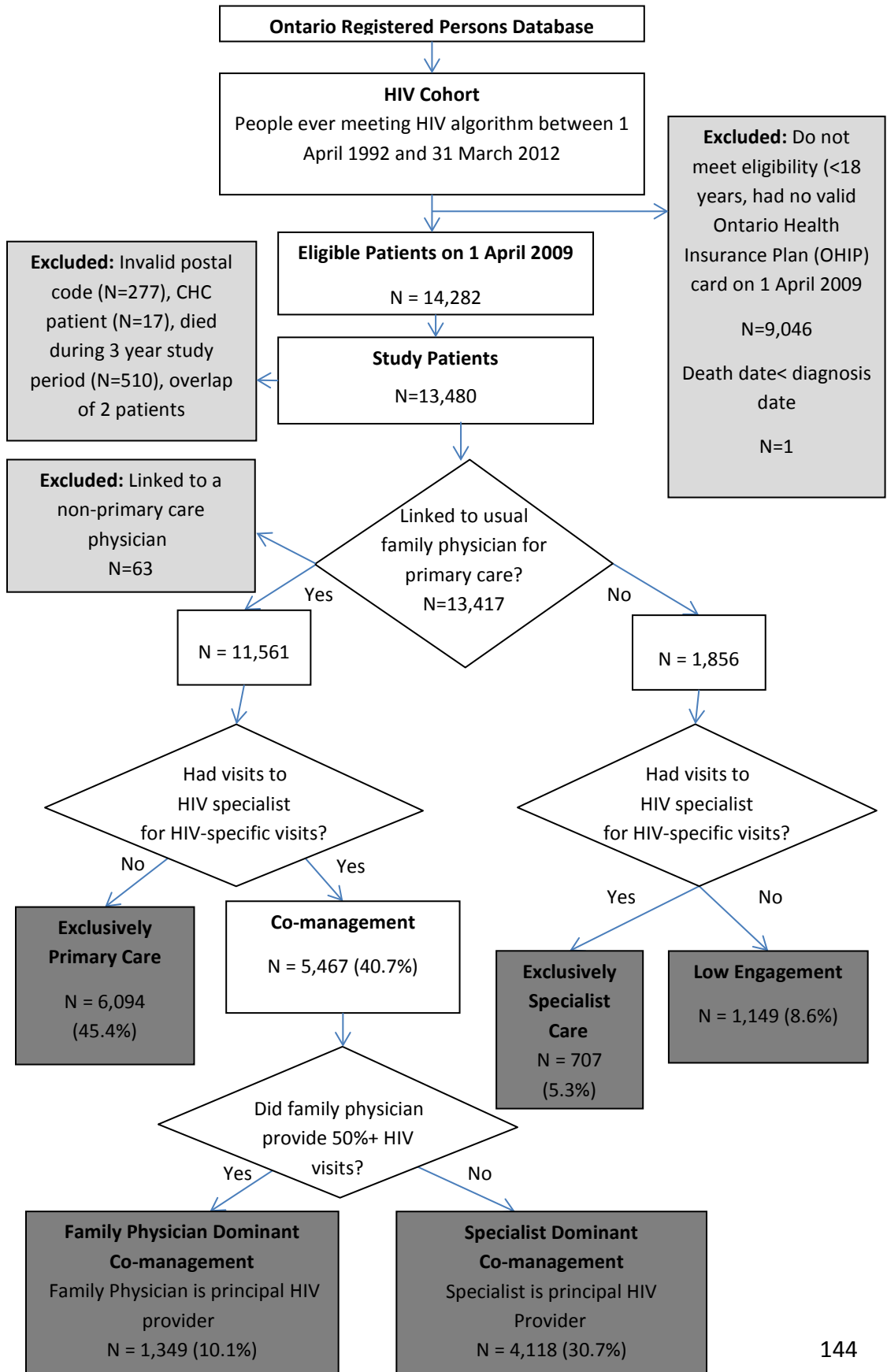
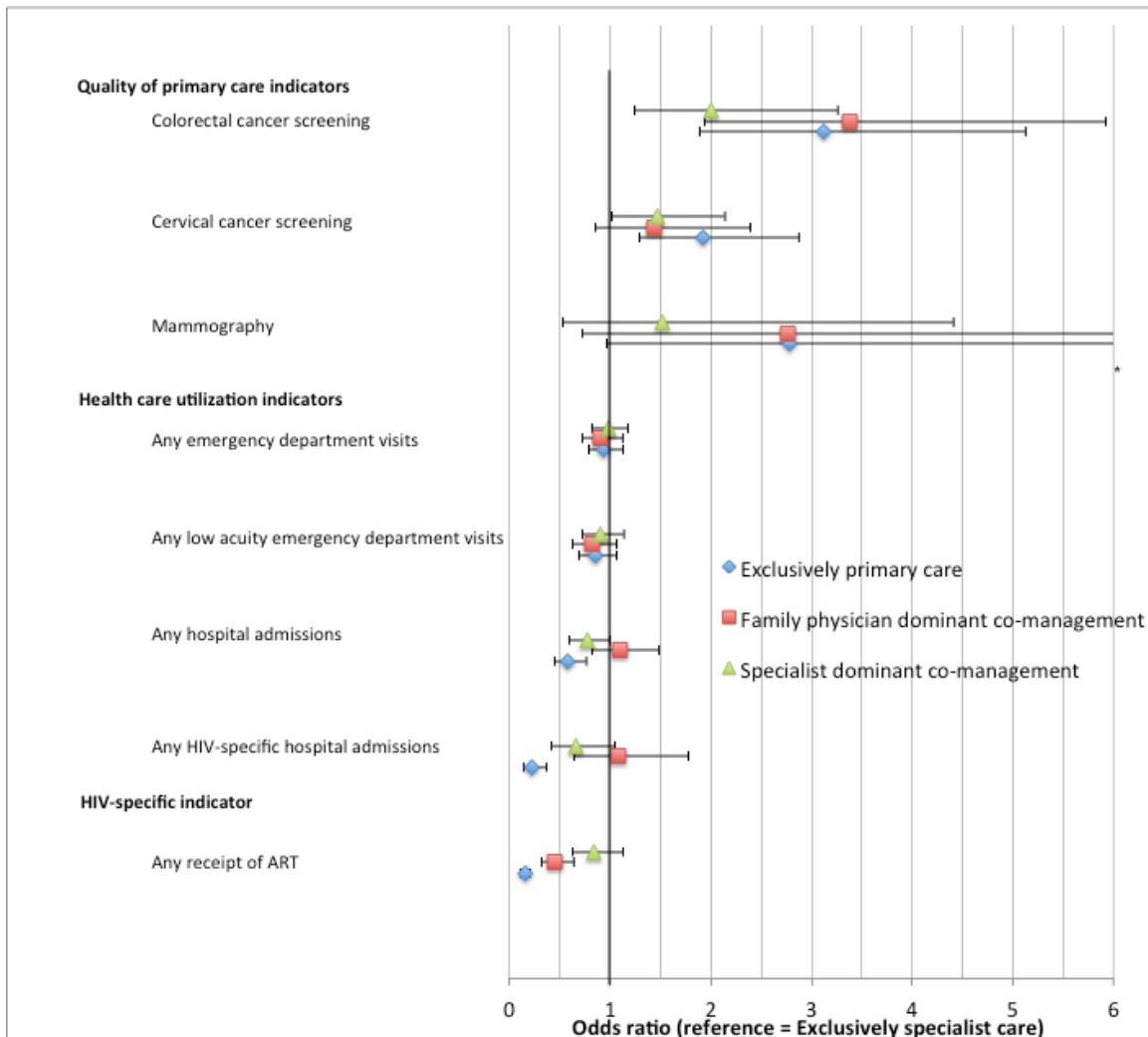


Figure 2: Hierarchical logistic regression analyses of study outcomes by typology category (Odds ratios (95% confidence intervals)) (reference = exclusively specialist care)



Models accounting for one source of clustering (family physician): any emergency department visits, any low acuity emergency department visit, any hospital admission, any HIV-specific hospital admission, any receipt of ART

Models accounting for two sources of clustering (family physician and HIV specialist): colorectal cancer screening, cervical cancer screening, mammography, diabetes eye exam

All models adjusted for patient covariates and number of visits during study period

*upper confidence limits of mammography truncated

Chapter 5

A population-based study evaluating the impact of family physician HIV experience on the delivery of care for people living with HIV in Ontario

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Abstract

Background: Provider HIV experience has been associated with improved HIV-specific outcomes. The objective of this study is to evaluate whether the HIV experience of a family physician modifies the association between model of care delivery and the quality of care for people living with HIV.

Methods: This is a retrospective population-based observational study from 1 April 2009 to 31 March 2012. 13,417 patients with HIV in Ontario were assigned to one of 5 possible patterns of care. We used multivariable hierarchical logistic regression analyses, adjusted for patient characteristics and pairwise comparisons, to evaluate the modification of the association between care model and quality of care (cancer screening, receipt of antiretroviral therapy (ART), and health care utilization) by level of physician HIV experience (≤ 5 , 6-49, 50+ patients).

Results: Most HIV patients (52.8%) saw exclusively family physicians for their care. Among patients seeing exclusively family physicians for their care, receipt of ART was significantly lower among those receiving care from family physicians with ≤ 5 patients and 6-49 patients compared to those with 50+ patients (mean levels of adherence (95% confidence interval (CI)) = 0.34 (0.30-0.39) and 0.40 (0.34-0.45), respectively, versus 0.77 (0.74-0.80)). Receipt of prevention maneuvers and health care utilization was unrelated to family physician HIV experience.

Conclusions: Family physician HIV experience was strongly associated with receipt of ART by HIV patients, especially among those seeing only family physicians for their care. Future work must determine the best models for integrating and delivering comprehensive HIV care among diverse populations and settings.

Introduction

Access and adherence to antiretroviral therapy (ART) has substantially reduced the mortality and morbidity arising from HIV infection. There is evidence that providers with more HIV training and/or HIV experience provide higher quality of care as measured by disease-specific indicators, including ART prescribing (1–6). However, many of these studies were performed early in the ART era, when both disease and treatments were novel and complex. Recent work has found similar quality of HIV-specific care between generalist and specialist physicians, although the HIV experience of these physicians varied(7,8). In addition, multidisciplinary care teams with non-expert family physicians may improve patients' ART adherence more than models with HIV specialists alone(9).

Furthermore, specialist HIV physicians are less adept than generalists at preventing and managing the common comorbidities emerging with increased HIV longevity (10–18). HIV patients who see primary care physicians with adequate experience (5 or more HIV patients), either alone or in shared care with specialists, report higher satisfaction than those seeing specialists alone(19). There is increasing recognition that the management of HIV requires a primary care presence but we have a poor understanding of how to integrate HIV-specific expertise within a primary care context (7,10,14–21). Overall, it has been difficult to distinguish the respective contributions of physician qualification and physician experience of care on the effectiveness of HIV care(3).

Using routinely collected administrative data, we have previously described the outpatient physician visits by HIV patients in Ontario, Canada. Building on a theoretical framework of the specialist-primary care interface(22), we have previously developed and characterized an intuitive typology of shared care for people with HIV based on actual patterns of care(23). We found that most HIV patients were linked to a usual family physician, and few saw exclusively HIV specialists. We further found that how

care was delivered had a strong impact on the quality of care provided, with models with primary care providers having better adherence to prevention maneuvers and fewer hospitalizations, and models with specialists having better adherence to ART prescribing (24).

The objective of this study is to explore whether the HIV experience of the family physician modifies the association between model of care delivery and the quality of care for people living with HIV. We hypothesized that the associations with outcomes requiring HIV expertise, such as ART prescribing, would be modified by the HIV experience of the family physician, but that routine primary care activities such as cancer screening would not.

Methods

Data sources:

We used the administrative databases held at the Institute for Clinical Evaluative Sciences (ICES) for this study. These databases are made available to accredited researchers through a data sharing agreement with the Ontario Ministry of Health and Long Term Care. These datasets were linked using unique, encoded identifiers and analyzed at ICES. The databases used include the Registered Persons Database, which includes demographic and mortality data for all residents eligible for provincial health care; 2006 Statistics Canada census data to link postal code of residence to attribute the household income quintile, as a proxy for socioeconomic status; the Ontario Health Insurance Program (OHIP) billing claims system, which contains 95% of physician services conducted in the province; the Discharge Abstract Database which captures all provincial hospital admission discharge data; the National Ambulatory Care Reporting System, which contains information on emergency department visits; Citizen and Immigration Canada data, which contains information on individuals granted permanent residency in Canada; the Client Agency Program Enrolment registry, which tracks patient

enrolment to individual family physicians; the ICES Physician Database, which is derived from the OHIP Corporate Provider Database, the Ontario Physician Human Resources Data Centre database and the OHIP database of physician billings, and which contains information on physician demographics, training, and practice setting; and the Ontario Drug Benefits, a claims database of prescriptions to individuals covered by the public system including those aged 65 and older and those receiving social assistance (Ontario Works, Ontario Disability Support Program), or eligible for the subsidized catastrophic access Trillium program.

Eligible population:

We identified eligible individuals in Ontario from the Registered Persons Database. Using OHIP billing claims, we applied a previously validated algorithm to people 18 years of age and older and living in Ontario between April 1, 1992 and March 31, 2012 with a sensitivity of 96.2% (95% CI 95.2% - 97.9%) and specificity 99.6% (95% CI 99.1% - 99.8%) for identifying people with HIV and receiving care in Ontario (25). We excluded patients with an invalid or out-of-province residence on July 1, 2009 (n=277). We excluded those patients within our cohort who were known to be receiving care in community health centres (CHCs) between 2008-2010 (n=17), as physicians in CHCs are salaried and do not submit billing to OHIP (26). Furthermore, to avoid misclassifying their typology category based on censored visit pattern data, we excluded patients who died during the 3-year study period (n=510).

Assignment of patients to a typology category:

We used the OHIP database to identify all outpatient physician visits made by HIV cohort patients between April 1, 2009 and March 31, 2012. We then used a previously reported approach to assign patients to one of 3 typology models in which patients had a usual family physician(23): exclusively primary care, family physician dominant co-management (family physician has the most visits for HIV care), specialist dominant co-management (HIV specialist has the most visits for HIV care). Briefly, physician specialty

was categorized into four groups: as “Family Medicine” (comprising the specialties of family medicine, family medicine/emergency medicine, general practice or community medicine, all of whom may be licensed to practice family medicine/general practice in Ontario), “Internal Medicine”, “Infectious Diseases” or “Other”. In contrast to the United States, where internal medicine specialists may act as primary care providers, Canadian internal medicine specialists are primarily consultant physicians. Physicians were deemed to be an HIV specialist if they were infectious disease or internal medicine specialists who had HIV-specific outpatient billing claims to patients in our HIV cohort. Patients were then assigned based on their visit data, including the specialty of the physician seen (family physician or HIV specialist) and the billing codes submitted (HIV-related (ICD-9 diagnosis code for visit was 042, 043, or 044) or non-HIV related) (Figure 1).

Patient characteristics:

Patient age, sex and postal code on April 1, 2009 were obtained from the Registered Persons Database. We used neighborhood-level postal codes linked to 2006 Statistics Canada census data to assign income quintiles and rurality scores. Rurality score was assigned categorically into major urban areas (score 0 to 9), non-major urban areas (10 to 39), and rural areas (40 or higher)(27). We used data from Citizenship and Immigration Canada to categorize patient immigration status as follows: Canadian born, immigrant from Western nations, immigrant from Africa or the Caribbean, and immigrant from other country. Immigrants from the HIV-endemic regions of Africa and the Caribbean were subcategorized here as they represent a growing proportion of new and prevalent HIV infections in Canada, are often demographically different from other groups, and whose health outcomes vary from others living with HIV(28–32).

The Johns Hopkins Adjusted Clinical Group System was used to ascertain comorbidity by assigning patients to up to 32 distinct Aggregated Diagnosis Groups (ADGs), and categorized the number of ADGs into low (<5 ADGs), medium (6-9 ADGs) and high (>=10

ADGs) (33,34). People with mental health conditions between April 1, 2007 and April 1, 2009 were broadly captured by using an algorithm previously validated to identify people receiving mental health services in the primary care setting(35). We used the Ontario Drug Benefits claims database to identify individuals who were eligible for public drug coverage and those who had actual claims during the study period.

Family physician HIV experience:

We used the number of unique patients in the HIV cohort that a physician billed for at least once during the 3-year study period to determine the physician's HIV experience, categorized as low (≤ 5 patients), medium (6-49 patients), or high-expertise (≥ 50 patients), as 6-49 patients is a HIV volume threshold that may lead to improved care and decreased mortality(2).

Outcome measures:

Our primary outcome of interest was the receipt of any ART prescription among those eligible for Ontario drug benefits. Secondary outcomes included preventative care: adherence to colorectal cancer screening (ascertained as one test over 2 years for individuals 50 – 74 years), adherence to breast cancer screening (ascertained as one mammography test over 2 years for women aged 50-69 years), and adherence to cervical cancer screening (ascertained as one cervical screening test over 2 years in women 21-69 years); and health service utilization outcomes: any emergency department visit over the latter 18 months of the 3-year study period (October 1, 2010 to March 31, 2012), and any hospital admissions (excluding maternity and same day surgery) (36).

Statistical analysis:

Descriptive statistics were generated to compare patient characteristics among the three family physician HIV experience categories for patients in Exclusively primary care typology category. Summary measures of outcomes were calculated for patients in each

physician experience category. As per ICES privacy requirements, cell sizes of 5 or fewer individuals are not reported.

We conducted multivariable hierarchical logistic regression analyses to examine the hypothesized associations with each quality outcome. We included main effects for typology category and family physician HIV experience (modeled as a three-level categorical variable), as well as the interaction between typology category and family physician HIV experience. We adjusted for patient characteristics: age, sex, neighborhood income quintile, rurality category, immigrant status category, comorbidity (ADG category), and presence of mental health comorbidity) as fixed covariates in the model. We accounted for clustering by family physician using random effects. For each model, we determined the adjusted odds ratios and obtained the predicted (least square) mean levels for each level of experience and within each typology category, together with 95% confidence intervals. Pairwise comparisons were conducted within each typology category using the Tukey-Kramer adjustment for multiplicity. An overall level of significance of 5% was used. All statistical analyses were conducted using SAS version 9.3 (SAS Institute, Cary, North Carolina).

Ethics approval

This study was approved by the Ottawa Hospital and Sunnybrook Health Sciences Centre Research Ethics Boards.

Results

There were 13,480 individuals eligible for our study on April 1, 2009 and were assigned to typology categories as described in Figure 1. The comparison of patient characteristics across typology categories has been described previously⁽³⁷⁾. Briefly, compared to other models, specialist dominant co-management had the highest

proportions of female patients, patients from low income neighborhoods and non-urban settings, and the highest proportions of non-Canadian born patients, in particular those with countries of origin in Africa and the Caribbean.

Among HIV patients seeing only family physicians, most (70.0%) see those in the highest HIV experience category (Table 1). Patients seeing the most HIV experienced family physicians were significantly more often male, urban dwelling, with lower comorbidity, and had higher mean number of outpatient visits to their family physician during the study period. While the observed prevalence of prevention maneuvers (colorectal, cervical and breast cancer screening) varied among the experience levels, patients of family physicians with the highest level of experience had by far the highest observed prevalence of receipt of ART among eligible patients, as well as the lowest observed prevalence of any emergency department visit, and any hospital admission.

Table 2 presents the p-values for the covariates from the hierarchical logistic regression analyses for each study outcome (main effects for typology, HIV experience and the interaction term, as well as patient-level covariates). After adjustment, typology category, family physician HIV experience, and their interaction term were significantly associated with receipt of ART. Typology category was also associated with receipt of colorectal cancer screening and any hospital admission, but family physician HIV experience and the interaction term of typology and family physician HIV experience were not significantly associated with any secondary outcomes.

Table 3 presents the model based least square mean estimates of adherence from the hierarchical logistic regression analyses together with 95% confidence intervals, After adjustment for multiplicity, no pairwise comparisons were significant except for among patients in exclusively primary care, where receipt of ART was significantly lower among those receiving care from family physicians with ≤ 5 patients and 6-49 patients compared to those with 50+ patients (mean levels of adherence (95% confidence

interval (CI) = 0.34 (0.30-0.39) and 0.40 (0.34-0.45), respectively, versus 0.77 (0.74-0.80)). There were no statistically significant pairwise differences in receipt of ART by family physician experience within the other typology categories, nor within typology categories for other outcomes. Figure 2 presents the model-based estimates of adherence to ART prescribing, stratified by family physician HIV experience category.

In our population-based and publicly funded system, we found that both the typology of care (who provides care) as well as HIV-specific experience of physicians are important, and that the HIV experience modifies the association between typology of care and quality of care outcomes for HIV related care. In particular, we found that family physician HIV experience was strongly associated with receipt of ART by HIV patients, especially among those seeing only family physicians for their care; those seeing a family physician with the highest level of HIV experience were almost twice as likely to receive ART than HIV patients seeing family physicians with less HIV experience. Preventative care and health service utilization were not influenced by family physician HIV experience. These results help to tease out the respective impacts of physician specialty and HIV experience on ART prescribing, arguably the most important indicator of adequate HIV care.

This work is consistent with a previous systematic review demonstrating that physician HIV experience is specifically associated with improved adherence to ART prescribing(2). The high experience thresholds varied considerably among studies included in the review, but the authors concluded the minimum volumes associated with improvements in prescribing to be 15-50 patients per year. Another review was conducted by the same authors(3) attempted to distinguish physician volume from physician experience, mainly to conclude that that both training and experience are important for HIV-specific outcomes. Most of the studies in this review were

conducted early in the ART-era, and we were surprised to see the persistence of such a strong association between both specialty and experience in our study given the improved tolerability and decreased complexity of newer ART regimens. More recent work has shown that generalists with either HIV experience or formalized specialist decision support perform equally well to HIV specialists for ART management(7,21), and that having a non-expert primary care physician as part of a multidisciplinary care team leads to improved ART adherence(38). However, physicians in our study practiced in a variety of settings, and potentially reflect a more real-world experience of the various ways care is delivered to people with HIV.

We have previously demonstrated that patients in models in which specialist physicians managed the majority of HIV care had lower rates of preventative care (24). As hypothesized, in this study we found that family physician HIV experience did not influence these primary care outcomes. Cancer screening rates were overall lower than those reported in the general Ontario population(39), a trend seen in other studies comparing screening among those with and without HIV(40). Furthermore, after adjustment for patient characteristics, outcomes related to primary care access, such as emergency department visits and hospital admissions, were not influenced by family physician HIV experience.

One limitation to assessing ART prescribing using our data is its restriction to patients eligible for publicly-funded drug benefits, ascertained based on age over 65 years or receipt of any drug prescription during the study period. Eligibility may vary over time, and some patients may be eligible but never fill a prescription. Furthermore receipt of one or more ART prescriptions may not reflect actual medication adherence.

There are additional limitations to our work. First, although we used validated measures of comorbidity burden, there may be measures of HIV severity that are unmeasured in this study and contribute to residual confounding of our findings. Second, patients

seeing family physicians with higher HIV experience had slightly more visits than did those less HIV experience, which may reflect improved retention and continuity associated with improved ART prescribing. Third, care delivered outside of the provincial health insurance plan, such as in community health centres (where about 1% of the Ontario population receives primary care (26)), and to those federally insured such as refugee claimants and some Aboriginal populations, is not captured within the administrative databases we used. Finally, it is possible that organizational or practice factors known to improve HIV care, such as case management, multidisciplinary care, extended hours, decision support and clinical information systems, and collocation of required clinic services(1,12,41,42) influenced our findings.

These results have important implications. Sixteen percent of HIV patients in Ontario receive care exclusively from family physicians with lower HIV experience; our results suggest potential disparities in antiretroviral therapy among these patients. Because we also found that this influence of family physician HIV experience is mitigated by having an HIV specialist within their model of care, in order to ensure adequate ART prescribing, care delivery models for people with HIV should include either an HIV specialist or a family physician with significant HIV experience. If access to HIV expertise is limited by geography or other barriers, alternate consultative models that allow patients to obtain HIV specialist expertise. Furthermore, because we have previously demonstrated that primary care oriented models are associated with improved preventative care for people with HIV compared to HIV specialist models, we suggest that this access to HIV expertise occur within a collaborative model that allows patients to retain continuity with their family physicians in order to foster a comprehensive approach to care delivery(20,43).Future work must determine the best models for integrating and delivering comprehensive HIV care among diverse populations and settings.

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Figure 1: Flow diagram of study participants

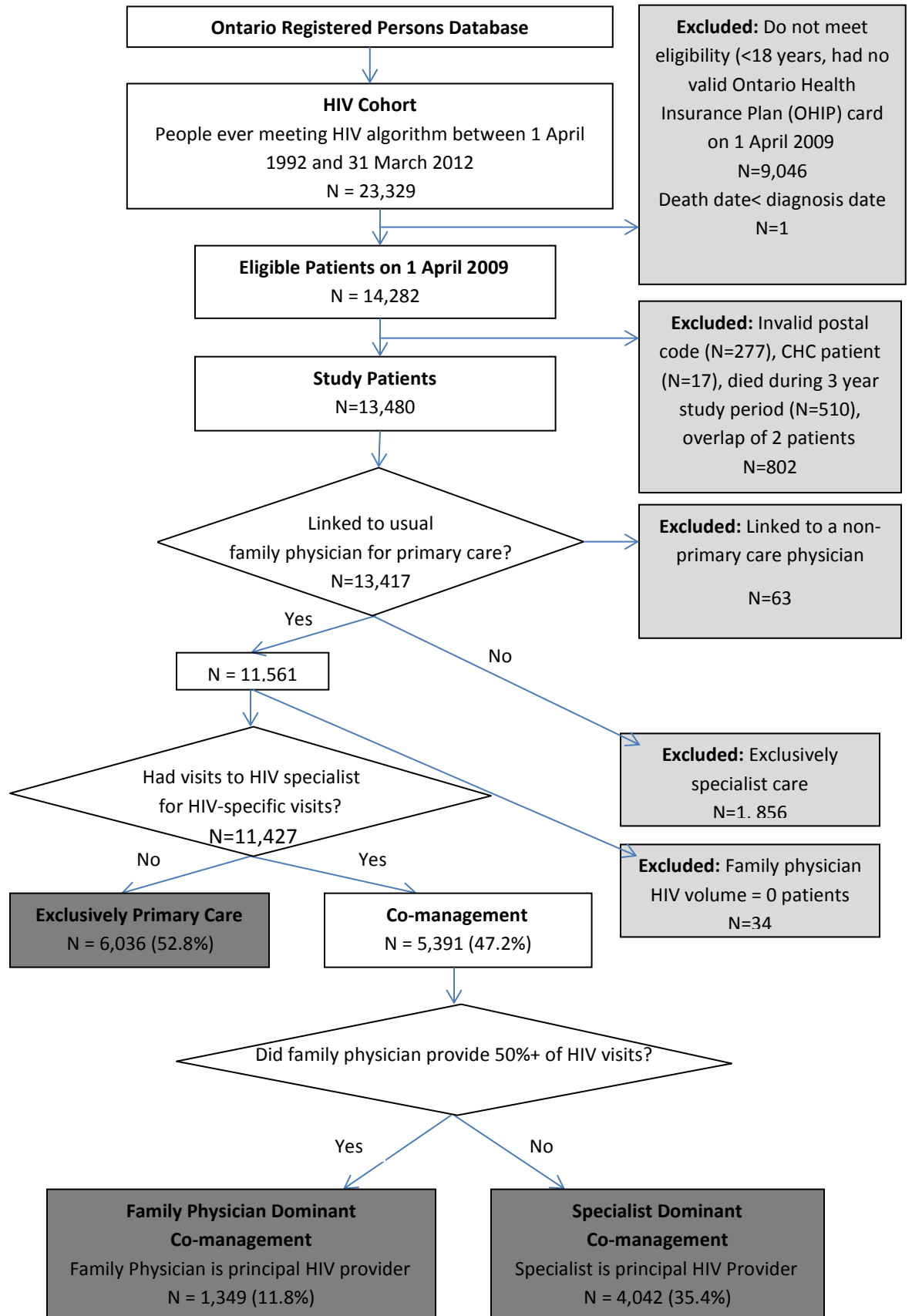
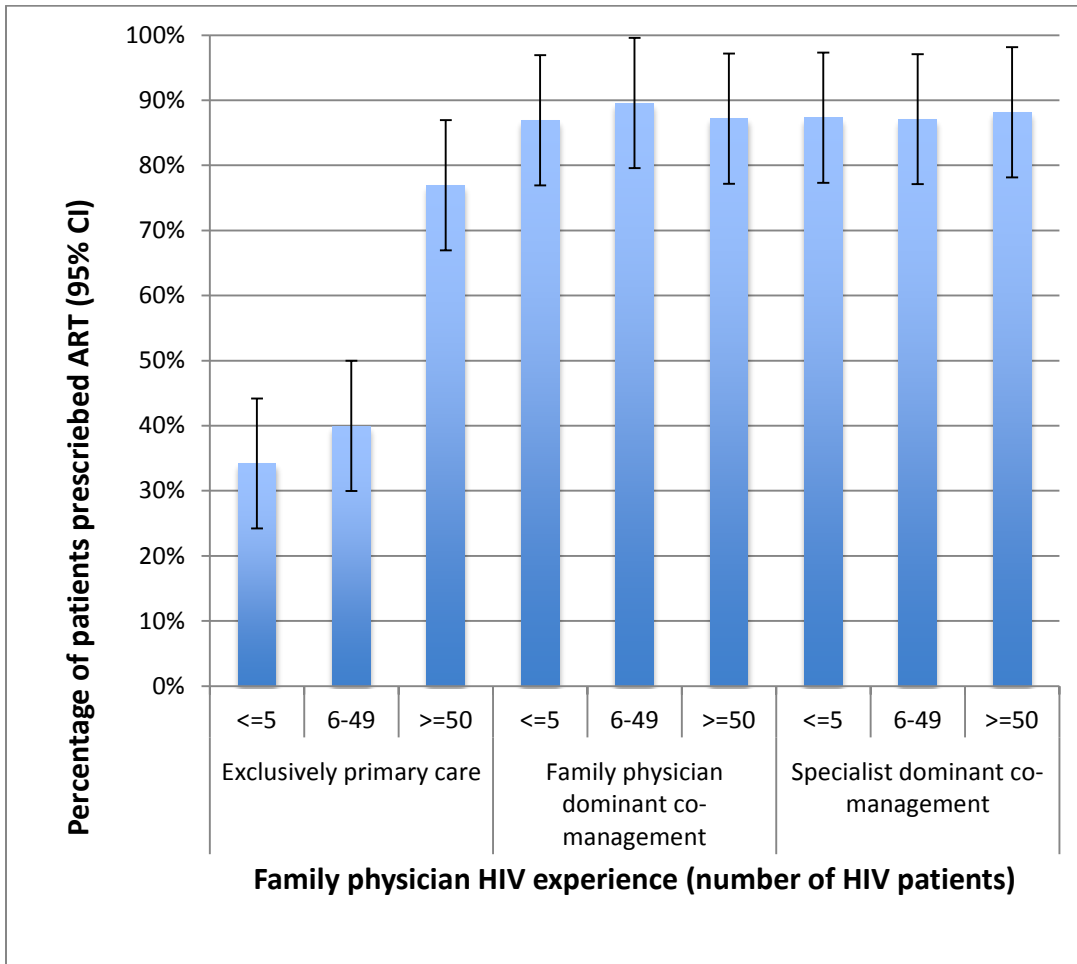


Figure 2: Adjusted prevalence of receipt of ART among eligible patients (percentage with one or more ART prescription during study period) by typology and family physician HIV experience. Error bars represent 95% confidence intervals.*



*adjusted for all patient covariates and accounting for clustering by family physician

Table 1: Characteristics of patients seen by exclusively family physicians with low (<5 HIV patients), moderate (6-49 HIV patients), and high (50+ HIV patients) experience levels. Entries are frequency (%) unless otherwise indicated

	50+ HIV patients N=4,163	6-49 HIV patients N=680	<=5 HIV patients N=1,193	Total N=6,036
Patient characteristics:				
Male sex	3,901 (93.7%)	481 (70.7%)	711 (59.6%)	5,093 (84.4%)
Age (years) (mean, (sd))	44.7(9.4)	45.0 (11.3)	46.4 (13.9)	45.0 (10.7)
Neighborhood income quintile				
Quintile 1 (lowest)	1,110 (26.7%)	215 (31.6%)	280 (23.5%)	1,605 (26.6%)
Quintile 2	801 (19.2%)	157 (23.1%)	270 (22.6%)	1,228 (20.3%)
Quintile 3	704 (16.9%)	107 (15.7%)	203 (17.0%)	1,014 (16.8%)
Quintile 4	687 (16.5%)	99 (14.6%)	227 (19.0%)	1,013 (16.8%)
Quintile 5 (highest)	813 (19.5%)	96 (14.1%)	210 (17.6%)	1,119 (18.5%)
missing	48 (1.2%)	6 (0.9%)	<=5 (0.3%)	57 (0.9%)
Rurality index				
Major urban	3,962 (95.2%)	611 (89.9%)	937 (78.5%)	5,510 (91.3%)
Non-major Urban	164 (3.9%)	61 (9.0%)	214 (17.9%)	439 (7.3%)
Rural	33 (0.8%)	7 (1.0%)	37 (3.1%)	77 (1.3%)
Missing	<=5 *	<=5 *	<=5 *	10 (0.2%)
Immigrant Status				
Canadian Born	3,545 (85.2%)	522 (76.8%)	1,029 (86.3%)	5,096 (84.4%)
Immigrant from Africa or Caribbean	244 (5.9%)	98 (14.4%)	68 (5.7%)	410 (6.8%)
Immigrant from Europe and Western Nations	96 (2.3%)	15 (2.2%)	19 (1.6%)	130 (2.2%)
Immigrant from other nations	278 (6.7%)	45 (6.6%)	77 (6.5%)	400 (6.6%)
Mental health condition	1,536 (36.9%)	322 (47.4%)	511 (42.8%)	2,369 (39.2%)

Number of ADGs**				
High	670 (16.1%)	162 (23.8%)	327 (27.4%)	1,159 (19.2%)
Medium	1,330 (31.9%)	225 (33.1%)	404 (33.9%)	1,959 (32.5%)
Low	2,163 (52.0%)	293 (43.1%)	462 (38.7%)	2,918 (48.3%)
Number of outpatient visits (mean(sd))	14.9 (12.2)	11.3 (16.8)	10.9 (14.3)	13.7 (13.4)
Quality indicators:				
Any ART prescription (n=3,412)	1,918 (77.3%)	146 (41.6%)	198 (34.1%)	2,262 (66.3%)
Colorectal screening (N=1,126)	321 (44.3%)	54 (34.6%)	102 (41.6%)	477 (42.4%)
Cervical screening (N=807)	129 (52.0%)	77 (44.0%)	210 (54.7%)	416 (51.5%)
Breast screening (N=245)	23 (38.3%)	28 (50.6%)	87 (64.4%)	138 (56.3%)
Any ED visit	1,146 (27.5%)	225 (33.1%)	425 (35.6%)	1,796 (29.8%)
Any hospital admission	271 (6.5%)	72 (10.6%)	122 (10.2%)	465 (7.7%)

* cell sizes <=5 individuals are not reported

** aggregated diagnosis groups

Table 2: P-values for each covariate in the hierarchical logistic regression analyses of study outcomes

	Receipt of ART	Colorectal cancer screening	Cervical cancer screening	Breast cancer screening	Any ED visit	Any hospital admission
Typology category	<0.01	0.01	0.10	0.24	0.23	<0.01
Family physician HIV experience	<0.01	0.10	0.03	0.95	0.74	0.46
Typology*family physician HIV experience interaction	<0.01	0.80	0.63	0.09	0.61	0.28
Age (yrs)	0.11	0.05	<0.01	0.01	<0.01	<0.01
Sex	0.14	0.74	n/a	n/a	0.28	0.76
Neighborhood income quintile	<0.01	0.40	0.68	0.06	<0.01	0.19
Rurality index	0.06	0.48	0.64	0.24	<0.01	<0.01
Immigrant status	<0.01	0.55	0.16	0.23	<0.01	0.01
Mental health diagnosis	<0.01	<0.01	0.49	0.39	<0.01	<0.01
Number of ADGs (high, medium, low)	<0.01	<0.01	<0.01	0.03	<0.01	<0.01

*adjusted for all listed patient covariates and interaction term of typology*family physician experience
Accounting for clustering by family physician

Table 3: Model-based mean quality indicators (proportion of patients receiving adherent care) with 95% confidence intervals for each typology of care category and level of HIV experience (adjusted for patient age, sex, income quintile, rurality, immigrant status, adjusted diagnosis group category, presence of a mental health condition, and experience category of the family physician and accounting for family physician cluster).

	Receipt of ART*	Colorectal cancer screening	Cervical cancer screening	Breast cancer screening	Any ED visit	Any hospital admission
Exclusively primary care						
<=5 patients	0.34 (0.30-0.39)	0.39 (0.32-0.47)	0.56 (0.50-0.62)	0.66 (0.56-0.77)	0.33 (0.30-0.35)	0.07 (0.06-0.09)
6-49 patients	0.40 (0.34-0.45)	0.34 (0.25-0.43)	0.41 (0.32-0.50)	0.61 (0.44-0.79)	0.32 (0.28-0.36)	0.09 (0.07-0.11)
50+ patients	0.77 (0.74-0.80)	0.43 (0.36-0.50)	0.54 (0.45-0.63)	0.49 (0.22-0.68)	0.29 (0.27-0.32)	0.06 (0.05-0.07)
Family physician dominant co-management						
<=5 patients	0.87 (0.77-0.97)	0.44 (0.14-0.75)	0.59 (0.27-0.91)	0.37 (0-0.90)	0.26 (0.13-0.39)	0.18 (0.07-0.28)
6-49 patients	0.90 (0.83-0.96)	0.43 (0.22-0.63)	0.26 (0.04-0.49)	0.35 (0-0.81)	0.31 (0.22-0.39)	0.13 (0.07-0.19)
50+ patients	0.87 (0.84-0.90)	0.49 (0.40-0.58)	0.48 (0.36-0.59)	0.79 (0.60-0.97)	0.32 (0.28-0.35)	0.13 (0.11-0.15)
Specialist dominant co-management						
<=5 patients	0.87 (0.85-0.89)	0.30 (0.25-0.35)	0.47 (0.42-0.52)	0.46 (0.35-0.56)	0.33 (0.30-0.35)	0.10 (0.09-0.11)
6-49 patients	0.87 (0.85-0.90)	0.25 (0.19-0.31)	0.39 (0.33-0.46)	0.61 (0.47-0.76)	0.34 (0.31-0.37)	0.09 (0.07-0.11)
50+ patients	0.88 (0.85-0.81)	0.40 (0.31-0.49)	0.49 (0.35-0.57)	0.31 (0.07-0.56)	0.32 (0.28-0.35)	0.10 (0.08-0.12)

ED = emergency department

* No significant within-typology differences except for receipt of ART among patients in exclusively primary care (<=5 patients vs. 50+ patients, and 6-49 patients vs. 50+ patients)

Chapter 10

Synthesis and Implications

10.1 Summary of study findings

My first study quantifies the substantial comorbidity prevalence among people living with HIV in Ontario and confirms the accumulation of multiple chronic conditions with age. Mental health conditions, physical comorbidities, and their multimorbidity were more prevalent among people with HIV than among the general population. Women had higher multimorbidity than men, and women with HIV had higher multimorbidity burden than women without HIV.

My second study describes the delivery of physician care to patients with HIV in Ontario. Family physicians, most of whom have low- or medium- HIV experience, were by far the most common specialty providing this care. Furthermore, family physicians provided the majority of both HIV and non-HIV care. Internal medicine and infectious disease specialists with lower HIV experience provided few, mostly non-HIV related visits, but more experienced specialists provided mostly HIV-related care. Finally, other specialties provide a large proportion of care; psychiatrists provided an amount of care to people with HIV that approaches that of HIV specialists (9.6 versus 12.5% of all visits).

In my third study, I developed and characterized a theoretically-derived typology of shared specialist and primary care among which patients with HIV, their physicians, and their visit patterns differ. Typology assignments were robust to variations in typology definitions. The majority of patients could be assigned to a usual provider of primary care, and about half of HIV patients saw only a family physician for their care. Only a small proportion of HIV patients saw a specialist exclusively. Almost 10% of HIV patients had a pattern of low engagement with no usual source of primary care, no specialist HIV care, and very few visits during the 3-year study period.

In my fourth study, I expanded upon this typology of care to demonstrate that the way care is delivered to people with HIV is significantly associated with patient outcomes. Overall, HIV patients with more primary care received better preventative care and had lower odds of hospital admissions, and those with more specialist care received better disease-specific care (both diabetes care and antiretroviral therapy). The odds of emergency department visits did not differ substantially between care models. Those identified as having low engagement in care, that is, no identified usual primary care provider and no HIV specialist, had very low emergency department use and hospitalizations, contrary to previous reports in other administrative chronic disease cohorts(46,105). These results confirm on a population level the need for both specialist and primary care expertise to cover the broad range of care needs for this increasingly complex population.

In my fifth study, I demonstrated that, family physician HIV experience modifies the association between model of care and receipt of antiretroviral therapy. Patients who see only family physicians had significantly higher odds of receiving antiretroviral therapy if their family physician had high HIV experience. This effect was particularly important for adherence to ART prescribing, especially in the models where family physicians are providing most of patients' HIV care.

10.2 General strengths and limitations

Several limitations of this thesis, such as certain health services being absent from physician billing claims (e.g. community health centres, those for aboriginal patients), are outlined within the individual studies. However, returning to the thesis framework, broader limitations warrant further discussion. Most notably, there are both strengths and limitations to using population-level administrative data to measure and evaluate

care.(106). As these data are primarily collected for other purposes, in our case mainly physician remuneration, they capture entire populations of individuals including those often underrepresented in deliberative cohorts, such as ethnic minorities and the poor. As these data are linked across several sources, I was able to develop models that incorporated characteristics from all domains of the framework - from system, to practice, to provider, to patient - and to evaluate their contributions to the care of people with HIV. Because of previous work using these data (14,107–111), I was able to reliably ascertain several comorbidities in a way not previously accomplished for HIV populations. The manner in which personal data are coded and the large numbers of patients with data available for analysis ensures confidentiality for a population for whom stigma, marginalization, and satisfaction with care play significant roles in disease experience and care seeking. Finally, the databases used capture the vast majority of physician services, thus provide a relatively complete picture of service utilization.

However, because these data are collected for other purposes, social variables are often determined by proxy measures such as neighborhood income (based on postal code files), or are missing altogether. As an example, I found that exclusively specialist care had higher prevalence of non-Canadian born and lower income patients, both factors associated with low screening rates. It is possible that residual confounding contributed to differences in observed outcomes. Similarly, there may be differences in the ascertainment of comorbidity among typology models. First, it is possible that billing claim-driven ascertainment of comorbidity may have differed due to billing differences between specialists and family physicians. Second, it is possible, and in fact likely, that currently unlinked HIV-specific public health data, such as HIV diagnosis dates, viral load measures, and CD4 cell counts, would shed light on HIV-specific morbidity that could partially explain higher rates of hospital admissions among patients in specialist-dominant models. Within the health care utilization framework, there are key individual and environmental contexts that contribute substantially to an individual's ability and motivation to engage in care, regardless of typology model. The association between

typology category and patient outcomes was strong, even after adjustment for known and measurable confounders, likely obviating many of these limitations. However, there may be residual confounding by these socio-ecological factors that explain some of my findings. Finally, identifying socioeconomic characteristics that influence care has little relevance if there are no upstream solutions in place to mitigate these disparities. Recent linkages with clinical care cohorts, such as the Ontario HIV Treatment Network Cohort Study(112), and anticipated linkages with public laboratory data will enhance the robust administrative data. However, qualitative studies are required to complement these quantitative findings in ways that add meaning and understanding the best ways to delivery care to this population.

Furthermore, it is possible that the differences found (and not found) between typology models are influenced by organizational, practice and community factors that are not measured by an administrative definition of shared care(113,114). For example, quality of HIV care has been shown to be improved through case management, multidisciplinary and group practices, extended hours, decision support and clinical information systems, and collocation of clinic activity(71,86,115–117). As patients increasingly roster to new primary care models(18), Ontario administrative data will better define interdisciplinary team care, including team composition and practice-based electronic health records. However, these will not delineate specialist-based interdisciplinary practices. I am currently leading research using practice-based surveys that will help delineate these HIV clinic practice features and will shed light on the variation between care settings and how these factors influence care.

Finally, there is an increasing impetus to view HIV care as a continuum (Figure 6) from HIV infection to viral load suppression. With the recognition that continuous ART leads to substantial gains in individual lifespans, but also dramatically reduces HIV transmission to others, there has been a convergence upon the ‘treatment and care cascade’ or ‘continuum’ as a useful framework for HIV care (Figure 6). This continuum identifies gaps

in care from HIV diagnosis to viral suppression, gaps that persist in Canada despite our universal healthcare system(118).

Figure 6: Continuum of HIV treatment and care (adapted from Mugavero et al)(95)
(Copied for purposes of this thesis with permission from Oxford University Press)

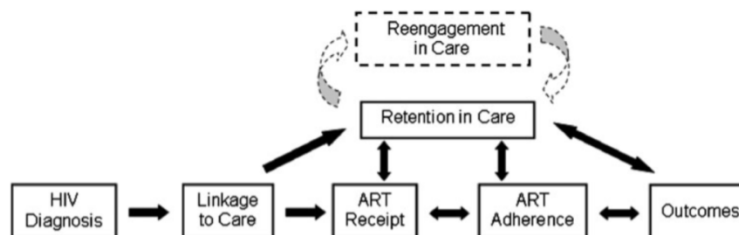
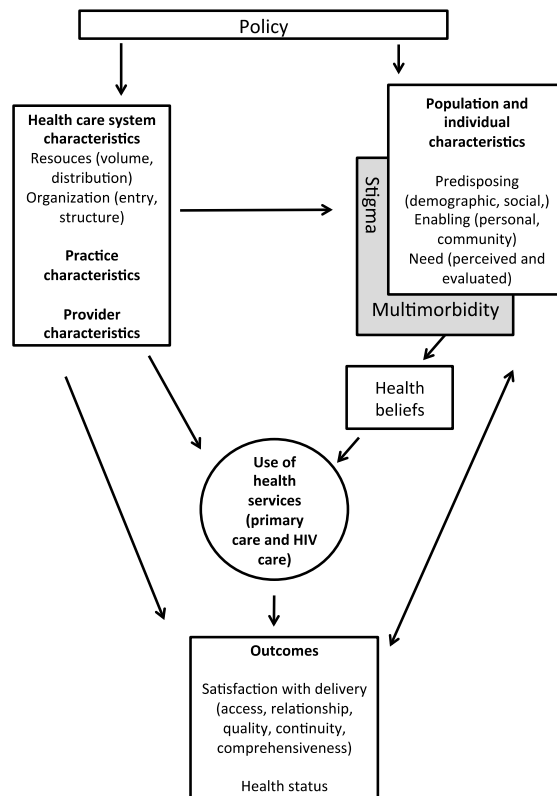


Figure 2. Blueprint for human immunodeficiency virus (HIV) treatment success. Inclusive of the steps in the treatment cascade following diagnosis, this illustration demonstrates the dynamic and bidirectional nature and relationships among steps and explicitly identifies the 3 processes of engagement in HIV medical care—linkage, retention, and reengagement. Abbreviations: ART, antiretroviral therapy; HIV, human immunodeficiency virus.

This thesis presents the first population-level data on the patterns of care for people living with HIV and engaged, at least to some degree, in care. However, I was unable to identify individuals who are unaware of their HIV positive status, estimated to be 26% of prevalent infections in Canada(119). Furthermore, until Ontario data sources are linked to public health laboratory data, we will not be able to identify patients who have a positive HIV test but are not obtaining HIV care such that they would be captured by physician billing claims. Future research will facilitate the linkages required to identify these individuals diagnosed but not in care and will assess key drivers of late presentation and engagement.

10.3 Synthesis of study contributions

Figure 7: Model of health service delivery for people living with HIV



Returning to the thesis framework (Figure 7), we review the complex mechanisms that contribute to health care utilization by people with HIV. By examining actual patterns of health care utilization, this body of literature makes an important contribution to our understanding of the health care delivery to a diverse population of people with HIV within a single-payer system. Specifically, it has expanded three domains of the framework: population characteristics, health care system resources and organization, and the comprehensiveness of outcomes. First, I have quantified socioeconomic and morbidity differences between those with and without HIV. Second, the health care utilization patterns have helped elicit the structure (volume and distribution of resources) and organization (relative amounts of primary and specialist care) of their care delivery. Finally, I greatly expanded our understanding of the association between care delivery and quality of care.

10.3.1 The contribution of multimorbidity as a population characteristic of people living with HIV

Within this framework, physical comorbidity, mental health conditions, and social inequality are syndemic in their effect on health care behaviors. This thesis quantifies the prevalence of several physical conditions as well as mental health conditions among people with HIV. I demonstrate that as people with HIV age, their patterns of multimorbidity reflect those of other aging populations. Some comorbidities may be HIV-associated, that is, related to HIV and its treatment, but others are not(120).

Multimorbidity, in particular with concomitant mental health conditions, is exacerbated by social disadvantage(121–123), which likely contributes to the burden of disease among those living with HIV. In addition, health behaviors, including smoking and substance use, have higher prevalence among those living with HIV and disproportionately contribute to their morbidity burden(78).

The synergistic influences are relevant to health care use in the Canadian context. In Canada, disparities in health and health care use persist despite universal, public funding of physician services. Individuals with low income and education have overall less contact with family physicians, but those who access primary care do so more frequently than those in more privileged groups(124). In a 2008 survey of community-dwelling adults with an ambulatory care sensitive condition, those with low income were higher users of primary care despite also having more emergency department visits, possibly reflecting less access to after-hours care(125). Lack of primary care access also exacerbates existing vulnerability. In British Columbia, lack of primary care was associated with increased emergency department use among intravenous drug users(126) and in Toronto, Ontario, was associated with increased duration of homelessness among homeless adults(100). Using population survey and administrative data, Glazier et al. (101) reported that vulnerable Ontarians had worse health status by several measures, including lower

preventative health care, despite having similar continuity of care and number of ambulatory visits. In Manitoba, Katz et al found that low income patients with ambulatory care sensitive lung disease had significantly higher odds of hospitalization compared to those in the highest income quintile(102). Despite significant advances in HIV care, inequitable delivery of this care persists in Ontario(127). A large proportion of individuals with HIV are estimated to not be accessing care at all, with women, those with low education and income, and those with substance abuse reporting lower quality of life and higher health burden than other groups.

10.3.2 The extent and organization of family physician care for people living with HIV

Measuring the volume and distribution of physician visits has been informative. The majority of all physician visits by this cohort were to family physicians, and only one third of all visits were identified as being for HIV-related care. This quantifies the significant breadth of care required by this population.

Recognizing the limitations of administrative data discussed previously, these data have also given us some insight into the *role* of family physicians in delivering care to people with HIV. Specifically, we have insight into how some of the qualities of primary care, such as primary care access, comprehensiveness, and continuity are experienced by people living with HIV(34). Defined by either contractual rostering or the majority of primary care services, the vast majority of HIV patients could be linked to a usual family physician. This doesn't speak to the quality of the physician-patient relationship or to the quality of integration and coordination patients experience after they enter the system, but does identify that, at a minimum, our health care system supports having access to a regular source of primary care. Having a regular source of primary care is an independent enabler of ultimate health care utilization, reduces perceived unmet needs, and improves health status, even among marginalized populations and those with chronic disease(46,100,128–130).

Comprehensive care, or the range of services provided, is another core pillar of primary care delivery and has been shown to improve health status among people with HIV(131). The comprehensiveness scores of family physicians were similar across typology models (0.6-0.7) and were in fact as high as a recent study evaluating the comprehensiveness scores of different remuneration models in Ontario(132). Continuity of primary care is also closely linked to improved individual health behaviors, better prevention, more appropriate health care use, and decreased costs, even in settings with universal access to physician services(133). Family physician continuity, previously considered high if 75% or more of primary care visits are to the same family physician(134), was high across our typology models (70-85%).

10.3.3 The strong association between the family physician – specialist interface and delivery of care

The first part of my multivariable analyses focused on how the delivery of care between family physicians and specialists affects outcomes for HIV patients. By assigning patients to a usual source of primary care, I was able to begin to tease out how relative amounts of specialist care contribute to quality of care. There was often a gradient effect to these results. Patients eligible for provincially covered drug coverage who had more of their HIV care provided by family physicians were much less likely to be prescribed antiretroviral therapy. However, patients who had more HIV care provided by HIV specialists were much less likely to receive preventative care. These findings persisted even after adjustment for patient characteristics, including level of comorbidity, urban or rural practice, and socioeconomic status.

The second part of my analyses took this typology of physician specialty further to evaluate the impact of physician HIV experience, which has been closely linked to, but not independently differentiated from, physician specialty in the delivery of HIV care. I looked

specifically at *family* physician expertise, identifying patients who saw family physicians alone and those who shared care with an HIV specialist. I found that among patients seeing only family physicians, those who see more experienced family physicians were significantly more likely to be prescribed ART. These findings persisted even after adjustment for patient characteristics. The association between family physician HIV experience and prevention was less clear, which is consistent with our findings regarding similar family physician comprehensiveness scores and continuity across typology models.

10.4 Implications for the health care delivery for people with HIV and the prioritization of future research

Due to the synergist relationship of individual morbidity, social status and health behaviors in predisposing to engagement in care, models of HIV care delivery require a population- rather than disease-specific approach. Starfield distinguished two scenarios in which patients have the simultaneous presence of chronic conditions; comorbidity, where there is one index condition and several related conditions, and multimorbidity, when there are multiple conditions, none of which is the index condition(26). There is no question that people living with HIV have unique care needs, of which access and adherence to antiretroviral treatment is arguably the most important. However, viewing the complexity of HIV patients from a disease-focused, comorbidity lens may minimize the important influence of mental health burden, behavioral risk, and marginalization that contribute to burden of disease(66,120,135). For example, I found that both mental health and physical comorbidity was associated with decreased colorectal cancer screening and receipt of ART among those eligible, and associated with increased emergency department visits, thus affecting both care utilization and quality of care. Previous research has also demonstrated that suboptimal control of comorbid conditions has implications for control of HIV itself(136). Finally, multimorbidity directly contributes to poor continuity of care, creating a direct gap between patients and their health

outcomes within our framework(122). Overall, disease-oriented approaches to chronic disease care contribute to the fragmentation of care and poor coordination that both frustrate clinicians(137) and disengage patients(138). In order to improve outcomes for people with HIV, an approach to care delivery must address overall disease burden as well as the modifiable behavioral and environmental risk factors associated with this burden(78,120).

The typology of care developed in this thesis demonstrates variation in patient and provider characteristics among different models of care delivery. There has been extensive literature highlighting the importance of specialist expertise and experience in the care and treatment of people living with HIV(65,71,72). However, I found that many patients with HIV in Ontario see only family physicians, and many of these physicians are not in high HIV volume practice. One fifth of these family physicians practice outside of urban settings where we see virtually no HIV specialists in practice. These findings have important policy implications; some patients elect to receive care, sometimes exclusively, in potentially “suboptimal” practice settings. In fact, we identified that 2,959 family physicians, representing 20% of the Ontario family physician workforce(139), saw HIV patients for at least one visit. The comprehensiveness and continuity of care provided by these physicians is similar to that provided to more general Ontario populations. Any HIV delivery framework must incorporate decision support strategies to support low volume family physicians and those practicing rurally to facilitate their adherence to ART prescribing(115). Furthermore, this information is important to health planners, as it identifies the primary setting as a potential foundation for health services delivery, even for this population for whom specialist care has been the norm. To improve health systems performance, access to primary care must be universal and its integrative function among patients, clinicians, and communities harnessed(32).

Within the thesis framework, care engagement is the key process through which improved outcomes occur. In more than one publication(95,128) Mugavero and

colleagues have referred to their ecological framework (Figure 3) to identify system level interventions essential to the care of people living with HIV, such as easing structural barriers to care (including flexible hours of delivery), multidisciplinary teams, addressing population-specific needs, case managers and navigators, electronic health records, and improved integration across care settings and providers. These are all tenants of *primary care* practice, however, most of their recommendations place a specialist HIV provider at the centre of the circle of care. They and others(140) also refer to the inability of the current workforce to sustain the primary medical care needs of patients with increasing comorbidity and complexity. However, the term ‘primary care’ is always couched as primary HIV care, or primary medical care, and the gap in care provision highlighted as reflecting a lack of HIV specialist trained providers. Furthermore, the framework separates primary care services from the HIV clinic, resulting in important ambiguity around the foundational organization of care required for this population. This problem is contextualized by other work. Chu and Selwyn provided a thorough commentary on the need to ground HIV care *within* primary care (66). A recent study sought to identify the optimal multidisciplinary care team for ART adherence, and found that multidisciplinary care teams with a *non*-expert primary care provider overall had improved adherence over specialist models (most importantly in collaboration with an HIV coordinator and a pharmacist), again highlighting the potential for a shift in the delivery of care from the “HIV clinic” to the primary care domain. Going forward, my findings support that strategies aiming to improve the comprehensiveness and integration of care for people with HIV need to be grounded in reforms to the primary care environment.

One well-established framework for effective, evidence-based clinical and quality improvement in the management of many chronic diseases is “The Chronic Care Model” (CCM)(141). CCM initiatives have become the foundation of patient care for chronic conditions such as ischemic heart disease(142), congestive heart failure(143–145), diabetes(143,144,146), asthma(143,144,146), COPD(147), and depression(143), and have been shown to improve patient-reported health status and quality of life in primary care

settings(148). Recent work has explored its utility in primary care based HIV care delivery(149). An Expanded model (E-CCM) has been recommended for Canadian contexts; this expansion explicitly nurtures community empowerment and policy linkages, integrating health promotion and prevention elements of the health system, and recognizes the critical influence of the social determinants on health behaviors(150). The E-CCM has been adopted by the Ontario Ministry of Health and Long Term Care's Chronic Disease Prevention and Management Framework(151).

This patient-centred, community based framework would address the multiple care delivery needs arising from this thesis. In fact, the E-CCM domains reflect the socioecologic layers of Mugavero's framework, identifying how care can be integrated from the individual, to the provider and their practice, to communities, to health systems and to the policy level. The E-CCM proposes a patient-centred approach, respecting the contributions of individual and systemic contextual barriers to health care seeking behavior(79); it addresses the impact of multimorbidity, especially the recognition that people with chronic disease are more than the sum of their parts(152); it explicitly promotes decision support strategies to empower lower HIV volume family physicians(115,153); and it addresses the need for integration between providers and across clinical and social services(154). Future work will explicitly evaluate the E-CCM framework in the delivery of care to people with HIV in Ontario.

Going forward, performance measurement strategies are required to monitor policy and system change. Assessment of the long-term care of people with HIV must incorporate indicators of complex and rapidly evolving HIV-specific care, as well as measures of access to care, coordination between providers (especially between family physicians and HIV experts), and patient-reported outcomes. Given the paucity of literature specifically addressing this population's primary care needs, evaluation criteria that anticipate the impact of policy change can be developed and applied(158). Colleagues and I are involved in developing such a framework for the comprehensive, community-based delivery of HIV

care within a Canadian primary care context. While this study has found across-stakeholder support for comprehensive and integrated care as the optimal standard for people with HIV, there was no emergent consensus on the role of performance measurement and reporting in monitoring these changes. This finding reflects the current reality that there is little public reporting of primary care performance data in Canada compared to other developed countries(159). Furthermore, implementing standards of care specifically related to the specialist-primary care interface will require a commitment to defining, understanding and measuring coordination and integration of care (8,10,32,39,42,90,91).

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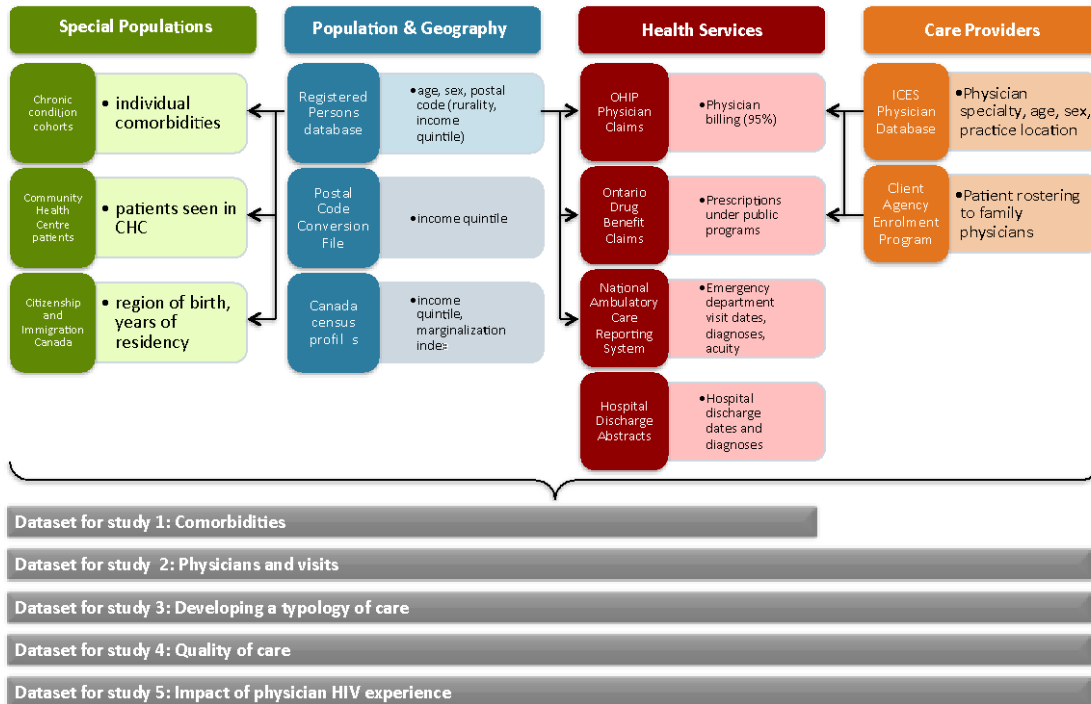
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Appendix 1 – Institute for Clinical Evaluative Sciences databases

ICES datasets for a population based evaluation of the delivery of care for people living with HIV in Ontario



Citizen and Immigration Canada data contains information on all individuals granted permanent residency in Canada from 1985 (N = 1,377,816) and includes demographic and socioeconomic information collected at the time of application for immigration status. Probabilistic data linkage was used to link these data to the RPDB and obtain IKNs where possible (85.8% of the records for the (1985-2010) data transfer).

The Client Agency Enrolment Program (CAPE) database tracks patient enrolment to individual family physicians and is obtained from the Ontario Ministry of Health Long Term Care.

The Canadian Institutes for Health Research Discharge Administrative Database (DAD) supplies information on acute care hospitalizations. These data are generated by trained health information professionals and subsequently verified for completion by CIHI. Every record corresponds to one hospital stay and includes patient demographics (sex, date of birth, postal code, county and residence code), clinical data (diagnoses, procedures, physician), and administrative data (institution/hospital number, admission category, length of stay, disposition). Diagnoses are coded using ICD-10 with one single diagnosis identified as the most responsible, and up to 25 other diagnoses included. Records are

submitted to, verified by, and periodically audited by CIHI. For Ontario submissions, the agreement of DAD diagnostic codes with chart review has been reported to be 89.8% (88%–92%)(160).

The Family Health Team Staffing Database (FHTSD) is updated on a quarterly basis by the Ministry of Health in Ontario and provides information on the type of health staff in the multidisciplinary capitation models.

The ICES Physician Database (IPDB) comprises information from the Ontario Health Insurance Plan (OHIP) Corporate Provider Database (CPDB), the Ontario Physician Human Resource Data Centre (OPHRDC) database and the OHIP database of physician billings. Main data elements include physician demographics (gender, sex); specialty (functional and certified); location; measures of physician activity (billings, workload, types or services provided). The Corporate Provider Database (CPDB) captures family physician socio-demographic information, tracks their enrolment in practices and the model to which the practice belongs, and contains information on the specific allied health professionals in the capitation-based multidisciplinary models.

The Ontario Health Insurance Program (OHIP) billing claims system captures provision of care to insured residents. The OHIP dataset records claims for about 95% of medically necessary physician services (inpatient and outpatient services and procedures), diagnostic and laboratory services conducted in the province. Two administrative codes are generated per service. The first is a diagnosis code, generated as a truncated three-digit version of the ICD-9 code, with only one diagnosis possible per service. The second is a service code generated specifically for physician remuneration.

The Ontario Drug Benefits (ODB) claims database includes drugs paid for by the public system for people aged 65 and older and people receiving social assistance (Ontario Works, Ontario Disability Support Program, and the subsidized Trillium program). Eligible drugs, including the majority of antiretroviral drugs, are listed in a provincial formulary according to their strength and dosage using a unique drug identification numbers (DINs). Pharmacies submit these data, which include patient, provider, and drug information, directly to the Ontario Ministry of Health and Long Term Care. It is important to note that ODB eligibility may change over time, and that claims data are initiated upon filling of, not receipt of, and ODB prescription.

The National Ambulatory Care Reporting System (NACRS)(161) captures information on visits to emergency departments and certain hospital outpatient clinics. Chart data extraction is performed by trained health information abstractors. Data elements include patient demographics, dates of service, ICD-10 diagnostic codes for up to 10 diagnoses (one of which is the main problem), and procedure codes.

The Registered Person's Database (RPDB) captures patient demographic information, including age, sex, postal code and mortality data, for Ontarians ever eligible for provincial health insurance.