**Characteristics of persistent mental health high-cost patients: a population-based analysis**

**Abstract**

**Background:** While most literature on high-cost health care users has evaluated this population as a whole, few studies have focused on high-cost patients with mental illness and whether they persist in the high-cost state. We sought to analyze persistent mental health high-cost patients in depth and determine predictors of persistency in the high-cost state.

**Methods:** We used eight years of longitudinal patient-level population data (2010 to 2017) from Ontario to follow high-cost patients (those in and above the 90th percentile of the cost distribution) with mental illness. We classified high-cost patients, based on the proportion of the study period spent in the high-cost state, as persistent (6 to 8 years), sporadic (1 to 2 years) or moderate (3 to 5 years). We compared characteristics between groups and determined predictors of being a persistent mental health high-cost patient.

**Results:** Among 52,638 mental health high-cost patients, 18,149 (34.5%) were persistent high-cost patients. Persistent mental health high-cost patients had higher mean annual costs of care ($44,714, 95% CI $43,724 to $45,703) compared to sporadic ($31,055, 95% CI $30,359 to 31,751) and moderate ($23,205, 95% CI $22,741 to $23,668) patients, largely due to psychiatric hospitalizations. Persistent mental health high-cost patients were more likely to be female, older, long-term residents, living in low-income or urban areas, or to have comorbidities. The strongest predictors of persistent (v. sporadic) high-cost status were HIV (RRR 4.32, 95% CI 3.08 to 6.06), psychosis (RRR 3.41, 95% CI 3.25 to 3.58), and dementia (RRR 3.21, 95% CI 2.81 to 3.68).

**Interpretation:** Among mental health high-cost patients, persistence in the high-cost state was mainly determined by psychosis and other comorbidities. Quality of care interventions directed at the management of psychosis and multimorbidity, as well as preventive interventions to target patients with mental illness before they become persistent high-cost patients are needed.

**Introduction**

To address rising health care costs, it is important to understand the composition of the high-cost population. Most work on high-cost patients has considered this population as a whole.1-3 However, prior work has shown that policies and interventions designed to address quality of care and high health care spending in general will likely not apply to all high-cost patient subgroups.4,5 Moreover, research has shown that high-cost patients are a heterogeneous population.6 For example, high-cost patients who use mainly mental health services are quite different from other high-cost patients – they are younger, live in poorer neighbourhoods, and have different health care utilisation patterns.4,6 They also have high levels of comorbidity and incur over 30% more costs than other high-cost patients, suggesting they may be a more complex population with higher needs.4,6

It is also important to understand whether high-cost patients remain in the high-cost state for long periods of time or whether this is a one-time occurrence. The few studies that have examined persistency in the high-cost state evaluated such patients as a whole and followed them for only three years.7,8 , Although prior studies have found that individuals with mental illness are more likely to be persistent high-cost patients,9,10, no studies have specifically examined persistency in the high-cost state among patients with mental illness4 or followed these patients for long periods of time.11 The goal of this study was to provide an in-depth analysis of persistent mental health high-cost patients using administrative health care data from Ontario, Canada’s most populous province.

**Methods**

***Study design and setting***

We undertook a retrospective population-based longitudinal cohort study of high-cost mental health patients to examine persistency in the high-cost state from 2010 to 2017 using data from Ontario.

***Data***

We used administrative health care data available through ICES, in Toronto, Ontario, to undertake our analysis. The ICES data repository contains individual-level linkable and longitudinal data on most publicly funded health care services for all legal residents of Ontario. It includes several health services databases, many of which have been validated and described in the literature,12 and used in costing analyses.4,6 We used the following databases: Discharge Abstract Database, Ontario Mental Health Reporting System, National Ambulatory Care Reporting System, Ontario Health Insurance Plan claims database, Ontario Drug Benefit claims database, National Rehabilitation Reporting System, Continuing Care Reporting System and Home Care Database. All databases were linked using unique encoded identifiers and analysed at ICES, in compliance with Ontario privacy legislation. A full description of each database can be found in Table A1 in the Appendix. This study was approved by the Institutional Review Board at Sunnybrook Health Sciences Centre, Toronto, Canada.

***Patient cohort***

We selected all adult patients (ages eighteen and older) who had at least one encounter with the Ontario health care system in 2010, the index year, and excluded those who did not have a valid health card number. Among these patients, we defined *high-cost patients* as all patients in and above the 90th percentile of the cost distribution, in line with previous work.4,6,8 This threshold enabled us to select a larger cohort of patients compared to other definitions (e.g. 95th percentile). *Mental health high-cost patients* were defined as those for whom costs related to mental health and addiction care accounted for 50% or more of their total costs.4 Previous research has shown that changing the threshold to 60% has little impact on the cohort definition4 as mental health and addiction-related costs account for most costs.

*Defining persistent mental health high-cost patients*

Costs related to mental health and addiction care were defined in line with previous work.4 We used a cost estimation algorithm, available at ICES, to estimate all direct health care costs incurred by patients and borne by the Ontario Ministry of Health.13 Details are provided in the Appendix. We followed individuals from 2010 to 2017 (i.e., eight years) to examine whether they moved in and out of the high-cost state (i.e., above or below the 90th percentile of the cost distribution). Prior work has defined “persistent (or consistent) high-cost patients” as those in the 80th percentile in all four half-year periods across two years, and “point high-cost patients” as the top users in the first year alone.11 Since this study indicated that persistent high-cost patients should incur high costs consistently and continuously over *several* periods, we defined persistent high-cost patients as those who remained in and above the 90th percentile of the cost distribution for 6 or more years (at any point) over the 8-year study period (i.e., 75% of the analysis period). We defined sporadic high-cost patients as those in the high-cost category for 1 or 2 years and moderate high-cost patients as those in the high-cost category for 3, 4 or 5 years. Some patients (the attrition cohort) did not have data for all 8 years due to loss to follow up (e.g. individuals who died, moved out of the province or those who were no longer eligible for public health care insurance in Ontario). We classified high-cost status similarly in the attrition and non-attrition cohorts and included both in the primary analysis.

***Analysis***

We compared the three patients groups in terms of socio-demographic characteristics – sex, age, migrant status, neighbourhood income quintile, rural residence, and administrative health region – and presence of chronic conditions – rheumatoid arthritis, asthma, cancer, COPD, diabetes, HIV, hypertension, congestive heart failure, Crohn’s/colitis, myocardial infarction, psychosis, and dementia – which were determined either through disease registries, (e.g. Ontario Cancer Registry), or validated algorithms.14-25 Given the lack of other relevant psychiatric chronic conditions, we attempted to determine the presence of mood disorders using at least one hospitalization record (with ICD-10 codes F30, F31, F32, F33, F34, F38, F39, F53.0 and DSM-IV codes 296.x, 300.4x, 301.13) and/or two physician billings (with diagnostic billing code 311 for depressive or other non-psychotic disorders, not elsewhere classified) within a one-year period. This algorithm has not been validated; therefore, it was only considered in a sensitivity analysis.

Cost analyses are described in the Appendix. A trends analysis of costs over time was undertaken using linear regression with a time trend for each patient group. We estimated a multinomial logistic regression model26,27 on the pooled data (i.e., all eight years of data combined) to determine the predictors of being a persistent or moderate mental health high-cost patient compared to being a sporadic one, where the dependent variable for each patient was constructed using the previous definitions and its value repeated for each year patients were in the data. This model controlled for patient socio-demographic characteristics and chronic conditions described beforehand, and calendar year indicator variables, all of which could vary over the eight years. The model coefficients were exponentiated to obtain the relative risk ratio for a one-unit change in the corresponding variable (where risk is measured as the risk of the outcome relative to the base outcome). 26,27 Clustered standard errors were estimated for all models to account for repeated observations on the same individual, where applicable.

*Sensitivity analysis*

We undertook sensitivity analyses, where an indicator of mood disorders was included in the model and where patients lost to attrition (i.e., all decedents and individuals ineligible for public health care insurance) were excluded from the analysis. Moreover, we estimated the odds of being a persistent mental health high-cost patient relative to being a moderate and sporadic one, in line with prior work.8

**Results**

Roughly 13% (n = 6,975) of individuals from the initial sample (n= 52,638) did not have data for all 8 years of the analysis due to loss to follow up (Table 1). Based on our definitions, 33.8% (n = 17,746) were classified as sporadic, 31.8% (n = 16,743) as moderate and 34.5% (n = 18,149) as persistent high-cost patients (18.3% patients were in the high-cost state for all eight years).

The overall cohort had a mean age of 45 and included roughly the same proportion of males (49%) and females (51%) (Table 2). Compared to sporadic high-cost patients, persistent high-cost patients were more likely to be older (mean age 47 v. 42), or female (52.7% v. 48.7%), to live in low-income neighbourhoods (30.9% v. 24.6%), or urban areas (93.2% v. 89.7%), and to have psychosis (55.2% v. 31.1%), diabetes (20.9% v. 8.9%), hypertension (30.6% v. 19.8%), COPD (15.7% v. 8.1%), dementia (7.2% v. 3.5%), or asthma (22.3% v. 17.3%). Moderate high-cost patients were relatively similar to persistent high-cost patients, except for a lower prevalence of psychosis (40.5% v. 55.2%) and diabetes (13.7% v. 20.9%).

Persistent high-cost patients had the highest mean costs in 2010 ($44,714, 95% CI $43,724 to $45,703), compared to moderate ($31,055, 95% CI $30,359 to $31,751) and sporadic high-cost patients ($23,205, 95% CI $22,741 to $23,668) (Table 3). In particular, 69% of total costs for persistent high-cost patients were made up of costs of psychiatric hospitalizations alone ($30,944, 95% CI $29,956 to $31,932), with other large costs incurred by physician services ($5,818, 95% CI $5,734 to $5,902), outpatient prescription drugs ($2,947, 95% CI $2,893 to $3,000) and hospital outpatient clinic visits ($2,666, 95% CI $2,608 to $2,724). Combined, these costs made up 94.8% of total costs. The proportion of potentially preventable acute care costs was small among all mental health high-cost patients (0.5% of total costs). Costs were quite high over the 8 years for persistent mental health high-cost patients, albeit these decreased a bit over time (Figure 1). Costs were lower for other mental health high-cost patients and followed a similar pattern but decreased substantially more over time, in particular after the first year for sporadic mental health high-cost patients. The change in costs was greater for moderate high-cost patients (βm=-2,935, p-value<0.001) followed by sporadic (βs=-2,067, p-value<0.001) and persistent high-cost patients (βp=--918, p-value<0.001); all between-group differences were statistically significant (p-value<0.001). Table A2 in the Appendix provides costs by health service for each year.

The risk of being a persistent high-cost patient, compared to being a sporadic high-cost patient, was higher for older patients (vs. ages 18-44, ages 45-64, RRR 1.19, 95% CI 1.13 to 1.25; ages 65-84, RRR 1.70, 95% CI 1.52 to 1.89; ages 85-105, RRR 1.23, 95% CI 0.93 to 1.62), but lower for males (RRR 0.79, 95% CI 0.75 to 0.82), immigrants (RRR 0.59, 95% CI 0.53 to 0.64) and refugees (RRR 0.64, 95% CI 0.55 to 0.74), rural dwellers (RRR 0.61, 95% CI 0.57 to 0.66) and those living in higher income neighbourhoods (e.g. highest vs. lowest neighbourhood income quintile, RRR 0.84, 95% CI 0.79 to 0.89) (Table 4). All comorbidities were associated with increased risk of persistent high-costs status, with the highest relative risk ratios observed for HIV (RRR 4.32, 95% CI 3.08 to 6.06), psychosis (RRR 3.41, 95% CI 3.25 to 3.58) and dementia (RRR 3.21, 95% CI 2.81 to 3.68). Associations of similar or slightly smaller magnitude were found for these variables with the risk of being a moderate rather than a sporadic high-cost patient (Table 4). Tables A3 and A4 in the Appendix provide the results of the multinomial logistic regressions including mood disorders and excluding patients lost to attrition, respectively; despite minor differences, the main findings were largely unchanged. Table A5 in the Appendix provides the odds ratios of being a persistent mental health high-cost patient versus being a moderate and a sporadic one; again, results were qualitatively the same.

**Interpretation**

Among our cohort of mental health high-cost patients, we found that over 1 in 3 were considered persistent high-cost patients, while nearly 1 in 5 remained in the high-cost state for all 8 years of the analysis. Persistent mental health high-cost patients were slightly older, made up of slightly more females, more likely to live in low-income urban areas and to have psychosis, hypertension, asthma and diabetes, compared to sporadic and moderate mental health high-cost patients. Their spending profile also differed – they had higher costs and the proportion of costs due to psychiatric hospitalizations was larger compared to the other two groups. We found that the main predictors of being a persistent mental health high-cost patient were having HIV, psychosis or dementia. We also found that having a mood disorder was predictive of being a persistent mental health high-cost patient in a sensitivity analysis. Results were largely unchanged when we dropped individuals who were lost to attrition over time. It is not surprising that having psychosis is predictive of being a persistent mental health high-cost patient; previous research has found that patients with psychosis have high costs of care.28 Moreover, having diabetes was also an important predictor of persistency. Other work has found that individuals with psychosis are less likely to have optimal diabetes care compared to those without psychosis, resulting in higher rates of diabetes-related hospitalizations,29 which can lead to higher costs.

Few studies have examined persistency in the high-cost state, particularly among high-cost patients with mental illness. Using administrative data from Ontario, Wodchis et al. found that 30.7% of individuals in the top 5% remained in the high-cost state from 2009 to 2011.7 Figueroa et al. examined persistency in the high-cost state among a 20% sample of Medicare fee-for-service beneficiaries from 2012 to 2014 using data on inpatient and outpatient care, physician services, tests and procedures, and drugs.8 They found that 28.1% of high-cost patients in the top 10% remained in the high-cost state for all 3 years. These patients were younger, more likely to be individuals of colour, live in lower income areas, be Medicare eligible, and dually eligible for Medicare and Medicaid compared to transient and never high-cost patients. Furthermore, they found that persistent high-cost patients’ spending was mostly due to outpatient care and drugs. While we examined a sub-group of high-cost patients, we also found that persistent mental health high-cost patients lived in lower income areas compared to moderate and sporadic mental health high-cost patients. However, these patients’ spending profile was substantially different – most costs were due to psychiatric hospitalizations, further confirming the need to consider them separately from other high-cost patients. In line with Figueroa et al., we also found that a small proportion of spending was due to preventable acute care hospitalizations among mental health high-cost patients. This is not surprising as most costs were due to psychiatric hospitalizations and not acute care hospitalizations. Therefore, it may make more sense to try to ascertain preventable *psychiatric* hospitalizations, where possible. While some psychiatric hospitalizations are likely part of the natural course of the disease, and thus inevitable, some hospitalizations, namely readmissions, could potentially be prevented through timely access to physician care30 and adherence to medication.31 This should be explored in future research. Also, as a non-trivial number of patients persisted in the high-cost state for 8 years, models predicting long-term persistency may also prove useful for decision makers. This may require a better understanding of how to prevent multimorbidity from developing among individuals with severe mental illness, for example through screening of chronic conditions where appropriate.32

We examined all adult mental health high-cost patients in Ontario; previous work has typically examined representative samples or patients 65 and older only. We followed patients for 8 years; most related work has followed patients for 3 years. Finally, we captured most health care services paid by the Ontario Ministry of Health under a comprehensive universal health care insurance system. While there is a large body of work on all high-cost patients,9,33,34 little attention has been devoted to those with mental illness and/or examined their trajectories of care.4 At a health systems level, this research will help inform interventions that preserve quality of care while reducing costs, including preventing persistence in the high-cost state. Previous literature suggests that persistent high-cost patients may be ideal targets for cost-saving interventions, as some costs may be reduced through proper disease management.35 For example, high support housing36 may help address long hospital stays, which are a driver of high costs. However, our results suggest there may be little scope to address these patients’ high costs without further understanding the reasons for high hospitalization costs and for related outcomes such long lengths of stay in hospital. These findings may be useful to inform initiatives that focus on improving the management of care among complex, high-need patients with medical and psychiatric multimorbidity, such as the Health Links Initiative in Ontario37, Accountable Care Organizations in the US, and the Better Care Fund in the UK.

***Limitations***

We did not examine children and adolescents, as some health services for this population are funded by ministries other than the Ministry of Health. We could not capture patients who did not access the health care system via settings for which we did not have data on. For example, we were not able to include the costs of community-based addiction-related care. We were only able to capture costs of outpatient drugs covered by the public provincial drug plan (although this was in line with the perspective of the analysis). The lack of these costs may have affected how patient cohorts were determined. Furthermore, we were only able to examine chronic conditions for which there were validated algorithms. This was particularly problematic for psychiatric conditions as there is only a validated algorithm for psychosis (the mood disorders algorithm is not validated and its definition was limited to the quality of the Ontario physician billings data; moreover, it likely underestimates the number of patients with mood disorders). Additionally, due to data limitations, we were not able to characterise patients in terms of their ethnicity/race, for example, as done in previous research.5

***Conclusion***

Many mental health high-cost patients persisted in the high-cost state, particularly those in low-income urban areas and with comorbidities. The higher costs incurred by this group were driven by psychiatric hospitalizations. Policymakers should consider interventions that address quality of care through the management of psychosis and multimorbidity and rising health care costs, as well as appropriate prevention policies that target patients with mental illness before they become persistent high-cost patients. More research is required to understand what more can be done to address persistency in the high-cost state and whether there may be potential to reduce psychiatric hospitalizations or the length of hospital stays.

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**Competing interests:** None to declare.

**Data sharing:** The data from this study is held securely in coded form at ICES. While data sharing agreements prohibit ICES from making the data publicly available, access may be granted to those who meet pre-specified criteria for confidential access, available at www.ices.on.ca/DAS.