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A minority of Quebecers use up the majority of healthcare resources

Understanding the pathways of high-cost use patients can help better guide health policy

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The idea of healthcare spending being concentrated among a minority of users is well documented. Understanding this particularly heavy use of healthcare services is essential for helping to better guide public policy.

The authors of a CIRANO study (Laberge et al., 2025) have analyzed longitudinal medical-administrative data from the TorSaDE cohort. They offer an original contribution with a Quebec context, analyzing high-use patients' activities and identifying the main factors associated with their care pathways.

The study highlights the diversity and complexity of these individuals' needs. The findings call for a rethinking of current strategies and in particular, a shift toward personalized approaches that anticipate needs, better support individuals and improve the system's efficiency.

In 2025, Canada spent an estimated \$400 billion for healthcare. That represents 13% of the country's gross domestic product (GDP) or \$9,626 per capita. In the March 2025 budget, the federal government announced increases to the Canada Health Transfer of 5% per year through 2028. Despite this additional funding, needs appear to be growing faster than what public budgets have allocated. This pressure is particularly acute in Quebec. According to Quebec's latest budget, the government will allocate \$69 billion to health and social services in 2026–2027, representing approximately 40% of total public spending. This would mark a 4% increase over the previous year. Despite these financial efforts, the healthcare system continues to face significant pressures, particularly related to an aging population, staff shortages and a growing complexity of needs.

Behind these figures lies a striking observation: a minority of people use up the majority of healthcare resources. These individuals are characterized by multimorbidity, socioeconomic vulnerability and a lack of continuity in their care. While the concentration of expenditures is well documented, little has been explored of these individuals' care pathways. The majority of studies use cross-sectional data, providing a static view of healthcare use. However, healthcare use patterns are dynamic, nonlinear and heterogeneous. A longitudinal approach helps better understand them.

The study of healthcare utilization intensity among certain individuals has led to the emergence of the concept of high-cost users (HCUs) of healthcare services (Krieg et al., 2016; Moe et al., 2013). The literature, however, does not offer a universal definition of HCUs. Some studies define them based on frequency of use, for example, four or more emergency room visits, 10 annual medical consultations or at least five hospitalizations within 12 months (Chiu et al., 2022; Doupe et al., 2012). Others, using a cost-based approach, define them as 5%–10% of individuals generating between 40% and 60% of total expenditures (Nghiem et al., 2023; Sowa et al., 2021; Wong et al., 2024). This method better reflects the disproportionate economic impact of these individuals and ensures comparability across studies. It's the approach we adopted.

In our study, an individual is considered an HCU if they fall into the top-fifth percentile of costs. In other words, we defined HCU as the 5% of individuals generating the highest annual costs for all services used. The total annual cost includes four components: the cost of hospitalizations, same-day surgeries, emergency room visits, and physician visits. Pharmaceutical service costs are not included, as this data is available only for individuals covered by the public drug insurance plan.

The cost calculation is based on a measure of relative resource utilization intensity called the NIRRU (*Niveau d'Intensité Relative des Ressources Utilisées* in French). This is a widely recognized indicator that assesses the intensity of health resources utilized based on the services received. The Régie de l'assurance maladie du Québec (RAMQ) medical-administrative data, combined with the NIRRU, enabled us to calculate the cost of each hospital stay. In 2019, the most recent year for which monetary NIRRU data is available, the monetary value of one NIRRU for a hospital stay was \$6,026. The cost of each hospitalization is calculated by multiplying the hospitalization's NIRRU by the monetary value of a single NIRRU. For example, if a hospitalization has an NIRRU of 2, the cost would be \$12,052. The monetary value of a NIRRU for an outpatient surgery was \$1,368, while an emergency room visit was \$356. The costs of medical consultations are based on set amounts billed by physicians to the RAMQ for each medical procedure.

The economic burden of high users of healthcare services: A 10-year trend

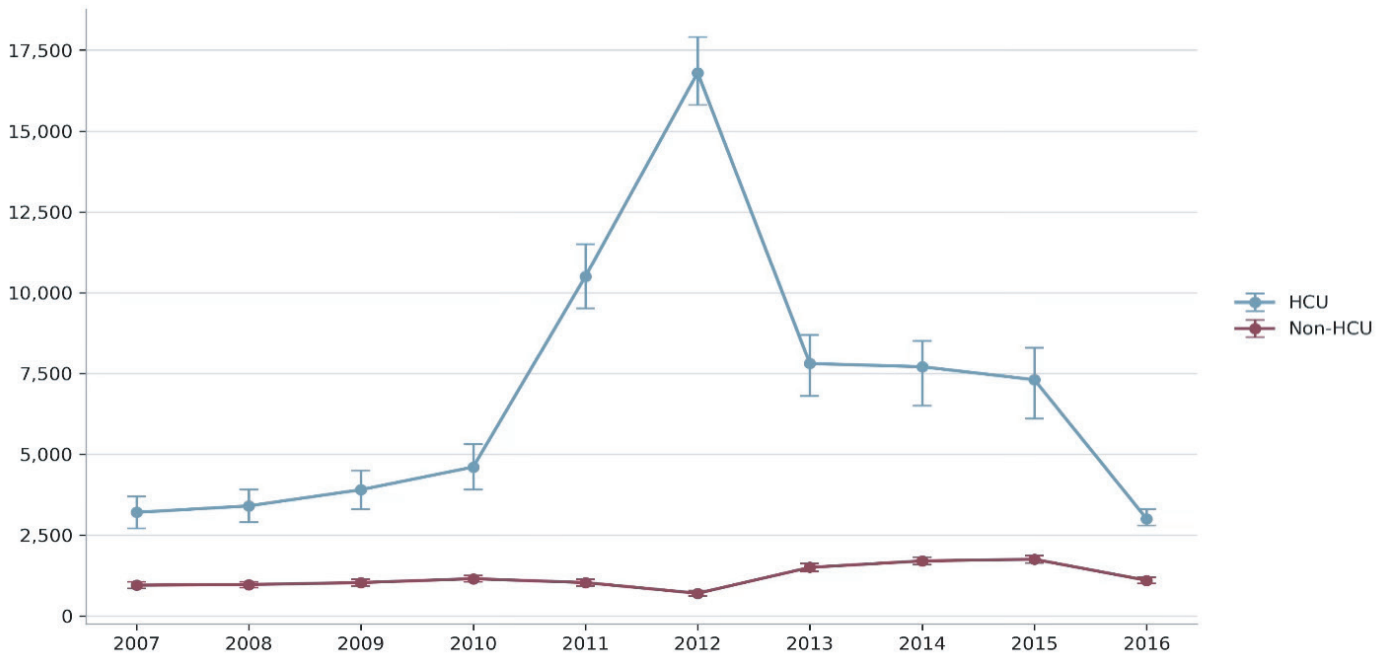
The TorSaDe cohort comprises just over 103,000 participants. We retained only those individuals who responded to the 2007–2008 and 2009–2010 Canadian Community Health Survey (CCHS) and for whom we have complete data on their healthcare utilization costs. This provided us with a sample of 19,556 individuals, with 977 of them categorized as HCU patients in 2012 and 18,579 who were not considered HCU patients in 2012.

We chose 2012 as the reference year for that sample because this allowed us to track changes in costs associated with HCU and non-HCU individuals over a 10-year study period, including the reference year, the five preceding years (2007–2011), and the four subsequent years (2013–2016).

The figure below compares 2012 HCU patients to 2012 non-HCU patients and highlights three major trends: a cost difference between HCU and non-HCU cases that was already significant prior to 2012, an exceptional spike in 2012 inherent in the method we used to identify HCU cases, and a gradual decline in costs after 2012. Prior to 2012, the 2012 HCU cases already had significantly higher average annual costs than the

non-HCU cases. In 2007, costs for HCUs averaged \$3,200, compared to \$900 for non-HCUs. By 2011, these costs had reached \$10,500—more than 10 times the average cost of \$980 for non-HCUs.

After 2012, average costs gradually declined, reaching approximately \$7,800 in 2013 and then \$3,000 in 2016. Despite this decline, the gap between HCU patients and the rest of the population remains significant. As evidenced by the wider confidence intervals for HCUs compared to non-HCUs throughout the entire period, costs for HCU patients are much more widely dispersed, meaning that some patients consume significantly more healthcare resources than the average.



Trends in the average annual cost of 2012 HCU and Non-HCU cases in Quebec from 2007 to 2016, in 2019 dollars

A retrospective longitudinal cohort analysis based on medical-administrative data matched with survey data

Our study employs data from the TorSaDE cohort (The Care Trajectories—Enriched Data), a longitudinal database comprising individuals in Quebec who responded to various waves of the Canadian Community Health Survey (CCHS) and authorized the linkage of their responses with administrative data from the Régie de l'assurance maladie du Québec (RAMQ) (Vanasse et al., 2021). The CCHS is a cross-sectional survey that collects information on health, including healthcare utilization, lifestyle habits and the general health status of the Canadian population.

The TorSaDe cohort comprises just over 103,000 participants from Quebec and covers the period from 1996 to 2016. It is distinguished by several major strengths.

The cohort is representative of the Quebec population, allowing for the generalization of results. Also, by tracking participants over two decades, we can see changes in healthcare utilization and associated costs over a long period—this is essential for understanding the dynamics of long-term care. The data combine self-reported responses from the CCHS with administrative data from the RAMQ, providing a comprehensive view of sociodemographic characteristics, perceived health status and actual health service utilization. The data also include detailed information on medical visits, hospitalizations and healthcare costs, enabling in-depth analyses. Five waves of the CCHS are included in our analyses: 2007–2008, 2009–2010, 2011–2012, 2013–2014, and 2015–2016.

High healthcare utilization does not stem solely from clinical needs; it's the result of a complex interaction of individual, social and organizational factors

We employed Andersen's (1995) behavioural model of healthcare utilization as a theoretical framework for understanding why some people use health services more than others. This model distinguishes three main types of factors: predisposing factors, enabling or disabling factors, and need factors.

Predisposing factors refer to individual characteristics that influence the likelihood of someone seeking care, including age, gender, ethnicity and socioeconomic characteristics such as education level and income. These predisposing factors are what influence the likelihood of frequent care-seeking. It is the enabling or disabling factors that influence the individuals' actual ability to access health services. Key among those factors would be access to primary care, namely being

registered with a family physician. Other enabling and disabling factors relate to material and organizational resources, such as health insurance coverage and available healthcare.

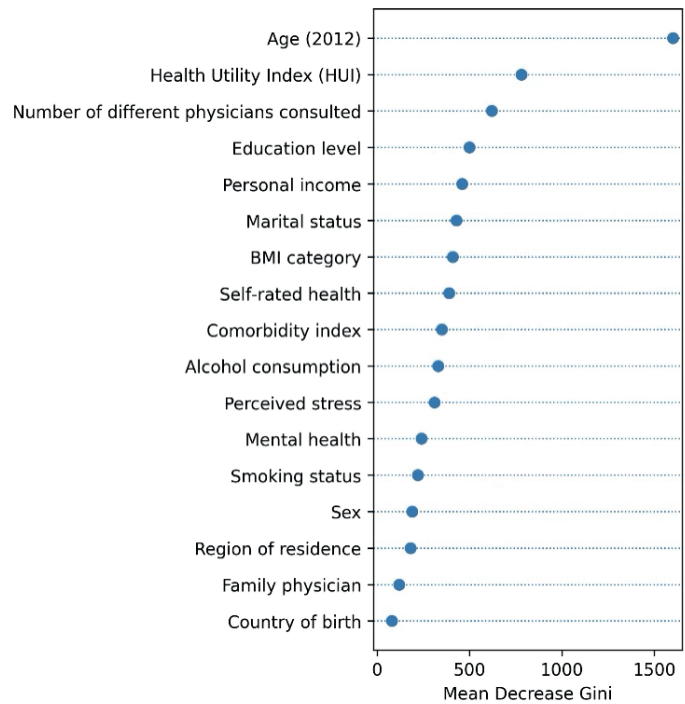
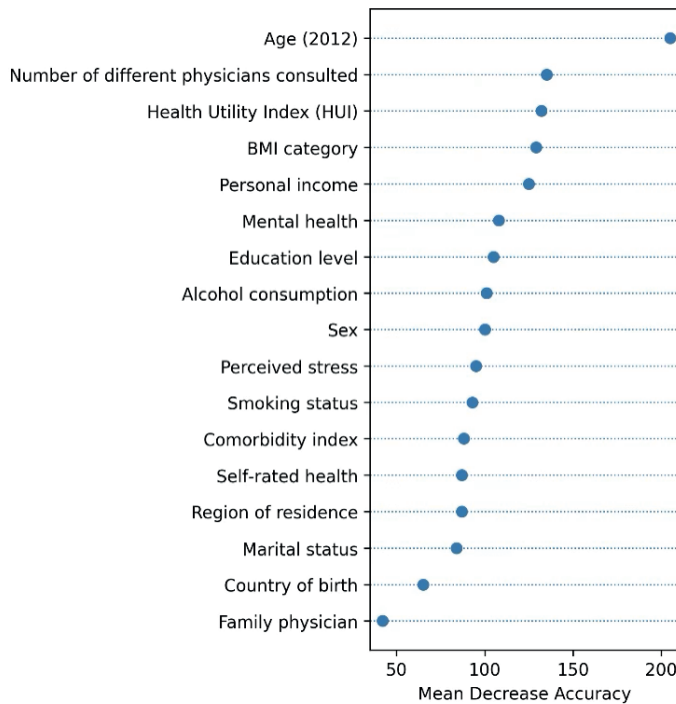
Need factors relate to an individual's perceived or objectively measured health status. This includes the Health Utilities Index Mark 3 (HUI3), the perception of general and mental health, the stress of daily life, as well as overall life satisfaction. Obesity, smoking and alcohol consumption can also be included in need factors. Other need factors associated with frequent use of healthcare services include a high comorbidity index, polypharmacy and visits to several different healthcare professionals over the course of a year. Need factors are often associated with chronic conditions or psychiatric disorders. They interact with predisposing factors to explain patterns of healthcare and service utilization.

We analyzed the socioeconomic, demographic, clinical and behavioural factors that distinguish HCU patients from the general population, employing several methodological approaches. One is the random forest, an artificial intelligence tool that identifies, among a large number of variables, those that contribute most to distinguishing individuals based on their probability of being an HCU. This method constructs several “decision trees” that, together, assess which factors most influence intensive healthcare utilization.

The two figures below help assess the importance of the variables used in the model. The figure on the left is based on the measurement of the *mean decrease accuracy* of the model when each variable is excluded. A high value indicates that the variable has a strong influence on classification accuracy. The figure on the right is based on the *mean decrease Gini*, an indicator derived from decision trees that measures a variable’s ability to improve class separation. The higher this value, the more the variable contributes to distinguishing between groups.

The random forest analysis identified the most influential variables in the classification of HCUs. Among these, age stands out as the primary determinant, followed by the number of different physicians consulted, the health utility index (HUI) and body mass index (BMI). These results are consistent with those of Nghiem et al. (2023), who demonstrate that the complexity of HCU profiles can be captured by machine learning models, since they simultaneously incorporate clinical, sociodemographic and behavioural variables.

A degree of caution is necessary when interpreting the machine learning model’s performance. There is no way to conclude that the random forest model offers superior predictive power compared to other classical statistical approaches, such as logistic regression.

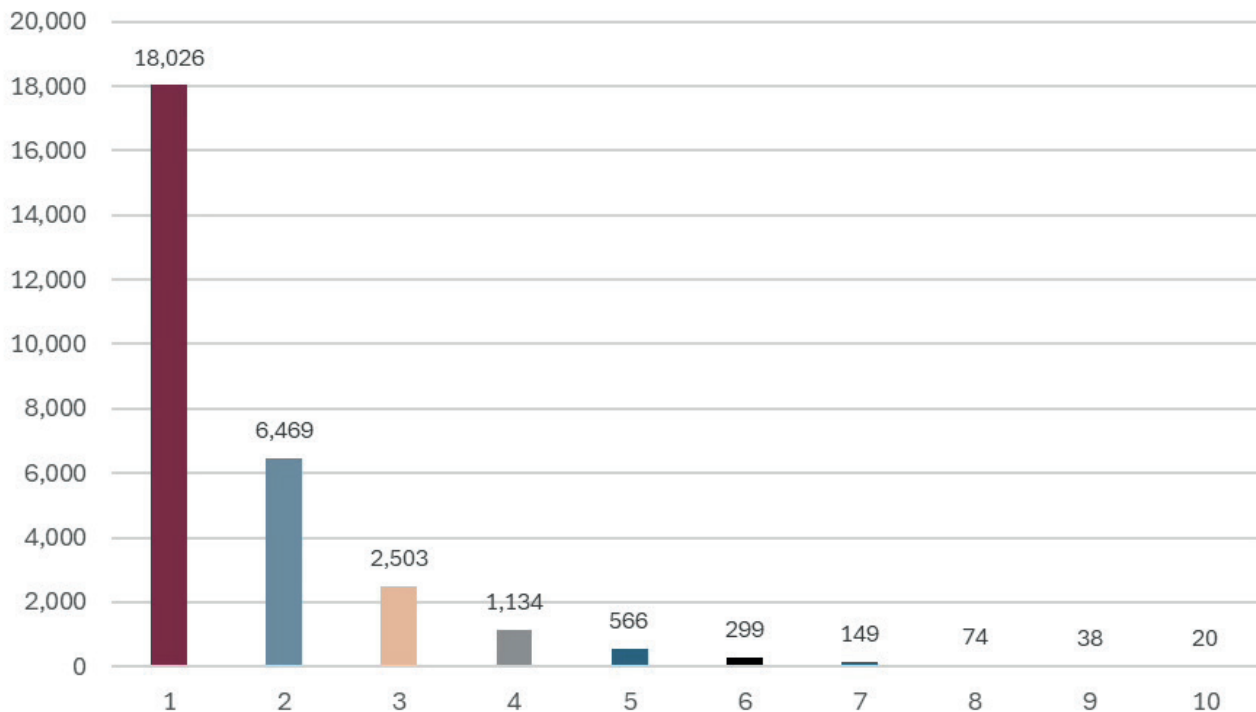


Key factors distinguishing HCUs of healthcare services in Quebec according to the random forest approach

Not all high users are alike

To examine the heterogeneity of care trajectories, our study population consists of individuals who responded to the various waves of the CCHS between 2007 and 2016 and authorized the linkage of their responses with administrative data from the RAMQ. By retaining only those participants for whom we have complete data on their health service utilization costs, we obtained a sample of 99,631 individuals. Of these, 29,278 were identified as HCUs at least once between 2007 and 2016, representing nearly 30% of the sample.

The majority of HCU patients (18,026 or 62%) were HCU only once. This proportion gradually decreases as the frequency of belonging to the HCU group increases. Thus, 6,469 individuals were HCU twice, while 2,503 individuals were HCU three times. The frequency continues to decrease, with 1,134 individuals having been HCU four times and 566 individuals five times. Beyond six occurrences, the number of individuals becomes marginal, with 299 individuals having been HCU six times, 149 seven times, 74 eight times, 38 nine times, and only 20 individuals having been HCU 10 times.



Distribution of the number of HCUs based on the number of years they were an HCU during the period

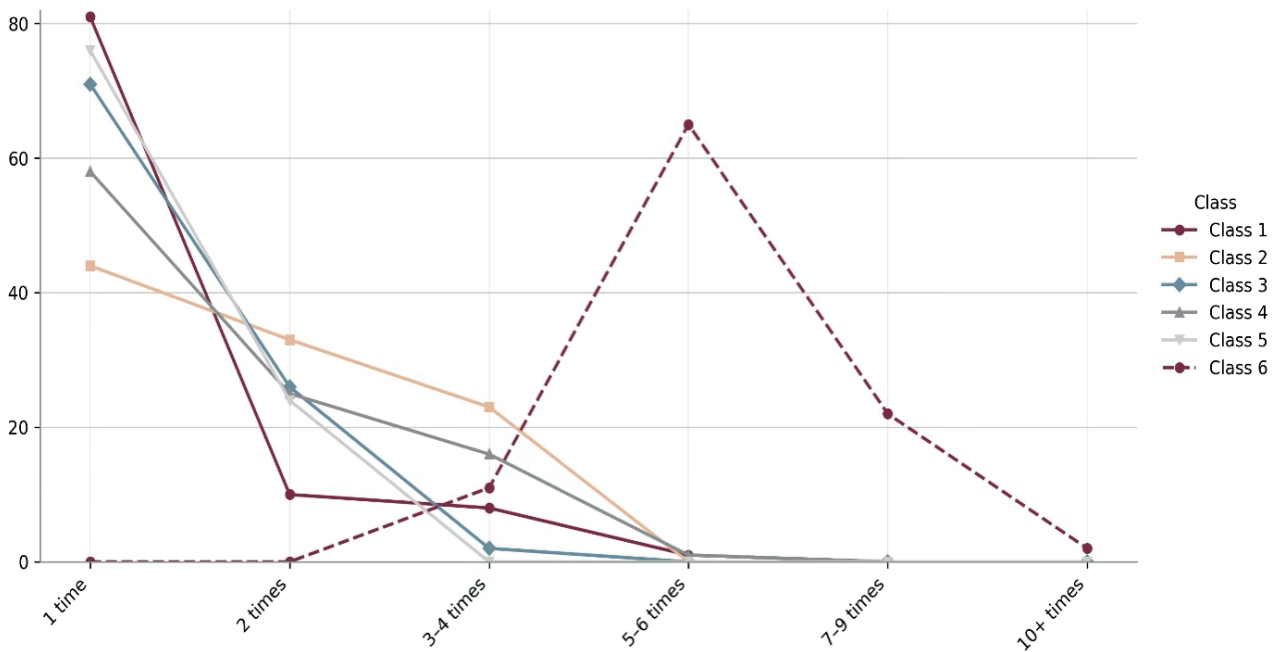
We explored the heterogeneity of healthcare utilization patterns among HCU patients using latent class analysis (LCA). LCA is a statistical method used to identify latent subgroups within a population based on observed variables. It allows for the modelling of groups of individuals who share similar characteristics based on their responses to questions or their observed behaviours. In the context of our study, this approach enables the grouping of individuals with similar usage profiles and takes into account both the frequency and persistence of their HCU status over time. A model with six HCU classes was selected. The figure below illustrates the trajectories of those classes.

Our analysis identifies three distinct profiles: occasional HCU, recurrent HCU and persistent HCU.

Occasional HCUs (Classes 1, 3, and 5) are characterized by high sporadic utilization, generally linked to an acute health episode requiring temporary care.

Recurrent HCUs (Classes 2 and 4) alternate between periods of high utilization and phases of lower utilization, often reflecting the intermittent management of chronic conditions.

Finally, persistent HCUs (Class 6), although a minority, place a sustained and disproportionate burden on the system's resources. This is often due to complex comorbidities, severe psychiatric disorders and multiple social vulnerabilities.



Proportion of HCUs (as a percentage) in each of the six classes based on the frequency of HCU status from 2007 to 2016

Latent class analysis

Latent class analysis is based on the idea that the relationships between observed variables may be influenced by unobservable latent factors (Collins and Lanza, 2009; Lanza and Rhoades, 2013; Nguena Nguetack et al., 2020). The selection of the optimal model relies on statistical criteria such as the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC). These criteria are commonly used to select the best model by balancing fit quality and model complexity. Methodological recommendations in latent classification suggest favouring the model with the lowest AIC and BIC, while avoiding an excessive increase in complexity (Nylund et al., 2007).

Analysis of successive differences reveals a gradual decrease in AIC and BIC values as the number of classes increases, indicating an improvement in model fit. This improvement is significant up to six classes, after which the gains become marginal.

The likelihood ratio (G^2) and Pearson's chi-square (χ^2) statistics confirm this trend. Up to six classes, the values of G^2 and χ^2 decrease significantly, indicating a gradual reduction in the model's fit error. Beyond six classes, this decrease becomes significantly smaller, suggesting that adding additional classes yields only a marginal improvement. Based on these results, the six-class model was selected.

High healthcare utilization cannot therefore be analyzed as a uniform phenomenon. While a majority of people temporarily carry this status due to a health episode requiring temporary care (stemming from more acute and episodic health needs), a sizeable proportion of individuals follow persistent utilization trajectories, often associated with severe multimorbidity, social vulnerabilities, and unmet care needs.

This heterogeneity implies that a uniform intervention strategy would be ineffective and even counterproductive. As demonstrated by Wodchis et al. (2016) and Moe et al. (2021), care must be tailored to the identified profiles; otherwise, patterns of overutilization are likely to recur.

What shapes healthcare utilization patterns

To identify the factors influencing membership in the different classes defined by latent class analysis, we estimated a multinomial logistic regression model, using Class 1 as the reference group. Our variable of interest is the categorical variable "Class," which has six categories. The model parameters were estimated using the maximum likelihood method, which involves finding the coefficient values that maximize the probability of observing the available data.

Among demographic factors, age emerges as a major discriminating factor. Older individuals are significantly more likely to belong to the recurrent and persistent classes.

This finding aligns with the results of Huynh et al. (2016), Hwang et al. (2015), and Palmer et al. (2014), who highlight the cumulative effect of aging on the prevalence of chronic diseases and the loss of autonomy. Age acts as a vulnerability factor when combined with other determinants, such as multimorbidity, low social support or episodes of acute care.

Low-income individuals are significantly overrepresented among persistent HCUs, a finding consistent with the work of Bieler et al. (2012), Hudon et al. (2016), and Bodenmann et al. (2017), who demonstrated the cumulative effect of poverty on limited access to preventive care, fragmented follow-up and avoidable hospitalizations.

Living alone is also associated with a high probability that a patient will belong to a group with persistent utilization. The lack of an informal social support can hinder self-management of health problems and reinforce reliance on the healthcare system as the primary safety net.

Access to primary care, which we associate here with registering with a family physician, reveals an ambivalent effect: individuals registered with a family physician are overrepresented among persistent HCU patients. This paradox can be explained by a reverse selection phenomenon: patients with complex needs are more often referred to family physicians for close monitoring. However, this registration does not in itself guarantee a reduction in service utilization if it is not accompanied by effective coordination, facilitated access and interprofessional continuity of care.

Clinically, HCU patients report a significantly more negative perception of their general and mental health and have a higher comorbidity index.

These observations are consistent with the findings of numerous studies that have established a close association between multimorbidity—particularly the coexistence of chronic cardiovascular, metabolic and musculoskeletal conditions—and increased use of healthcare services (Moe et al., 2021; Sowa et al., 2021; Wong et al., 2024).

People with multimorbidity consult a greater number of healthcare professionals over the course of a year. Often suffering from multiple chronic conditions and sometimes from mental health disorders, they may require the coordinated intervention of several specialists to ensure adequate care. In this context, the use of multiple healthcare professionals does not necessarily reflect a failure of the healthcare system, but rather an attempt to address multiple medical needs that the family physician cannot manage alone.

Healthy behaviours, particularly not smoking, also help shape these trajectories. Daily smoking is strongly associated with the recurrent and persistent HCU categories, which supports the findings of Chiu et al. (2022) and Wong et al. (2024). Those studies find links between risky lifestyle habits and an increase in medical complications and intensified care needs.

On the other hand, regular alcohol consumption, in our sample, does not fall into this category and is associated with a lower likelihood of belonging to the group of persistent HCUs.

Better understanding for better action

Our study reveals a key reality for Quebec's healthcare system: a very small proportion of the population accounts for nearly half of healthcare spending. It also reveals that high healthcare utilization cannot be explained solely by high clinical needs. Rather, it results from a complex interaction between medical vulnerabilities, social determinants and organizational characteristics.

For the healthcare system, these findings call for a paradigm shift from a model focused on managing individual episodes of care to an integrated and preventive approach. Understanding and identifying care and high-risk pathways is a strategic asset for planning targeted care. Early identification of patient profiles allows for proactive intervention, offering targeted interventions before overutilization sets in.

Such an approach is difficult to implement in clinical practice because the cost data needed to identify HCUs are not always available in real time. In the absence of cost data, certain medical and healthcare utilization histories, as well as socioeconomic characteristics of individuals, serve as relatively simple, easy-to-track indicators. They can prove useful in helping professionals more effectively identify those at highest risk.

Effective action requires strengthening interprofessional coordination and moving beyond a strictly biomedical perspective

The most effective interventions are those that combine multiple dimensions: improved access to primary and interdisciplinary care, as well as predictive technologies and social support. Strategies combining integrated primary care, case management and social support have proven effective in improving continuity of care and reducing hospitalizations.

Finally, our findings underscore the urgent need for health policy planning to incorporate social determinants of health. Effective management of care pathways cannot be limited to optimizing medical resources; it must include structural interventions addressing housing, food security, mental health and the fragmentation of care. Understanding care pathways makes it possible to improve the quality of care, optimize the efficiency of the system and strengthen equitable access to health services.

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