# Characteristics and Practice Patterns of Family Physicians Who Provide Home Visits in Ontario, Canada: A Cross-Sectional Study

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## ABSTRACT

**Background:** Physician home visits are essential for populations who cannot easily access office-based primary care. The objective of this study was to describe the characteristics, practice patterns, and patient characteristics of physicians who provide home visits.

**Methods:** We used a retrospective, cross-sectional cohort design with health administrative data to describe home visit physicians and their patients in Ontario, Canada between January 1st, 2019 and December 31st, 2019. We selected a population-based cohort of home visit family physicians who had at least one home visit in 2019 (N=6,572). Physician demographics, practice patterns, and aggregated patient characteristics were compared between the top 5% of physicians by home visit volume and the majority (bottom 95%) of home visit physicians.

**Results:** The top 5% of home visit physicians (n=330) performed 58.6% of all home visits. Compared to the majority of home visit physicians (n=6,242), the top 5% were more likely to be male and practice in large urban areas, and rarely saw patients who were enrolled to them (median of 4% *vs.* 87.5%). Their patients were younger, had higher levels of healthcare resource utilization, resided in lower income and large urban neighborhoods, and were more likely to be recent immigrants, and less likely to have a medical home.

**Interpretation:** A small subset of home visit physicians provided a large proportion of home visits in Ontario, Canada in 2019. These home visits may be addressing a gap in access to primary care for certain patients, but could be contributing to lower continuity of care.


**Keywords:** physician home visits, primary care, Ontario, continuity of care

## INTRODUCTION

Home-based primary care is an essential service for individuals who are homebound and cannot easily access office-based primary care.[1–3] Without primary care at home, these individuals have more emergency department visits and hospitalizations.[4–6] Among end-of-life patients, physician home visits increase the likelihood of dying at home, which is desired by many.[7] Home visits are also perceived positively by patients, caregivers, and providers.[8]

Prior studies in Ontario have focused on physicians who perform home visits for older, functionally impaired, and homebound patients.[6] However, recent evidence suggests that up to half of physician home visits are for low-complexity patients who are under 50 years old and in self-reported good health.[9,10] These patients were least likely to have had a previous encounter with the visiting physician, and had low levels of previous and subsequent healthcare utilization.[10]

Though home visits have been declining since the 1930s[9,11,12], there has been a recent resurgence in the number of physician home visits in both the United States[13–15] and Canada.[3] However, the overall number of home-visiting US physicians has been decreasing, suggesting a small number of physicians are performing a high volume of home visits.[13,14] Given an ageing population in Canada, there is a need to plan for increasing numbers of homebound and palliative patients, by understanding who is providing home visits and how they practice. Here, we sought to describe the characteristics and practice patterns of family physicians who provided home visits compared to those who did not provide home visits in Ontario. We hypothesized that high-volume home visit physicians (top 5%) would have different practice

patterns from most home visiting physicians, and we explored this group and their patients' characteristics.

## METHODS

### Setting

Ontario is the most populous province in Canada, with ~14.5 million residents in 2019. The Ontario Health Insurance Program (OHIP) provides public health insurance to all residents, without premiums or co-payments. In Ontario, primary care is mostly provided by family physicians (FPs). Most of these practice within a medical home, known in Ontario as a Primary Care Enrolment Model (PEM),[16] where they work in a group of physicians who share accountability for after-hours care, formally enroll patients, and receive some blended payments.[2,4,6,7,17–19] Physicians not working in a medical home are paid on a fee-for-service basis.[16] Approximately 93% of Ontarians aged 16 or older have a primary care provider, and 82% are formally enrolled in a medical home.[16,20] The Ontario Ministry of Health incentivizes physician home visits by offering special visit premiums [21] and volume-based bonus payments (Tables S1A and S1B).[22]

### Study Design and Data Sources

This was a retrospective, population-based cross-sectional study of family physicians, using administrative health datasets. Datasets were linked using unique encoded identifiers and analyzed at ICES. ICES is an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyze health care and

demographic data, without consent, for health system evaluation and improvement (see Table S2 for list of databases used).

**Study Population and Physician Groups**

*Home visit physicians*

We identified all Ontario physicians who provided at least one home visit between January 1st and December 31st, 2019 (N=7,211), and then restricted to the categories of "family/general practice" and "family/emergency medicine" (FP/GPs and FP/EMs; n=6,572, see Table S3 for top 10 physician specialties). The first home visit per physician was selected as the "index" visit (see Figure S1 for cohort flow chart).

*Home visit physician volume groups*

Based on the distribution of the Lorenz curve, we selected the top 5% of physicians for the 'high-volume' group. The 'majority' group of physicians were those not in the top 5% (i.e., the bottom 95%) of home visit volumes in 2019. We created additional categories based on home visit volume incentive thresholds from the Ontario Ministry of Health, grouping physicians according to whether their annual volume fell within each of the following categories: 1-11, 12-23, 24-67, 68-127 and 128+ encounters in 2019.

*Office visit-only physicians*

All FP/GPs in Ontario with an active billing number and who provided at least one office visit between January 1st and December 31st, 2019 (N=8,186). We selected each physician's first office visit as the index visit.

**Physician Characteristics**

Measures included: physician age, self-reported gender (as "male" or "female"), location of graduating medical school (Canada or other), location of practice (urban/rural), and type of medical home (PEM). We also measured the following aggregated physician-level *practice measures* from January 1st, 2019 to December 31st, 2019: number of home visits and unique patients, number of home visits per patient, proportion of total fee-for-service billings from home visits, number of patients seen on a day doing home visits, number of home visits per day with at least one home visit, and proportion of home visits made during off-hours (evenings/weekends/holidays). *Patient* characteristics aggregated at the physician-level were: proportion of patients aged 65 years and older, proportion of patients living in a lower income neighborhood, proportion of patients residing in a large urban area, proportion of patients who were recent immigrants,[23] proportion of patients enrolled to the physician personally, or enrolled to a member of the visiting physician's group, proportion of patients previously known to the physician in the prior 2 years, and proportion of patients not enrolled in a medical home. For each of these measures, we reported the physician-level median. Using the definitions of visit type in Table S4, we similarly reported the median proportion of home visits that were palliative, to patients who received home care, or neither.[10]

We also examined the physicians' typical (median) patient's age, as well as their patients' healthcare resource utilization over the previous 2 years (obtained from The Johns Hopkins ACG® System Version 10) grouped into low (0-2), moderate (3), and high (4-5) ACG® System Resource Utilization Bands (RUBs),[24] (see Table S5 for operational definition of all variables).

## Data Analysis

### *Lorenz Curve*

To explore the distribution of home visit volumes performed by home visiting physicians, we used a Lorenz curve analysis.[25,26] The greater the deviation of the curve from the diagonal midline, the more inequality there is amongst physicians, indicating that a small number of physicians provide a high proportion of all home visits. The findings from the Lorenz curve guided us in selecting a threshold for the high-volume physicians (top 5%).

### *Physician comparisons*

We described the characteristics of physicians providing home visits either as physician-level medians of patient proportions (median percentage, IQR) or as counts and frequencies of aggregated patient medians.

We made two comparisons based on home visit volumes: 1) high-volume physicians (top 5%) compared to the majority of home visit physicians, and 2) the majority of physicians providing home visits compared to physicians who didn't provide home visits. Statistical comparisons were made using the standardized mean difference (SMD), with 10% (0.1) considered meaningful.[27] In addition, we examined physician characteristics across volume incentive thresholds using the Kruskal-Wallis tests for median variables, and Chi-square for categorical variables, at a two-tailed $p < .05$ significance threshold. All comparisons were unadjusted, as we sought to describe and contrast the real-world characteristics and practice patterns of home visit physicians. All analyses were done in SAS software, version 9.4 (SAS Institute Inc., Cary, NC).

## Ethics Approval

The use of the data in this project is authorized under Section 45 of Ontario's Personal Health Information Protection Act (PHIPA) and does not require review by a Research Ethics Board.

## RESULTS

*Lorenz curves*

In 2019, 387,139 home visits were performed by 6,572 family physicians (Figure 1). Ninety percent of these home visits (n = 348,430) were performed by the top 26.8% (n = 1,765) of physicians. The top 10% of physicians (n = 658) performed 73% of all home visits (n = 282,762), and the top 5% (n = 330) performed 58.6% (n = 227,321).

*Characteristics of high-volume home visit physicians*

The top 5% of home visit physicians (n=330) were of similar age to the majority of home visit physicians (51 *vs.* 50 years, SMD = 0.04), and were more likely to be male (63.3% *vs.* 53.7%, SMD = 0.20; see Table 1), to practice in large urban locations (54.8% *vs.* 43.1%, SMD = 0.24) and were less likely to be part of a medical home (64.5% *vs.* 84.9%, SMD = 0.48). High-volume physicians were less likely to participate in capitation (21.9% *vs.* 13.6%, SMD = 0.22) or team-based models (SMD = 0.50), and more likely to practice in an enhanced fee-for-service (30.8% *vs.* 38.5%, SMD = 0.16) or fee-for-service model (15.1% *vs.* 35.5%, SMD = 0.48).

The high-volume home visit physicians performed a median of 477.5 (IQR = 346-813) home visits in 2019, compared to 9 visits (IQR = 2-28) for the majority of home visiting physicians

(SMD = 2.58). They saw a median of 126 unique patients (IQR = 79-240), compared to 5 unique patients for the majority of physicians (IQR = 2-12, SMD = 2.50).

A median of 31.5% (IQR = 16.6-51.6%) of the high-volume physicians' total fee-for-service income came from home visits, compared to 0.9% (IQR = 0.2-3.4%) for the majority of physicians (SMD = 2.22). On any given day that a home visit was performed, the high-volume physicians saw a median of 3 patients (IQR = 2-5.5), whereas most home visit physicians only saw 1 patient per day (IQR = 1-1, SMD = 3.09). High-volume physicians had a median of 4.1 home visits per patient, compared to 1.6 visits for most home visit physicians (SMD = 1.20). Off-hours home visits were performed more often by high-volume physicians (median of 17.9% *vs.* 16.7%, SMD = 0.27).

*Physician-level aggregated patient characteristics of high-volume home visit physicians*

Whereas the majority of home visit physicians were more likely to have a median patient age of over 80 years, the median patient age for the top 5% of physicians was more likely to be between 65 and 79 years (Table 1). A lower proportion of the top 5% of physicians' patients were aged 65 years or older (physician-level median of 82.4% *vs.* 96.3%, SMD = 0.66).

A median of 4% (IQR = 0-56.3%) of home visits from high-volume physicians were to patients enrolled to them or their own group, compared to 87.5% (IQR = 28.6-100%) for the majority of home visit physicians (SMD = 1.12). Patients of the high-volume physicians were less likely to belong to a medical home (median of 73% *vs.* 97.8%, SMD = 1.03). The top 5% of physicians saw fewer patients who were previously known to them in the prior 2 years (72.3% *vs.* 100%, SMD = 1.13). Home visit patients of the high-volume physicians were more likely to live in lower

income neighborhoods (median of 46.4% *vs.* 37.5%, SMD = 0.23), large urban areas (median of 66.4% *vs.* 6.3%, SMD = 0.29), and were more likely to be recent immigrants (0.2% *vs.* 0%, SMD = 1.19). High-volume physicians saw more palliative patients (median of 7.1% *vs.* 3.8%, SMD = 0.30), and more patients who neither had a palliative visit nor received homecare (median of 42.6% *vs.* 29.4%, SMD = 0.10). High-volume physicians were more likely to have a typical patient with high healthcare resource utilization (median of 88.5% *vs.* 80.3%, SMD = 0.23).

*Comparison of the majority of home visiting family physicians to physicians who don't provide home visits*

The majority (95%) of physicians who provided home visits were older than those who did not (median of 50 *vs.* 46, SMD = 0.21) and more likely to be a Canadian medical graduate (60.4% *vs.* 52.4%, SMD = 0.16; see Table 2). Home visiting physicians were more likely to practice in a rural (9.9% *vs.* 5.9%, SMD = 0.15) or small urban location (20.8% *vs.* 12.7%, SMD = 0.22), and were 1.7 times more likely to belong to a medical home (84.9% *vs.* 48.8%, SMD = 0.83).

Nearly all (median 96.3%) home visit physicians' patients were over 65 years of age, compared to only 20.5% for the no home visit group (SMD = 1.69), and home visit physicians had a much lower proportion of patients from large urban settings. Home visit physicians had a higher proportion of visits with patients who were previously known to them and were less likely to see patients who did not belong to a medical home (2.2% *vs.* 21.4%, SMD = 0.64). The typical home visit patient was more likely to have high healthcare utilization (80.3% *vs.* 18.5%, SMD = 1.57).

*Trends across volume incentive thresholds*

Differences across volume incentive thresholds were consistent with the comparison of the top 5% and the majority of home visit physicians. As home visit volume increased, there was a decrease in proportion of female physicians, home visits made to the physicians' own enrolled patients or to patients in their group, patients previously known to them, patients with moderate levels of healthcare usage, homecare recipients, and palliative home visits (Table S6). Conversely, we saw an *increase* in proportion of patients who lived in lower income neighborhoods or large urban areas, patients who were not in a medical home, and patients who were neither palliative nor receiving homecare services.

**INTERPRETATION**

In this population-based study of all physicians providing home visits in Ontario in 2019, we found that the top 5% of physicians by home visit volume performed more than half (58.6%) of all home visits in the province. A median of just 4% of home visits performed by the high-volume physicians were to patients enrolled to them personally or to their group, compared to 87.5% for the majority of home visit physicians. High-volume physicians were more likely to practice in large urban areas, and less likely to be part of a medical home. Their patients were younger, lived in lower income neighborhoods, were more likely to be recent immigrants, had high levels of healthcare utilization, and were less likely to be enrolled to a medical home. We observed similar trends in physician-level characteristics across home visit volume incentive thresholds.

Home-visiting physician characteristics in our study are concordant with findings from other provinces[28,29] and the United States[13] (i.e., older, male, and practice located in rural locations).

Visits to those who were neither palliative nor receiving home care accounted for 29.4% of the visits made by most home visit physicians, and 43.6% of the visits made by the high-volume physicians.[10] Though we found that the majority of home visiting physicians see older, functionally impaired patients, the high-volume physicians are serving a distinct subset of the population. Given the patient characteristics of the high-volume physicians (i.e., younger, low income, high healthcare utilization, and recent immigrants), they may be addressing a gap in equitable access to healthcare resources. Home visits may provide a low-barrier option for those with disabilities, without transportation, or without alternative childcare. Some of the home visits by high-volume physicians may reflect an 'uberization' of health care, such that service is driven by patients who determine where and when they will be delivered care.[30]

Greater patient-physician continuity is associated with fewer emergency department visits and hospitalizations, as well as higher levels of patient and physician satisfaction.[31,32] Additionally, there is evidence that homecare patients who are enrolled to high-volume home visiting physicians have lower rates of emergency department use and hospital admissions compared to those who are enrolled to physicians who provide *no* home visits.[6] Here, we found that high-volume physicians rarely saw patients who were enrolled to them or their group. It is unknown whether the benefits of seeing a high-volume home visit physician extend to visits occurring outside of the medical home, such as those provided by high-volume home visit physicians.

Patients of high-volume physicians may have difficulty accessing their enrolled physician and use home visits as an alternative. Yet, a median of 72.3% of the high-volume physicians' patients were previously known to them in the prior 2 years, suggesting fairly high relational continuity with the home visit physicians, if not with the medical home physician. Though our

study does not provide direct insight into *informational continuity*, we do know that it is not a requirement for home visit physicians to communicate with the patient's enrolled physician. Policymakers should consider strengthening informational continuity by requiring home visit physicians to share notes with the patient's rostering physician, or through a shared electronic patient record, which is not universal in Ontario. It may not be possible for the patient's own enrolled physician to provide home visits themselves, and our findings suggest that home visit physicians may fill a gap in primary care for these patients. Physicians who provide a high-volume of home visits may also be 'specializing' in home visits. Policymakers might consider how high-volume home visit physicians fit into existing payment structures and professional practice standards. Such home visit specialists may benefit from a focused practice designation, allowing for unique continuing medical education opportunities, competencies, and oversight.

Whereas previous studies of home visit physicians focused on specific programs or patient populations (palliative, homebound, frail, and/or older patients[2,4,6,7,17–19] ), we examined all family physicians who provided home visits across the entire health care system.

**Limitations**

There are several limitations to our study. First, health administrative data sources don't allow us to know the detailed reasons why high-volume physicians see so many patients – all we can observe is their billing patterns. Second, we did not examine quality of care indicators, such as the efficiency or effectiveness of home visits. Third, in using health administrative data, we cannot know patients' perspectives, and why they may have sought a home visit rather than an office visit with their enrolled physician. Although we can hypothesize that they may face

barriers accessing their family physician, we do not have the qualitative data to support this. Fourth, our findings are set in Ontario, and may not be generalizable to settings without universal funding coverage for physician home visits. Finally, our study does not encompass the COVID-19 pandemic. Given a shift to providing telehealth and virtual visits during the COVID-19 pandemic,[33,34] more research is needed to examine how the practice patterns of physicians who provide home visits have changed over time.

**Interpretation**

In this retrospective population study of Ontario, Canada, we found that the top 5% of home visit physicians provided more than half of all home visits in 2019. These high-volume home visit physicians rarely saw their own enrolled patients, or their group members' patients. Patients of high-volume physicians were younger, lived in lower income and large urban neighborhoods, and were more likely to be recent immigrants. Physicians who provide home visits might enhance primary care for those who face barriers to attending office visits or who are otherwise unattached. These findings can be used to inform further research and policies to support optimal integration of physician home visits into comprehensive primary care.

## Data Sharing Statement

The dataset from this study is held securely in coded form at ICES. While legal data sharing agreements between ICES and data providers (e.g., healthcare organizations and government) prohibit ICES from making the dataset publicly available, access may be granted to those who meet pre-specified criteria for confidential access, available at www.ices.on.ca/DAS (email: das@ices.on.ca). The full dataset creation plan and underlying analytic code are available from the authors upon request, understanding that the computer programs may rely upon coding templates or macros that are unique to ICES and are therefore either inaccessible or may require modification.

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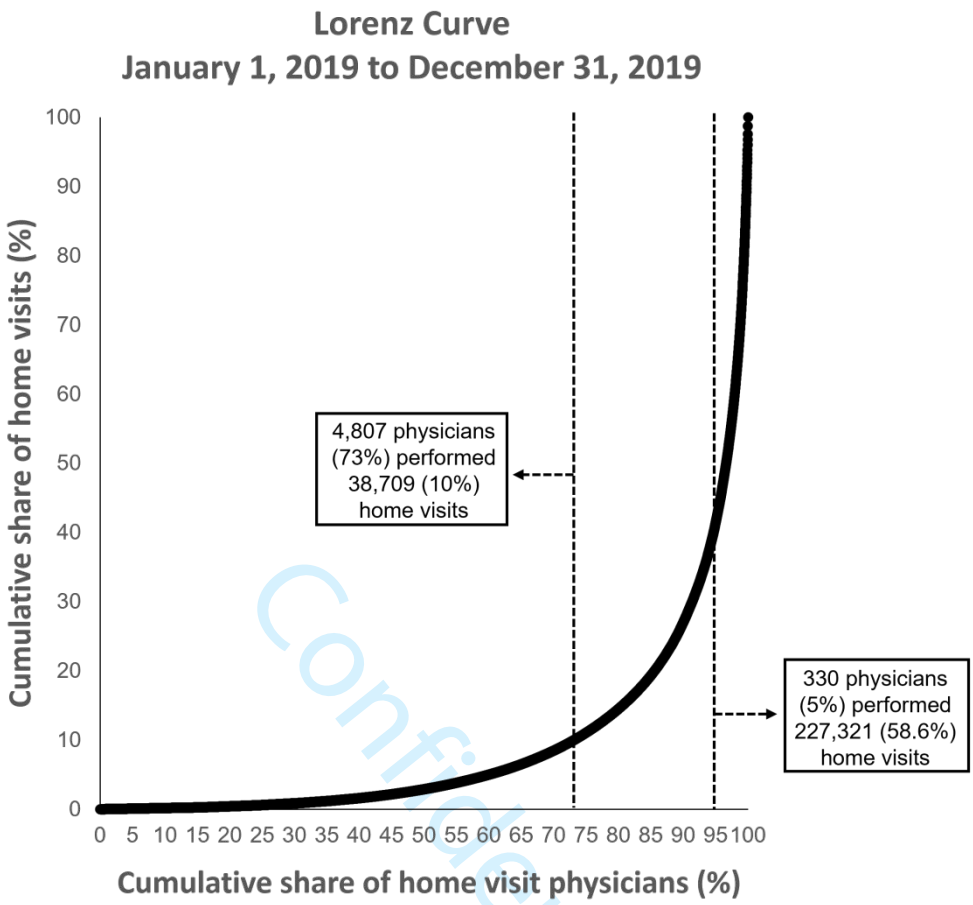



*Note.* This curve was generated by rank-ordering family physicians by their volume of home visits, then plotting the cumulative percent of physicians (x-axis) against the cumulative percent of home visits (y-axis).

**Figure 1.** Lorenz curve of the distribution of home visits across family physicians who provided at least one home visit from January 1, 2019 to December 31, 2019 in Ontario, Canada.

**Table 1. Characteristics of Physicians, their Practice Patterns, and their Patient Characteristics for the Top 5% of Home Visit Physicians Compared to the Majority of Home Visit Physicians.** Unless otherwise stated, variables are measured between January 1st, 2019 and December 31st, 2019.

| Physician Characteristics | Top 5% of Home Visit Physicians N = 330 | Majority of Home Visit Physicians N = 6,242 | Standardized Mean Difference |
|---|---|---|---|
| **Physician age (years), n (%)** | | | |
| Median (IQR) | 51 (38-61) | 50 (38-60) | 0.04 |
| **Self-reported physician gender, n (%)** | | | |
| "Female" | 121 (36.7) | 2,887 (46.3) | 0.20 |
| **Canada medical graduate, n (%)** | | | |
| Yes | 196 (59.4) | 3,768 (60.4) | 0.02 |
| Missing | 61 (18.5) | 1,228 (19.7) | 0.03 |
| **Physician urban/rural practice, n (%)** | | | |
| Large urban | 181 (54.8) | 2,689 (43.1) | 0.24 |
| Medium urban | 89 (27.0) | 1,606 (25.7) | 0.03 |
| Small urban | 49 (14.8) | 1,299 (20.8) | 0.16 |
| Rural | 10 (3.0) | 616 (9.9) | 0.28 |
| Missing | 33 (0.5) * | | - |
| **Physician medical home enrolment, n (%)** | 213 (64.5) | 5,301 (84.9) | 0.48 |
| **Physician compensation model, n (%)** | | | |
| Capitation | 45 (13.6) | 1,370 (21.9) | 0.22 |
| Team-based | >= 35 (>= 10.6) * | 1,950 (31.2) | 0.50 |
| Enhanced fee for service | 127 (38.5) | 1,924 (30.8) | 0.16 |
| Fee for service | 117 (35.5) | 941 (15.1) | 0.48 |
| Other | 60 (0.9) * | | 0 |
| **Physician-Level Home Visit Volumes and Payment** | **Top 5% of Home Visit Physicians N = 330** | **Majority of Home Visit Physicians N = 6,242** | **Standardized Mean Difference** |
| **Number of home visits, median (IQR)** | 477.5 (346-813) | 9 (2-28) | 2.58 |
| **Number of unique patients seen, median (IQR)** | 126 (79-240) | 5 (2-12) | 2.50 |
| **Patients seen per day on a day doing home visits, median (IQR)** | 3 (2-5.5) | 1 (1-1) | 3.09 |
| **Number of home visits per patient, median (IQR)** | 4.1 (2.4-6.4) | 1.6 (1-2.5) | 1.20 |
| **Home visits income (% total billing), median (IQR)** | 31.5 (16.6-51.6) | 0.9 (0.2-3.4) | 2.22 |
| **Proportion of home visits that are off-hours[a] (%), median (IQR)** | 17.9 (3.8-84.5) | 16.7 (0-66.7) | 0.27 |

| Physician-Level Patient Characteristics | Top 5% of Home Visit Physicians N = 330 | Majority of Home Visit Physicians N = 6,242 | Standardized Mean Difference |
|---|---|---|---|
| **Median patient age (years), n (%)** | | | |
| <18 years | 110 (1.7) * | | 0.13 |
| 18 - 39 years | 199 (3.0) * | | 0.13 |
| 40 - 64 years | 42 (12.7) | 696 (11.2) | 0.05 |
| 65 - 79 years | 115 (34.8) | 1,637 (26.2) | 0.19 |
| 80+ years | 157 (47.6) | 3,616 (57.9) | 0.21 |
| **Proportion of patients aged 65 years or older (%), median (IQR)** | 82.4 (61.6-95.1) | 96.3 (70-100) | 0.66 |
| **Median patient healthcare resource utilization band, n (%)** | | | |
| Low (0 - 2) | 0 | 122 (2.0) | 0.20 |
| Moderate (3) | 38 (11.5) | 1,109 (17.8) | 0.18 |
| High (4 - 5) | 292 (88.5) | 5,011 (80.3) | 0.23 |
| **Proportion of patients in a lower income neighborhood (%), median (IQR)** | 46.4 (30.7-57.1) | 37.5 (3.8-71.4) | 0.23 |
| **Proportion of large urban patients (%), median (IQR)** | 66.4 (1.9-97.2) | 6.3 (0-100) | 0.29 |
| **Proportion of recent immigrant patients[b] (%), median (IQR)** | 0.2 (0-2) | 0 (0-0) | 1.19 |
| **Proportion of home visits made to patients who are enrolled to them personally (%), median (IQR)** | 0.3 (0-50.1) | 75 (0-100) | 0.93 |
| **Proportion of home visits made to their own or to their group enrolled patients (%), median (IQR)** | 4 (0-56.3) | 87.5 (28.6-100) | 1.12 |
| **Proportion of patients previously known in the prior 2 years (%), median (IQR)** | 72.3 (34.1-94) | 100 (80-100) | 1.13 |
| **Proportion of patients not in a medical home (%), median (IQR)** | 27 (18.8-41.1) | 2.2 (0-29.8) | 1.03 |
| **Proportion of home visits made to patients who received 2+ home care visits in the previous 30 days (%), median (IQR)** | 53.9 (32.1-82) | 60 (28.1-87.1) | 0.08 |
| **Proportion of home visits that were palliative (%), median (IQR)** | 7.1 (0-95.8) | 3.8 (0-50) | 0.30 |
| **Proportion of home visits that were neither homecare nor palliative (%), median (IQR)** | 42.6 (1.2-66.6) | 29.4 (0-61.5) | 0.10 |

*Note.* Standardized mean differences greater than or equal to 10% (0.1) are considered meaningful. ***** Cells adjusted or combined to prevent re-identification of groups < 6 individuals. [a] 'Off-hours' was defined as a visit occurring between 5pm and 7am on weekdays or anytime on Saturday/Sunday and public holidays. [b] 'Recent' was defined as within the past 10 years.

**Table 2. Characteristics of Physicians with No Home Visits Compared to the Majority of Home Visit Physicians as well as their Patients and Practice Patterns.** Unless otherwise stated, variables are measured between January 1st and December 31st, 2019.

| Physician Characteristics | Majority of Home Visit Physicians N = 6,242 | No Home Visit Physicians N = 8,186 | Standardized Mean Difference |
|---|---|---|---|
| **Physician age (years), n (%)** | | | |
| Median (IQR) | 50 (38-60) | 46 (36-57) | 0.21 |
| **Self-reported physician gender, n (%)** | | | |
| "Female" | 2,887 (46.3) | 4,083 (49.9) | 0.07 |
| **Canada medical graduate, n (%)** | | | |
| Yes | 3,768 (60.4) | 4,292 (52.4) | 0.16 |
| Missing | 1,228 (19.7) | 2,257 (27.6) | 0.19 |
| **Physician urban/rural practice, n (%)** | | | |
| Large urban | 2,689 (43.1) | 4,346 (53.1) | 0.20 |
| Medium urban | 1,606 (25.7) | 2,295 (28.0) | 0.05 |
| Small urban | 1,299 (20.8) | 1,038 (12.7) | 0.22 |
| Rural | 616 (9.9) | 480 (5.9) | 0.15 |
| Missing | 32 (0.5) | 27 (0.3) | 0.03 |
| **Physician medical home enrolment, n (%)** | 5,301 (84.9) | 3,992 (48.8) | 0.83 |
| **Physician compensation model, n (%)** | | | |
| Capitation | 1,370 (21.9) | 915 (11.2) | 0.29 |
| Team-based | 1,950 (31.2) | 898 (11.0) | 0.51 |
| Enhanced fee for service | 1,924 (30.8) | 2,102 (25.7) | 0.11 |
| Fee for service | 941 (15.1) | 4,194 (51.2) | 0.83 |
| Other | 57 (0.9) | 77 (0.9) | 0 |
| **Physician-Level Patient Characteristics** | **Majority of Home Visit Physicians N = 6,242** | **No Home Visit Physicians N = 8,186** | **Standardized Mean Difference** |
| **Median patient age (years), n (%)** | | | |
| <18 years | 98 (1.6) | 67 (0.8) | 0.07 |
| 18 - 39 years | 195 (3.1) | 2,513 (30.7) | 0.79 |
| 40 - 64 years | 696 (11.2) | 4,724 (57.7) | 1.12 |
| 65 - 79 years | 1,637 (26.2) | 612 (7.5) | 0.52 |
| 80+ years | 3,616 (57.9) | 270 (3.3) | 1.47 |
| **Proportion of patients aged 65 years or older (%), median (IQR)** | 96.3 (70-100) | 20.5 (11.1-34) | 1.69 |
| **Median patient healthcare resource utilization band, n (%)** | | | |
| Low (0 - 2) | 122 (2.0) | 38 (0.5) | 0.14 |
| Moderate (3) | 1,109 (17.8) | 6,633 (81.0) | 1.63 |
| High (4 - 5) | 5,011 (80.3) | 1,515 (18.5) | 1.57 |
| **Proportion of patients in lower income neighborhoods (%), median (IQR)** | 37.5 (3.8-71.4) | 40.1 (27.9-52.8) | 0.08 |
| **Proportion of large urban patients (%), median (IQR)** | 6.3 (0-100) | 53.6 (2.9-86.2) | 0.18 |
| **Proportion of recent immigrant patients[a] (%), median (IQR)** | 0 (0-0) | 1.9 (0.2-5.4) | 1.77 |

| Physician-Level Patient Characteristics | Majority of Home Visit Physicians N = 6,242 | No Home Visit Physicians N = 8,186 | Standardized Mean Difference |
|---|---|---|---|
| **Proportion of patients previously known in the prior 2 years (%), median (IQR)** | 100 (80-100) | 54.4 (12-82.6) | 1.32 |
| **Proportion of patients not in a medical home (%), median (IQR)** | 2.2 (0-29.8) | 21.4 (10.1-35.2) | 0.64 |

*Note.* Standardized mean differences greater than or equal to 10% (0.1) are considered meaningful. [a] 'Recent' was defined as within the past 10 years.

**List of Supplemental Materials**

**Table S1A: Volume Incentive Thresholds for Patient Enrolment Model Physician Home Visits.** Applicable to physicians in patient enrolment models of care (BSM, SJHC, WAHA, RNPGA, SEAMO, HIV, GHC, CCM, FHG, FHN, and FHO) for both rostered and unrostered patients.

Available: https://www.health.gov.on.ca/en/pro/programs/ohip/bulletins/11000/bul11088.pdf

https://www.health.gov.on.ca/en/pro/programs/ohip/bulletins/11000/bul11089.pdf

| Bonus Level | Home Visits | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Necessary annual criteria | 3 or more patients served and | 6 or more patients served and | 17 or more patients served and | 32 or more patients served and |
| | 12 or more encounters | 24 or more encounters | 68 or more encounters | 128 or more encounters |
| Annual Bonus | $1,500 | $3,000 | $5,000 | $8,000 |

**Table S1B: Volume Incentive Thresholds for Fee-For-Service Physician Home Visits.** Applicable for fee-for-service (FFS) physicians.

Available: https://www.health.gov.on.ca/en/pro/programs/ohip/bulletins/4000/bul4609.pdf

| Bonus Level | Home Visits | |
|---|---|---|
| | A | B |
| Necessary annual criteria | 3 or more patients served and | 6 or more patients served and |
| | 12 or more encounters | 24 or more encounters |
| Annual Bonus | $1,500 | $3,000 |

## Table S2: ICES data sources

| Database name | Description |
|---|---|
| **Client Agency Program Enrolment Database (CAPE)** | Links physicians to their enrolled patients under several patient enrolment models of clinical practice. These funding models include enhanced fee for service, non-team capitation, and team-based capitation.(1) |
| **Discharge Abstract Database (DAD)** | Information on all admissions (excluding designated mental health beds) to acute care hospitals in Ontario. This includes dates of admission as well as diagnostic and procedural codes. Overall, diagnostic codes were found to be 82% sensitive for primary diagnosis when verified against chart abstraction.(2) |
| **Home Care Database (HCD)** | Includes all publicly funded home care services, including the service type (end-of-life or not).(3) |
| **ICES Physician Database (IPDB)** | Contains yearly (fiscal) information about all physicians in Ontario. It is used to describe physician characteristics, such as sex, speciality, location, and measures of physician activity (billings, workload, types of services provided).(4) |
| **Immigration Refugees and Citizenship Canada Permanent Resident Database (IRCC)** | Contains information on immigrants who have landed in Ontario since 1985.(5) |
| **National Ambulatory Care Reporting System (NACRS)** | Includes information for all emergency department visits since 2000. A re-abstraction study of diagnostic codes found 85% agreement for the main presenting problem.(6) |
| **Ontario Health Insurance Plan (OHIP)** | Contains information on all billing claims submitted by Ontario physicians (consultations and procedures). Fee for service is the primary method of remuneration for 95% of specialist physicians and 50% of primary care physicians in Ontario. However, physicians practicing in non fee-for-service models submit shadow billings to OHIP, which appear as billing claims with a payment value of $0.(7) |
| **Registered Persons Database (RPDB)** | Contains demographic information about anyone who has ever received an Ontario health card number, i.e. all Ontarians alive at any time since 1990 (over 16 million records).(8) |

**Table S3: Top 10 Specialties of Physicians who Provided Home Visits in Ontario, Canada between January 1st, 2019 and December 31st, 2019.**

| Main Specialty | Frequency, n (%) (N = 7,211) |
|---|---|
| Family practice/general practice | 6,438 (89.3) |
| Psychiatry | 152 (2.1) |
| Family practice/emergency medicine | 134 (1.9) |
| Pediatrics | 63 (0.9) |
| Geriatric medicine | 58 (0.8) |
| Internal medicine | 47 (0.6) |
| Geriatric psychiatry | 32 (0.4) |
| General surgery | 22 (0.3) |
| Anesthesiology | 19 (0.3) |
| Dermatology | 18 (0.2) |

**Table S4: Codes Used to Identify Palliative Care and Not Palliative Home Visits.** Home visits were first classified as palliative if any palliative codes were present

| Type of Home Visit | Code | Descriptor of code |
|---|---|---|
| **Palliative care** | B998 | Palliative Home Visit - Special visit premium daytime/evenings/weekend |
| | B997 | Palliative Home Visit - Special visit premium nights |
| | B966 | Palliative Home Visit- Travel premium |
| | A777 | Pronouncement of death |
| | A902 | House call to pronounce death |
| | A905 | General/Family practice - Limited consultation |
| | A945 | General/Family Practice - Special palliative care consultation |
| | G512 | Palliative care case management fee |
| **Not palliative** (used for home care services group and 'other' group) | A901 | House call assessment (in FP/GP section) |
| | A900 | Complex house call assessment- for "frail elderly or housebound" |
| | B960, B990, B961, B992 | Home visit Special visit premiums daytime |
| | B962, B994, B964, B996 | Home visit Special visit premiums evenings and nights |
| | B963, B993 | Home visit Special visit premiums Weekends and holidays |

**Table S5: Operational Definitions for all Variables.** Unless otherwise stated, variables are measured between January 1st, 2019 and December 31st, 2019.

| Physician Characteristics | | |
|---|---|---|
| **Variable** | **Data Source** | **Definition** |
| Physician age | IPDB | Age in years |
| Physician sex | IPDB | Male<br>Female |
| Canada medical graduate | IPDB | "CMG" variable in IPDB categorized as:<br>Yes<br>No<br>Missing |
| Physician urban/rural practice | IPDB | Postal code converted to RIO score(16)<br>0: large urban (metropolitan areas)<br>1-9: medium urban<br>10-39: small urban<br>40+: rural |
| Physician specialty | IPDB | MAINSPECIALTY variable indicates practice specialty of physician. |
| Physician medical home enrolment | CAPE | Whether the physician is part of a medical home (primary care enrolment model), or not. |
| Physician compensation model | CAPE, IPDB | The type of patient enrolment model the physician belongs to.<br>Categories are:<br>Team-Based (Family health team)<br>Capitation (Family health network or family health organization)<br>Enhanced Fee-For-Service (Comprehensive care model or family health group)<br>Other (all other models)<br>Fee-For-Service |
| **Physician-Level Home Visit Volumes and Payment** | | |
| Number of home visits | OHIP | Count of all home visits provided in the 365 days after the index home visits. |
| Number of unique patients seen | OHIP | Count of unique patients seen in subsequent 365 days after randomly selected index home visits. |
| Patients seen per day on a day doing home visits | OHIP | Median number of patients seen on a day doing home visits, in the 365 days following the index home visit. |
| Number of home visits per patient | OHIP | Ratio between the count of all home visits in subsequent 365 days after randomly selected index home visits, divided by the count of unique patients seen in home visits. |
| Home visit income (% total) | OHIP | Proportion of total billings ($) that are generated by home visit codes in the 365 days after the index home visit. |
| Proportion of 'off-hours' home visits | OHIP | Proportion of home visits in the 365 days following the index home visit that are accompanied by an off-hours premium code (B997, B987, B962, B994, B964, B996, B963, B993). |

| Physician-Level Patient Characteristics | | |
|---|---|---|
| **Variable** | **Data Source** | **Definition** |
| | | |
| Median patient age | RPDB, OHIP | Median patient age in the 365 days following the index home (or office) visit. Categorized as:<br><18 years (children)<br>18-39 years (young adult)<br>40-64 years (middle aged)<br>65-79 years (younger seniors)<br>80+ years (older seniors) |
| Proportion of patients aged 65 or older | RPDB, OHIP | Proportion of patients aged 65 or older at the time of the index home (or office) visit. |
| Median patient healthcare resource utilization | DAD, NACRS, OHIP | Using Resource Utilization Bands (RUBs), per the Johns Hopkins ACG® System Version 7, in 2 years prior to the index date.(18) Categorized as:<br>Low (0-2)<br>Moderate (3)<br>High (4-5) |
| Proportion of patients in a lower income neighborhood | RPDB, Census, OHIP | Proportion of patients with nearest census-based income quintile of 1 or 2 based on postal code (based on 2016 census). |
| Proportion of large urban patients | RPDB, OHIP | Proportion of all home (or office) visits with patients who reside in a large urban location. Postal code converted to RIO score(16)<br>0: large urban/metropolitan |
| Proportion of recent immigrant patients | IRCC, OHIP | Present in the CIC (IRCC) database and landing date is within the past 10 years of index visit. |
| Proportion of home visits made to patients who are rostered to them personally | CAPE, OHIP | Using macro getpcprovider.sas, count of each physician's home visits to their own rostered patients in the 365 days following the index home visit. |
| Proportion of home visits made to their own rostered patients or to their group | CAPE, OHIP | Using macro getpcprovider.sas, count of each physician's home visits to patients who are rostered and have a group number that matches the physicians' group number in the 365 days following the index home visit. |
| Proportion of patients previously known in the prior 2 years | OHIP | Proportion of patients with whom a physician has had any encounter with in the previous 2 years in any setting, other than the index encounter. |
| Proportion of patients not in a medical home | CAPE, OHIP | Proportion of patients not enrolled in a medical home at first encounter. |
| Proportion of home visits made to patients who received 2+ home care visits in the previous month | HCD, OHIP | Count of home visits in the subsequent 365 days after the index visit where the patient had at least 2 home care visits in the 30 days before the home visit. |
| Proportion of home visits that were palliative | OHIP | Count of home visits in the subsequent 365 days after the index visit that were palliative (Appendix Table 3). |
| Proportion of home visits that were neither home care nor palliative ('other') | OHIP | Count of home visits in the subsequent 365 days of the index visit that were 'other' home visits (Appendix Table 3). |

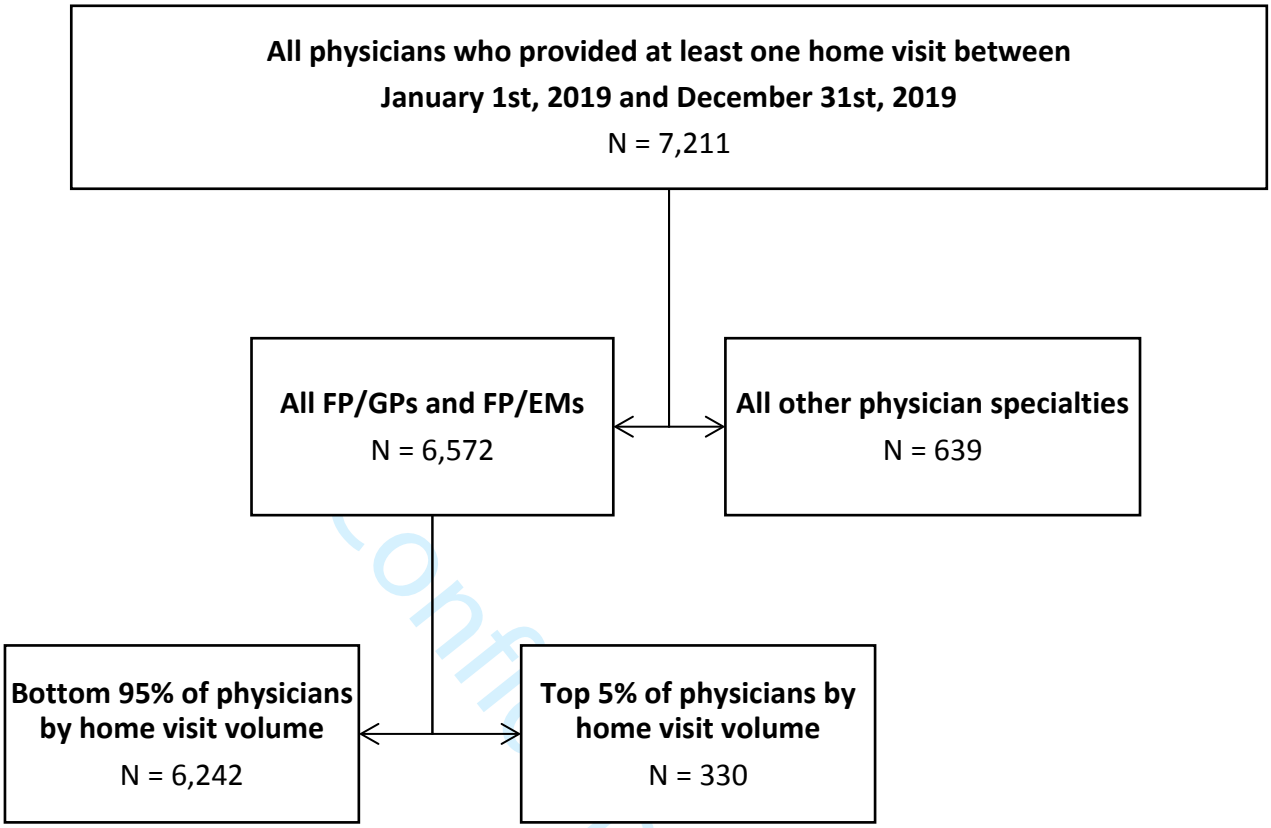
**Table S6: Physician-Level Characteristics, Practice Patterns, and Patient Characteristics at Each Home Visit Volume Incentive Threshold, in Ontario, Canada.** Measured from January 1st, 2019 to December 31st, 2019. Physician specialty restricted to family/general practice and family/emergency medicine.

| Physician Characteristics | 1-11 Home Visits (N = 3,504) | 12-23 Home Visits (N = 957) | 24-67 Home Visits (N = 1,111) | 68-127 Home Visits (N = 384) | >= 128 Home Visits (N = 616) | p-value** |
|---|---|---|---|---|---|---|
| **Physician age, median (IQR)** | 50 (38-60) | 50 (38-59) | 52 (39-61) | 51 (39-62) | 50 (37-62) | 0.359 |
| **Physician female sex, n (%)** | 1,707 (48.7) | 437 (45.7) | 477 (42.9) | 150 (39.1) | 237 (38.5) | <.001 |
| **Canada medical graduate, n (%)** | 2,092 (59.7) | 590 (61.7) | 696 (62.6) | 225 (58.6) | 361 (58.6) | 0.631 |
| **Physician urban/rural practice** | | | | | | <.001 |
| Large urban | 1,582 (45.1) | 393 (41.1) | 440 (39.6) | 156 (40.6) | 299 (48.5) | |
| Medium urban | 936 (26.7) | 220 (23.0) | 269 (24.2) | 105 (27.3) | 165 (26.8) | |
| Small urban | 641 (18.3) | 228 (23.8) | 272 (24.5) | 90 (23.4) | 117 (19.0) | |
| Rural | 327 (9.3) | 110 (11.5) | 127 (11.4) | 31 (8.1) | 31 (5.0) | |
| Missing | 24 (0.4) * | | | | | |
| **Physician medical home enrolment, n (%)** | 2,940 (83.9) | 864 (90.3) | 967 (87.0) | 322 (83.9) | 421 (68.3) | <.001 |
| **Physician compensation model, n (%)** | | | | | | <.001 |
| Capitation | 759 (21.7) | 222 (23.2) | 244 (22.0) | 94 (24.5) | 95-97 (15.4-15.7) * | |
| Team | 1,058 (30.2) | 341 (35.6) | 372 (33.5) | 112 (29.2) | 105 (17.0) | |
| Enhanced Fee for Service | 1,085 (31.0) | 291 (30.4) | 343 (30.9) | 116 (30.2) | 216 (35.1) | |
| Fee-for-Service | 564 (16.1) | 93 (9.7) | 144 (13.0) | 62 (16.1) | 195 (31.7) | |
| Other | 38 (1.1) | 10 (1.0) | 8 (0.7) | 0 | <= 5 * | |
| **Number of home visits, median (IQR)** | 3 (1-6) | 16 (14-19) | 38 (30-49) | 89 (77.5-108) | 279 (171-508) | <.001 |
| **Unique home visit patients, median (IQR)** | 2 (1-4) | 8 (6-11) | 16 (11-23) | 35 (25-48.5) | 80 (50-150) | <.001 |
| **Number of home visits per patient, median (IQR)** | 1 (1-1.7) | 2 (1.5-2.6) | 2.4 (1.8-3.2) | 2.6 (1.9-3.6) | 3.5 (2.3-5.3) | <.001 |
| **Home visit income (% total), median (IQR)** | 0.2 (0.1-0.8) | 1.6 (0.8-3.2) | 3.6 (1.8-6.9) | 7.7 (4.2-14.5) | 21.1 (10.6-40.9) | <.001 |
| **Patients seen per day on a day doing home visits, median (IQR)** | 1 (1-1) | 1 (1-1) | 1 (1-1) | 1 (1-2) | 2 (1.5-4) | <.001 |
| **Proportion of 'off-hours' home visits [a], median (IQR)** | 14.3 (0-66.7) | 21.1 (5.6-57.1) | 16.4 (4.0-58.6) | 14.4 (3.3-51.4) | 15.4 (3.6-74.3) | <.001 |

| Physician-Level Patient Characteristics | 1-11 Home Visits (N = 3,504) | 12 – 23 Home Visits (N = 957) | 24 – 67 Home Visits (N = 1,111) | 68 – 127 Home Visits (N = 384) | >= 128 Home Visits (N = 616) | p-value** |
|---|---|---|---|---|---|---|
| **Median patient's age, n (%)** | | | | | | <.001 |
| <18 years | 70 (2.0) | 9 (0.9) | 8 (0.7) | 8 (2.1) | 15 (2.4) | |
| 18 - 39 years | 147 (4.2) | 21 (2.2) | 17 (1.5) | 6 (1.6) | 8 (1.3) | |
| 40 - 64 years | 498 (14.2) | 63 (6.6) | 82 (7.4) | 39 (10.2) | 56 (9.1) | |
| 65 - 79 years | 963 (27.5) | 238 (24.9) | 244 (22.0) | 87 (22.7) | 220 (35.7) | |
| 80+ years | 1,826 (52.1) | 626 (65.4) | 760 (68.4) | 244 (63.5) | 317 (51.5) | |
| **Proportion of patients aged 65 or older, median (IQR)** | 100 (62.5-100) | 91.7 (75-100) | 92 (75.6-98.2) | 89.9 (72.9-97.8) | 85.2 (68.3-96.2) | <.001 |
| **Median patient healthcare resource utilization in subsequent year, n (%)** | | | | | | <.001 |
| Low (0 - 2) | 118 (3.4) | <= 5 * | 0 | 0 | 0 | |
| Moderate (3) | 789 (22.5) | 135-137 (14.1-14.3) * | 125 (11.3) | 43 (11.2) | 54 (8.8) | |
| High (4 - 5) | 2,597 (74.1) | 817 (85.4) | 986 (88.7) | 341 (88.8) | 562 (91.2) | |
| **Proportion of patients in a lower income neighborhood, median (IQR)** | 33.3 (0-85.7) | 40 (15.8-64.3) | 41.8 (20-64.6) | 42.1 (25.3-61.7) | 45.6 (26.5-57.9) | <.001 |
| **Proportion of large urban patients, median (IQR)** | 0 (0-100) | 8.3 (0-100) | 7.1 (0-95.7) | 12 (0-94.0) | 41 (0.8-96.4) | <.001 |
| **Proportion of recent immigrant patients[b], median (IQR)** | 0 (0-0) | 0 (0-0) | 0 (0-0) | 0 (0-0) | 0 (0-1.7) | <.001 |
| **Proportion of home visits made to patients who are rostered to them personally, median (IQR)** | 80 (0-100) | 83.3 (50-100) | 75 (20-93.9) | 59.3 (2.4-89) | 5.3 (0-71.8) | <.001 |
| **Proportion of home visits made to their own rostered patients or to their group, median (IQR)** | 100 (33.3-100) | 88.2 (58.8-100) | 80 (29.2-96.1) | 65.2 (5.3-90.8) | 14.3 (0-75.5) | <.001 |
| **Proportion of patients previously known to them in the prior 2-years, median (IQR)** | 100 (77.8-100) | 100 (88.2-100) | 96.5 (84.8-100) | 90.4 (65.7-98.9) | 78.7 (40.6-96.3) | <.001 |
| **Proportion of patients not in a medical home, median (IQR)** | 0 (0-28.6) | 10 (0-25) | 12.5 (0-32.4) | 17.8 (7-36.2) | 24.4 (14.1-38.8) | <.001 |
| **Proportion of home visits made to patients who received 2+ home care visits in the previous 30 days, median (IQR)** | 62.5 (0-100) | 61.9 (41.2-81) | 59.3 (40.7-75.7) | 56.6 (40.7-72.9) | 55.4 (34.9-80) | 0.019 |
| **Proportion of home visits that were palliative, median (IQR)** | 0 (0-50) | 9.5 (0-43.8) | 10.7 (0-37.5) | 7.7 (0.4-45.8) | 12.7 (0.1-91.5) | <.001 |
| **Proportion of home visits that were neither home care not palliative ('other'), median (IQR)** | 25 (0-75) | 30 (12.5-54.5) | 33.3 (16.7-55.3) | 37.1 (18.8-56.2) | 36.9 (2.9-62.5) | <.001 |

* Cells adjusted to prevent re-identification of groups <6 individuals. ** p-values obtained using Kruskal-Wallis test for median (IQR) variables, and Chi-square for categorical variables. [a] 'Off-hours' was defined as a visit occurring between 5pm and 7am on weekdays or anytime on Saturday/Sunday and public holidays. [b] 'Recent' was defined as within the past 10 years.

**Figure S1. Cohort Flowchart for Home Visit Physician-Level Characteristics from January 1st, 2019 to December 31st, 2019.** FP = family physician, GP = general physician, EM = emergency medicine.



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