Workload and patterns of care in the Timmins Family Health Team in Ontario

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Abstract

Objective To characterize primary care physician and nurse practitioner ("GP") workload and availability, and any relationship with daytime, low-acuity emergency department (ED) and after-hours walk-in clinic (WIC) visit counts.

Design Retrospective database review.

Setting Timmins, Ont, with 5 family health team (FHT) office sites, 1 after-hours FHT WIC, and 1 ED.

Participants An anonymous data set representing 21 voluntarily enrolled GPs comprising 33 211 office appointments among 15 908 patients, plus 2043 ED visits and 2713 WIC visits, over 18 months.

Main outcome measures Roster size corrections for inactive ("dormant") patients, nursing supports, and patient complexity (age and sex). *Availability of GPs* was defined as the corrected number of office visits per patient per year. Linear and nonlinear relationships between GP availability and each roster's chronic disease burden (congestive heart failure, chronic obstructive pulmonary disease, and diabetes); ED visit count per patient; and WIC visit count per patient.

Results Corrections for dormant patients and then for each of relative nursing support and patient complexity changed roster sizes by a mean (SD) of -8.4% (14.5%), -7.1% to 5.6% (median -1.6%), and 32.0% (18.2%), respectively. Combining these corrections increased effective roster size by a mean (SD) of 18.4% (7.3%). Larger rosters were not proportionately more dormant. In the Timmins FHT, GPs saw unique patients about 2.05 times per year (range 1.39 to 3.81). Availability of GPs did not change with increasing numbers of patients with congestive heart failure, chronic obstructive pulmonary disease, or diabetes in the roster. The ED diversion model had low explanatory power and was likely unreliable. The WIC diversion model was more robust, predicting 0.08 fewer WIC visits per patient per year if GP availability increased from 2.0 to 3.0 visits per patient per year (relative risk reduction of 41%).

Conclusion Sampled GPs manage a more complex patient population on average than their uncorrected roster sizes imply. There was no evidence that larger rosters or those with more patients with comorbid conditions reduced GP availability. Increasing physician availability might decrease WIC attendance.

Editor's key points

- Primary care physicians and nurse practitioners ("GPs") must balance patient volumes and appointment lengths to support the needs of their patient roster. This study aimed to identify if there might be an "optimal" patient volume from a population health perspective by testing for evidence of breakdowns in care as GP workload increases.
- Availability of GPs was defined as the number of visits per patient per year and was corrected for dormancy, nursing support, and patient complexity. The authors wanted to identify whether increased workload translates to less availability and, in turn, causes patients to divert to the emergency department and walk-in clinics (WICs).
- The rosters of the sample of GPs from the Timmins Family Health Team were more complex on average than formal roster sizes implied. There was no evidence that larger rosters and those with more patients with chronic disease reduced GP availability. Increasing GP availability might decrease after-hours WIC attendance, but did not seem to affect low-acuity, daytime emergency department visits. Future research should use WIC exit surveys to measure patient motivation to divert from the GP's office.

Points de repère du rédacteur

- Les médecins de soins primaires et les infirmières praticiennes (PG) doivent faire un juste équilibre entre le volume de patients et la durée des rendez-vous pour répondre aux besoins des patients sur leurs listes. Cette étude avait pour but de déterminer s'il pouvait y avoir un volume « optimal » de patients selon une perspective de santé populationnelle en cherchant des éléments de preuve corroborant des ruptures dans les soins à mesure qu'augmente la charge de travail des PG.
- La disponibilité des PG était définie comme le nombre de visites par patient par année, rajusté pour tenir compte des patients inactifs, du soutien en soins infirmiers et de la complexité des patients. Les auteurs voulaient déterminer si les charges de travail accrues se traduisaient par une moins grande disponibilité et, par ricochet, incitaient les patients à se tourner vers les services d'urgence et les cliniques sans rendez-vous (CSR).
- Les listes de l'échantillon de PG de l'équipe de santé familiale de Timmins étaient en moyenne plus complexes que le laissait croire la taille officielle des listes. Il n'y a pas eu de preuves que les listes plus nombreuses et celles comptant plus de patients atteints de maladies chroniques réduisaient la disponibilité des PG. L'augmentation de la disponibilité des PG pourrait faire diminuer la fréquentation des CSR après les heures normales, mais elle n'a pas semblé influencer le nombre de visites au service d'urgence de faible acuité durant la journée. D'autres projets de recherche devraient utiliser des sondages à la sortie des CSR pour analyser ce qui motive les patients à ne pas s'adresser à la clinique des PG.

Charge de travail et profils des soins dans l'équipe de santé familiale de Timmins en Ontario

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Résumé

Objectif Caractériser la charge de travail et la disponibilité des médecins de soins primaires et des infirmières praticiennes (PG), de même que les relations, s'il en est, avec le nombre de visites durant le jour au service d'urgence de faible acuité et celles après les heures normales dans les cliniques sans rendez-vous (CSV).

Type d'étude Une revue rétrospective de bases de données.

Contexte Timmins (Ontario), dont 5 cliniques d'équipes de santé familiale (ESF), 1 CSR d'une ESF et 1 service d'urgence.

Participants Un ensemble de données anonymes représentant 21 PG inscrits volontairement et comportant 33 211 rendez-vous en clinique par 15 908 patients, plus 2043 visites au service d'urgence et 2713 visites à une CSR, sur une période de 18 mois.

Principaux paramètres à l'étude Des rajustements à la taille des listes pour tenir compte des patients inactifs (« dormants »), le soutien par des infirmières et la complexité des patients (âge et genre). La *disponibilité des PG* était définie comme étant le nombre rajusté de visites à la clinique par patient, par année. Les relations linéaires et non linéaires entre la disponibilité des PG et le fardeau de morbidité chronique de chaque liste (insuffisance cardiaque congestive, maladie pulmonaire obstructive chronique et diabète); le nombre de visites aux services d'urgence par patient; et le nombre de visites à la CSR par patient.

Résultats Les rajustements pour les patients dormants, puis pour chaque soutien infirmier relatif et la complexité des patients ont modifié la taille des listes en moyenne (ET) par -8,4 % (14,5 %), -7,1 % à 5,6 % (moyenne de -1,6 %), et 32,0 % (18,2 %), respectivement. La combinaison de ces rajustements a fait augmenter en moyenne (ET) la taille effective des listes par 18,4 % (7,3 %). Les listes plus nombreuses n'étaient pas proportionnellement plus dormantes. Dans l'ESF de Timmins, les PG voyaient des patients individuels environ 2,05 fois par année (variant entre 1,39 et 3,81). La disponibilité des PG n'a pas changé en raison d'un nombre plus grand de patients souffrant d'insuffisance cardiaque congestive, de maladie pulmonaire obstructive chronique ou de diabète dans leur liste. Le modèle de la diversion vers les services d'urgence avait une faible puissance explicative et n'était probablement pas fiable. Le modèle de diversion vers les CSR était plus robuste, et prévoyait 0,08 moins de visites à une CSR par patient par année si la disponibilité des PG augmentait de 2,0 à 3,0 visites par patient par année (réduction du risque relatif de 41 %).

Conclusion Les PG de l'échantillon géraient une population plus complexe de patients en moyenne que ne le laissait entendre la taille de leurs listes non rajustées. Il n'a pas été constaté que les listes plus nombreuses ou celles comptant plus de patients avec comorbidités réduisaient la disponibilité des PG. L'augmentation de la disponibilité des PG pourrait faire diminuer la fréquentation des CSR.

Primary care physicians and nurse practitioners ("GPs") must balance patient volumes and appointment lengths to support the needs of their patient roster. Past research has accordingly asked whether an optimal roster size exists. In general, smaller rosters are associated with better scores for cancer screening, chronic disease hospitalizations, and low-acuity emergency department (ED) visits[1]; alcohol misuse screening and pneumonia vaccinations[2]; and access to appointments and regular diabetes care.[3] Health promotion is also more common.[4] Smaller daily patient volumes are associated with fewer unnecessary antibiotic prescriptions.[5] Among patients with a GP, the increased continuity of care expected with smaller rosters[6] might also reduce pharmacy and hospitalization costs.[7,8]

Although smaller rosters sound ideal, their widespread adoption might worsen existing GP shortages found in many parts of Canada. Would slightly larger rosters—and the corresponding increased workload—in these cases make the best of a bad situation? To address what might be an "optimal" patient volume from this population health perspective, we tested for evidence of breakdowns in care as GP workload increases. In other words, we sought to identify when GP workload is too great.

To measure workload, *roster size* is a seductively simple term. However, a GP's total in-office time and time per patient is often flexible and variable among practitioners. *Roster size* alone is thus not necessarily a comparable metric. In addition, *roster size* can be both an arbitrary (eg, at the administrative level) and an "observed" (eg, total unique patients actually seen in a given time frame) term; these values might not be equivalent.

There are other patient- and practice-level factors that also limit the comparability of roster sizes. Roster workload varies with patient medical needs,[9] the breadth of support services offered by the office or primary care team,[10] the presence of medical students or residents,[11] and other health care services in the community.[11] Additionally, GPs vary in their approach to patient encounters; they each accommodate different patient loads based on practice style alone.[12]

"Observed" roster sizes are described with the following definitions:

$$\text{rosterSize} = \frac{\text{totalAppointments}}{\text{numVisitsPerPatient}} \quad (1)$$

where

$$\text{totalAppointments} = \frac{\text{totalHoursWorked}}{\text{hoursPerAppointment}} \quad (2)$$

and, therefore,

$$\text{rosterSize} = \frac{\text{totalHoursWorked}}{\text{numVisitsPerPatient} \times \text{hoursPerAppointment}} \quad (3)$$

Equation 3 shows how observed roster size is dependent on the number of patient visits (as these increase, roster size must decrease), the appointment length (as these increase, roster size must decrease), and the GP's work hours (as they decrease, so must roster size).

Although it, too, cannot distinguish among patient- and practice-level variation, the average number of patient visits per year ("numVisitsPerPatient," which we will call *availability* and refer to as γ) is, in our opinion, a more intuitive term describing physician workload compared with roster size. Derived from equation 3 and defined as

$$\gamma = \frac{\text{totalHoursWorked}}{\text{rosterSize} \times \text{hoursPerAppointment}} \quad (4)$$

this term integrates both GP clinic time and relative patient workload (roster size), and conceptually represents the patient's perspective.

We studied GPs working in a family health team (FHT) in Ontario. In this system, GPs roster patients for an annual "capitation" payment per patient rostered. They are expected to be available for their roster's health care needs; however, they are free to set their schedule and are also free to see unrostered patients on a fee-for-service basis. There is no penalty for reduced GP availability, unless that patient sees a GP nonemergently outside of the FHT. Visits to the ED and to the affiliated FHT walk-in clinic (WIC) are not penalized. There is thus a financial incentive to have a large roster of patients without necessarily remaining highly available.

The purpose of this study was to characterize GP workload and availability in the Timmins FHT, and to identify whether increased workload (eg, roster size, chronic disease burden) translates to less availability and, in turn, causes patients to divert to EDs and WICs. We will help identify unsustainable workload thresholds, if any, and the corresponding opportunities to improve patient care.

Methods

Timmins is a city in northern Ontario with a population of about 42 000. The FHT consists of a network of 40 GPs (35 physicians and 5 nurse practitioners), plus nursing support staff, working among 5 office sites and sharing inpatient, after-hours, and weekend walk-in care data using a single electronic medical record database.

After receiving ethics approval from Laurentian University in Sudbury, Ont, we collected patient encounter and scheduling data, as well as counts of WIC access and daytime (8 AM to 5 PM), low-acuity (Canadian Triage and Acuity Scale score 4 or 5 [out of 5]) ED visits from June 2016 to December 2017 for the Timmins FHT. These data were obtained with permission from a sample of anonymous GPs opting in to the study. All FHT patients enrolled since the FHT's inception have signed consent

to data collection for quality improvement and research purposes (those who opted out were excluded). Unless unrostered, all patient clinic visits were assigned to their home rostered GP; this assumed any (rare) locum care and cross-coverage was equivalent.

We used R, 3.4.3,[13] for all data analysis. Our approach was as follows (please see **CFPlus*** for specific details).

First, to describe the real workload, we corrected the "formal" (administrative) roster sizes, here adjusting for "dormant" patients by removing patients with no activity in the past 18 months[14] and by adding any unrostered patient visits. We then adjusted for relative variations in nursing support by inflating or deflating the effective roster size according to the relative number of full-time-equivalent nurses among each of the 5 clinics, assuming that nursing support can inflate or deflate an effective roster size by 10%.[11] Last, we adjusted for patient complexity by inflating or deflating patient counts according to the age- and sex-based complexity correction algorithm in Murray et al.[9] This algorithm underweights visit likelihood for patients aged 10 to 49, and overweights increasing extremes of age, with slightly heavier weights assigned to females than to males.

To further measure workload, we then used existing ICD-9 coding to calculate the proportions of patients in each roster with congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), and diabetes.

Next, we calculated GP availability using the corrected roster sizes calculated as above, combined with a known total annual appointment count for each GP (equation 4).

To test for effects of excessive workload on GP availability, we used linear models, first indirectly by asking whether the proportion of dormant patients was greater in larger (uncorrected) rosters (ie, to test for patient neglect), and then directly, by asking whether larger corrected roster sizes tended to have lower (corrected) availability per patient. Third, after correcting for any effects of roster size, we tested whether GPs with a larger roster burden of chronic disease tended to be less available.

Last, we used generalized additive models (GAMs),[15] a flexible nonlinear technique, to identify whether a reduced or threshold GP availability is associated with increased patient diversion to either EDs or WICs, correcting for differences in patient age (grouped as infant [0 to <2], child [2 to <18], adult [18 to <65], and senior [≥65]), sex, and the presence of CHF, COPD, and diabetes.

*A **detailed description of the approach to data analysis** is available at **www.cfp.ca**. Go to the full text of the article online and click on the **CFPlus** tab.

Results

Overall, 21 GPs representing all 5 practice sites agreed to share roster and encounter data for the study. We considered data from 15 908 patients (including 1586 unrostered). The patient population was 2.3% infants, 19.2% children, 59.5% adults, and 19.0% seniors; 52% of the patients were women.

We modeled data from 33 211 office appointments, 2043 low-acuity ED visits occurring between 8 AM and 5 PM, and 2713 after-hours WIC visits.

Correcting for patient dormancy, nursing supports, and patient complexity

Removing dormant patients (while adding unrostered patients who were seen) reduced formal roster sizes by a mean (SD) of 8.4% (14.5%; **Figure 1A**). There was no significant second-order effect to indicate a disproportionate increase in dormant patients with increasing roster size (**Figure 1A**; $P>.05$). The correction for nursing care supports changed the effective nondormant roster size by -7.1% to 5.6% on average (median -1.6%; **Figure 1B**). Correcting for patient complexity increased the mean (SD) practical roster size by 32.0% (18.2%; **Figure 1C**). Taken together, all corrections increased the effective mean (SD) roster size by 18.4% (7.3%; **Figure 1D**).

Availability of GPs (γ_{cor})

The availability of GPs, expressed as the corrected mean (SD) number of visits per patient per year was 2.05 (0.52; **Figure 2**), and ranged from 1.39 to 3.81. There was no significant linear relationship with corrected roster size (**Figure 3**; $P>.05$).

Chronic diseases

The average (SD) proportions of CHF, COPD, and diabetes were 0.5% (0.5%), 2.2% (1.6%), and 6.4% (2.8%) per roster, respectively (**Figure 4A**). There was no significant linear relationship with corrected GP availability (**Figure 4B**; $P>.05$ in all cases).

Diversion to the ED

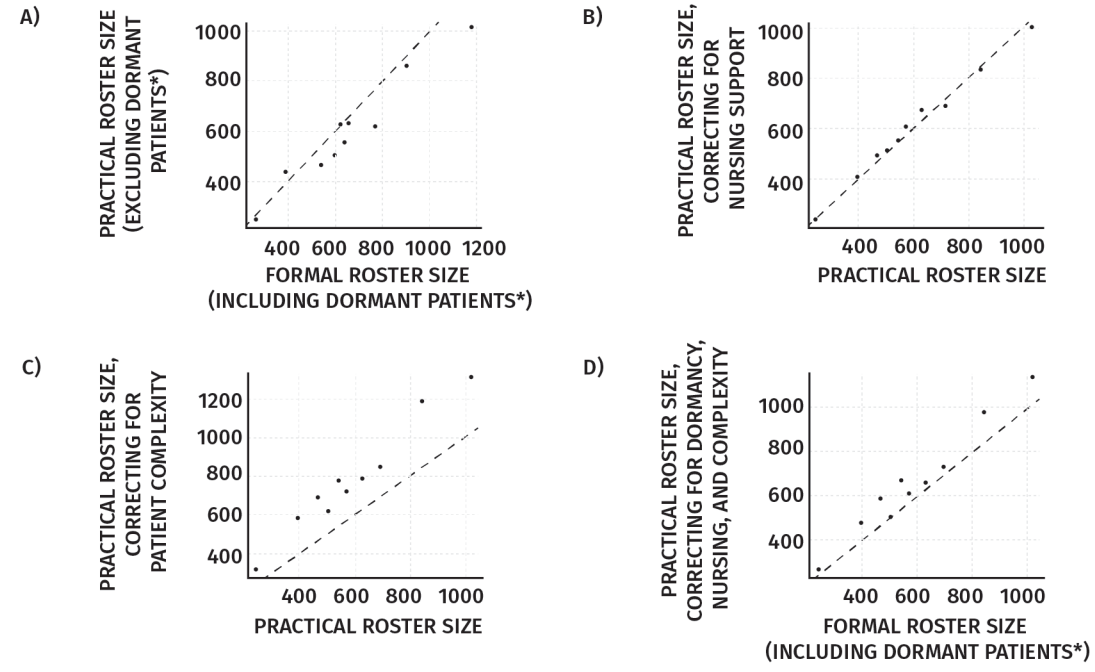
Daytime, low-acuity ED visits averaged (SD) 0.13 (0.42) per person per year.

The GAM of ED diversions had poor explanatory power, with less than 1% of deviance explained. There was a paradoxical hump-shaped (second-order) pattern suggesting increased ED visits with increasing GP availability up to about 2.5 GP visits per year, and then a decrease (**Figure 5A**; $P<.05$). It was not robust to removing a set of outlying data points (**Figure 5B**).

Diversion to the WIC

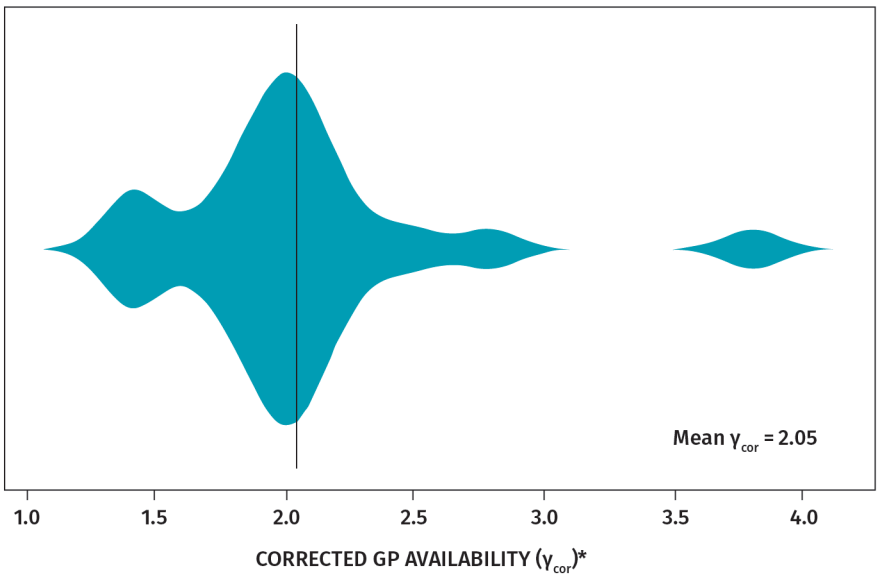
After-hours FHT WIC visits averaged (SD) 0.17 (0.54) per person per year.

Figure 1. Roster size: ***Effect of correcting for*** *A) patient dormancy, B) nursing supports, C) patient complexity, and D) the combined effect of these 3 corrections. Dashed lines are 1:1 trend lines (ie, no effect of correction). Binned average values among roster size subsets are shown to protect participant anonymity. The actual sample size is 21.*



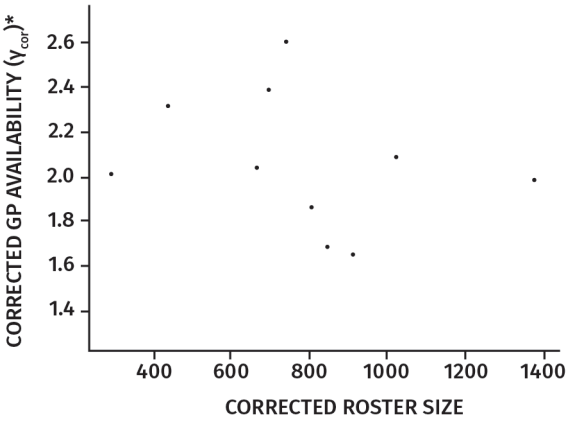
**Dormant patients* are those with no visits in the past 18 months.

Figure 2. Patterns of GP availability (average number of visits per patient per year), corrected for dormancy, nursing support, and patient complexity, among study participants: *The solid line represents the overall mean.*



*No. of visits per patient per year. Higher values represent greater availability.

Figure 3. Corrected GP availability as a function of corrected roster size: ***Linear regression (not shown) shows no significant first- or second-order trend. Binned average values among roster size subsets are shown to protect participant anonymity.*** *The actual sample size is 21.*



*No. of visits per patient per year.

Based on several model diagnostics (available from **CFPlus***), the GAM of WIC visits had a reasonable fit; 2.9% of deviance was explained. There was a significant decrease in expected WIC visit counts with increasing GP availability (**Figure 6A**; $P<.05$). This pattern was robust to outliers (**Figure 6B**). All else being equal, an increase in γ_{cor} from 2.0 to 3.0 visits per patient per year predicts a decrease in WIC attendance by 0.08 (relative risk reduction of 41%).

Here, males and seniors (≥65 years) were less likely than females and adults aged 18 to 65 years, respectively, to present to the WIC (incident rate ratio [IRR] of 0.68 [males] and 0.72 [seniors]; $P<.001$). Children and infants were significantly more likely to present compared with adults (IRR = 1.30 [children] and 1.99 [infants]; $P<.001$). Patients with COPD were also more likely to present (IRR = 1.46; $P=.018$). Diabetes and CHF diagnoses did not influence WIC visit counts.

Discussion

This research characterized GP workload and availability within a single practice community. We then tested whether higher workloads might reduce GP availability, which in turn could force patients to seek outside care. Here, we found a mixed picture.

First, we found that the effective workload in these GPs' rosters is likely higher than what official roster numbers predict. Although about 8% of each roster is dormant on average, this relative workload reduction is more than offset by the average 32% increase in patient complexity, here driven by extremes of age (approximately 19% of the patient population for each of seniors and children). Nursing support corrections by design could only account for relative differences among the 5 FHT offices.

Fortunately, there was no evidence of GPs being overwhelmed by increased roster sizes or comorbidity. Here, the proportion of dormant patients did not increase in larger rosters. Furthermore, GP availability did not decline with increasing roster size, nor with chronic disease prevalence. The Timmins FHT integrates nursing care extensively into chronic disease management, and this might play an important role in maintaining the team's capacity.

The average GP availability (γ_{cor}) of 2.05 visits per patient per year (range 1.39 to 3.81) sits between previous published values of 1.575[14] and 3.17[9]; we might thus expect this availability to be relatively "normal" from a primary care perspective. However, **Figure 4** shows a negative skew to the data. Adding a larger number of participating GPs could address whether the negative skew is representative.

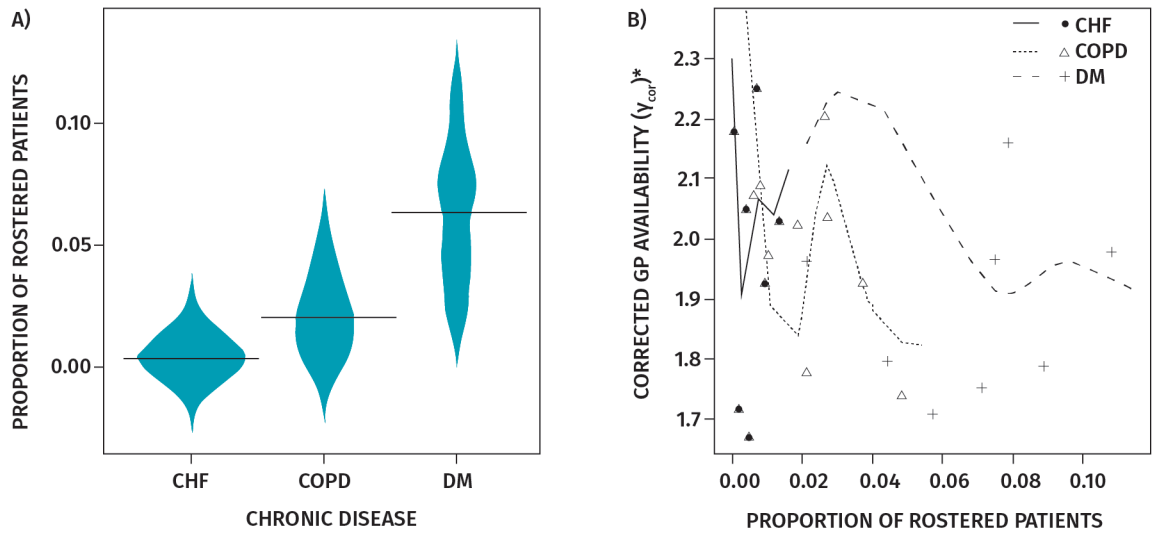
Unfortunately, we found evidence that as physicians become less available, visits to the after-hours WIC increase. There was no evidence of a threshold or a plateau value: more availability monotonically translates to fewer visits to the WIC. However, although improved from the ED model, the explanatory power of the WIC diversion model is low. This might be expected given high variability in the data with zero-inflation (eg, average [SD] of 0.17 [0.54] WIC visits per person per year), and myriad underlying conditions affecting the decision to visit a WIC. Further exit-survey research asking patients what motivated their WIC visits would be informative and could clarify whether reduced GP availability contributes.[16]

In the WIC model, we found that seniors (≥65) and men were less likely to visit compared with the reference categories of adults and women, respectively. By contrast, infants (<2) and children (2 to <18) were more likely to attend. Infants, children, and women are recognized as relatively higher-needs groups in the Murray et al[9] correction algorithm for patient complexity, so many of these patterns are to be expected. However, contrary to the algorithm, seniors had fewer observed visits. There might be an underlying disincentive to walk-in care for seniors that warrants further investigation.

Limitations

Our analysis of patient diversion to the ED was inconclusive. Given the low explained deviance, outlier sensitivity, and conceptually implausible results in the models, we are not confident that the patterns shown reflect true underlying relationships; the data might be overfit. This could reflect a true absence of relationship between low-acuity ED attendance and GP availability. For instance, Sancton et al[16] instead suggest that low-acuity ED visits from patients with a GP are often driven by patient perceptions that their issue is best dealt with

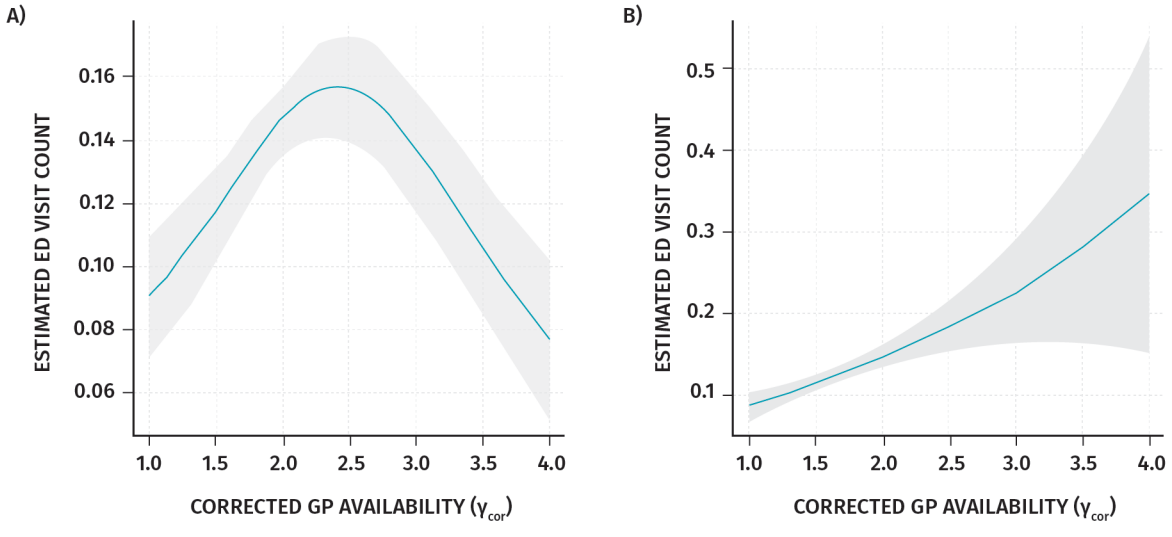
Figure 4. Chronic disease burdens of patient rosters and the relationship to GP availability: *A) Proportion of patients with CHF, COPD, or DM (solid lines represent the group mean); B) Local polynomial regressions of chronic disease burden vs GP availability. None showed statistically significant linear trends either with or without correction for roster size (not shown). Binned average values among chronic disease proportion subsets are shown to protect participant anonymity. The actual sample size is 21.*



CHF—congestive heart failure, COPD—chronic obstructive pulmonary disease, DM—diabetes mellitus.

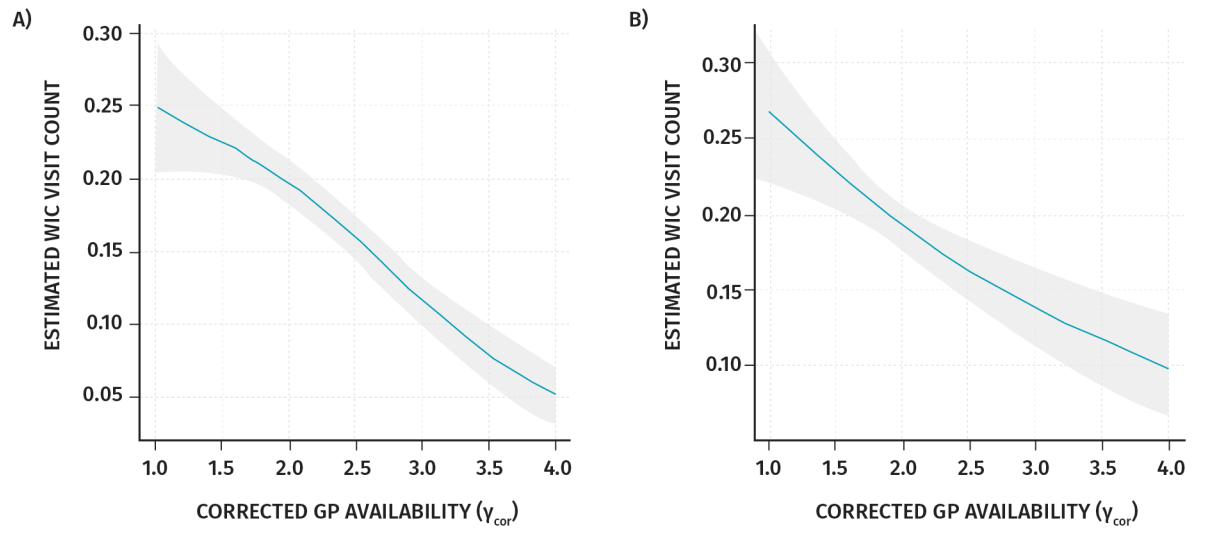
*No. of visits per patient per year. Higher values represent greater availability.

Figure 5. Nonlinear (GAM) effect of GP availability (number of visits per patient per year) on ED visits: *A) Highly available GP outliers included and B) excluded, for the reference categories of adult females with no comorbidities. Shading represents 95% CIs.*



ED—emergency department, GAM—generalized additive models.

Figure 6. Nonlinear (GAM) effect of GP availability (number of visits per patient per year) on WIC visits, with highly available GP outliers included (panel A) and excluded (panel B) for the reference categories of adult females with no comorbidities: *Shading represents 95% CIs.*



GAM—generalized additive models, WIC—walk-in clinic.

in the ED setting; in other cases, they are a direct referral from a GP after already having had an office visit.

One important limitation of our sample was the use of rosters from GPs opting in to the study, rather than from random selection. These might represent a highly-motivated subset of practitioners who are more likely to be available to their patients compared with the FHT average. In addition to broadening the GP sample, if possible, future work could also consider the role of same-day access, a new administrative priority for the FHT. Same-day appointments could both increase or unintentionally reduce GP availability—for instance, if these appointments are well-used in some cases but often unbooked in others. Optimizing the same-day appointment count might be a useful adjunct to reduce patient diversions without needing to increase workload or availability.

Conclusion

Our sample of GP rosters from the Timmins FHT is more complex on average than formal roster sizes imply. There is no evidence that the larger rosters and those with more patients with chronic conditions have reduced GP availability. Increasing GP availability might decrease after-hours WIC attendance, but not low-acuity, daytime ED visits. Future research should use WIC exit surveys to measure patient motivation to divert from the GP's office.

Dr Farmer is a family physician and Clinical Instructor for the Island Medical Programme on Vancouver Island, BC. **Dr Patel** is a locum family physician and hospitalist in Ontario and mentors international medical graduates for the Northern Ontario School of Medicine.

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Contributors

Both authors contributed to the concept and coordination of this project, and to drafting the manuscript.

Competing interests

None declared

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