**Appendix 1 (as supplied by the authors): Study protocol**

**Design**

We conducted a retrospective, population-based, cohort study. The study used linked provincial administrative data bases (enrollee file, physician billing files, and hospital discharge files) covering a 3 year period (from April 1, 2003 to March 31, 2006). The cohort comprised adults aged 18 and over with billing claims for publicly-covered health services during a 2-year baseline period (from April 1, 2003 to March 31, 2005), who were alive at the end of the baseline period. The outcome, number of ED visits, was measured during the third year.

The study protocol was approved by the provincial body responsible for approving the use of administrative databases for research (Commission d'accès à l'information) and the Research Ethics Committee of St. Mary's Hospital.

**Study sample**

We selected a stratified random sample from adult enrollees who had at least one health care claim during the baseline period. The strata were based on the binary variables age (less than 65 and 65 or more), and type of area of residence (metropolitan areas, defined as an urban core of 500,000 residents or more, and urban areas, defined as those outside metropolitan areas, but within 30 minutes of a secondary or tertiary level hospital[1]. From these, four strata were defined as follows: 1) residence in a metropolitan area and aged less than 65; 2) residence in a metropolitan area and aged 65 or more; 3) residence in an urban area and aged less than 65 and 4) residence in an urban area and aged 65 or more. We sampled 100,000 individuals within each stratum. This sample size was chosen to reflect the needs of specific research questions and corresponding analyses. Individuals eliminated from the sample were: 1) those that died prior to April 1, 2005; 2) those who received long-term care at any point during the study period (as

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identified using the type of billed act and the departure and arrival locations before and after hospitalization) and 3) those that lived outside of Quebec at any point during the study period (as identified by the absence of residence location in the database on one of 3 time points: April 1, 2003, 2004 and 2005). The final sample comprised 367,315 individuals.

**Measures**

Outcome

The outcome was the number of ED visits during the 12-month follow-up period. We used a validated measure of an ED visit, defined as one or more ED billings on up to 2 consecutive days.[2]

Independent variables:

We computed the primary care measures during the 2-year baseline period, among individuals with at least 3 ambulatory physician visits (excluding ED visits). An ambulatory physician visit was defined as one or more billings by the same physician on the same date and from the same location, either in private offices or clinics (including family medicine groups and hospital clinics). Visits exclusively for diagnostic acts were excluded.

Affiliation of individuals with a primary physician was based on the following algorithm, adapted from one validated in a prior study.[3] An FP was coded as the primary physician if there were at least 2 visits to the same FP or if there was at least one FP visit with a complete annual exam. If more than one FP met these criteria, the primary physician was the FP with the most visits. In the case of ties, the primary physician was considered to be the one with the most complete annual exams, or if none, the FP most recently visited. Individuals without a primary FP were coded as having a specialist as primary physician if there were at least 2 visits to the same specialist; the primary physician was the one with the most visits. Individuals with ties in

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specialist visits were coded as having no affiliation. All specialties were considered except: anatomic pathology, anaesthesiology, medical microbiology and infectious disease, medical biochemistry, neurosurgery, neuropsychiatry, diagnostic radiology, radiation-oncology, nuclear medicine, medical genetics and community health.

We measured continuity of care using the Usual Provider Continuity (UPC) index as the proportion of ambulatory doctor visits that occurred with the primary physician.[4] Comprehensiveness of FP care was measured by the number of complete annual exams (indicated in the billing code).[5] No corresponding measure was available of the comprehensiveness of care with a specialist.

Potential effect modifiers/confounders

Information on age and location of residence was determined at the mid-point of the 2-year baseline period (April 1, 2004). Age was grouped (18-34,35-64, 65-74, 75+). Material deprivation percentile groups from lowest to highest level of deprivation (1-49, 50-100, missing) were coded from the 6-digit postal code.[6] Area of residence was coded as metropolitan or other urban.

To minimize confounding by multi-morbidity, we developed a multi-morbidity confounder score using all diagnoses that comprise the Charlson Comorbidity Index[7] and other diagnoses that may be associated with ED utilization (mental health diagnosis, injuries). Diagnoses were obtained from physician billing and hospital discharge data. The multi-morbidity confounder score was computed as the weighted sum of indicator variables of diagnosis. The weights used to compute the score were the regression coefficients of each diagnosis from a negative binomial regression model to predict the number of ED visits during the outcome period.[8]

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Use of medical services during the baseline period was measured by the following categorical variables: 1) total number of ambulatory physician visits (0 to 2, 3 to 8, 9 to 24, 25 or more); 2) total number of days hospitalized (none, 1 to 3 days, 4 to 7 days, more than a week); and 3) total number of ED visits (none, 1, 2, 3 or more).

**Statistical methods**

Primary analyses

All statistical methods used throughout the study accounted for stratified sampling by the usage of probability weights[9]. Descriptive statistics of all variables of interest were calculated. We used negative binomial regression to study the impact of the primary care variables on the number of ED visits during the one-year follow-up period, using the Incidence rate ratio (IRR) as the measure of effect[10] . In all the following regression models we adjusted for the covariates. All covariates except multi-morbidity were analyzed as categorical variables. The multi-morbidity confounder score was used as continuous variable in all models. Stratification of the models for multi-morbidity was performed using a categorization of the variable in quintiles.

An offset was used as the logarithm of the total number of days where the individual was able to visit the ED (i.e. the person was alive and not hospitalized). Because the UPC measure requires at least 3 physician visits, the main sample for analysis was restricted to individuals with 3 or more ambulatory physician visits in the baseline period. A regression model containing affiliation with a primary physician was fitted to the main analysis sample (see figure 1). Restricting the analysis sample to individuals with a FP (subsample A, figure 1), we fitted a regression model with UPC and a second model with the number of complete annual exams with this FP. Restricting the analysis sample to individuals with a specialist as the primary physician (subsample B, figure 1), we fitted a regression model for UPC with this physician. The four

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models comprise what we refer to as the main models. Robust or sandwich estimation of variance was used to account for the fact that the sample is not the result of simple random sampling.[11] We used McFadden Pseudo $R^2$ [12] as a measure of global fit of the regression models considered. This is a likelihood based measure defined for generalized linear models which generalizes the $R^2$ for ordinary regression (percentage of variance explained). A rule of thumb is that a *pseudo-*$R^2$ value larger than 0.20 indicates good fit[13].

Interactions were explored between the primary care variables and the covariates: each interaction term was added, in turn, to the main models. Likelihood ratio tests were performed to assess the statistical significance of the added interaction terms. When the p-values of the tests were smaller than 5%, the main models were stratified by the levels of the covariate implied in the significant interaction. Clinically important interactions were identified using stratified analyses, as those in which there were important differences between stratum specific IRRs (e.g., a statistically significant effect of the primary care variable in only one stratum).

Secondary and sensitivity analyses

We investigated the effect of adjusting for baseline ED visits, by fitting the main models without baseline ED visits. To permit comparison of the results with previous cross-sectional studies, all main models were also fitted using as the outcome the number of ED visits during the baseline period. Finally, we conducted sensitivity analyses in which the main models were fitted under different scenarios: 1) on a sample excluding deaths after baseline, 2) using as outcome, the number of outpatient ED visits during follow-up (those not leading to an hospitalization); 3) using as outcome a different definition of ED visit for smaller EDs (the optimal definition of ED visit for smaller EDs is a maximum of one billing day in the ED)[2].

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