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Abstract:	Objectives: This study investigated the use of outpatient care, and sociodemographic and clinical characteristics of patients with substance-related disorders (SRD) to predict treatment dropout from specialized addiction treatment centers. The study also explored risks of adverse outcomes, frequent emergency department (ED) use (3+ visits/year), and death, associated with treatment dropout within the subsequent 12 months. Methods: The study examined a cohort of 16,179 patients who completed their last treatment episode for SRD between 2012–13 and 2014–15 (financial years: April 1 to March 31) in 14 specialized addiction treatment centers using Quebec (Canada) health administrative databases. We used multivariable logistic regressions to measure risk of treatment dropout (1996–96 to 2014–15), while survival analysis controlling for sex and age assessed the odds of frequent ED use and death in 2015–16. Results: Of the 55% of patients reporting dropout from SRD treatment over the 3-year period, 17% were frequent ED users, and 1% died in the subsequent 12 months. Patients residing in the most socially deprived areas, having polysubstance-related disorders or personality disorders, and having previously dropped out of specialized addiction treatment centers had increased odds of current treatment dropout. Older patients, those with a history of homelessness, past SRD treatment, or more concurrent outpatient care outside specialized addiction treatment centers had decreased odds of treatment dropout. Patients who dropped out were subsequently at higher risk of frequent ED use and death. Conclusions: This study highlighted that patients with more severe problems and previous dropout may need more sustained and adequate help to prevent subsequent treatment dropout. Specialized addiction treatment centers may consider enhancing their follow-up care of patients over a longer duration and better integrating their treatment with other outpatient care resources to meet the multiple needs of the more vulnerable patients using their services.

Highlights

- Past dropout most strongly predicted current dropout from addiction treatment.
- Past addiction treatment and use of 4+ outpatient services prevented dropout.
- Past homelessness prevented treatment dropout; social deprivation increased it.
- Polysubstance-related and personality disorders increased treatment dropout.
- Treatment dropout may lead to frequent emergency department use and death.

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Predictors of dropout from treatment among patients using specialized addiction treatment centers

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Declaration of interest

None

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Author contributions

MJF and CH designed the overall research project and were responsible for data collection. MJF and CH designed the analytical plan for the article. ZC produced the quantitative analyses and tables. MJF, GG and ZC wrote the article, and CH revised the final version. All authors approved the final version of the article.

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Predictors of dropout from treatment among patients using specialized addiction treatment centers

1. Introduction

Treatment dropout, usually defined as failure to complete a planned treatment program (Andersson et al., 2018), frequently occurs among patients with substance-related disorders (SRD). According to the 2011 Treatment Episode Data Set (TEDS-D) from the Substance Abuse and Mental Health Services Administration in the United States (SAMHSA, 2013), completion rates for specialized residential and outpatient addiction treatments were 65% and 48%, respectively (Stahler et al., 2016). A 2020 systematic review and meta-analysis reported a 30% dropout rate for psychosocial treatment in SRD (Lappan et al., 2020). Dropout affects the effectiveness of addiction treatment (Lappan et al., 2020), and is associated with higher risk of relapse (Simsek et al., 2019) and readmission. By contrast, retention in addiction treatment increases the odds of longer-term abstinence, employment, improvement in health conditions, and quality of life (Dalton et al., 2021; Harley et al., 2018), while reducing problems with the law and risk of premature death (G. Morandi et al., 2016). A better knowledge of patient and service use characteristics that predict dropout from addiction treatment may suggest targeted interventions to reduce or prevent dropout (Simsek et al., 2019).

Younger age, personality and cognitive disorders, and low therapeutic alliance were the most frequent risk factors identified in a 2013 systematic review evaluating dropout from addiction treatment (Brorson et al., 2013). The 2020 systematic review cited above also found higher treatment dropout rates among African Americans; low-income populations; patients using cocaine, methamphetamine, and major stimulants; and those treated in intensive, specialized addiction programs (Lappan et al., 2020). Patients diagnosed with co-occurring SRD-mental

disorders at their first treatment episode for SRD also had higher odds of treatment dropout, regardless of addiction treatment program, according to the 2009–2011 US national survey conducted by SAMHSA (Krawczyk et al., 2017). Research has identified psychological distress as increasing the odds of dropout from inpatient (Andersson et al., 2018) or outpatient (Mee et al., 2019) treatment. By contrast, the 2009–2011 US survey found that higher levels of education, employment, stable housing, having less recent SRD diagnoses, and primary use of alcohol predicted treatment completion (Stahler et al., 2016).

Most previous studies on SRD have limited their assessments of treatment dropout to single organizations or programs (Basu et al., 2017; Daigre et al., 2021; Iovine et al., 2020; Maremmani et al., 2016; McHugh et al., 2013; Mee et al., 2019; Panlilio et al., 2019), while few have considered addiction treatment episodes (Arndt et al., 2013; Krawczyk et al., 2017; Stahler et al., 2016), which may involve the integration of several treatment programs to address overall patient needs (e.g., referrals from residential/inpatient to outpatient treatment). In addition, studies have rarely focused on patients treated exclusively in specialized addiction treatment centers (Andersson et al., 2018; Arnaudova et al., 2020; Tull & Gratz, 2012), which mainly treat vulnerable patients affected by severe SRD and other biopsychosocial issues (Huynh et al., 2016), increasing their risk of frequent treatment dropout. Research has rarely investigates previous addiction treatment and dropout, and concurrent care in outpatient services other than addiction treatment—conditions that may affect current dropout from addiction treatment (Iovine et al., 2020; McHugh et al., 2013). In addition, few studies have investigated associations between dropout from treatment for SRD with subsequent risks of emergency department (ED) use or death (G. Morandi et al., 2016). Patients with SRD are known to be frequent ED users (3+ visits/year) (Armoon et al., 2021; Cederbaum et al., 2014), which often results from lack of adequate outpatient care, a key quality of care indicator.

Risk of death is known to be higher among patients with SRD compared with the general population (Chesney et al., 2014; Iturralde et al., 2021).

This longitudinal study is original in investigating the use of outpatient care in relation to patient sociodemographic and clinical characteristics as predictors of patient dropout from their last addiction treatment episode and in examining treatment dropout associated with subsequent 12-month risk for frequent ED use or death. The study hypothesized that patients with more previous addiction treatment episodes and more concurrent frequent outpatient care would be less likely to drop out of SRD treatment, while, conversely, those who previously dropped out of SRD treatment would be more likely to drop out from their current treatment episode. Patients with SRD and other complex biopsychosocial issues usually need many SRD treatment episodes before they achieve remission (Fleury, Djouini, et al., 2016; Nosyk et al., 2013). This study also hypothesized that patients who dropped out from treatment for SRD would have a greater risk of frequent ED use or death.

2, Methods

2.1 Study sample, sources, and design

Data for the study emanated from a cohort of 19,099 patients with SRD who used one of 14 (16 in total) Quebec specialized addiction treatment centers in 2012–13 (financial year: April 1–March 31). Patient data were collected from the center databases (SIC-SRD) for the years 2009–10 to 2015–16. These addiction centers provide specialized programs for SRD and behavioral addiction (e.g., gambling), including detoxification, substitution treatment and rehabilitation, and brief intervention units accessible through self-referral, referral from primary care services, or by court order. To be included in the study, patients had to be Quebec residents, 12+ years old, and eligible for the Quebec Public Health Insurance Plan (RAMQ) between 1996–97 and 2015–16, as patient

data from the SIC-SRD and RAMQ were merged for this study period. Patients also had to have terminated treatment (completion or dropout) in specialized addiction treatment centers. Those hospitalized >90 days in the 12-month period prior to termination of their treatment and those who died during this period were excluded, as their uptake of outpatient services could not be adequately assessed.

Patient data from the SIC-SRD included sociodemographic characteristics, type of SRD, and services received in these centers. The RAMQ database, merged with the SIC-SRD data for each patient and year, through a unique patient identifier, integrated billing systems for all Quebec physician services, excluding only 6% of services occurring outside the public system (Régie de l'assurance maladie du Québec, 2017). Other data concerned patient diagnostics, death registration, and services used in major health care organizations throughout the province (e.g., ED, hospitalization, psychosocial interventions in community healthcare centers). Diagnostic codes from RAMQ, including reasons for death, were provided by the International Classification of Diseases Ninth and Tenth Revisions (Appendix 1). The SIC-SRD integrated standardized instruments that measured SRD (yes/no), based on the Addiction Severity Index (Bergeron et al., 1992; McLellan et al., 1980) or the Global Appraisal of Individual Needs (Dennis et al., 2008).

Figure 1, which depicts the analytical framework for the study, identifies each variable, including the period of measurement, linked to RAMQ fields and the SIC-SRD database. Predictors of patient dropout, the dependent variable, were classified and tested according to patient sociodemographic and clinical characteristics, and outpatient care use measured before the closure of the patient's last treatment episode in specialized addiction treatment centers (i.e., dropout or not, or treatment completion). The study measured adverse outcomes associated with treatment dropout, frequent ED use, or death within the year following closure of the last treatment

episode for each patient. As the study used health administrative databases, the study did not require informed consent from patients. The Quebec Commission for Access to Information granted access to the databases, and the ethics review board of a health organization approved the study protocol.

2.2 Variables

The study measured the dependent variable, patient dropout/or not or treatment completion at closure of the patient's last treatment episode in specialized addiction treatment centers, from the 2012–13 to 2014–15 (financial years: April 1–March 31). The specialized addiction treatment center database (SIC-SRD) provided reasons justifying patient case closure following treatment episodes (i.e., dropout, completion). A treatment episode ran from start date to the end of treatment (e.g., from residential/inpatient to outpatient treatment), and included information on the number and type of programs used, frequency of interventions received, and duration of treatment episode.

Concerning independent variables used in evaluating treatment dropout, patient sociodemographic characteristics included: sex, age group, living in the most materially and socially deprived areas, which were measured in the year of the last treatment episode in specialized addiction treatment centers; as well as criminal history with or without incarceration and history of homelessness, both measured from 2009–10 to the year of the last treatment episode. The Material and Social Deprivation Indexes were based on the smallest dissemination areas established for the 2011 Canadian census. The Material Deprivation Index included ratios of population employment, average income, and education levels less than high school, while the Social Deprivation Index included proportions of patients living alone, those with single civil status and single-parent families (Pampalon et al., 2009). Both indexes were classified in quintiles

but were regrouped for this study as the least (1–3) and the most (4–5 and not assigned) deprived areas, e.g., homeless individuals, residents in nursing homes.

Patient clinical characteristics included type of SRD, number of years with SRD, and diagnoses of mental disorders, traumatic brain injury, or chronic physical illnesses. The study measured these variables within the duration of the last treatment episode in specialized addiction treatment centers and the remaining time within the 24-month study period, except for number of years with SRD, which we measured from 1996–97 (based mostly on the RAMQ database) to the year of the last treatment episode, to differentiate between acute or chronic cases of SRD. Type of SRD referred to exclusive groups: alcohol-related disorders only, cannabis-related disorders only, drug-related disorders other than cannabis only, and polysubstance-related disorders. Mental disorders included serious mental disorders (schizophrenia spectrum and other psychotic disorders, bipolar disorders), personality disorders, and common mental disorders (anxiety, depressive, adjustment disorders, other common mental disorders). Chronic physical illnesses included various diseases (e.g., diabetes, cardiovascular illnesses), based on an adapted version of both the Charlson and Elixhauser Comorbidity Indexes (Simard et al., 2019) (Appendix 1).

Outpatient care included number of treatment episodes received for SRD prior to the last treatment episode in specialized addiction treatment centers, and dropout from treatment for SRD prior to the last treatment episode, both measured from 2009–10 to 2014–15; as well as having used 4+ other concurrent outpatient services, measured for the duration of the last treatment episode in specialized addiction treatment centers and the remaining time within the 12-month study period. Services received outside of specialized addiction treatment centers referred to any care received from general practitioners (GP), psychiatrists, or psychosocial clinicians in community health care centers throughout the province. Related studies identified having received

4+ outpatient services yearly as a minimum standard for adequate frequency of care among patients with mental disorders, including SRD (Menear et al., 2014; Young et al., 2008).

Adverse outcomes, frequent ED use, or death, measured within 12 months after the last treatment episode, included any reason for ED visits and any cause of death. We defined frequent ED use as 3+ visits/year, a minimum standard for frequent ED use (Gaulin et al., 2019; Krieg et al., 2016), and a key indicator for measuring inadequacy of outpatient care in response to patient needs (Davies et al., 2017; Fleury et al., 2019).

2.3 Analyses

Descriptive analyses in the study included percentages for categorical variables, and mean values for continuous variables. The intraclass correlation coefficient (ICC) for the study was small (<0.01), indicating low shared variance among patients from the 14 addiction centers, which precluded the need for multilevel analysis. The study used bivariate logistic regression to examine associations between each independent variable and the dependent variable: patient dropout/or not (or treatment completion) from the last SRD treatment episode in specialized addiction treatment centers. Based on criterion procedures for forward model selection, we entered independent variables identified as significant in the bivariate analyses (alpha = 0.20) (Mickey & Greenland, 1989) into the multivariable logistic regression model. The study used the Akaike Information Criterion (AIC) (Akaike, 1973) to select independent variables for the final multiple logistic model, and tested collinearity statistics using variance inflation factors (VIF), with 5 as the maximum level of VIF (Menard, 2001). Considering that time to the outcome events (frequent ED use and death) was of interest, and measured from the last treatment episode to the events within the following 12 months, the study used the Cox proportional hazards model (Miller, 1997) to estimate the risks of events taking into account sex and age. All patients who did not have an event

by the end of the 12 months were censored. For frequent ED use, the Cox model also censored those who died before the events occurred. The odds ratios (OR), hazard ratios (HR), p-values and 95% confidence intervals were reported. Study staff performed statistical analyses using STATA SE (version 17) program (StataCorp, 2021).

3. Results

Of the 19,099 patients, 16,395 completed at least one treatment episode in specialized addiction treatment centers; the study excluded 91 deceased patients and 125 patients hospitalized over 90 days, leaving 16,179 patients in the cohort. Of these, 55% dropped out from their last SRD treatment episode (**Table 1**). Two thirds of patients were male, 21% were under 25 years old and 35% aged 45+; 57% lived in the most materially deprived areas and 62% in the most socially deprived areas; 19% had a criminal history, and 14% had experienced homelessness. Most patients (57%) had polysubstance-related disorders; 23% had alcohol-related disorders, 10% cannabis-related disorders, and 10% drug-related disorders other than cannabis exclusively. Most had mental disorders (64%), including 17% personality disorders, and 32% chronic physical illnesses. Nearly half (45%) of patients were in their first treatment episode at specialized addiction treatment centers, whereas 16% had completed 3+ previous episodes, and 40% had dropped out of treatment for SRD prior to their last treatment episode; 56% used 4+ outpatient services other than in specialized addiction treatment centers. Most SRD treatment episodes consisted of one SRD program only, comprising a median of 6 interventions of about 4 months duration (**Table 2**). The most widely used program that included 95% of patients involved specialized treatment for SRD, either inpatient (10%) or outpatient (85%), but mainly consisted of rehabilitation services with individual psychosocial counseling (**Table 2b**). Concerning adverse outcomes, 17% of patients qualified as frequent ED users and 1% died (**Table 1**).

Compared with patients under 25 years old, the odds of treatment dropout from specialized addiction treatment centers for those 45+ years old were 24% lower (**Table 3**). The odds were 13% higher for patients living in the most socially deprived areas, but 25% lower for those with a history of homelessness. Patients with polysubstance-related or personality disorders had higher odds (13% vs. 9%) of SRD treatment dropout. Those who received previous SRD treatment episodes had decreased odds of current dropout: 30% less among those with one previous episode, 37% less with two, and 51% less with 3+ episodes. However, patients who had previously dropped out from SRD treatment had 1.63 times greater odds of current treatment dropout. Those who used 4+ outpatient services either from GP, psychiatrists or psychosocial clinicians in community health care centers had 14% lower odds of dropout from treatment for SRD.

Patients who dropped out of treatment for SRD had a 15% and 39% higher risk of frequent ED use and death, respectively, within the 12-month period following closure of their last treatment episode, versus patients who did not drop out of treatment (**Table 4**). Compared with men, women had a 23% higher risk of frequent ED use, but 40% lower risk of death. These risks increased with age by 1% for frequent ED use and by 6% for death.

4. Discussion

This research was original in studying the use of outpatient care in relation to patient characteristics to predict dropout at the last treatment episode for SRD, and in examining risk of frequent ED use and death during the 12 months following treatment dropout. The treatment dropout rate (55%) was higher in this study than the 30% reported in the 2020 systematic review and meta-analysis of psychosocial treatment in SRD (Lappan et al., 2020). The exclusive focus on patients treated in specialized addiction treatment centers, including vulnerable patients with SRD, and on treatment "episodes" for SRD, including a few inpatient treatment programs (10%), may explain the higher treatment dropout rate in our study. The cohort mainly consisted of individuals living in the most

materially and socially deprived areas, those with polysubstance-related disorders and co-occurring mental disorders and included a third affected by chronic physical illnesses.

Findings confirmed the first hypothesis—that patients with past dropout from SRD treatment would be more likely to dropout from further addiction treatment, whereas those who received more previous addiction treatment, and concurrent 12-month outpatient care would be less likely to drop out. Previous treatment dropout was the strongest predictor of current dropout, suggesting a recurrent pattern of dropout from addiction treatment. The fact that remission among patients with SRD often involves multiple cycles of relapse and treatment over several years is well known (Kendler et al., 2018; McCabe et al., 2016; Sarvet & Hasin, 2016). Patients with previous treatment dropout may thus be targeted for increased motivational treatments and evaluation of treatment appropriateness in response to their needs as a remedy for recurring treatment failure. Interventions such as pretreatment educational interventions (Lara-Cabrera et al., 2016), motivational interviewing (Smedslund et al., 2011), and cognitive behavioral therapy (Dalton et al., 2021), along with the establishment of reliable patient registries, may be prioritized and deployed for better follow-up care of these patients.

By contrast, more prior treatment episodes played a protective role against current treatment dropout from specialized addiction treatment centers, underlining the key role of treatment persistence and adherence, as well as sustained treatment over time (Godley et al., 2014; McKay, 2021) for patients facing complex issues. However, only 55% of patients in this cohort received more than one treatment episode over the six-year period, with a small minority (15%) receiving more than 3 treatment episodes. Most patients also received few interventions in their last treatment episode (n=6), and these usually were dispensed within a limited 4-month duration. Treatment programs might be extended, integrating flexible, longer-term support and crisis

interventions inspired by various case management models from the mental health or chronic care sectors (Fleury, Perreault, et al., 2016; Fries & Rosen, 2011; S. Morandi et al., 2017). More extensive implementation of programs like assertive community treatment (Penzenstadler et al., 2019) and intensive case management (Vanderplasschen et al., 2019) prioritizing patients with SRD and integrated dual disorder treatment (SRD-mental disorders) (Kikkert et al., 2018), while still scarce in most Quebec territories, would be highly beneficial.

The lower odds of treatment dropout among patients with frequent (4+) outpatient care suggested that the therapeutic alliances created with clinicians outside of specialized addiction treatment centers may have helped to reinforce retention in addiction treatment. Therapeutic alliance was identified as a promising predictor for preventing treatment dropout in the 2013 systematic review (Brorson et al., 2013), but little research has yet to support this result. In our study, outpatient clinicians may have referred patients for addiction treatment, in conjunction with other biopsychosocial interventions. Physicians (GP or psychiatrists) and other psychosocial professionals (e.g., psychologists) usually provided longer-term interventions than those in specialized addiction treatment centers that also supported therapeutic alliances and treatment completion. While most patients in this cohort had multimorbidity and high needs requiring diverse and continuous services, many (44%) did not however receive sufficiently intensive outpatient care from GP or the mental health care sector. This suggests the need to reinforce outpatient care outside of specialized addiction treatment centers as well, for instance by developing programs like screening, brief intervention, and treatment referral to appropriate services (Bray et al., 2017), or collaborative care between specialized sectors and primary care settings (Watkins et al., 2017).

Most patient characteristics that predicted treatment dropout in this study have been previously investigated (Brorson et al., 2013; Lappan et al., 2020). The increased odds of treatment dropout among younger patients, compared with those 45+ years old, may be explained by the difficulty that younger patients with SRD have in acknowledging their condition, or by their reluctance to use services. Younger patients often prefer to resolve their own problems, and fear stigmatization (Lynch et al., 2020; Wu et al., 2011). The need for family support in attending appointments may also have explained dropout from treatment among adolescents or emerging adults. Yet in Quebec, adolescents 14+ years old may seek care without parental consent (Protecteur du citoyen, Mai 2022). Social deprivation (e.g., living alone, single-parent families), experienced by most patients (62%) in this study, is often identified in related research as a hindering factor in service use (Butler et al., 2013). This situation may explain low patient incentives in this study to complete addiction treatment and seek recovery, as compared with patients identified as having strong social support (Mutschler et al., 2013). In previous research, stable housing was associated with completion of addiction treatment (Stahler et al., 2016). Yet having a "history" of homelessness protected patients in this cohort against treatment dropout. Perhaps this difficult past motivated patients to complete addiction treatment to access or maintain their current housing; SRD is a key factor in housing eviction (Montgomery et al., 2017). Previously homeless patients integrated into programs like permanent supported housing may also have benefitted from case management support, which research has found to reduce ED use (Baxter et al., 2019).

The 2013 review on treatment dropout (Brorson et al., 2013) identified some studies (5/18) where "polysubstance use" was associated with dropout from addiction treatment, although heterogeneity in measures of consumption contributed to these mixed results. Our study assessed polysubstance-related disorders compared with specific substance-related diagnoses (either

alcohol, cannabis, or drug-related disorders other than cannabis). As these patients usually have more severe health and social issues requiring diversified and intensive interventions (Bhalla et al., 2017; McCabe et al., 2017), it was unsurprising that our results showed higher levels of treatment dropout for this group. As for personality disorders, these are one of the mental disorders most frequently associated with treatment dropout in previous studies (Brorson et al., 2013; Kienast et al., 2014; Tull & Gratz, 2012). Patients with borderline personality disorder, in particular, have great difficulty creating therapeutic alliances (Richard-Lepouriel et al., 2015), and are often very critical or unsatisfied with services they receive (Mirhaj Mohammadabadi et al., 2022), which may explain their higher levels of dropout from treatment. Dialectical behavior therapy may help to increase treatment retention among patients with co-occurring SRD-borderline personality disorders (Bloom et al., 2012).

The findings also confirmed the second hypothesis—that patients who dropped out of treatment would have greater risk of frequent ED use or death. The association of treatment dropout with relapse (Simsek et al., 2019) suggests that patients who dropout of treatment may become frequent ED users. Research reporting high ED use among patients with polysubstance-related disorders (Fleury et al., 2022) and personality disorders (Gentil et al., 2021; Richard-Lepouriel et al., 2015), coupled with findings from this study revealing that these diagnoses predicted dropout from addiction treatment, may be a reflection of limited outpatient care or inadequate health services (Burns, 2017). Previous studies also identified higher risk of death by accident (EMCDAA, 2015), suicide (Lynch et al., 2020), and from chronic physical illnesses (Roerecke & Rehm, 2014) among patients with untreated SRD. The finding of a higher risk of frequent ED use among women may be explained by their greater vulnerability to adverse health effects (Beaudoin et al., 2015), while higher risk of death among men may reflect more risky

behaviors. Finally, the increased risks of frequent ED use and death with age were logical, as older patients are more likely to suffer from chronic physical illnesses (Barnett et al., 2012; Jurisson et al., 2021).

4.1 Limitations

First, administrative health databases were primarily developed for financial purposes and, as such, provide only proxy measures of patient needs. Second, some variables that may have impacted treatment dropout, like types of drugs (e.g., opioids), ethnicity, education, or use of resources like Alcohol Anonymous or private psychologists were unavailable for this study. Third, while the study measured all independent variables in the study used to assess dropout before closure of the patient's last treatment episode, any causality between treatment dropout and these variables must be interpreted with caution. Fourth, as the study data were available only until March 31, 2016, the study could not consider the effects of the COVID-19 pandemic on patient dropout from specialized addiction treatment centers. Finally, the findings may not be generalizable to other contexts outside specialized addiction treatment centers, to populations without access to health insurance, or individuals who received only residential/inpatient treatment for SRD.

5. Conclusion

This study was relevant in investigating past addiction treatment, prior treatment dropout, and the concurrent use of outpatient care outside of specialized addiction treatment centers, in terms of how these patterns of care influenced addiction treatment dropout. Last treatment episodes were studied for this cohort, including the continuum of treatment programs, identifying few patients who were treated in residential/inpatient care, with the great majority receiving outpatient care. The study highlighted that patients with more severe issues and previous treatment dropout may need more sustained and adequate help to prevent subsequent dropout, and that past addiction

treatment along with more concurrent use of other outpatient services protected against dropout. Specialized addiction treatment centers should enhance follow-up care for patients for longer durations and better integrate their services with those of other health care providers in their attempt to meet the multiple needs of these vulnerable patients with SRD.

Declaration of interest

None

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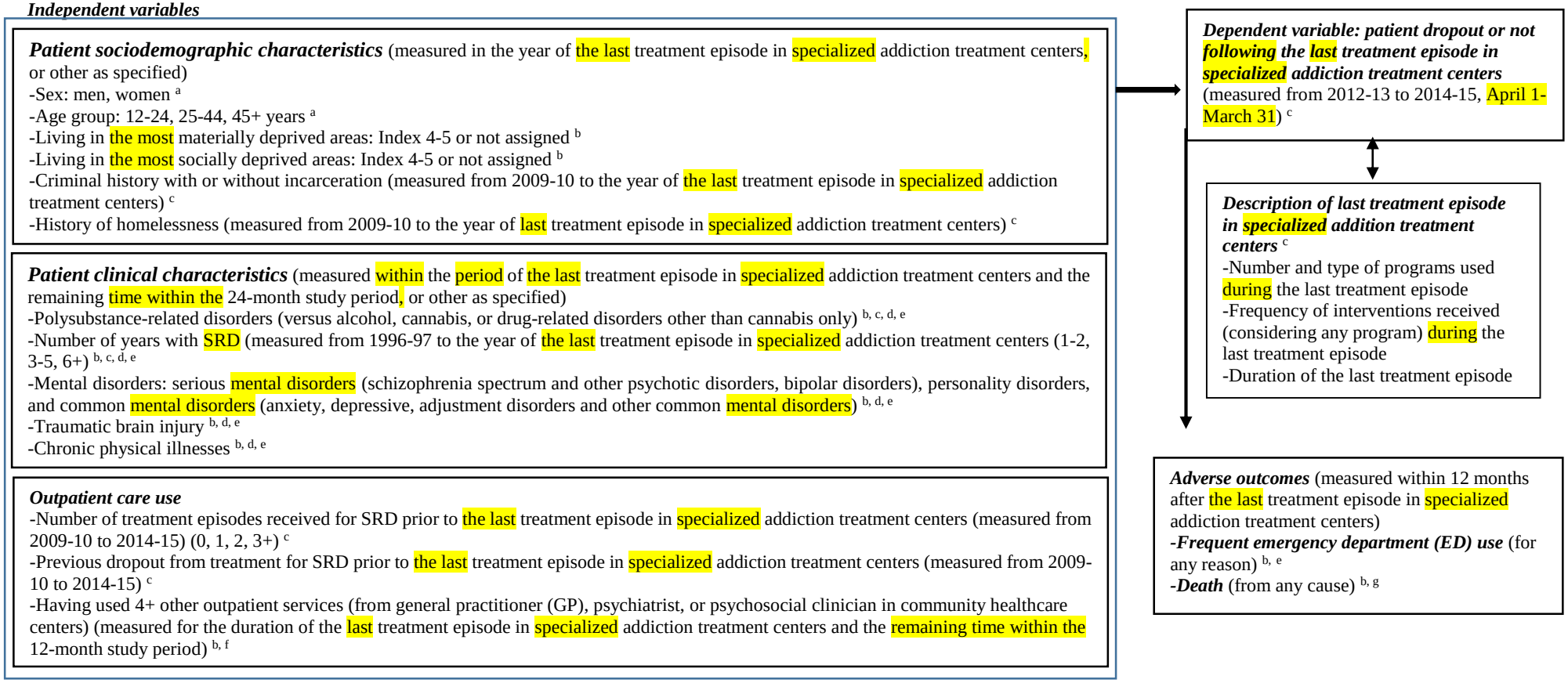
Figure 1 – Analytical framework: Predictors of dropout from specialized addiction treatment centers and related adverse outcomes following the last treatment episode for substance-related disorders (SRD)



[a] *Fichier d'inscription des personnes assurées* (FIPA, Health Insurance Registry); [b] *Régie de l'assurance maladie du Québec* (RAMQ, Physician Claims Database); [c] *Système d'information clientèle pour les services de réadaptation dépendances* (SIC-SRD, Specialized Addiction Treatment Centers Database, including having SRD and behavioral addictions based on standardized instruments); [d] *Maintenance et exploitation des données pour l'étude de la clientèle hospitalière* (MED-ECHO, Hospital Inpatient and Day Surgery Database); [e] *Banque de données communes des urgences* (BDCU, ED Database); [f] *Système d'information permettant la gestion de l'information clinique et administrative dans le domaine de la santé et des services sociaux* (I-CLSC Database, Psychosocial Interventions in Community Healthcare Centers, including GP working on salary); [g] *Fichier des décès du Registre des évènements démographiques* (RED, Vital Statistics Death Database). * For definitions of variables included in the study see footnotes under Table 1 or in the Methods section. Details on diagnostic codes are presented in Appendix 1.

Table 1. Characteristics of patients who dropped out/or not from their last treatment episode for substance-related disorders (SRD) in specialized addiction treatment centers, and characteristics of the entire patient cohort (2012-13 to 2014-15, April 1-March 31) (N=16,179)

	No dropout [a] (Treatment completion)		Dropout [a]		Total		Bivariate analysis
	n	%	n	%	n	%	p-value
	7,342	45.38	8,837	54.62	16,179	100.00	
Patient sociodemographic characteristics (measured in the year of the last treatment episode in specialized addiction treatment centers, or other as specified)							
Women	2,466	33.59	3,045	34.46	5,511	34.06	≥0.2
Men	4,876	66.41	5,792	65.54	10,668	65.94	
Age group (years)							
12-24	1,417	19.30	1,926	21.79	3,343	20.66	<0.2
25-44	3,091	42.10	4,124	46.67	7,215	44.59	
45+	2,834	38.60	2,787	31.54	5,621	34.74	
Living in the least materially deprived areas: Index 1-3	3,238	44.10	3,733	42.24	6,971	43.09	<0.2
Living in the most materially deprived areas: Index 4-5 or not assigned [b]	4,104	55.90	5,104	57.76	9,208	56.91	
Living in the least socially deprived areas: Index 1-3	2,871	39.10	3,215	36.38	6,086	37.62	<0.2
Living in the most socially deprived areas: Index 4-5 or not assigned [b]	4,471	60.90	5,622	63.62	10,093	62.38	
Criminal history with or without incarceration (measured from 2009-10 to the year of the last treatment episode in specialized addiction treatment centers)	1,344	18.31	1,773	20.06	3,117	19.27	<0.2
History of homelessness (measured from 2009-10 to the year of the last treatment episode in specialized addiction treatment centers)	1,155	15.73	1,073	12.14	2,228	13.77	<0.2
Patient clinical characteristics (measured within the period of the last treatment episode in specialized addiction treatment centers and the remaining time within the 24-month study period, or other as specified)							
Type of SRD [c]							<0.2
Alcohol-related disorders only	1,829	24.91	1,873	21.19	3,702	22.88	
Cannabis-related disorders only	779	10.61	878	9.94	1,657	10.24	
Drug-related disorders other than cannabis only	772	10.51	904	10.23	1,676	10.36	

Polysubstance-related disorders	3,962	53.96	5,182	58.64	9,144	56.52	
Number of years with SRD (measured from 1996-97 to the year of the last treatment episode in specialized addiction treatment centers)							<0.2
1-2	4,472	60.91	5,476	61.97	9,948	61.49	
3-5	1,624	22.12	1,991	22.53	3,615	22.34	
6+	1,246	16.97	1,370	15.50	2,616	16.17	
Serious mental disorders [c, d]	1,378	18.77	1,674	18.94	3,052	18.86	≥0.2
Common mental disorders [c, d]	4,144	56.44	5,065	57.32	9,209	56.92	≥0.2
Personality disorders [c]	1,226	16.70	1,590	17.99	2,816	17.41	<0.2
Traumatic brain injury [c]	237	3.23	302	3.42	539	3.33	≥0.2
Chronic physical illnesses [c, e]	2,463	33.55	2,693	30.47	5,156	31.87	<0.2
Outpatient care use							
Number of treatment episodes received for SRD prior to the last treatment episode in specialized addiction treatment centers (measured from 2009-10 to 2014-15)							<0.2
0	3,465	47.19	3,757	42.51	7,222	44.64	
1	1,820	24.79	2,400	27.16	4,220	26.08	
2	921	12.54	1,313	14.86	2,234	13.81	
3+	1136	15.47	1367	15.47	2503	15.47	
Previous dropout from treatment for SRD prior to the last treatment episode in specialized addiction treatment centers (measured from 2009-10 to 2014-15)	2,364	32.20	4,040	45.72	6,404	39.58	<0.2
Having received 4+ other outpatient services (from any general practitioner (GP), psychiatrist, or psychosocial clinician in community healthcare centers) (measured for the duration of the last treatment episode in specialized addiction treatment centers and the remaining time within the 12-month study period) [f]	4,282	58.32	4,834	54.70	9,116	56.34	<0.2
Adverse outcomes (measured within 12 months after the last treatment episode in specialized addiction treatment centers**)**							
Frequent emergency department (ED) use (3+ visits/year; for any reason) [g]	1,178	16.04	1,564	17.70	2,742	16.95	
Death (from any cause)	75	1.02	109	1.23	184	1.14	

[a] The specialized addiction treatment centers database (SIC-SRD) provided reasons justifying patient case closure from an episode of treatment (e.g., treatment dropout, treatment completion). A treatment episode ran from the start date to the end of treatment (or date of file closure) and may include more than one type of program. Treatment episode is defined and detailed below Table 2. Dropout, or not (or completion of treatment), the dependent variable, was measured at the closure of the last episode of treatment for each patient, from the financial years starting April 1, 2012 to March 31, 2015 (a 3-year period). All independent variables were measured before the occurrence (dates) of patient dropout or not.

[b] Material and social deprivation indexes related to the smallest residential dissemination areas, based on the 2011 Canadian census. For this study, quintiles were regrouped into two levels representing less (1-3) and more (4-5 or not assigned) deprived areas. "Not assigned" areas included missing address or areas where index assignment was not feasible. An index cannot usually be assigned to residents of nursing homes or to homeless individuals. See methods section for more information.
[c] See Appendix 1 for diagnostic codes.
[d] Serious mental disorders included: schizophrenia spectrum and other psychotic disorders, and bipolar disorders; and common mental disorders: anxiety, depressive, adjustment disorders and other common mental disorders).
[e] Chronic physical illnesses included: renal failure, cerebrovascular illnesses, neurological illnesses, endocrine illnesses, tumor without or with metastasis, chronic pulmonary illnesses, diabetes complicated and uncomplicated, cardiovascular illnesses, and other chronic illness categories (e.g., blood loss anemia).
[f] Having received 4+ other outpatient services yearly was identified as a minimal standard for adequate frequency of care, based on previous studies (see references in methods section).
[g] A minimum of three visits per year is the standard definition for frequent ED use, based on previous research (see references in methods section). Any reason of ED use is accounted in ED visits.

Table 2: Characteristics of the last treatment episode for substance-related disorders (SRD) in specialized addiction treatment centers

	Mean	SD	Median	IQR	Min	Max
Number of programs used during the last treatment episode [a]	1.22	0.48	1	0	1	5
Frequency of interventions received (any program) during the last treatment episode	11.04	20.62	6	11	0	696
Duration of the last treatment episode in days	187.82	224.63	129	173	1	6060

[a] An episode of treatment runs from the start date to the end of treatment (or closure of patient file). Treatment programs offered in specialized addiction treatment centers included: physician activities (e.g., substitution treatment), inpatient or outpatient services for gambling, and specialized SRD services either inpatient (e.g., detoxification treatment) or outpatient (e.g., counselling, rehabilitation, brief treatment) (see methods section). For a patient to be included in the study, his/her treatment episode should include the use of substance use treatment programs, with available information on treatment dropout/or not (or the completion of treatment), the dependent variable.

Table 2b: Types of programs used in the last treatment episode for substance-related disorders (SRD) in specialized addiction treatment centers

Program	Physician activities	Inpatient services for gambling	Outpatient services for gambling	SRD inpatient services	SRD outpatient services	Total
n	841	92	687	3,294	27,071 + 1,081	33,066
%	2.54	0.28	2.08	9.96	85.14 (81.87 + 3.27)	100.00

Episode of treatment runs from the start date to the end of treatment (or closure of patient file). For treatment dropout/or not from the last treatment episode, the dependent variable, the last treatment episode for each patient was measured for the period 2012-13 to 2014-15 (April 1-March 31, financial years), and programs for SRD needed to be accounted for (only gambling programs were excluded).

Table 3. Multivariable logistic regression results: Predictors of patient dropout from the last treatment episode for substance-related disorders (SRD) in specialized addiction treatment centers (reference group: no dropout [a])

	OR	p-value	95% CI	
Age (ref.: under 25 years old)				
25-44 years old	0.98	0.668	0.90	1.07
45+ years old	0.76	<0.001	0.70	0.83
Living in the most materially deprived areas [b]	1.06	0.077	0.99	1.13
Living in the most socially deprived areas [b]	1.13	<0.001	1.05	1.20
History of homelessness	0.75	<0.001	0.6	0.819
Polysubstance-related-disorders [c]	1.13	<0.001	1.060	1.209
Personality disorders [c, d]	1.09	0.047	1.001	1.192
Number of previous treatment episodes received for SRD before the last treatment episode received in specialized addiction treatment centers (ref.: 0)				
1	0.70	<0.001	0.633	0.769
2	0.63	<0.001	0.552	0.710
3+	0.49	<0.001	0.433	0.562
Previous dropouts from treatment for SRD prior to the last treatment episode in specialized addiction treatment centers	2.63	<0.001	2.385	2.908
Having received 4+ other outpatient services (from any general practitioner (GP), psychiatrist, or psychosocial clinician in community healthcare centers) [e]	0.86	<0.001	0.809	0.921

[a] See note [a] below Table 1.
[b] See note [b] below Table 1.
[c] See note [c] below Table 1.
[d] See note [d] below Table 1.
[e] See note [f] below Table 1.
* See Table 1 for the timeframe of the construction of variables.

Table 4. Study outcomes [a] – Cox proportional hazards regression analysis measuring relationships between dropout from the last treatment episode for substance-related disorders (SRD) in specialized addiction treatment centers and frequent emergency department (ED) use (3+ visits/year) or death

	Frequent ED use [b]				Death			
	HR	**p-value**	**95% CI**		**HR**	**p-value**	**95% CI**	
Treatment dropout vs. no dropout [c]	1.15	<0.001	1.07	1.24	1.39	0.028	1.04	1.87
Women vs. men	1.23	<0.001	1.14	1.33	0.60	0.003	0.43	0.84
Age (years)	1.01	<0.001	1.01	1.02	1.06	<0.001	1.05	1.07

[a] Any reason for ED use (3+/year) or any cause of death are included within the 12-month period following the last treatment episode in specialized addiction treatment centers.
[b] See note [g] below Table 1.
[c] See note [a] below Table 1.

Credit author statements

Author contributions

MJF and CH designed the overall research project and were responsible for data collection. MJF and CH designed the analytical plan for the article. ZC produced the quantitative analyses and tables. MJF, GG and ZC wrote the article, and CH revised the final version. All authors approved the final version of the article.