PREDICTORS OF DETOXIFICATION SERVICES USE IN ALBERTA:

A PROVINCIAL SOCIO-DEMOGRAPHIC AND UTILIZATION ANALYSIS

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ABSTRACT

Detoxification is the first step in the substance use and addictive behaviours recovery process, serving as the transition between dependency and reduced use or abstinence. Completing detoxification is an important milestone in initiating recovery and remission of withdrawal symptoms, as well as facilitating follow-up treatment. However, high non-completion rates, low transition to residential treatment, and frequent use of detoxification services pose significant challenges to substance use disorder and behavioural addiction treatment and detox programs. This is the first study of the predictors in detoxification programs in Alberta, marking a significant step in understanding the predictors of completion and non-completion rates of detoxification, transfer to residential treatment, and repeated use of detox services based on data from five residential withdrawal management services in Alberta, Canada. The thesis consists of three manuscripts: (1) The first manuscript identifies the factors that predict detoxification service use, estimates program completion and non-completion rates, and the proportion of clients who cycle between completion and non-completion; (2) The second manuscript estimates clients' transition rates from detoxification to residential treatment services and identifies predictors of such transitions; (3) The third manuscript estimates the prevalence of repeated use of residential withdrawal management services in Alberta, Canada and identifies predictors of frequent use.

PREFACE

BL, EP, and RL contributed to the manuscripts' conceptualization, editing, and submission approval.

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List of abbreviations

LOS - Length of Stay
ASIST - The Addiction System for Information and Service Tracking database
FY - Fiscal Year
MI - Multiple Imputation
OR - Odds Ratio
AHS - Alberta Health Services
NDP - The New Democratic Party

Chapter One: Introduction

Detoxification is often the necessary first step in the substance use disorder and behavioural addiction recovery process for many individuals because it serves as their initial contact with the treatment system (Amodeo et al., 2008; Arroyave et al., 1980; Kenne et al., 2010; Li et al., 2008; Running Bear et al., 2017). It is designed to manage acute withdrawal symptoms, followed by facilitating and advocating for substance use disorder and behavioural addiction treatment entry after detoxification (Li et al., 2008; Running Bear et al., 2017). Detoxification alone may temporarily reduce the harms associated with substance use disorder and behavioural addiction for a short time (Chutuape et al., 2001). However, due to the narrow and short-term focus of detoxification-only programs and the frequency of relapse, continuous substance use disorder and behavioural addiction treatment is necessary to achieve long-term abstinence or recovery from addiction (Li et al., 2008; Mark et al., 2002; Mattick & Hall, 1996; Timko et al., 2015; Zhu & Wu, 2018). Keeping clients engaged until completion (Kenne et al., 2010) and transitioning them to treatment after they are discharged from detox (Carroll et al., 2009; Specka et al., 2011; Zhu & Wu, 2018) while also reducing the repeated use of detoxification services (McLellan et al., 2005; Tomasson & Vagum, 1998) are among the most significant challenges in the treatment system. Thus, this dissertation focuses on three interconnected detoxification outcomes: completion/non-completion, a continuation of treatment post-detoxification, and frequent utilization of detoxification services.

Rationale and Significance of the Study

There is broad recognition of the importance of completing detoxification for the remission of withdrawal symptoms (Blondell et al., 2006), reducing the odds of relapse (Kouimtsidis et al., 2021), and its potential to facilitating follow-up treatment (Amodeo et al.,

2008; Blondell et al., 2007; Dayal et al., 2017; Li et al., 2008; Ling et al., 2022; Running Bear et al., 2017). Detoxification followed by treatment helps break the cycle of frequent detoxification for many clients (Carrier et al., 2011; McCarty et al., 2000) by preventing or delaying subsequent readmissions (Daley et al., 2010; McLellan et al., 2005; Running Bear et al., 2022). However, several studies have demonstrated a high non-completion rate of up to 63% (Hogan et al., 2018; Sidana et al., 2023; Specka et al., 2011; Timko et al., 2015), and up to 87% failed to proceed with further treatment services after detox discharge (Acevedo et al., 2016, 2017; Campbell et al., 2010; Carroll et al., 2009; Ford & Zarate, 2010; Frydrych et al., 2009; Kelly et al., 2016; Lee et al., 2014; Mark et al., 2002; Timko et al., 2016; Tuten et al., 2007; Zhu & Wu, 2018). A smaller proportion of detoxification clients accounts for a disproportionately higher admissions rate (Chang et al., 2016; Li et al., 2007; Tomasson & Vaglum, 1998). These clients are likely to be non-completers (Callaghan & Cunningham, 2002; Yedlapati & Stewart, 2018) and less likely to transition to treatment (Mark et al., 2006). This makes detoxification one of the most expensive healthcare treatments in terms of cost per day (Haley et al., 2011).

There is no consensus in the literature on the definitions of completion, transition to treatment, and frequency of use. The inconclusive findings in the literature on completion, transition to treatment, and frequent utilization of detoxification are attributed to differences in the study duration, follow-up times, range of admissions, treatment programs, and healthcare policy. These factors highlight the need to study the rates of completion/non-completion, frequency of utilization, and transition to treatment, as well as socio-demographic, program, and substance use disorder and behavioural addiction[1] factors, among other variables. Analyzing the rates of completion and non-completion, the transition to treatment after detoxification, and the

[1] In this thesis, "behavioral addiction" refers specifically to gambling behavior.

frequency of service utilization can help identify predictors related to client characteristics, program factors, and substance use disorder and behavioural addiction. This information can inform services tailored to the specific needs of individuals. Additionally, it supports the standardization of detoxification programs and optimizes the high costs associated with these services. Despite the vital role of detoxification in reducing the personal and societal costs of addiction (Ford & Zarate, 2010) and minimizing harm to individuals dealing with addiction (Raistrick et al., 2006) and its potential to lead to further treatment (Amodeo et al., 2008), it has not been extensively researched in Canada, and no previous studies have been conducted in Alberta. Moreover, existing studies are not up-to-date and do not serve as valid evidence in the current context. As a first step in establishing evidence-based practices in Alberta detox services, this study has the potential to contribute to improving detox practices, provide input for program design, promote treatment, and reduce frequent utilization rates.

Literature Review

Overview of Detoxification Services

Detoxification ("detox") is the initial stage of the three interlinked phases of substance use disorder and behavioural addiction treatment, followed by rehabilitation services such as outpatient, residential[2], or inpatient primary and extended care, maintenance, or recovery, which includes aftercare, relapse prevention, or domicile care (Institute of Medicine, 1990 cited in Mark et al., 2003). It consists of at least three main components: evaluation of medical, psychological, and social conditions; stabilization of clients through the withdrawal process; and facilitation and advocacy of treatment entry following detoxification (Li et al., 2008; Running

[2] The Government of Alberta consulted with different stakeholders and recommended using "Live in " instead of Residential (AHS, 2024).

Bear et al., 2017). While detoxification and stabilization are crucial for managing the severity of withdrawal symptoms in the early stages of the continuum of care, continuous substance use disorder and behavioural addiction treatment are necessary to achieve long-term abstinence or recovery from addiction (Day & Daly, 2021; Li et al., 2007; Mark et al., 2002; Zhu & Wu, 2018). Detoxification is often the necessary first step in a continuum of care that leads to long-term recovery from addiction (David et al., 2022; Kenne et al., 2010; Running Bear et al., 2022), despite evidence suggesting that recovery is possible without treatment (Cloud & Granfield, 2008; Granfield & Cloud, 2001; Sobell et al., 1996).

Individuals withdrawing from substance use disorders and behavioural addictions experience a wide range of symptoms, which vary based on the type of abused substance and the severity of dependence (WHO, 200). Common symptoms include nausea, vomiting, diarrhea, anxiety, and insomnia (WHO, 2009, p. 32). Specifically, withdrawal symptoms from alcohol may include anxiety, excessive sweating, tremors, dehydration, increased heart rate, elevated blood pressure, insomnia, nausea, and vomiting. In severe cases, withdrawal can lead to life-threatening complications such as seizures and delirium tremens (Airagnes et al., 2023; Canadian Center on Substance Use and Addiction, 2017; Timko et al., 2016; WHO, 2009). Detox services may use medication and substitution/maintenance therapy to accelerate and supplement the withdrawal process (Li et al., 2008; Stotts et al.,2009), which eventually improves the overall health and well-being of substance use disorder and behavioural addiction individuals (Li et al., 2008). A study conducted in New Zealand revealed that individuals' quality of life improved after completing detoxification services, regardless of whether they relapsed later. However, those who remained abstinent significantly improved their quality of life (Macfarlane et al., 2019). Conversely, Mattrick and Hall (1996) found no difference in the well-being improvement

of individuals with a substance use disorder between those who accessed detox services and those who did not. Nonetheless, many individuals in different countries continue to believe that detox services alone can bring about lasting changes in substance use disorder (Mattick & Hall, 1996). Despite such endorsements, Quelch et al. (2019) found that abstinence rates decreased with detoxification over time. Abstinence decreased from 68.1% to 44.7% and 36.2% at 3, 6, and 12 months post-detoxification, respectively. Similarly, for individuals who underwent detoxification without following up on treatment, the risk of relapse increased by 65% within the first month of discharge from detoxification (Bailey et al., 2013; Walley et al., 2020). Thus, detoxification is not an end in itself but rather a transitional state between dependence and abstinence or reduced use (Diaper et al., 2014), ideally followed by initiating treatment and promoting continued abstinence (Day & Daly, 2021; Kosten & O'Connor, 2003; Lee et al., 2014; Levola et al., 2021; Li et al., 2008).

Detox Completion

It is widely recognized that completing detoxification is crucial for starting the recovery process, relieving withdrawal symptoms (Blondell et al., 2006), decreasing the likelihood of relapse (Kouimtsidis et al., 2021), and enhancing the overall quality of life, irrespective of any future relapses (Macfarlane et al., 2019). Completing detoxification predisposes improved program outcomes with its potential to facilitate follow-up treatment (Amodeo et al., 2008; Blondell et al., 2007; Dayal et al., 2017; Li et al., 2008; Ling et al., 2022; Running Bear et al., 2017). Conversely, client dropout (failure to complete) and leaving against medical advice pose significant challenges to the substance use disorder and behavioural addiction field in general and detox programs in particular (Kenne et al., 2010). It affects the quality of effective and efficient care for individuals with substance use and behavioural addictions (Li et al., 2007) by

increasing the likelihood of relapse and lowering the likelihood of entering abstinence-based treatment (Kosten & O'Connor, 2003; Sidana et al., 2023). However, numerous studies have demonstrated high non-completion rates of up to 63% (Hogan et al., 2018; Sidana et al., 2023; Specka et al., 2011; Timko et al., 2015), which is challenging in addressing the needs of clients and the utilization of resources. This makes detoxification services one of the most expensive services that significantly cost the treatment system (Haley et al., 2011).

Continuity to Treatment

Continuity to addiction treatment after detoxification not only lowers the chance of relapse (Acevedo et al., 2018; Blodgett et al., 2014; Ford & Zarate, 2010; Lee et al., 2014; Livingston et al., 2022; Tuten et al., 2007) and reduces the risk of accidental overdose (Day, 2005; Wines et al.,2007), but it also reduces substance use, leads to fewer arrests, lowers the homelessness rate, and increases the employment rate (Ford & Zarate, 2010; Teesson et al., 2006). A person who goes through detoxification-only service could have decreased tolerance to drugs, which could increase the risk of overdose from relapse (Stein et al., 2009) and increase the mortality rate (Strang et al., 2003). Follow-up treatments have the potential to reverse these adverse effects.

Nevertheless, despite the importance of successful recovery and continuity of care after detoxification, several studies have suggested that up to 87% of individuals fail to proceed with further treatment services after discharge (Acevedo et al., 2016, 2017; Campbell et al., 2010; Carroll et al., 2009; Ford & Zarate, 2010; Frydrych et al., 2009; Kelly et al., 2016; Lee et al., 2014; Mark et al., 2002; Timko et al., 2016; Tuten et al., 2007; Zhu & Wu, 2018). The lower transition rate is partly due to individuals who underwent detoxification not having the goal of transitioning to treatment or temporarily reducing harm. McKeganey et al. (2004) found that

73% of clients who accessed residential detoxification had an intention to achieve abstinence, 8% had only harm reduction goals, and 19% had both abstinence and harm reduction objectives. The literature reports different criteria for the transition duration that affect the comparison of the transition rates of discharge from detox to treatment. While a short interval is ideal for individuals to transition to treatment, the literature demonstrates varying duration criteria, such as 14-day criteria (Garnick et al., 2010; Lee et al., 2014) to 7-day criteria (ASAM, 2014; Garnick et al., 2020; Haley et al., 2011; Harris et al., 2016; Lee et al., 2014), and 30-day criteria (Ford & Zarate, 2010; Stein et al., 2009).

Detoxification Readmission

Readmission poses a significant challenge to the healthcare system by putting pressure on the limited treatment capacity and resources (Chang et al., 2016; Ken et al., 2010; Running Bear et al., 2022) and creates system inefficiency, as a small proportion of clients occupy the limited detoxification beds, thus reducing the chance of admission of other clients (McLellan et al., 2005; Running Bear et al., 2022). Apart from having limited resources, re-detoxification can have a detrimental impact on the quality of life of people with substance use disorders. Repeated withdrawal from alcohol may be associated with reduced brain plasticity, reflected in a delay in recovery from impairment of attention and executive function (Loeber et al., 2010) and an increased risk of overdose from opiates (Walley et al., 2020). This is why individuals who have gone through treatment three or more times have a more prolonged recovery treatment time (Callaghan, 2002; Dennis et al., 2005) and lack a journey to bring the required social and behavioural changes necessary for ongoing rehabilitation (McLellan et al., 2005).

Individuals with more frequent admissions to detoxification services represent a small proportion of detoxification individuals but account for a disproportionately higher rate of

admissions (Chang et al., 2016; Li et al., 2007). For example, Chang et al. (2016) found that 6% of individuals admitted four or more times accounted for 23% of all detoxification facility admissions in one year. Li et al. (2007) showed that individuals with multiple admissions constituted 24% of all detoxification individuals but accounted for 44% of all detoxification admissions. Similarly, an earlier study by Tomasson and Vaglum (1998) found that 6% (n = 12) of clients had over 50 admissions, equivalent to over four admissions per individual. This 6% had an admission at least four times, referred to as repeat entry into care, and they are an important group for the healthcare system to identify.

For many individuals, detoxification followed by treatment reduces the likelihood of one or more readmissions to detoxification (Carrier et al., 2011; McCarty et al., 2000) and prevents or delays subsequent readmission (Carrier et al., 2011; Daley et al., 2020; McLellan et al.,2005; Running Bear et al., 2022). However, for many individuals who experience repeated withdrawal relapses or lack of treatment, detoxification-only services may become a frequent option (McLellan et al., 2005; Richman & Neumann, 1984). This is referred to as a "revolving door" (Mark et al., 2006, p. 439), multiple detoxifications (McLellan et al., 2005), or detoxification loop (Richman & Neumann, 1984).

The likelihood of frequent readmission to detox programs is increased by a high non-completion rate, coupled with the frequency of clients being unable to continue treatment after detoxification (Carrier et al., 2011; Li et al., 2008; Mark et al., 2006; McLellan et al., 2005; Spear, 2014; Van den Berg et al., 2015). This frequent admission, in turn, places a significant burden on the healthcare system because treatment resources, which are limited to begin with, are disproportionately used by a small fraction of the population (Chang et al., 2016; Kenne et al., 2010; Li et al., 2007; McLellan et al., 2005). The high cost of detoxification services, coupled

with the health risks associated with rapid relapse, makes readmission to treatment a crucial indicator of inefficiencies in substance use and behavioural addiction treatment system (Carrier et al., 2011; Spear, 2014).

Public investment in detoxification programs is a cost-effective means of reducing harm to individuals struggling with addiction and can also positively impact families and society (Raistrick et al., 2006). However, the lower detoxification service completion and transition to treatment rates, combined with the increasing frequency of use, have made detoxification one of the most expensive healthcare treatments in terms of cost per day (Haley et al., 2011), with an average cost per episode ranging from $3,625 to $7,250 (Medical Detox Ontario, 2021). The mean index admission cost recorded in the United States is $1,779 (Quinn et al., 2017), but the cost increases with successive admissions. This high cost of treatment likely contributes to the unsustainability of healthcare spending in Canada (Canadian Medical Association [CMA], 2022), where the per-person cost of addiction was estimated at $1,579 in 2017 for Albertans of any age (CCSA, 2020).

Detoxification Services in Canada

In Canada, substance use disorder cost the economy $56 billion in 2017 (CCSA, 2020), reduced life expectancy by 11 years from 82 to 71 (World Bank, 2020), and killed more than 67,515 people at an early age in a year (Canadian Substance Use Costs and Harms Scientific Working Group, 2018). There is a considerable gap between Canada's demand and available treatment services (McPherson & Boyne, 2017). Although there are approximately 1.3 million individuals (4.4% of Canadians) who meet the criteria for a substance use disorder (Pirie et al., 2016), the rate of individuals entering any treatment is low. For example, only one in three individuals who had a lifetime diagnosis of alcohol dependence had ever attended treatment for

their alcohol concerns in Canada (Cunningham & Breslin, 2004). Not everyone who has an alcohol use disorder requires detox, although the study seems to be sampling more severe users. More detox referrals than the number of admissions also show higher demand than the available services (Li et al.,2007) and a low prevalence of accessing detox services (Vipler et al., 2008).

Classification of Detox Service Setting

There are two ways of classifying detox services: by setting and the type of service provided. Canada has five alcohol and drug treatment settings. First, outpatient or community treatment is offered to people who have a safe home and whose substance use disorder does not put others at serious risk. Second, inpatient or hospital treatment is recommended for people with alcohol and drug problems and those with medical and mental health challenges. Clients in this setting require intensive and comprehensive medical care and supervision. Third, residential treatment is a 24-hour and seven-days-a-week treatment that involves an intensive and structured program. It is utilized by clients who have complex and long-standing alcohol and drug use problems. Fourth, continuing care provides post-treatment support for recovery and helps maintain healthy changes. Fifth, withdrawal management centres, also called detox centres, are where individuals with alcohol and drug dependencies can withdraw safely from hospitals, residential centres, and non-residential centres (Canadian Center on Substance Use and Addiction, 2017). These five types of settings are not necessarily mutually exclusive.

There are different types of detox services across Canada, including medical, social, and home detoxifications. Medical detox programs utilize medication and medical supervision to withdraw clients from alcohol or other drugs safely. Health care staff administer medications that minimize or suppress the severity of withdrawal symptoms (Canadian Center on Substance Use and Addiction, 2017; Mattick & Hall, 1996). Medical detoxification centres are ideal for

individuals with severe withdrawal symptoms or when the detoxification is unmanageable in other service settings (Diaper et al., 2014; Merkx et al., 2014). In general, medically assisted detoxification has higher abstinence rates than those without medical assistance (Merkx et al.,2014). The second type of service is social detox programs, which provide a supportive and supervised environment in which to withdraw from alcohol and other drugs. It is less costly and requires frequent contact with clients for feedback and for building trust. The supplementation of medicine reduces the severity of withdrawal symptoms. The third type of detox is home detox, a program in which people receive support from their primary care provider to withdraw in their homes (Arroyave et al., 1980; Canadian Center on Substance Use and Addiction, 2017; Mattick & Hall, 1996). It has been proven safe and is 11-23 times cheaper than inpatient admission, thus making it more affordable (Davis, 2018) and feasible in a low-resource setting (Nadkarni et al., 2020). However, non-residential (daytox, intensive outpatient) and home detox services (Meister et al., 2019) are not offered in Alberta.

Within these detox types, there are specialized services based on specific substance use and behavioural addictions to address a particular group of people or a combination of them. For example, Running Bear et al. (2016, 2017) discussed specialized alcohol detox services that target alcohol users among Indigenous people in Alaska. Similarly, there are opiate specialized centres in Alberta. Although the prevalence of opiate dependence is lower than that of alcohol and marijuana, the burden of the disease is substantial, with high rates of morbidity, mortality, disease transmission, increased healthcare costs, crime and law enforcement costs, loss of productivity, and increased family distress (Amato et al., 2005). This dissertation focuses only on Alberta-wide adult residential detoxification programs.

Detox Services in Alberta

Unlike the United States and some other countries, there are no detox service guidelines or standards of practice in Canada in general and in Alberta in particular. Only British Columbia, Saskatchewan, Ontario, Nova Scotia, and Northwest territories have provincial standards, guidelines, and best practices related to detox services (Meister et al., 2019). The absence of standard practices in evaluating and comparing detox services with other comparative studies poses a problem.

The majority of Alberta's withdrawal management services are directly operated by Alberta Health Services, with in-house medical support and designated beds. At the end of the 2015-2016 fiscal year, there were six Alberta Health Services (AHS) operated detox facilities[3] (114 beds), nine contracted agencies (115 beds and 83 shelter mats), and four mandatory detox facilities for youth (22 beds) (Meister et al., 2019). Moreover, an inpatient detox facility is provided by hospitals that target addiction and medical and mental health in Alberta. There were 2,360 hospital admissions for detox services in the fiscal year 2015-2016 (Meister et al., 2019). Of these facilities, this dissertation focuses on five residential detoxification and five residential treatment services across Alberta, which have 116 detox and 174 residential treatment beds.

Predictors of Completion/Non-Completion, Transition to Treatment, and Readmission/Frequency of Detoxification Utilization

Completion/non-Completion

A dichotomized literature review between completion and non-completion shows that lower completion or higher non-completion rates are associated with demographic variables of

[3] Some contracted providers have additional beds or mats that are funded through sources other than AHS and are not included in these bed numbers (Meister et al., 2019)

lower educational attainment (Dayal et al., 2017; de Weert-van Oene et al., 2007; Levola et al., 2021), being single (Cobos et al.,1997); being younger (Armenian et al., 1999; Hakansson & Hallen, 2014; Kenne et al., 2010; Levola et al., 2021; Li et al., 2007; Pytell & Rastegar,2018; Sofin et al., 2017), being either an Indigenous female or a non-Indigenous male (Li et al., 2013), and being unemployed (Levola et al., 2021; Sofin et al., 2017). In addition, program variables of having fewer (average of 1.52) previous admissions to detoxification (Kenne et al., 2010) predict lower completion. The polysubstance use, other than alcohol (Callaghan, 2003; Levola et al., 2021; Li et al., 2013; Li et al., 2007), predicts lower completion or higher non-completion while misusing opiates (Callaghan & Cunningham, 2002; Li et al., 2013; Li et al., 2007; Sarkar et al., 2016; Silins et al., 2008) has low odds of completion.

The factors that predict completion include a longer length of stay (LOS) (David et al., 2022; Dayal et al., 2017; Hakansson & Hallen, 2014; Kovas et al., 2007; Ling et al., 2018; Sidana et al., 2023) and detoxing primarily from alcohol (Hogan et al., 2018; Levola et al., 2021; Sarkar et al., 2016). While Barnaby and Gibson (2008) discovered that non-completion was not influenced by gender, age, marital status, educational attainment, employment status, or clients' place of origin, others reported contradictory results on the relationship between detoxification completion/non-completion and the number of previous admissions (Kenne et al., 2010; Sofin et al.,2017; Specka et al., 2011), gender (Li et al., 2013; Sofin et al., 2017), days of admission/discharge (Armenian et al., 1999; Li et al., 2007; Pytell & Rastegar, 2018), and age (Levola et al., 2013; Pytell & Rastegar, 2018; Serkar et al., 2016).

Transition to Residential Treatment

The transition from detox to residential treatment can be predicted by various factors, including sociodemographic characteristics, the type of substance use and behavioural

addictions, and various program factors. Studies have shown that individuals have a better transition to treatment if they are employed (Ford & Zarate, 2010), educated beyond the high school level (Timko et al., 2015), married (O'Farrell et al., 2008), female (Zhu & Wu, 2018), and younger (age 12-17 vs. 18-25) (Zhu & Wu, 2018). However, age (Kelly et al., 2016) and gender (Carroll et al., 2009) were found to have no association with transition rates in some studies. Moreover, individuals had better transition rates if they had completed detox (compared to those who did not) (Haley et al., 2011), had longer rather than shorter lengths of stay (Running Bear et al., 2017), and were admitted for alcohol use disorders rather than opiate use disorder (Zhu & Wu, 2018). Some studies found that increasing client admissions increases the chance of transition to treatment following discharge from detoxification (Timko et al., 2015), while others have found that transitioning to treatment reduces readmission (Carrier et al., 2011). However, whether these findings can be applied to the Canadian universal healthcare system is unclear.

Readmission/Frequency of Utilization

Regardless of the conceptualization of readmission, the literature review demonstrates that clients who used multiple substance use disorder and behavioural addiction tended to have more readmissions (Callaghan & Cunningham, 2002; Tomasson & Vaglum, 1998), particularly if they used alcohol rather than opiates (Running Bear et al., 2022). Clients had a higher risk of readmission if they had unstable housing (Callaghan, 2003; Running Bear et al., 2014; Silins et al., 2008), were unemployed (Callaghan & Cunningham, 2002; Running Bear et al., 2014), were single or unmarried (Callaghan & Cunningham, 2002), had a longer average LOS (Chang et al., 2016), and were urban residents (Carrier et al., 2011). Clients who did not complete detoxification had higher readmission rates (Callaghan & Cunningham, 2002; Yedlapati & Stewart, 2018). Moreover, Mark et al. (2006) found that clients with repeated admissions to

detoxification services are less likely to transition to treatment after detoxification. Conversely, Amodeo et al. (2008) found that clients with repeated admissions had a higher transition rate to treatment following detoxification.

Knowledge Gaps

There is a lack of consistency in the conceptualization of completion, transition to treatment, and frequency of readmission to detoxification. The lack of national or Alberta-specific detoxification service guidelines or standards of practice complicates the evaluation of detoxification outcomes in Alberta, Canada, where this study was conducted (Meister et al., 2019). The literature review lacked a standardized measurement of completion versus non-completion due to inconsistencies in defining what to include, completion, and non-completion. For example, Carroll et al. (2009) defined detox completion as a client who finished a three-day program or left with a follow-up plan in place, while Specka et al. (2011) defined completion as a client who was not discharged prematurely due to disciplinary reasons (e.g., drug or alcohol use or aggressive behaviour), provided drug-free urine specimens, showed no clinically relevant signs of withdrawal, and had a length of stay (LOS) ranging from 6 to 90 days. It also excluded the third category of clients who cycled between completion and non-completion[4]. As substance use disorder is a chronic disease, multiple detoxifications and relapses are common (Dennis et al., 2005), in which clients go through a cycle of completion and non-completion before transitioning to long-term treatment. However, previous studies have only compared non-completers and completers without studying clients in a cycle of completion and non-completion, which is an important group to identify.

[4] The completion and non-completion cycle refers to individuals who completed some admissions while not completing others during the study period from 2015 to 2022.

There are also inconsistencies in measuring the transition to treatment following discharge from detoxification, partly due to the differences in the duration between discharge from detoxification and entry into treatment and the inclusion of various treatment settings and support groups. For example, Kelly et al. (2016) discussed a transition rate that includes a residential rehabilitation program, outpatient counselling, mutual support group, or different criteria used to measure transition to treatment, with a duration of 7 days (ASAM, 2014; Haley et al., 2011) to 14 days (Garnick et al., 2010 and Lee et al., 2014) and other criteria of 30 days (Ford & Zarate, 2010).

The literature review also described inconsistencies in conceptualizing readmission and the frequency of utilization rates. The lack of consensus in measuring readmission rates in the literature was mainly due to differences in the definition, study population, treatment programs, and follow-up times (Chang et al., 2016; Van den Berg et al., 2015), making a comparison between studies challenging. Previous research has shown readmission rates of two or more admissions (Li et al., 2007; Running Bear et al., 2014; Spear, 2014; Van de Berg et al., 2015; Yedlapati & Stewart, 2018), three or more admissions (McLellan et al., 2005), four or more admissions (Chang et al., 2016; Tomasson & Vaglum, 1998), and more in various study periods.

Our classification is consistent with that of Tomasson and Vagum (1998), who defined a "revolving door career" (p. 129) as four or more admissions and found that the development of such a career was rare in cases with fewer than four admissions. This classification was later adapted by Chang et al. (2016). The skewed distribution of admissions in our data further supports the use of this classification. Using Tomasson and Vagum's classification can also provide insight into the system's efficiency level in accommodating the most frequent detoxification clients. Addiction is a chronic illness that often requires multiple treatments or

detoxification episodes to achieve long-term recovery (AHS, 2018; Lee et al., 2014; McKeganey et al., 2004; Van den Berg et al., 2015). In addition, as readmissions due to relapse are common, it is not that valuable to study every readmission, as every readmission should not be treated as problematic (Lee et al., 2014). Thus, exploring the most frequently admitted clients provides input for improving practices and a better understanding of this group.

Although the extant literature has established a significant relationship between detoxification completion/non-completion, transition to treatment and frequency of utilization rates and various demographic, socioeconomic, substance use disorder and behavioural addiction, program delivery, and systemic factors, the findings remain ambiguous due to the differences in treatment program settings; the populations studied and the variability in the length of study. The variability of the results and contradictions and some of the variables included in this study warrant an investigation of the predictors of completion/non-completion, the transition to residential treatment, and the frequency of utilization in the Canadian context to better understand the best outcomes for clients' recovery trajectories and make optimal use of available resources. These differences make model development for the prediction of completion problematic. This gap was echoed recently in a scoping review that found variability in the definition of non-completion examined (Ling et al., 2022).

Scarcity of Studies

Despite its important role in reducing the individual and societal costs of addiction (Ford & Zarate, 2010), detoxification has not been widely studied in Canada in general or Alberta in particular. The only study available in Canada that addresses detox completion rates is Li et al. (2013), while non-completion was discussed by Callaghan and Cunningham (2002), Li et al. (2007), and Ling et al. (2018). In the existing literature, the only published article evaluating the

link between detoxification and treatment among non-opioid users was by MacKinnon et al. (2022); however, this study does not show the admission of clients into substance use disorder treatment and excludes opioid users. Moreover, only two studies (Callaghan, 2003; Li et al., 2008) were published on readmission issues, which were published over 15 years ago. Except for Ling et al. (2018), these studies were all conducted in British Columbia, Canada. This lack of knowledge of client characteristics and program effectiveness makes it challenging for decision-makers to develop appropriate interventions to improve treatment outcomes (Li et al., 2007) and establish service guidelines and standards of practice (Meister et al., 2019). Furthermore, these studies were not up-to-date or did not reflect the current context of Alberta. Moreover, the few studies available are outdated and do not serve as valid evidence in the current context.

Existing studies are inconclusive about whether the realities observed in the international literature can be translated into the Canadian setting in which healthcare access and coverage are universal. Most studies were conducted in a small proportion of single centres with diverse healthcare infrastructures and treatment policies (Ghosh et al., 2022). The findings will be the first step in establishing evidence-based best practices in Alberta detox services. Thus, by addressing the identified gaps, this study intends to improve detox practices, provide input for program design, promote treatment, and bring down frequent utilization rates.

Purpose of Thesis

This dissertation set out to estimate the rates of detox completion in Alberta between 2015 and 2022 and identified the predictors of detoxification completion and non-completion and the transition to residential treatment following detox and the repeated use of detox services. Administrative data spanning seven years were collected from five residential withdrawal management programs in Alberta, Canada. These data included socio-demographic

characteristics, program delivery variables, primary substances of choice, and the number of substances used. The study was approved by the University of Alberta Research Ethics Board (protocol number: Pro00108773).

Objectives

Study 1. The objectives of the first study were to (1) Assess the rate of detox completion/non-completion and (2) Identify the client characteristics and predictors of detox completion/non-completion.

Study 2. The objectives of the second study were to (1) Assess the transition rate from detox to addiction treatment and (2) Identify the client characteristics and predictors of transition to addiction treatment.

Study 3. The objectives of the third study were to (1) Assess the rate of frequency of detoxification utilization and (2) Identify the client characteristics and predictors of the frequency of utilization of detoxification.

Methods

This retrospective study utilized administrative data collected by Alberta Health Services (AHS) between 2015 and 2022, stored in the Addiction System for Information and Service Tracking (ASIST) database. The original data was structured from admission history into a wide/horizontal 20,215 client-level data format, capturing each client's information in one unique record. Data for some independent variables were missing, so multiple imputations were used to obtain accurate estimates and a complete dataset (Enders, 2013). Multiple imputation is suitable for any missing data pattern (Enders, 2010) or when the causes of the missing values are uncertain (Enders, 2013), and it outperforms simpler techniques, such as complete case analysis, single imputation, and pairwise deletion (Enders, 2013; Liu & De, 2016). The study imputed

only independent variables representing education, employment, sex, marital status, urban/rural residence, and primary substance use disorder and behavioural addiction of concern. Several factors were used to predict the imputed data, including education, employment, gender, marital status, age, date of admission, date of discharge, facility zone, facility name, and reason for ending treatment.

Descriptive statistics, the chi-square test, the Mann-Whitney *U* test, and the Kruskal-Wallis tests were used to assess the relationship between the dependent and independent variables and the effect size (as determined using Phi, Cramer's V, and epsilon squared). Data on completion status were analyzed using a multinomial regression model with three categories (completion, non-completion and who cycled between completion and non-completion). The remaining dependent variables were subjected to a binary logistic regression with two categories: transition to residential treatment or not following discharge from detoxification and frequency of detoxification service utilization (≤ 3 times versus ≥ 4 times). There was no evidence of multicollinearity, as all variance inflation factor values were less than 5. All data were analyzed using SPSS version 29.

Dissertation Structure

The thesis consists of six chapters: an introduction and methodology, three individual manuscripts (study one, study two, and study three), a discussion of the main findings and implications, and a conclusion. The objectives of the thesis are answered in the three manuscripts submitted for publication. The discussion chapter synthesizes the findings from the three studies and is followed by a discussion of policy and practical implications. The dissertation is finalized with the conclusion chapter.

In the first manuscript (Chapter 2), I estimate the rates and identify the predictors of completion and non-completion of detox, as well as rates of cycling between completion and non-completion. Unlike previous studies, which have treated completion solely as a dichotomous variable, this study included a third category of clients—those who cycle between completion and non-completion—to more accurately reflect the challenging realities of recovering from addiction. Individuals who use withdrawal services in the hope of achieving abstinence face many potential trajectories of use. Clients in these three categories were compared in terms of their socio-demographic characteristics, healthcare use variables, primary substance use disorder and behavioural addiction of choice, and number of substance use disorders and behavioural addiction.

In the second manuscript (Chapter 3), I report on the estimated rate at which detox service utilizers transition to residential treatment and identify socio-demographic, healthcare utilization, and substance use disorder and behavioural addiction variables to shed light on this transition. Clients in two categories—those who transitioned to residential treatment and those who did not—were compared in terms of their socio-demographic characteristics, healthcare use variables, and the number and types of substance use disorder and behavioural addiction. This study is the first in Canada to provide useful insights into the rate and predictors of transitioning to residential treatment following discharge from detoxification.

In the third manuscript (Chapter 4) I report on the third study in which I estimated the rate and identified the predictors of frequent use of residential withdrawal management services. I compared high-frequency and low-frequency users' socio-demographic characteristics, healthcare use variables, and the number and types of substance use disorders and behavioural addictions.

In Chapter 5, I present the key findings from the three manuscripts, analyze their implications for policy and interventions, and discuss the strengths and limitations of these studies.

Chapter 6 concludes the dissertation by summarizing the main findings of the rates and predictors of completion, transition to treatment, and repeated utilization of detoxification services, as well as their implications and recommendations for future research.

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Chapter Two: Predictors of Residential Detoxification Completers and Non-Completers in Alberta [*]

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Abstract

Objectives: We aimed to identify predictive factors for completion, non-completion and cycling between completion and non-completion among clients admitted to Alberta Residential Withdrawal Management Services.

Methods: The study included data on clients from a provincial database (N = 20,020) admitted to residential withdrawal management units across Alberta between April 1, 2015, and March 31, 2022. We collapsed admission-level data into client-level data, where each individual's information is captured as a unique record. Multinomial logistic regression was performed to investigate predictors of completion, non-completion, and multiple cycles of completion and non-completion. Clients in these three categories were compared in their socio-demographics, primary substance use disorder and behavioural addiction concern, and other program variables

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of admission count, length of stay, transition to treatment, facilities utilized, days of discharge, and years of admission.

Results: The study sample included 39,952 admissions, with a mean of two per client. Overall, 55.8% (n = 11,170) of discharged clients completed the program, 25.5% (n = 5,106) were non-completed, and 18.7% (n = 3,744) cycled between completion and non-completion. Regression analysis indicated that clients who used a single substance use disorder and behavioural addiction, primarily alcohol, cocaine and marijuana, completed post-secondary education, were employed or had unstable employment, and were married had lower odds of non-completion. Other variables related to higher odds of completion were urban residence, multiple admissions to a facility, and longer lengths of stay. Conversely, clients who primarily used amphetamines, barbiturates, crystal meth, opiates, and tranquillizers had higher odds of non-completion. Female gender, being discharged on Saturday and Sunday, using detoxification as a standalone service without transitioning to residential treatment and admission to two or more facilities also predicted higher odds of non-completion.

Conclusion: Results indicated that the type of substance use disorder and behavioural addiction , gender, education, marital status, employment, place of residence, and transition to residential services were associated with detoxication outcomes. These findings can inform the customization and allocation of services, targeted support, service intensity and areas requiring additional attention and investment to improve treatment outcomes.

Keywords: Completion, non-completion, predictors, demographic, program, detoxification

Introduction

Detoxification is often the necessary first step along a continuum of care to long-term recovery from addiction (David et al., 2022; Kenne et al., 2010; Running Bear et al., 2022) to

reduce the severity of withdrawal symptoms that could be both psychological (Center for Substance Abuse Treatment, 2006) and physiological (Day & Daly, 2021; Li et al., 2007). Detoxification is ideally followed by initiating treatment and promoting continued abstinence (Day & Daly, 2021; Kosten & O'Connor, 2003; Lee et al., 2014; Levola et al., 2021; Li et al., 2008). Despite the short-term value of detoxification in reducing addiction-related harms (Chutuape et al., 2001), it is rarely adequate to maintain abstinence and long-term recovery without subsequent long-term treatment (Carrier et al., 2011; Li et al., 2008; McLellan et al., 2005; Spear, 2014).

Completing detoxification services, as the first crucial step towards recovery and remission of symptoms of substance use disorder (Blondell et al., 2006), predisposes improved outcomes with its potential to facilitate follow-up treatment (Amodeo et al., 2008; Blondell et al., 2007; Dayal et al., 2017; Li et al., 2008; Ling et al., 2022; Running Bear et al., 2017) or aftercare support (Hakansson & Hallen, 2014; Kouimtsidis et al., 2021). Furthermore, clients who complete detoxification have lower relapse rates (Kouimtsidis et al., 2021) and improved quality of life regardless of subsequent relapses (Macfarlane et al., 2019). However, numerous studies showed that up to 63% of clients who entered a detoxification unit did not complete the program (Hogan et al., 2018; Sidana et al., 2023; Specka et al., 2011; Timko et al., 2015). Retaining clients until treatment completion is one of the major challenges of the detoxification treatment system (Kenne et al., 2010).

A high non-completion rate from detoxification presents a barrier to recovery management (David et al., 2022; Donovan et al., 2013; Odenwald & Semrau, 2013; Sidana et al., 2023) and is associated with a greater likelihood of relapse after detoxification and a lower likelihood of entering abstinence-based treatment (Kosten & O'Connor, 2003; Sidana et al.,

2023). Our study aimed to assess the characteristics of people not ready to complete treatment and understand the reasons for attrition. Our findings may help healthcare planners address the issues that lead to lower completion rates (Sofin et al., 2017) and generate evidence-based targeted interventions to prevent non-completion (Ling et al., 2018).

Although the extant literature has established a significant relationship between detoxification completion/non-completion rates and various demographic, socioeconomic, substance use disorder and behavioural addiction , program delivery, and systemic factors, the findings remain ambiguous due to differences in treatment program settings; the populations studied and variability in the length of study. These differences make model development for the prediction of completion problematic. This gap was echoed recently in a scoping review that found variability in the definition of non-completion examined (Ling et al., 2022). As substance use disorder is a chronic disease, multiple detoxifications and relapses are common, where clients go through a cycle of completion and non-completion before transitioning to long-term treatment (Dennis et al., 2005). However, previous studies only compared non-completers versus completers and never studied clients in a cycle of completion and non-completion.

With a dichotomized completion outcome (i.e. complete vs. do not complete), previous studies found that lower completion and higher non-completion rates were associated with the following demographic factors: lower educational attainment (Dayal et al., 2017; de Weert-van Oene et al., 2007; Levola et al., 2021); being single (Cobos et al.,1997); misusing opiates (Callaghan & Cunningham, 2002; Li et al., 2013; Li et al., 2007; Sarkar et al., 2016; Silins et al., 2008); using polysubstance other than alcohol (Callaghan, 2003; Levola et al., 2021; Li et al., 2013; Li et al., 2007); being younger (Armenian et al., 1999; Hakansson & Hallen, 2014; Kenne et al., 2010; Levola et al., 2021; Li et al., 2007; Pytell & Rastegar,2018; Sofin et al., 2017); being

either an Indigenous female or non-Indigenous males (Li et al., 2013); being unemployed (Levola et al., 2021; Sofin et al., 2017); and, having few (average of 1.52) previous admissions to detoxification (Kenne et al., 2010). Factors that predicted completion included a longer LOS (David et al., 2022; Dayal et al., 2017; Hakansson & Hallen, 2014; Kovas et al., 2007; Ling et al., 2018; Sidana et al., 2023) and detoxing primarily from alcohol (Hogan et al., 2018; Levola et al., 2021; Sarkar et al., 2016). While Barnaby and Gibson (2008) discovered that non-completion was uninfluenced by gender, age, marital status, educational attainment, employment status, and clients' place of origin, others reported contradictory results on the relationship between detoxification completion/non-completion and the number of previous admissions (Kenne et al., 2010; Sofin et al.,2017; Specka et al., 2011), gender (Sofin et al., 2017), days of admission/discharge (Armenian et al., 1999; Li et al., 2007; Pytell & Rastegar, 2018), and age (Serkar et al., 2016).

While these studies provide valuable insights, it is unclear whether the realities observed in the international literature can be translated into a Canadian setting where healthcare access is universal. The variability of results and contradictions warrants investigating the predictors of completion and non-completion in the Canadian context. In Canada, detoxification services and completion/non-completion need to be better understood to ensure they produce the best outcomes for clients' recovery trajectories and make optimal use of available resources. Public investment in detoxification programs is cost-effective in reducing harm to people experiencing problematic substance use disorder and behavioural addiction , their families, and society (Raistrick et al., 2006). However, it is also one of the most common and expensive per-day treatment pathways (Haley et al., 2011). The estimated cost of a detoxification episode ranges from $3,625 to $7,250 in Canada (Medical Detox Ontario, 2021), while a mean index admission

cost of $1,779 was recorded in the USA (Quinn et al., 2017). Non-completion of detoxification increases the likelihood of readmission, which subsequently raises the cost of detoxification. Despite the role of detoxification in the reduction of individual and societal costs associated with addiction (Ford & Zarate, 2010), it has not been widely studied in Canada (Meister et al., 2019). A handful of peer-reviewed articles have been published on detoxification completion/non-completion, including studies from British Colombia on detoxification completion (Li et al., 2013), non-completion (Callaghan & Cunningham, 2002; Li et al., 2007), and predictors of patients leaving against medical advice from inpatient detoxification services in a single Ontario hospital with data covering over two years (Ling et al., 2018). Our study is the first in Canada to examine the detoxification of adults across multiple publicly funded centres across a provincial health system. This study aims to determine the rate and predictors of completion or non-completion in publicly funded detoxification programs across Alberta from 2015 to 2022. The University of Alberta Research Ethics Board (REB) protocol No Pro00108773 approved the study.

Method

Study Setting and Design

This retrospective research study used administrative data from the Addiction System for Information and Service Tracking (ASIST) database collected from fiscal year (FY) 2015 to 2022 (April 1, 2015, to March 31, 2022) by Alberta Health Services (AHS), the provincial health authority. ASIST includes data on substance use disorder of concern, demographic variables, admission and discharge dates, transition to residential services, and facility information. Our final client-level dataset used for analysis consisted of 20,020 cases representing 39,952

admissions. We only retained cases that captured data from admission to final status. Due to unknown completion statuses, we excluded 197 admissions (195 clients).

Treatment Setting

Our study is based on the five publicly funded residential detoxification facilities with a total of 116 beds. Two facilities in Calgary and Edmonton accounted for nearly 80% of all admissions. They are staffed by a multidisciplinary team that provides 24-hour service (AHS, 2022a). AHS recognizes that recovery is a unique journey for each individual (AHS, 2022). Within 24 hours of admission to detoxification facilities, healthcare providers collaborate closely with clients, and when appropriate, with family members and other referral sources to identify their specific needs and develop an individualized initial treatment plan (AHS, 2022a). This treatment plan is reviewed and revised daily based on the client's progress (AHS, 2022a). Following this, a personal care plan for post-treatment recovery is created (AHS, 2022a), which includes planning for post-discharge (AHS, 2022a). The post-treatment plan outlines referral sources to monitor the client's status, discuss follow-up plans, and share treatment recommendations (AHS, 2022a). Completion of detox services is considered successful when clients have fulfilled their individualized initial or revised treatment plans and established their follow-up plans.

Early discharge, also referred to as non-completion, can be initiated by either the healthcare provider or the client (AHS, 2022a). Healthcare providers may begin the discharge process if a client is unable to meet program expectations or exhibits violent or aggressive behavior. On the other hand, clients have the right to initiate discharge at any time and for any reason. When early discharge occurs, healthcare providers will discuss the associated risks with the client, revise the treatment and personal care plan, and provide naloxone to clients with a

history of opioid use disorder (AHS, 2022a). Additionally, the client's referral sources will be updated to ensure they are aware of the changes and can offer appropriate support (AHS, 2022a). Instances of discharge initiated by staff and clients are compiled as non-completion data.

Study Population Characteristics

The median age of the study sample was 35 years. There were 11 individuals aged 17 included in the study as mature minors; this could also be typographical errors. Most clients were male (64.3%), single (60.1%), and unemployed (63.9%). The most frequent substance use disorder and behavioural addictions taking into consideration all substance use disorders and behavioural addictions, were alcohol (27.3%), tobacco (14.9%), crystal meth (14.1%), and opiates (13.0%). Most (71.8%) were individuals with poly-substance use and behavioural addictions (more than one substance use disorder and behavioural addiction). Over half of the cases (55.8%) of clients completed the program, 25.5% were non-completed, and 18.7% were in a cycle of completion and non-completion.

Measures

Outcome Variable. The outcome variable was the clients' completion status, which was categorized as completion, non-completion, and a cycle of completion and non-completion.

Independent Variables. Independent variables included demographic characteristics (education, marital status, gender, employment, place of residence), program variables (number of admissions, LOS, transition to treatment, facilities utilized, days of discharge, and years of admission (admission during COVID-19 emergency), and substance use disorder and behavioural addictions (primary substances use disorder and addictive behaviour of choice, and its counts) (details of these variables were assessed in Table 1).

Statistical Methods

Descriptive statistics were used to characterize all clients. Further analyses were conducted on data stratified by completion, non-completion, and a cycle of completion and non-completion. We used chi-square tests for categorical variables and the Kruskal-Wallis test for non-normally distributed continuous variables. We also calculated effect size (Cramer's V, and Epsilon square (ε^2). Multivariate multinomial logistic regression analysis was used since the outcome variable was trichotomous. All demographics, program-level factors, and primary concerns of substance use disorder and behavioural addiction were considered for inclusion in the analysis to identify predictors of treatment outcomes. There was no evidence of multicollinearity as all variance inflation factor values were <5. Data were analyzed using SPSS version 29.

Missing Data Management

We used multiple imputations (MI) that are well-suited for any missing pattern (Enders, 2010) when more than 5% of data points are missing (Jakobsen et al., 2017), yielding more accurate estimates that resulted in a better complete dataset than complete case analysis (listwise and pairwise deletion) and single imputation case techniques (Enders, 2013; Li & De, 2016). Our choice of MI is consistent with the nature of our data, where there is uncertainty about the causes of missing data (Enders, 2013). We used a fully conditional specification MI approach that has proven to produce reliable results (Lee & Carlin, 2010). Several factors, including education, employment, gender, marital status, date of admission, date of discharge, facility zone, facility name, and service end reason, were used to predict missing data points. The imputed data was generated based on five MI data sets to provide a final set of comprehensive data. We only imputed independent variables of education, employment, gender, marital status, urban/rural, and

primary concern of substance use and behavioural addictions. The proportions of imputed values are generally consistent with the original values.

Results

This study included 20,020 unique clients who utilized one of Alberta's five residential detoxification services and were admitted 39,952 times, with admissions between 1 and 64. Of these 20,020 clients, 55.8% (11,170) were discharged after completion, 25.5% (5,106) were non-completed, and 18.7% (3,744) cycled between completion and non-completion across all admissions. The average number of admissions per client was 2, while the mean LOS was 4.5 days. Higher rates of non-completion were observed among females (29%) than males (24%); less than high school clients (31%) than post-secondary education (21%); and single (not married) (28%) than married (24%). On average, non-completers were younger than those who completed (35 vs. 39 years). Table 1 summarizes the results of bivariate analyses.

Table 1. *Characteristics of Clients and Significant Levels by Completion Status*

Variable	Entire Sample (20,020)		Completion (11170, 55.8%)		Non-Completion (5106,25.5%)		Cycle between completion and non-completion (3744, 18.7%)		Chi-Square /Kruskal-Wallis	Effect Size
	n	%	n	%	n	%	n	%		
Primary Substance use and behavioural addictions [9]										
Alcohol										
Yes	13605	68.30	8098	59.50	2862	21.00	2645	19.50	448.5***	S
No	6309	31.70	3004	47.60	2207	35.00	1098	17.40		
Androgen										
Yes	355	1.80	157	44.20	63	17.80	135	38.00	88.2***	S
No	19559	98.20	10945	56.00	5006	25.60	3608	18.40		
Amphetamine										
Yes	1096	5.50	548	50.00	330	30.10	218	19.90	17.2***	N
No	18818	94.50	10554	56.10	4739	25.20	3525	18.70		
Antidepressant										
Yes	574	2.90	327	57.00	165	28.70	82	14.30	9.1*	N
No	19340	97.10	10775	55.70	4904	25.40	3661	18.90		
Barbiturates										
Yes	1304	6.60	520	39.90	290	22.20	494	37.90	339.2***	S
No	18610	93.50	10582	56.90	4779	25.70	3249	17.50		
Cocaine										
Yes	4980	25.00	2816	56.50	1280	25.70	884	17.80	4.8	
No	14934	75.00	8286	55.50	3789	25.40	2859	19.10		
Crystal Meth										
Yes	7012	35.20	3246	46.30	2123	30.30	1643	23.40	396.2***	S
No	12902	64.80	7856	60.90	2946	22.80	2100	16.30		
Gambling										
Yes	2530	12.70	1343	53.10	715	28.30	472	18.70	12.7**	N
No	17384	87.30	9759	56.10	4354	25.10	3271	18.80		
Inhalant										
Yes	362	1.80	189	52.20	115	31.80	58	16.00	8.1*	S
No	19552	98.20	10913	55.80	4954	25.30	3685	18.90		

[9] Missing count of 106

Variable	Entire Sample (20,020)		Completion (11170, 55.8%)		Non-Completion (5106,25.5%)		Cycle between completion and non-completion (3744, 18.7%)		Chi-Square /Kruskal-Wallis	Effect Size
	n	%	n	%	n	%	n	%		
Marijuana										
Yes	2673	13.40	1511	56.50	736	27.50	426	15.90	19.0***	N
No	17241	86.60	9591	55.60	4333	25.10	3317	19.20		
Opiates										
Yes	6502	32.70	2746	42.20	2223	34.20	1533	23.60	723.2***	S
No	13412	67.40	8356	62.30	2846	21.20	2210	16.50		
Other Addiction										
Yes	252	1.30	115	45.60	80	31.70	57	22.60	10.7**	N
No	19662	98.70	10987	55,9 %	4989	25.40	3686	18.70		
Psychedelics										
Yes	420	2.10	224	53.30	135	32.10	61	14.50	12.2**	N
No	19494	97.90	10878	55.80	4934	25.30	3682	18.90		
Tobacco										
Yes	7435	37.30	3948	53.10	1985	26.70	1502	20.20	36.6***	N
No	12479	62.70	7154	5740.00	3084	24.70	2241	18.00		
Tranquillizer										
Yes	775	3.90	371	47.90	262	33.80	142	18.30	31.2***	N
No	19139	96.10	10731	56.10	4807	25.10	3601	18.80		
Educational level										
Less than High School	916	4.60	454	49.60	281	30.70	181	19.80	133.1***	S
High school	4769	23.80	7725	53.90	3835	26.80	2775	19.40		
Post-secondary	14335	71.60	2991	62.70	990	20.80	788	16.50		
Employment										
Employed	6852	34.20	4200	61.30	1508	22.00	1144	16.70	382.4***	S
Unemployed	12797	63.90	6810	53.20	3572	27.90	2415	18.90		
Unstable employment	371	1.90	160	43.10	26	7.00	185	49.90		
Gender										
Female	7153	35.70	3753	52.50	2039	28.50	1361	19.00	62.0***	N
Male	12867	64.30	7417	57.60	3067	23.80	2383	18.50		
Marital status										
Divorce, Separated, and Widowed	2976	14.90	1862	62.60	616	20.70	498	16.70	354.9***	S
Married	4722	23.60	2869	60.80	1136	24.10	717	15.20		

Variable	Entire Sample (20,020)		Completion (11170, 55.8%)		Non-Completion (5106,25.5%)		Cycle between completion and non-completion (3744, 18.7%)		Chi-Square /Krusk al-Wallis	Effe ct Size
	n	%	n	%	n	%	n	%		
Single	12038	60.10	6320	52.50	3330	27.70	2388	19.80		
Unstable marriage	284	1.40	119	41.90	24	8.50	141	49.60		
COVID[1]										
Before COVID	5099	48.10	2858	56.10	1156	22.70	1085	21.30	1465.7***	L
Within COVID	4023	38.00	2184	54.30	1178	29.30	661	16.40		
Both	1475	13.90	395	26.80	124	8.40	956	64.80		
Admission										
2015-2018	10278	51.30	6195	60.30	2798	27.20	1285	12.50	3479.4***	L
2019-2022	7050	35.20	4101	58.20	2095	29.70	854	12.10		
Both	2692	13.50	874	32.50	213	7.90	1605	59.60		
Facilities										
Facility 1	280	1.40	193	68.90	64	22.90	23	8.20	1746.0***	M
Facility 2	645	3.20	353	54.70	199	30.90	93	14.40		
Facility 3	2921	14.60	1881	64.40	618	21.20	422	14.40		
Facility 4	7259	36.30	3684	50.80	2440	33.60	1135	15.60		
Facility 5	7878	39.40	4764	60.50	1685	21.40	1429	18.10		
Multiple facilities (>=2)	1037	5.2	295	28.4	100	9.6	642	61.9		
Discharge Day										
Saturday and Sunday	3390	16.90	1856	54.70	1293	38.10	241	7.10	822.8***	S
Monday to Friday	15253	76.20	8738	57.30	3528	23.10	2987	19.60		
Mix of both	1377	6.90	576	41.80	285	20.70	516	37.50		
Urban-Rural										
Urban	16867	84.30	9222	54.70	4442	26.30	3203	19%.0	550.1***	S
Rural	2788	13.90	1825	65.50	640	23.00	323	11.60		
Migration between urban and rural	365	1.80	123	33.70	24	6.60	218	59.70		
Single Vs Polysubstance										
Single	5618	28.20	14296	71.80	1430	25.50	378	6.70	810.8***	S
Polysubstance	14296	71.80	7292	51.00	3639	25.50	3365	23.50		
Transition to treatment										

Variable	Entire Sample (20,020)		Completion (11170, 55.8%)		Non-Completion (5106,25.5%)		Cycle between completion and non-completion (3744, 18.7%)		Chi-Square /Kruskal-Wallis	Effect Size
	n	%	n	%	n	%	n	%		
Detoxification+ Treatment	4869	24.30	3078	63.20	418	8.60	1373	28.20	1096.0***	M
Detoxification alone	15151	75.70	8092	53.40	4688	30.90	2371	15.60		
Alcohol Vs Opiates										
Alcohol	10984	55.20	6921	63.00	2144	19.50	1919	17.50	954.4***	M
Opiates	3881	19.50	1569	40.40	1505	38.80	807	20.80		
Alcohol and Opiates	2621	13.20	1177	44.90	718	27.40	726	27.70		
Neither Alcohol nor Opiates	2428	12.20	1435	59.10	702	28.90	291	12.00		
Length of Stay (LOS										
Mean rank			12430.3		4755.5		9957.7		6243.1***	S
Count of admission										
Mean rank			8650.3		7844.8		17022.2		9146.4***	RS
Age										
Mean rank			10785		8726.8		9450.4		487.9***	W

*** p < 1, p <0.01**, *p <0.05 Cramér's V N= negligible S=small, M=Medium, L=Large
Epsilon Square W= Weak, RS=Relatively Strong, S= Strong

1 The province of Alberta had a COVID-19 emergency declared between March 17, 2020 and December 14, 2021. The total number of days was 637 days. This is compared with the same number of days (from June 19, 2018, to March 16, 2020 before the COVID-19 emergency was declared.

Results of Multivariate Analysis

Variables remaining in the final multinomial regression model are presented in Table 2. Our model accurately predicted membership of the completion groups 87.8% of the time, non-completion 69.4%, and the group that cycled between completion and non-completion 56%, resulting in an overall predictive accuracy of 77.1%. The model explained 63.5% of the variance in treatment outcomes based on the Nagelkerke R^2.

Primary Substance Use Disorder and Behavioural Addiction

When adjusting for the other predictors in the model, alcohol (OR (Odds Ratio) = 0.73, $p < 0.001$), cocaine (OR = 0.89, $p < 0.05$*)*, and marijuana (OR = 0.78, $p < 0.001$) users were less likely to be non-completed versus completion of detoxification. On the contrary, users of amphetamines (OR = 1.40, $p < 0.01$), barbiturates (OR = 1.70, $p < 0.001$), crystal meth (OR = 1.70, $p < 0.001$), opiates (OR = 2.78, $p < 0.001$), and tranquillizers (OR = 1.71, $p < 0.001$) were more likely to be non-completed versus completion. In addition, clients who used mono substance use disorder and behavioural addiction (OR = 0.86, $p < 0.05$) versus polysubstance use had lower odds of non-completion.

Table 2. *Logistic Regression Results by Completion Status*

	Non-Completion	95% Confidence Interval		Cycle between completion and non-completion	95% Confidence Interval	
Variable	Exp(B)	Lower Bound	Upper Bound	Exp(B)	Lower Bound	Upper Bound
Count of admission	0.77***	0.72	0.83	2.47***	2.36	2.58
Average LOS	0.39***	0.38	0.40	0.73***	0.71	0.75
Primary substance use and behavioural addictions						
Opiates (ref = No)	2.78***	2.49	3.09	2.35***	2.08	2.65
Tranquilizer (ref = No)	1.71***	1.35	2.15	1.31*	1.01	1.69
Barbiturates (ref=No)	1.70***	1.38	2.10	1.37**	1.13	1.66
Crystal meth (ref = No)	1.70***	1.52	1.90	1.69***	1.50	1.91
Amphetamines (ref = No)	1.40**	1.13	1.73	1.23	0.98	1.53
Cocaine (ref = No)	0.89*	0.80	0.99	1.01	0.90	1.14
Marijuana (ref = No)	0.78***	0.68	0.89	0.88	0.76	1.03
Alcohol (ref = No)	0.73***	0.65	0.81	1.10	0.97	1.25
Androgen (ref = No)	0.81	0.52	1.27	0.92	0.63	1.35
Antidepressant (ref =No)	0.97	0.72	1.32	0.78	0.56	1.08
Gambling (ref = No)	0.11	0.97	1.33	1.02	0.86	1.21
Inhalant (ref = No)	0.44	0.81	1.62	1.03	0.71	1.50
Other addiction (ref = No)	1.37	0.92	2.04	1.64*	1.10	2.44
Psychedelics (ref = No)	1.10	0.75	1.42	0.67*	0.46	0.97
Tobacco (ref = No)	0.99	0.90	1.11	1.17**	1.04	1.31
Educational levels						
High school (ref)						
Less than high school	1.09	0.89	1.34	1.11	0.88	1.41

	Non-Completion	95% Confidence Interval		Cycle between completion and non-completion	95% Confidence Interval	
Variable	Exp(B)	Lower Bound	Upper Bound	Exp(B)	Lower Bound	Upper Bound
Post Secondary	0.79***	0.71	0.88	0.81***	0.71	0.91
Detoxification Only (ref=detoxification+residential treatment)						
Detoxification alone	2.45***	2.14	2.80	1.35***	1.20	1.51
Facilities Utilized (ref=Facility 5)						
Facility 1	0.87	0.66	1.64	0.76	0.45	1.30
Facility 2	22.65***	16.52	31.05	6.16***	4.43	8.56
Facility 3	1.15	1.00	1.34	1.07	0.90	1.27
Facility 4	3.56***	3.20	3.96	1.77***	1.56	2.01
Combination of two or more	2.78***	2.09	3.74	2.71***	2.23	3.30
Discharge Days (ref = Monday to Friday)						
Saturday and Sunday	1.41***	1.27	1.57	0.79**	0.67	0.94
Both	1.30**	1.07	1.56	2.25***	1.94	2.61
Gender (ref = Male)						
Female	1.19***	1.09	1.31	1.21***	1.09	1.34
Admission Year (ref = 2019 to 2022)						
2015 to 2018	0.76***	0.69	0.84	0.88*	0.78	0.99
Both	0.73**	0.59	0.90	1.32***	1.13	1.53
Employment (ref = Unemployed)						
Employed	0.76***	0.67	0.81	0.93	0.83	1.04
Unstable employment	0.73**	0.30	0.82	1.22	0.91	1.63
Marital status (ref = Single)						
Divorce, Separated, and Widowed	0.91	0.80	1.04	0.92	0.79	1.07
Married	0.87*	0.78	0.97	0.88*	0.77	1.00
Unstable marriage	1.01	0.59	1.74	1.29	0.91	1.82
Mono vs multiple substances						
Mono substance (ref = Polysubstance)	0.86*	0.76	0.98	0.73***	0.71	0.75
Place of residence (ref = rural)						
Urban	1.28***	1.13	1.46	1.40***	1.19	1.65
Migrated between urban and rural	0.93	0.55	1.58	1.40	1.00	1.97

***p <0.001, **p <0.01, *p <0.05

Socio-demographic Variables

Clients who had completed post-secondary education (OR = 0.79, $p < 0.001$) were less likely to be discharged early than those in high school. Moreover, clients who were employed (OR = 0.76, $p < 0.001$) and had unstable jobs (OR = 0.73, $p < 0.01$) compared to the unemployed were less likely to be non-completed versus completed. Females (OR = 1.19, $p < 0.001$) versus males had higher odds of non-completion versus completion. Married (OR = 0.87, $p<0.05$) compared to single clients had lower odds of non-completion. Clients who were residents of urban (OR=1.28, $p<0.001$) compared to rural were more likely not to complete versus completion.

Program Variables

An increase in the count of admissions to detoxification services (OR = 0.77, $p < 0.001$) and an increase in the LOS (OR = 0.39, $p < 0.001$) were associated with lower odds of non-completion versus completion. Clients admitted between FY 2015-18 (OR = 0.76, $p < 0.001$) compared to those admitted between FY 2019-22 were less likely not to complete detoxification services. Moreover, those discharged on Saturday and Sunday (OR = 1.41, $p < 0.001$) versus Monday to Friday had higher odds of non-completion versus completion. Clients who utilized detoxification as a standalone service compared to those who transitioned to residential treatment had higher odds of non-completion (OR = 2.45, $p < 0.001$). Clients who were admitted into Facility 2 (OR = 22.65, $p < 0.001$), Facility 4 (OR = 3.56, $p < 0.001$), and those who utilized two or more facilities (OR = 2.78, $p < 0.001$) compared to Facility 5 had higher odds of non-completion versus completion.

Clients Cycle Between Completion and Non-Completion: Clients who had higher odds of cycling between completion and non-completion included those who used: barbiturates (OR = 1.37, $p < 0.05$), crystal meth (OR = 1.69, $p < 0.001$), opiates (OR = 2.35, $p < 0.001$), other addiction (OR = 1.64, $p < 0.05$), tobacco (OR = 1.17, $p < 0.01$), and tranquillizers (OR = 1.31, $p < 0.05$). Conversely, those who used psychedelics (OR = 0.67, $p < 0.05$) were less likely to cycle between completion and non-completion versus completion. Individuals with a single rather than polysubstance use disorder and behavioural addiction had lower odds (OR = 0.73, $p < 0.001$) of cycling between completion and non-completion.

Compared to high school students, clients who completed post-secondary education (OR = 0.81, $p < 0.001$) were less likely to cycle between completion and non-completion. Females (OR = 1.21, $p < 0.001$) versus males had higher odds of being in cycles of completion and non-completion versus completion. Moreover, clients who were married (OR = 0.88, $p<0.05$) were less likely to cycle between completion and non-completion. Moreover, clients who resided in urban areas (OR = 1.40, $p<0.001$) compared to rural residents were more likely to cycle between completion and non-completion versus completion.

An increase in the number of admissions to detoxification services (OR = 2.47, $p < 0.001$) was associated with increased odds of cycling between completion and non-completion versus completion. On the other hand, an increase in the LOS (OR = 0.73, $p < 001$) decreased the odds of a cycle of completion and non-completion versus completion. Clients who were admitted in Facility 2 (OR = 6.16, $p < 0.001$), Facility 4 (OR = 1.77, $p < 0.001$), and those who utilized two or more facilities (OR = 2.71, $p < 0.001$) had higher odds of cycling between completion and non-completion than completion. Clients admitted into detoxification facilities between 2015 and 2018 (OR = 0.88, $p < 0.05$) compared to those admitted between 2019 and 2022 were less likely

to cycle between completion and non-completion. Those discharged on Saturday and Sunday (OR = 0.79, $p < 0.01$) compared to those discharged on Monday to Friday had lower odds of cycling between completion and non-completion. Moreover, clients who utilized detoxification as a standalone service (OR = 1.35, $p < 0.001$) compared to those who transitioned to residential treatment have higher odds of cycling between completion and non-completion versus completion.

Discussion

In this study, we reported completion and non-completion rates and predictors among Alberta clients undergoing residential detoxification, including a subgroup that cycled between completion and non-completion. Overall, 20,020 clients were admitted into the five AHS detoxification facilities between 2015 and 2022, with an average rate of 2 admissions. A greater proportion of clients completed treatment than non-completed or cycled between completion and non-completion. Based on over 20 studies reviewed on completion/non-completion, our completion rate of 55.8% fell within the range of 37 to 94% reported in previous studies. The 25.5% non-completion rate is within the range of 5 to 63% (Hogan et al., 2018; Sidana et al., 2023; Specka et al., 2011; Timko et al., 2015). The 18.7% of clients that cycled between completion and non-completion illuminated the challenges and non-linearity of recovery processes where an individual accessed detoxification services several times. This is consistent with the chronic nature of addiction, which takes a median of nine years from the first treatment episode to the last use or a median of 27 years from the first to last use (Dennis et al., 2005) due to the frequency of relapse.

All previous studies had a dichotomous classification between completion and non-completion, which is incompatible with our trichotomous results. Our dichotomized sensitivity

analysis demonstrated that 69% completion and 31% non-completion rates were within the range of previously reported results (Specka et al., 2011; Timko et al., 2015). For every 6.2 admissions, there was one non-completer. The completion status varied with the socio-demographic, substance use disorder and behavioural addiction, and program variables.

Primary Substance Use Disorder and Behavioural Addiction

Our study indicated that users of alcohol, cocaine, and marijuana had higher odds of completion, whereas users of opiates, crystal meth, barbiturates, amphetamines and tranquillizer had higher odds of non-completing detoxification services. Our results are consistent with previous research indicating that participants who consumed alcohol were more likely to complete detoxification (Callaghan, 2003; Hogan et al., 2018; Li et al., 2007; Sarkar et al., 2016; Timko et al., 2015), while those who used opiates were less likely to complete detoxification (Callaghan & Cunningham, 2002; Li et al., 2013; Li et al., 2007; Sarkar et al., 2016; Silins et al., 2008; Zhu & Wu, 2018). Moreover, our results of tranquillizer users' lesser likelihood of being completers were consistent with the study by Dayal, Sarkar, and Balhara (2017). The variation in completion/non-completion rates among individuals with substance use disorder or gambling problems may be related to management strategies rather than the *substance* itself (Specka et al., 2011). Although the initial withdrawal symptoms are similar for different substances, management and treatment can vary significantly due to differences in the severity of complications (Kosten & O'Connor, 2003).

Despite unique withdrawal management practices to address alcohol and opiates (AHS, 2022b; 2023), opiate non-completion remains higher than alcohol. This high opiate non-completion may also reflect the growing rate of overdose in Alberta (Scace, 2023; Public Health Agency, 2023). Non-completion of opiate detoxification likely increases exposure to overdose by

decreasing users' tolerance because of the initiation of detoxification (Walley et al., 2020), and the odds of overdose spike if not followed by subsequent treatment or appropriate provision of a naloxone kit when non-completion occurs, as stated in the opiate protocol (AHS, 2022b; 2023). On the other hand, since alcohol withdrawal is life-threatening (Day & Daly, 2021), clients may prefer to stay until completion. The differences in completion rates across substance use disorder and behavioural addiction suggest that evidence-informed withdrawal protocols should be developed for different substance use disorders and behavioural addiction. Results related to substances of cocaine, marijuana, crystal meth, barbiturates, and amphetamines have not been reported in previous studies.

Clients with substance use disorder of barbiturates, crystal meth, opiates, tranquillizers, tobacco, and other addictions had higher odds of cycling between completion and non-completion, similar to odds of non-completion. In contrast, clients with substance use disorder of psychedelic had lower odds of cycling between completion and non-completion. In addition to the type of substance use disorders and behavioural addiction, the number of substances people with substance use disorders and behavioural addiction significantly predicted the completion status of clients. Clients who had a single-substance use disorder and behavioural addiction compared to poly-substance use disorders and behavioural addiction had higher odds of completion, consistent with previous studies by Levola et al. (2021) and Sofer et al.(2018). Similarly, clients with mono-substance substance use disorders and behavioural addictions had lower odds of cycling between completion and non-completion.

The Social Determinants of Health

The social determinants of health have previously been associated with the detoxification completion status of clients (Mutter & Ali, 2019). Our study showed that clients who had

completed post-secondary education were less likely to be non-completed than those who had not completed high school, supported by previous studies (de Weert-van Oene et al., 2007; Sofer et al., 2018; Sofin et al., 2017). Clients who completed post-secondary education had the highest employment rates. Accordingly, our data shows that individuals who are employed or have unstable employment have a lower chance of not completing detoxification compared to those who are unemployed. This finding is consistent with previous studies on employed clients conducted by Levola et al. (2021) and Sofin et al. (2017). However, there was no existing literature on the relationship between unstable employment and detoxification completion. Our study found that female clients were more likely not to complete detox, which was supported by Li et al. (2013) but contradicts the findings of Sofin et al. (2017). Further study is needed to examine the reasons for the variation in completion across gender.

In our study, married clients were less likely to be non-completed than single clients. Studies by Cobos et al. (1997), Mutter and Ali (2019), and Morgan and Dennis (2022) were consistent with our results, but Dayal et al. (2017) found that married clients had higher non-completion rates than single clients and Barnaby and Gibson (2008) reported that marital status had no relationship with completion. The role of couples in improving treatment outcomes has been widely documented previously (Rowe, 2012), and it may be beneficial to extend this to detoxification clients. Moreover, clients who resided in urban areas compared to rural areas had higher odds of non-completion. It might be associated with a stronger social support system in rural than urban areas (Burnette et al., 2021); however, it contradicts previous research that revealed no relationship between these variables (Barnaby & Gibson, 2008).

Program Variables

Program outcome variables such as frequency of admissions, transition to residential treatment following detoxification, LOS, facilities utilized, days of discharge, and admission years predicted completion/non-completion significantly. Our study has shown that those clients who completed detoxification had a more extended stay consistent with previous studies (David et al., 2022; Dayal et al., 2017; Hakansson & Hallen, 2014; Kovas et al., 2007; Ling et al., 2018; Sidana et al., 2023; Specka et al., 2011). The length of stay (LOS) in detox programs can vary depending on the facilities and the specific substance use disorders or behavioural addictions that individuals experience. On average, the duration at these facilities ranges from 4 to 11 days. Clients with androgen substance use disorders typically have a mean LOS of 6 days, while those with inhalant substance use disorders average about 4.4 days. Despite these differences, longer lengths of stay are generally associated with better long-term outcomes. An individual with a longer LOS could spend more time engaging in programming sessions, contributing to favourable outcomes, such as more sober days (Ford & Zarate, 2010) and spending more time with service providers, likely increasing the odds of entry to longer-term treatment (Running Bear et al., 2017), the end goal of detox. Our study revealed that non-completer clients had fewer admissions than completers, consistent with a previous study by Kenne et al. (2010). It might indicate that non-completed clients may be discouraged from being readmitted into detox. Clients who had multiple admissions to detoxification had a better outcome and higher odds of completion. It implies that not all frequent admissions are undesirable; however, an intervention that increases completion rates could decrease costs for the healthcare system and increase the chance of transition to treatment.

Our study found that clients who did not complete detoxification were less likely to enter residential treatment following discharge, consistent with previous studies (Ford & Zarate, 2010; Kenne et al., 2010; Specka et al.,2011). Completing detoxification services increases the likelihood of entering treatment following detoxification (Running Bear et al., 2017), one of the primary goals of detoxification. Clients who have a higher chance of not completing detoxification may seek detoxification services for two reasons. Firstly, they may want to reduce harm without intending to continue further treatment. Secondly, they may mistakenly assume that once their withdrawal symptoms are resolved, they can manage their addiction on their own after detoxification (McLellan et al., 2005). Although an individual's goal to use detoxification as harm reduction versus continuing to abstinence-based treatment varies, completion of detoxification is a desirable outcome for individual recovery.

The higher odds of non-completion among clients admitted between 2019 and 2022 than those admitted between 2015 and 2018 could be linked to a change of government and provincial treatment policy in 2019 and the COVID-19 emergency restrictions. The higher odds of non-completion since 2019 might also be related to service delivery disruptions and service providers' fatigue during COVID-19 emergencies (Kim et al., 2020; Mellis et al., 2021; Russell et al., 2021), staff shortages and imposed pandemic restrictions, including restrictions on visitation for family support, which might have discouraged clients from completing their program. Readiness to address service disruptions during large-scale emergency declarations is needed. Future research can analyze the treatment policy differences between the NDP (The New Democratic Party) that governed the province between 2015 and 2018 and the Conservative party in charge of the province from 2019 to 2022. Further, clients discharged on weekends had a higher likelihood of not completing than those discharged on weekdays, consistent with previous

studies (Blondell et al., 2006; Hogan et al., 2018; Li et al., 2013; Li et al., 2007). This might be due to changes in the number of weekend staff working (Li et al., 2013) and clients' desire to attend other weekend events (Blondell et al., 2006). Increasing the number of staff and programming on the weekend and family involvement as a recovery support group may help decrease non-completion.

Our research identified lower completion rates among clients admitted to Facility 2 or Facility 4 or those who utilized two or more facilities. These differences were independent of urban/rural locations; thus, further study is necessary to determine the reasons for the significant variations in odds ratio among these facilities. We have also observed a recurring trend between clients who cycled between completion and non-completion and non-completion clients on length of stay, facilities utilized, transition to residential treatment, place of residence, and year of admission (2015 to 2018). On the other hand, as the frequency of admission increases, the odds of the cycle between completion and non-completion increase, which may imply that these clients had a higher frequency of admission.

Strengths and Limitations of the Study

Our study has several strengths, including the use of a large province-wide sample, the many correlates considered, and the inclusion of the participants who cycled between completion and non-completion, which portrays the complexities of addiction and treatment. Methodologically, this study includes all clients without stringent inclusion or exclusion criteria obtained from routine patient care and provides a naturalistic dataset (Van den Berg et al., 2015) compared to data collected from selected self-reports (Evans et al., 2010). In addition, using longitudinal administrative data is valuable in investigating substance use disorder and behavioural addiction as the changes unfold over the long term (Evans et al., 2010).

Our study has limitations. The database owner excluded clients admitted and discharged on the same day and clients who died during the recovery process, which might lower the non-completion rate. The data for this study only represent clients within the provincial health services and do not include other detoxification services in the community or privately run facilities. Therefore, these findings do not represent all detoxification facilities in the province. Additional research on private and other non-governmental detoxification facilities and qualitative research that explores the perspectives of clients and service providers would be beneficial. It is important to interpret the results of our study with caution due to the high risk of type I error caused by examining a large number of independent variables. Although we could compare different facilities, we could not determine the characteristics responsible for the observed differences. Therefore, we recommend conducting future quasi-experimental or experimental studies that compare different types of facilities to address this issue.

Conclusion

The findings of this study reveal novel findings about the characteristics of clients who completed detoxification, were non-completed, or cycled between completion and non-completion from residential withdrawal management services. These findings can be utilized to develop targeted interventions for clients at risk of non-completion. Our study highlighted the challenges and non-linearity of the recovery process, where clients experience a completion cycle, get readmitted and then non-completed detoxification services several times. The 19% who cycled between completion and non-completion could have been misclassified in previous studies using a binary outcome. Our findings underscore the need to address the social determinants of health and program outcomes to improve the completion of detox. Further research comparing treatment outcomes between facilities/programs is needed.

Abbreviations:

LOS- Length of Stay

ASIST - The Addiction System for Information and Service Tracking database

FY- Fiscal Year

MI- Multiple Imputation

OR- Odds Ratio

AHS- Alberta Health Services

NDP- The New Democratic Party

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Declarations

Ethical Approval

- This study was approved by the University of Alberta Research Ethics Board (REB) protocol No Pro00108773.

Competing interests

- The authors declare no competing interests.

Authors' contributions

- AM wrote the first draft of the manuscript, which all authors critically revised. All authors read and approved the final manuscript.

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Availability of data and materials

- The datasets generated and analyzed can not be shared due to the restrictions of the dataset owner.

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Chapter Three: Predictors of Transitioning to Residential Treatment *

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Abstract

***Objectives*:** We aimed to estimate the rate of clients' transitions into residential treatment following detoxification and identify predictors of such transitions in five provincial residential withdrawal management services across Alberta, Canada.

***Methods*:** We analyzed data of clients (N=20,215) admitted to five provincially funded residential detoxification ("detox") services between April 1, 2015, and March 31, 2022. We conducted a binary logistic regression to investigate predictors of the transition to residential treatment following discharge from detox.

***Results*:** Out of 20,215 unique clients, slightly less than a quarter (24.3%, n = 4,915) transitioned into residential treatment after being discharged from detox. Most clients (75.7%, n = 15,300) used detox services without transitioning into residential treatment. Regression analysis indicated that clients that had higher odds of transitioning to residential treatment were people with substance use disorder of androgen and inhalants, completed their detox stay, were readmitted,

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used a facility that has the highest count of residential treatment beds, attended more than one facility, were employed or had unstable employment, and were rural residents. Other variables related to higher odds of transition included: completing post-secondary education, being married, and having a longer length of stay. Conversely, clients that were less likely to transition to residential treatment tended to: be older, primarily with substance use disorder of opiates or crystal meth, live in an urban setting or migrate between urban and rural areas, have not completed detox, or not have completed high school. While the COVID-19 emergency decreased rates of transition to treatment, facilities with fewer beds and the co-location of detox and treatment facilities increased these rates.

***Conclusion*:** Results indicated that the type of substance use disorder and behavioural addiction, education, marital status, employment, place of residence, completion status and readmission status were discriminating variables in clients' transition to residential treatment. These findings can inform the customization and allocation of services, targeted support, service intensity and areas requiring additional attention and investment to improve the transition to treatment.

Introduction

Detoxification involves a set of interventions designed to manage acute intoxication and withdrawal from addiction (Lee et al., 2014). These services connect individuals with rehabilitative treatment centres following detoxification and prepare them for further treatment (Li et al., 2008; Running Bear et al., 2022). Continued treatment following detoxification helps clients maintain sobriety and enhances their recovery (Day & Daly, 2021; Levola et al., 2021; Li et al., 2007; Zhu & Wu, 2018). While detoxification services alone reduce the harms associated with addiction for a short time (Chutuape et al., 2001), they are rarely sufficient to maintain abstinence (Levola et al., 2021; NIDA, 2018) and often ineffective in addressing the social and

behavioural changes required to achieve sustained recovery (Acevedoa et al., 2018; Blodgett et al., 2014; Haley et al., 2011; McLellan et al., 2005; NIDA, 2018). Individuals who only access detoxification services without further treatment experience a higher risk of relapsing (Walley et al., 2020). Bailey et al. (2013) found that 27% of patients relapsed on the first day of discharge from detoxification, while 65% relapsed within a month of being discharged. While undergoing detox, individuals' tolerance to substance use disorder and behavioural addiction decreases, and relapse can increase the chances of an overdose and even death (Stein et al., 2009; Strang et al., 2003; Walley et al., 2020).

Individuals admitted to treatment following detoxification experience more favourable outcomes (Campbell et al., 2009), such as lower chances of relapse (Ford & Zarate, 2010; Livingston et al., 2022; Tuten et al., 2007), fewer incidences of drug overdose (Wines et al., 2007), reduced substance use disorder and behavioural addiction , and increased employment rates (Ford & Zarate, 2010). They also experience fewer arrests, lower rates of homelessness and fewer days of incarceration (Ford & Zarate, 2010; Teesson et al., 2006). In Canada, where the healthcare system is publicly funded, addiction and treatment create pressure on healthcare expenditure; detoxification in combination with follow-up treatment not only improves the odds of recovery from addiction but also improves readmission rates and reduces public expenditures (Ford & Zarate, 2010; Zhu & Wu, 2018).

Detoxification is one of the most common and expensive cost-per-day forms of treatment (Haley et al., 2011), and costs increase as readmission rates rise at a standalone detox service (Kenne et al., 2010). The average estimated cost of a detoxification episode ranges from $3,625 to $7,250 in Canada (Medical Detox Ontario, 2021), while a mean index admission cost of $1,779 was recorded in the USA (Quinn et al., 2017).

Detoxification followed by treatment interrupts the frequent readmission cycle for many clients (Carrier et al., 2011; McCarty et al., 2000) by preventing or delaying subsequent readmission (Daley et al., 2010; McLellan et al., 2005; Running Bear et al., 2022). Furthermore, addiction is a chronic disease that requires ongoing treatment even after detoxification (Lash et al., 2011; Popovici et al., 2008). Nevertheless, despite the importance of a successful recovery of continuity of care after detoxification, several studies have suggested that up to 80% of clients fail to proceed with further treatment services after discharge (Acevedo et al., 2016, 2017; Campbell et al., 2010; Carroll et al., 2009; Frydrych et al., 2009; Kelly et al., 2016; Mark et al., 2002; Timko et al., 2016; Tuten et al., 2007).

There is significant variation in transition rates across various studies, which could be influenced by the time gap between discharge from detoxification and admission to treatment, as well as by the type of transition service, such as peer support services versus treatment or both. Reported transition rates range from 13% (Zhu & Wu, 2018) to between 13% and 64% (Lee et al., 2014) to 80% (Ford & Zarate, 2010; Kelley et al., 2016). Following detoxification, a timely transition to treatment has been shown to enhance treatment outcomes further (Blodgett et al., 2014; Carroll et al., 2009; Schmidt et al., 2017). The duration of time in detoxification ranges from short duration (i.e. same day) (Garland et al., 2023) to 14 days (Acevedo et al., 2016; Lee et al., 2014; Schmidt et al., 2017) to longer than 14 days (Ford & Zarate, 2010; Haley et al., 2011; Teseson et al., 2006). There are no performance criteria for post-detoxification service continuity in Canada, including in the province of Alberta, where this study was conducted.

Various factors, including socio-demographic characteristics, the type of substance use disorder and behavioural addiction, and other program factors, can predict the transition from detox to residential treatment. Studies have shown that individuals had a better transition to treatment if

they were employed (Ford & Zarate, 2010), educated beyond the high school level (Timko et al., 2015), married (O'Farrell et al., 2008), female (Zhu & Wu, 2018), and younger (age 12-17 vs 18-25) (Zhu & Wu, 2018). However, age (Kelly et al., 2016) and gender (Carroll et al., 2009) were found to have no association with transition rates in some studies. Moreover, individuals who completed detox versus non-completers (Haley et al., 2011), those who had longer versus shorter lengths of stay (Running Bear et al., 2017), and individuals experiencing alcohol use disorder than individuals who used opiates (Zhu & Wu, 2018) had better transition rates. Some studies found that an increase in count of admission increases the chance of transition to treatment following discharge from detoxification (Timko et al., 2015), while others found that transitioning to treatment reduces readmission (Carrier et al., 2011). However, whether these findings can be applied to the Canadian universal healthcare system is unclear.

There is a dearth of peer-reviewed research on the transition from detoxification to residential treatment in Canada. The only article published recently was from Vancouver, Canada and evaluated the linkage to substance use disorder and behavioural addictions treatment after clients attended detoxification for nonopioid substances (MacKinnon et al., 2022). This study (MacKinnon et al., 2022), however, did not show the admission of clients into substance use disorder and behavioural addiction treatment and excluded clients who used opioids. Our study is the first multicentre study with a large sample of adult clients who utilized publicly funded detoxification services followed by residential treatment.

We examined the transition rates from detoxification into residential treatment and the predictors of such transitions. We used administrative data collected by Alberta Health Services over seven years (2015-2022) to determine a broad range of values that present a complex picture. We specifically examined demographic factors such as employment, sex, age,

educational level, marital status, and place of residence; admission and completion data including readmissions, detox completion status, number of facilities visited, admission year (including admission during the COVID-19 emergency), and length of stay (LOS); and type of primary substance use disorder and behavioural addiction of concern and number of substances use disorder and behavioural addiction. These variables were analyzed regarding their predictive significance and the likelihood of transition into residential treatment following detoxification. The University of Alberta Research Ethics Board (REB) protocol number Pro00108773 approved the study.

Methods

Study Setting and Design

This retrospective study used administrative data from the Addiction System for Information and Service Tracking (ASIST) database, collected by Alberta Health Services (AHS) between fiscal years 2015 and 2022. ASIST contains essential data on substance use, demographic variables, detox admission and discharge dates, transition to residential services, and facility information from Alberta's five residential detoxification facilities. We restructured the data from 40,149 admission-level data, which includes information based on each admission to detoxification, into a wide/horizontal 20,215 client-level data format, where each client's information is captured in one unique record.

Treatment Setting

Our study is based on the data from 10 publicly funded facilities in Alberta, Canada: 5 residential detox facilities with a total of 116 beds and 5 residential treatment facilities with a total of 174 treatment beds. These facilities are operated by staff who provide around-the-clock service. Clients are screened for admission to detox facilities through phone calls or face-to-face

meetings. Once a healthcare provider determines that detoxification is necessary, intake information for admission is collected. Within 24 hours of admission, an individualized daily treatment plan is created in consultation with the client. Based on the assessment, clients may initiate opioid agonist therapy and medication for alcohol or nicotine. The post-discharge plan includes a discussion of follow-up plans and treatment recommendations, naloxone education and the provision of a naloxone kit (AHS, 2022a). The data were collected using the same standard method across all five detoxification facilities.

Study Population Characteristics

The age range of the population studied was 17 to 91 years, with a median age of 35.3 and a mean age of 37.7 years. The study included eleven mature minors who were 17 years old, which could also be a typographical error. Most of the clients were male (64.3%), single (60%), and unemployed (64%). The most frequently used primary substance use disorder and behavioural addiction taking into consideration all substances and behavioural addictions, were alcohol (27.3%), tobacco (15%), crystal meth (14%), and opiates (13%). About 72% of clients had multiple substance use disorders and behavioural addictions. Most clients (75.7%; 15,300) used only the detox service, while the remaining 24.3% (4,915) transitioned to residential treatment following detox discharge.

Measures

Outcome Variables. This study's binary outcome variable was whether clients transitioned to residential treatment or not following discharge from detoxification.

Independent Variables. The independent variables for this study were: demographic characteristics (education, marital status, age, sex, employment, place of residence); healthcare utilization variables (completion status, length of stay, readmission, facilities utilized, years of

discharge); primary substances use disorder and behavioural addiction of choice; and number of substances use disorder and behavioural addiction (single versus polysubstance use disorder and addiction) (see Table 4).

Statistical Procedures

We used bivariate statistics to compare the outcomes of two groups: detox alone and detox plus residential treatment. Categorical variables were analyzed using chi-square tests, while non-normally distributed continuous variables were analyzed using the Mann-Whitney U test. Effect size (Cramer's V) was also considered (see Table 4). We used multivariate binary logistic regression analysis as the outcome variable was dichotomous. The odds ratio with a 95% confidence interval (CIs) and significance level were calculated to identify the discriminating variables between the two categories. The detox-alone group was taken as the reference category. The analysis was conducted using IBM SPSS version 29.

Missing Data Management

We encountered missing independent variables in our data set. To address this issue, we employed multiple imputations (MI) to obtain more accurate estimates and a complete dataset (Enders, 2013). MI is a suitable method for any missing pattern (Enders, 2010), and it outperforms other techniques such as complete case analysis, single imputation case techniques, and pairwise deletion (Enders, 2013; Liu & De, 2016). Our data set had missing values with uncertain causes, which makes MI a reasonable choice (Enders, 2013). We used a fully conditional specification MI method, which is reliable and suitable for imputing large datasets containing categorical and continuous variables (Lee & Carlin, 2010; Liu & De, 2016). We only imputed independent variables related to education, employment, sex, marital status, urban/rural, and primary substance use disorder and behavioural addiction of concern. Several factors were

used to predict imputed data, including education, employment, sex, marital status, age, date of admission, date of discharge, facility zone, facility name, and service end reason. We computed five MI datasets. The proportion of imputed values remained consistent with the original values.

Results

We examined data on 20,215 unique individuals who utilized Alberta's five residential detox and five residential treatment facilities from fiscal year (FY) 2015 to 2022. These individuals were collectively admitted 40,149 times. There are five detox facilities with bed counts of 6, 8, 20, 40, and 42. Two of these facilities have co-located residential treatment facilities with bed counts of 12 and 36. Out of 20,215 unique client admissions, 24.3% (4,915) transitioned to residential treatment after detox, while 75.7% (15,300) used detox as a standalone service. Transitioning clients were admitted to residential treatment 10,463 times, and their average admission rate was over twice per individual. We found that 6.5% (1,321) of discharged detox clients were admitted to residential treatment on the same day, 7.8% (1,570) within seven days, 8.7% (1,768) within 14 days, 11.1% (2,242) within 30 days, and 13.2% (2,673) after 30 days or more; however, these classifications are not mutually exclusive.

Clients who were in unstable marriages (defined as those clients who changed their marital status within the study period) had the highest transition rate of 40%, while singles (unmarried) had the lowest transition rate of 23%, which was statistically significant ($p<0.001$). It was observed that both currently and previously married individuals, including those who were divorced, separated, or widowed, had a higher transition rate of 26% than the average of 24%, but there was no statistically significant difference between these two groups. Clients who had unstable employment (defined as those who changed between employed and unemployed status) had the highest transition rate of 44% followed by employed (28%) and unemployed clients

(22%) (p<0.001). Moreover, a greater proportion of clients who had post-secondary education transitioned compared to those who did not complete high school education (27% vs. 20%) (p<0.001).

Results showed that 26.2% (1,348) of clients transitioned to residential treatment before the COVID-19 emergency declaration (between March 17, 2020 and December 14, 2021), compared to only 21.2% (866) during the COVID-19 emergency declaration. We also conducted a comparison of the transition rate between clients who primarily used alcohol vs. opiates. Our findings revealed that clients whose primary substance use disorder was alcohol (n = 2,862, 25.8%) had a significantly higher transition rate than those whose primary substance use disorder was opiates (n = 777, 19.8%) (p<0.001). Furthermore, clients discharged on weekdays (n = 3,797, 24.7%) had significantly higher transition rates than those discharged on weekends (n = 710, 20.6%) (p<0.001). Table 4 shows a description of bivariate results.

Results of Multivariate Analysis

Our logistic regression compared clients who transitioned from detox to residential treatment with those who only used detox services (Table 3). Our model accurately predicted the transition to a residential treatment group 15.6% of the time and detox only 96.5%, resulting in an overall predictive accuracy of 76.8%. The model explained 17.6% of the variance in treatment outcomes based on Negelkerke's R^2. It revealed that clients who used opiates (OR = 0.81) or crystal meth (OR = 0.85) were less likely to transition to residential treatment than clients who did not use these substance use disorders. On the contrary, clients had a higher likelihood of transitioning to residential treatment if their primary issue was androgen (OR = 1.42), barbiturates (OR = 1.21), inhalants (OR = 1.35) or gambling (OR = 1.23).

Table 3. *Regression Results, Transition to Residential Treatment*

Variable	Exp(B)	95% C.I. for EXP(B) Lower	Upper
Primary substance use disorder and behavioural addiction			
Alcohol (No[R])	0.97	0.88	1.06
Androgen (No[R])	1.42**	1.10	1.83
Amphetamine (No[R])	0.94	0.79	1.10
Antidepressant (No[R])	1.06	0.84	1.34
Barbiturates (No[R])	1.21**	1.05	1.38
Cocaine (No[R])	1.04	0.95	1.13
Crystal meth (No[R])	0.85***	0.78	0.93
Gambling (No[R])	1.23**	1.09	1.39
Inhalant (No[R])	1.35*	1.03	1.76
Marijuana (No[R])	0.95	0.85	1.06
Opiates (No[R])	0.81***	0.74	0.88
Other addiction (No[R])	0.96	0.70	1.32
Psychedelics (No[R])	1.19	0.92	1.54
Tobacco (No[R])	1.02	0.94	1.11
Tranquilizer (No[R])	0.91	0.75	1.10
Educational levels			
High School [R]			
Less than high school	0.82*	0.69	0.98
Post-secondary	1.16**	1.06	1.26
Sex			
Male[R]			
Female	1.03	0.96	1.11
Detox Facilities Utilized			
Facility 5[R]			
Facility 1	0.58***	0.46	0.74
Facility 2	0.64***	0.58	0.69
Facility 3	0.36***	0.25	0.53
Facility 4	1.23***	1.10	1.37

Variable	Exp (B)	95% C.I. for EXP(B) Lower	Upper
Admission Year			
2019-2022[R]			
2015 to 2018	1.14**	1.05	1.24
Both	1.75***	1.56	1.97
Employment			
Unemployed [R]			
Employed	1.34***	1.24	1.45
Unstable employment	1.53***	1.21	1.93
Marital status			
Marital status [R]			
Divorced, Separated and Widowed	1.09	0.98	1.22
Married	1.11*	1.01	1.22
Unstable marriage	1.05	0.80	1.38
Completion			
Completion [R]			
Non-completion	0.35***	0.31	0.40
Cycle between completion and non-completion	0.84**	0.76	0.93
Place of residence			
Rural[R]			
Urban	0.72***	0.65	0.80
Migrated between urban and rural	0.43***	0.33	0.55
Average Length of Stay (day)	1.10***	1.08	1.11
Age	0.99***	0.99	0.99
Readmission status			
Not readmitted[R]			
Readmitted	2.13***	1.94	2.35
Mono Vs multiple substance use disorder and behavioural addiction			
Polysubstance use disorder and behavioural addiction [R]			
Mono substance use disorder and behavioural addiction	0.91	0.82	1.01

Variable	Exp(B)	95% C.I. for EXP(B) Lower	Upper	Variable	Exp (B)	95% C.I. for EXP(B) Lower	Upper
Combination of two or more	1.30**	1.12	1.5	***p<0.001, **p<0.01, *p<0.05 R- reference category			

Clients who did not complete high school (OR = 0.82) were less likely to transition into treatment, whereas those who completed post-secondary education (OR = 1.16) were more likely to transition than those who just completed high school. Compared to unemployed clients, those employed (OR = 1.34) and those with unstable employment (OR = 1.53) had higher odds of transitioning to residential treatment. Additionally, married clients (OR = 1.11) had higher odds of transitioning than those who were single. Clients living in urban areas (OR = 0.72) and those who migrated between rural and urban areas (OR = 0.43) were less likely to transition into treatment than rural clients. Finally, clients were less likely (OR = 0.99) to transition to treatment with each additional year of age.

Several factors predicted the transition to residential treatment from detox programs, including completion and readmission status, LOS, facilities utilized, and year admitted. Compared to clients who completed detox, those who did not complete (OR = 0.35) and those clients who cycled between completion and non-completion (OR = 0.84) were less likely to transition to residential treatment. Readmitted clients (OR = 2.13) were more likely to transition to treatment than non-readmitted clients. Clients admitted from 2015 to 2018 had higher odds (OR = 1.14) of transitioning than those admitted from 2019 to 2022. Additionally, clients with a greater LOS in detox had higher odds of transitioning to treatment (OR = 1.10). Clients admitted to detox Facility 3 (OR = 0.36), Facility 1 (OR = 0.58), or Facility 2 (OR = 0.64) were less likely to transition than clients who utilized detox Facility 5. On the other hand, Facility 4 (OR = 1.23)

clients and those who used multiple facilities (OR = 1.30) were more likely to transition to treatment than clients who used a single substance use disorder and behavioural addiction.

Discussion

This retrospective multicentre study reported rates of transitions from detoxification to residential treatment and its predictors within Alberta Health Services (AHS). Our research indicated that the transition to residential treatment after discharge from detox was predicted by substance use disorder and behavioural addiction factors, socio-demographic characteristics, and program variables.

Transition to Residential Treatment Rates

We found that only 24% of clients received continuous service by transitioning from detox into residential treatment. These individuals had an average of three admissions to detoxification services over the study period. On the contrary, 76% of clients used detox services without transitioning into residential treatment, which is lower than the US-wide report of 87% (Zhu & Wu, 2018). This figure suggests that most clients use detox services to reduce adverse health, social, or economic consequences without necessarily reducing consumption, as the Alberta recovery-oriented approach reported (AHS, 2020). The 2018 AHS Harm Reduction Report indicated that some detox facilities follow a harm reduction model while others focus on abstinence (AHS, 2018). Conversely, in one of the Alberta detox facility's pamphlets, detox services were advertised to help users withdraw from substance use disorder and behavioural addiction safely and transition to a healthy lifestyle (AHS, 2011). In this way, some clients may have considered detoxification as a sufficient standalone service for their withdrawal (McLellan et al., 2005; Tuten et al., 2007). However, harm reduction and abstinence are not mutually

exclusive, as harm reduction can be a crucial element of transitional support until abstinence is attainable for some clients (McKeganey et al., 2004).

Our data indicates that a 24% transition rate is higher than the two US-wide reports of 15% (Treatment Episode Data Set [TEDS], 2020) and 13% for 7-year transition rates into treatment (Zhu & Wu, 2018); however, it is lower than the transition rate of 53.7% reported by a US study using three months of data (Carroll et al., 2009) and similar to the 1-year rate of 24.5% reported in Germany (Specka et al., 2011). The differences in these rates could be accounted for by the years of data considered, the healthcare system and treatment settings as inpatient clients in the US versus opiate-dependent inpatient clients in Germany. A much broader set of criteria for transitioning into treatment and mutual help groups was established by Timko et al. (2015), which ranged from 14% for transitioning to a mutual help group within 180 days to 92% for a brief family treatment intervention within 90 days. However, such data were not available for our study sample.

Our study's 40-day median duration from discharge from detox to entry into residential treatment may not be ideal for decreasing relapse and readmission rates. In addition, 41.6% (2,046 of 4,915) transitioned clients used residential treatment more than once with a mean number of admissions of three, which may imply the existence of revolving door phenomena among and between detox and residential treatment. This may portray the complexity of addiction and treatment and suggests looking at the treatment ecology as a whole. The low transition rate may be due to insufficient treatment beds in the province. While across Alberta, there are more residential treatment beds (n=174) available than residential detox beds (n=116), detox clients usually stay for a shorter period (approximately five days) than those in residential

treatment (at least a month). This discrepancy makes the available treatment beds insufficient to accommodate the detox clients seeking treatment.

A shorter time duration (i.e. more direct entry) between detox and treatment has been shown to improve treatment outcomes (Acevedo et al., 2018), such as decreased readmission (Carrier et al., 2011; Lee et al., 2014; Mark et al., 2006) and duration of relapse (Ford & Zarate, 2010). Unfortunately, it is not easy to compare, from the extant literature, the length of the transition periods between detox and treatment, as studies have reported varying durations using different criteria. Based on the 14-day continuity criteria (Garnick et al., 2010; Lee et al., 2014), our result of 9% is lower than the results reported elsewhere (Acevedo et al., 2016; Garnick et al., 2020; Lee et al., 2014). Moreover, our 8% transition with a 7-day criterion (Garnick et al., 2020; Harris et al., 2016; Lee et al., 2014) was lower than the 22% reported by Haley et al. (2011) and 43% by Timko et al. (2015). Our 11% of clients that transitioned within 30 days was much lower than reported elsewhere (Ford & Zarate, 2010; Stein et al., 2009). In our study, only a small percentage of clients met the above transition duration criteria.

Healthcare Utilization Variables

Completion and Readmission

Program outcomes were related to transitioning to treatment from detox. We found that clients who did not complete detox services had lower odds of transitioning than those who completed residential detoxification. Other studies have similarly found that clients who completed detox had enough time to withdraw from their substance use disorder and behavioural addiction and were encouraged to seek successful post-detoxification follow-up, including a transition to treatment (ASAM, 2014; Acevedo et al., 2016; Haley et al., 2011; Kelly et al., 2016). Our analysis further shows that a longer LOS increases the odds of transition, consistent

with previous studies (Campbell et al., 2010; Carroll et al., 2009; Running Bear et al., 2017). Furthermore, a longer LOS among those who completed detox (Morgan & Dennis, 2023) indirectly complements a higher transition rate. That is, clients could have sufficient time for discharge planning and completing the program.

Our finding of higher odds of transitioning among readmitted clients supports the idea that repeated admissions lead to higher transition rates, consistent with Timko et al. (2015). Although readmission to detox services may be viewed as a poorer treatment outcome, readmissions may not necessarily be negative for clients if the service delivery is translated into a gateway to treatment (Lee et al., 2014). Our results contradict the findings of Carrier et al. (2011), which suggested that clients who received treatment following detoxification were less likely to be readmitted to detox. This is consistent with the notion that substance use disorder is a chronic illness in which clients may require multiple treatment episodes on the road to recovery (Lee et al., 2014; Scott et al., 2005). Indeed, the Alberta detoxification program recognizes that recovery may take multiple admissions (AHS, 2022). An intervention that targets the most frequent users rather than less frequent users may reduce resource waste and improve transition (McLellan et al., 2005).

Time Period and Days of Discharge

Our study found that clients admitted from fiscal year 2019 to 2022, compared to those admitted from 2015 to 2018, had lower chances of transitioning to treatment. Although other factors may contribute to these differences, such as changes in the treatment policies of the provincial government during the United Conservative Party government (from 2019 to 2022) and the New Democratic Party government (from 2015 to 2018), our focus was on the impact of the COVID-19 emergency declaration. Our results suggest that the COVID-19 pandemic

affected the use of detox and treatment services, which has made it more difficult for clients to transition to treatment. Specifically, the transition rate for clients admitted during the COVID-19 emergency, which aligns with fiscal years 2019 to 2022, was lower than for those admitted prior to the emergency declaration. This decrease may also be due to the increase in substance use disorder and relapse during the COVID-19 lockdown (Barrio et al., 2021; Kim et al., 2020) and service disruptions and service provider fatigue during the COVID-19 emergency (Kim et al., 2020; Mellis et al., 2021; Russell et al., 2021). Transition rates were lower for clients discharged on weekends (Saturday or Sunday) than Monday to Friday. Research on the completion of detoxification has found similar trends account for changes in the number of weekends worked (Li et al., 2013), and the desire to attend weekend events (Blondell et al., 2006) may also be extended to residential treatment. However, further study is needed to understand this trend.

Differences among Facilities

Rates of transitions to treatment were influenced by the facility to which a client was admitted. Clients admitted to multiple facilities and those in Facility 4 had higher transition rates compared to Facility 5. In contrast, the transition rates of the other three facilities (1-3) were the lowest. Our research suggests that some clients may be switching detox facilities to increase their chances of receiving residential treatment. However, further investigation is needed to understand the reasons behind this. In a novel discovery, we also found that the transition rate from detoxification to residential treatment was higher when detox and residential treatment services were in the same facility (Facility 4), contrary to a study by Garnick et al. (2020). Attending a co-located facility (i.e. detox and treatment in the same location) may be related to a higher likelihood of transitioning, even during the COVID-19 emergency. Facility 4 had a higher transition rate with a medium bed count. Clients in the detox facility with the largest count of co-

located residential treatment beds had higher odds of transitioning to those treatment beds. Two of the three detox facilities with the lowest odds of transitioning to residential treatment had the lowest count of detoxification beds. This finding contradicts a study by Campbell et al. (2010), which concluded that fewer beds increased treatment entry following detoxification. Recent media reports have suggested that the provincial government plans to increase the number of treatment beds (Conrod, 2021). However, increasing the number of beds may not be enough to achieve an improved transition rate to treatment without making the necessary programmatic changes, such as including couples therapy (Rowe, 2012) and hiring navigators to motivate clients to transition to residential treatment. The limited information on the characteristics of the facilities responsible for the observed differences prevented us from further comparing facilities and the odds of transition to residential treatment, as in Lee et al. (2014). We therefore recommend conducting future quasi-experimental or experimental studies that compare different types of facilities to address these issues.

Primary Substance Use Disorder and Behavioural Addiction

As a type of substance use predicts the transition to treatment, we found that clients who primarily used opiates and crystal meth had a lower likelihood of transitioning to residential treatment but a higher likelihood of seeking detox services. In contrast, clients who struggled with problematic gambling or who used barbiturates, inhalants, and androgens had a higher chance of transitioning to residential treatment. Our comparison of alcohol and opiates, two substance use disorders with different detox protocols, revealed that clients who used alcohol transitioned more frequently than clients who used opiates—a finding consistent with Zhu and Wu (2018). This finding is concerning since clients who use opiates are at a higher risk of overdose after detoxification (Wines et al., 2007) and transitioning to treatment is crucial to

reducing mortality rates from overdose (Walley et al., 2020). Additionally, we observed that clients who used multiple substance use disorders had a higher rate of transition. This likelihood may be attributable to clients feeling a greater urgency to seek treatment due to the use of multiple substance use disorders and behavioural addictions and believing that residential treatment is their best option for recovery. The variation in the odds of transition to treatment between substance use disorder and behavioural addiction highlights the need to improve the withdrawal management practices for specific substances.

Sociodemographic Variables

Education and Employment

Our findings indicate that better-educated clients were more likely to transition to residential treatment than those with less than a high school education. This finding is consistent with Timko et al. (2015). In addition, clients in our study who were employed or had unstable employment, compared to unemployed clients, were more likely to transition. Similarly, Ford and Zarate (2010) found a significant association between employment and transition rates, with clients with post-secondary education having higher employment rates than those with less (i.e. high school only) education. Employment is valuable for preventing relapse (Walton & Hall, 2016). When unemployed clients transition to treatment, it may motivate them to seek employment since many employers expect abstinence from drug or alcohol use. On the other hand, clients who transition from being employed to unemployed may be affected by their substance use disorder and behavioural addiction or by the expectation from potential employers that they seek treatment, which can contribute to their change in employment status.

Marital Status and Place of Residence

In our study, clients who transitioned to residential care were more likely to be married. The addiction therapy literature has documented the importance of involving couples in addiction treatment (Sherrell& Gutierrez, 2014). Specifically, the involvement of concerned significant others increases the likelihood of entering treatment following detoxification (O'Farrell et al., 2007, 2008). In addition, rural residents were more likely to transition into treatment than urban clients and those who relocated between urban and rural areas. Rural residents with higher odds of transitioning were the most likely to be married, which may be related to rural residents enjoying stronger social cohesion than urban residents (Burnette et al., 2021).

Age and Gender

Our data showed that as age increases, the odds of transition decreased. This finding is consistent with two previous studies that showed younger ages are associated with improved transition rates (Market al., 2002; Zhu & Wu, 2018). The analysis of clients' ages yielded inconsistent results in the bivariate and multivariate analyses. The bivariate model indicated that older clients were likelier to transition into treatment, but the multivariate model showed contrary results, with the OR being close to one. This suggests that age may interact with other personal characteristics or does not have a practically significant effect and highlights the need for future investigations. Although more males than females transitioned into treatment, and males transitioned faster than females, these differences were insignificant, consistent with Carroll, Triplett, and Mondimore (2009).

Strengths and Limitations

This study has several notable strengths. It is the first research in Canada that focuses specifically on admission to residential treatment following discharge from detoxification. Hence, this study can provide a foundation for future research. The large sample size and multicentre data collected from routine patient care provide more reliable results than self-reported data. However, there are some limitations to consider. The transition was only considered within residential treatment in AHS and did not include outpatient services. The study did not include clients who accessed detox services outside AHS. Furthermore, the data only represents clients within provincial health services and does not include other detox services in the community or privately run facilities and inpatient detox facilities. Finally, it is vital to interpret the results of this study with caution due to the high risk of type I error caused by examining a large number of independent variables.

Conclusion

Our research has revealed new insights into the characteristics and predictors of clients who transition from detoxification to residential addiction treatment. The findings have implications for future studies and the potential to improve the low transition rates and the long duration between detox and treatment. Although readmission is not ideal, it provides an opportunity for clients to continue their recovery efforts. Improving the non-completion rate combined with an intervention focusing on employment and couples therapy can enhance transition rates. Our research has shown that co-locating detox and addiction treatment facilities and ensuring completion of the detox program can increase the transition rate. Reforming detox service provisions in order to ensure the continuity of treatment within a narrow window and creating a stronger network between detox and treatment services could increase the transition

rate in the continuum of care and enhance recovery. Targeted interventions such as motivational counselling and treatment navigators (Brolin et al., 2017; Schilling et al., 2002; Torres et al., 2020) may help to address the low transition rates. Messaging the benefits of continuing with treatment, whether residential or outpatient, should be emphasized in detox programs. Finally, tailoring detox programs based on individual harm reduction or abstinence goals may enhance treatment transitions.

Abbreviations:

LOS- Length of Stay

ASIST - The Addiction System for Information and Service Tracking database

FY- Fiscal Year

MI- Multiple Imputation

OR- Odds Ratio

AHS- Alberta Health Services

NDP- The New Democratic Party

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Declarations

Ethical Approval

- This study was approved by the University of Alberta Research Ethics Board (REB) protocol No Pro00108773.

Competing interests

- The authors declare no competing interests.

Authors' contributions

- AM wrote the first draft of the manuscript, which all authors critically revised. All authors read and approved the final manuscript.

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Availability of data and materials

- The datasets generated and analyzed can not be shared due to the restrictions of the dataset owner.

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Table 4. *Bivariate Analysis Results, Transition to Residential Treatment*

Variable	Entire Sample (20215)		Detox+Treatment (4915, 24.3%)		Detox alone (15300, 75.7%)		Chi-Square	Effect Size
	n	%	n	%	n	%		
Primary Substance use disorder and behavioural addiction[14]								
Alcohol								
Yes	13729	68.30	3548	25.80	10181	74.20	51.61***	0.05
No	6377	31.70	1350	21.20	5027	78.80		
Androgen								
Yes	359	1.80	145	40.40	214	59.60	50.97***	0.05
No	19747	98.20	4753	24.10	14994	75.90		
Amphetamine								
Yes	1106	5.50	301	27.20	805	72.80	5.18*	0.02
No	19000	94.50	4597	24.20	14403	75.80		
Antidepressant								
Yes	589	2.90	167	28.40	422	71.60	5.25*	0.02
No	19517	97.10	4731	24.20	14786	75.80		
Barbiturates								
Yes	1312	6.50	449	34.20	863	65.80	74.08***	0.06
No	18794	93.50	4449	23.70	14345	76.30		
Cocaine								
Yes	5025	25.00	1291	25.70	3734	74.30	6.44**	0.02
No	15081	75.00	3607	23.90	11474	76.10		
Crystal meth								
Yes	7070	35.20	1672	23.60	5398	76.40	3.00	
No	13036	64.80	3226	24.70	9810	75.30		
Gambling								
Yes	2556	12.70	723	28.30	1833	71.70	24.49***	0.045
No	17550	87.30	4175	23.80	13375	76.20		
Inhalant								
Yes	362	1.80	120	33.10	242	66.90	15.45***	0.03
No	19744	98.20	4778	24.20	14966	75.80		
Marijuana								
Yes	2693	13.40	632	23.50	2061	76.50	1.35	
No	17413	86.60	4266	24.50	13147	75.50		
Opiates								
Yes	6565	32.70	1463	22.30	5102	77.30	22.80***	-0.03
No	13541	67.40	3435	25.40	10106	74.60		
Other Addiction								
Yes	258	1.30	65	25.20	193	74.80	0.1	
No	19848	98.70	4833	24.40	15015	75.60		
Psychedelics								
Yes	429	2.10	114	26.60	315	73.40	1.17	
No	19677	9790.00	4784	24.30	14893	75.70		
Tobacco								
Yes	7501	37.30	1922	25.60	5579	74.40	10.35***	0.02
No	12605	62.70	2976	23.60	9629	76.40		
Tranquillizer								

[14] Missing 109 cases

Variable	Entire Sample (20215)		Detox+Treatment (4915, 24.3%)		Detox alone (15300, 75.7%)		Chi-Square	Effect Size
	n	%	n	%	n	%		
Yes	787	3.90	177	22.50	610	77.50	1.56	
No	19319	9610.00	4721	24.40	14598	75.60		
Educational level								
Less than Highschool	926	4.60	183	19.70	744	80.30	28.82***	0.04
Post Secondary	4815	23.80	1290	26.80	3525	73.20		
High School	14473	71.60	3442	23.80	11031	76.20		
Employment								
Employed	6923	34.30	1940	28.00	4983	72.00	175.05***	0.09
Unemployed	12921	63.90	2812	21.80	10109	78.20		
Unstable employment	371	1.80	163	43.90	208	56.10		
Sex								
Female	7214	35.70	1717	23.80	5497	76.20	1.60	
Male	13001	64.30	3198	24.60	9803	75.40		
Marital status								
Divorce, Separated, and Widowed	3018	14.90	774	25.60	2244	74.40	54.19***	0.05
Married	4773	23.60	1217	25.50	3556	74.50		
Single	12140	60.10	2810	23.10	9330	76.90		
Unstable marriage	284	1.40	114	40.10	170	59.90		
Readmission status								
Readmission	7489	37.10	2721	36.30	4768	63.70	933.95***	0.22
Not readmitted	12726	62.90	2194	17.20	10532	82.80		
COVID 19[15]								
Before COVID-19	5143	48.00	1348	26.20	3795	73.80	308.44***	0.17
Within COVID	4088	38.20	866	21.20	3222	78.80		
Both	1475	13.80	660	44.70	815	55.30		
Admission year								
2015-2018	10366	51.30	2336	22.50	8030	77.50	675.99***	0.18
2019-2022	7156	36.00	1394	19.50	5762	80.50		
Both	2693	13.30	1185	44.00	1508	56.00		
Facilities								
Facility 5	7971	39.40	2069	26.00	5902	74.00	553.46***	0.17
Facility 3	290	1.43	44	15.20	246	84.80		
Facility 1	679	3.36	171	25.20	508	74.80		
Facility 4	2944	14.60	891	30.30	2053	69.70		
Facility 2	7294	36.10	1259	17.30	603 5	82.70		
Multiple Facilities (>=2)	1037	5.10	481	46.40	556	53.60		
Days of Discharge								
Saturday and Sunday	3439	17.00	710	20.60	2729	79.40	47.13***	0.05
Monday to Friday	15398	76.20	3797	24.70	11601	75.40		
Mix of Both	1378	6.80	408	29.60	970	70.40		
Residence								
Urban	17030	84.20	3974	23.30	13056	76.70	57.34***	0.05
Rural	2820	13.90	825	29.30	1995	70.70		
Migration between Urban and Rural	365	1.80	116	31.80	249	68.20		

[15] The province of Alberta had a COVID-19 emergency declared between March 17, 2020 and December 14, 2021. The total number of days was 637 days. This is compared with the same number of days (from June 19, 2018, to March 16, 2020) before the COVID-19 emergency was declared.

Variable	Entire Sample (20215)		Detox+Treatment (4915, 24.3%)		Detox alone (15300, 75.7%)		Chi-Square	Effect Size
	n	%	n	%	n	%		
Single Vs Multiple substance use disorder and behavioural addiction Count								
Single	5707	28.40	1164	20.40	4543	79.60	67.99***	-0.07
Polysubstance use disorder and behavioural addiction	14399	71.60	3734	25.90	10665	74.10		
Completion								
Completion	11170	55.80	3078	27.60	8092	72.40	1095.99***	0.23
Non-Completion	5106	25.50	418	8.20	4688	91.80		
Both completion and Non-completion	3744	18.70	1373	36.70	2371	63.30		
Alcohol Vs Opiates								
Alcohol	11089	55.20	2862	25.80	8227	74.20	62.099***	0.056
Opiates	3925	19.50	777	19.80	3148	80.20		
Alcohol and Opiates	2640	13.10	686	26.00	1954	74.00		
Neither alcohol nor Opiates	2452	12.20	573	23.40	1879	76.60		
Age								
Mean (SD)			37.92 (11.5)		37.62 (12.0)		-2.449*	0.47
LOS								
Mean (SD)			5.4 (3.4)		4.3 (3.1)		-21.34	

Chapter Four: Predictors of Frequent Residential Detoxification Utilizers in Alberta *

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Abstract

Objectives: We aimed to estimate the rate of and identify predictors of frequent utilization of residential withdrawal management services in Alberta, Canada.

Method: We analyzed clients' data (N = 20,215) with 40,149 admissions to five provincially funded residential detoxification services between April 1, 2015, and March 31, 2022. Employing binary logistic regression, we compared socio-demographics, primary substance use disorder and behavioural addiction, and various program variables for clients with more frequent (four times or more) detoxification service utilization and those with three or fewer readmissions.

Results: Twelve percent (n = 2,401) of clients were more frequent utilizers, accounting for 40% of the total admissions. Regression analysis indicated that clients had higher odds of more frequent detoxification service utilization if they used multiple substance use disorders and behavioural addictions, used primarily androgens and barbiturates, lived in urban areas or moved between urban and rural areas, had cycled between completion and non-completion of detoxification treatment, and had transitioned to residential treatment following discharge from

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detoxification. Other variables related to higher odds of more frequent detoxification utilization included clients who had unstable marriages and jobs, who were older, and who stayed longer in detoxification facilities.

Conclusion: The results indicate that there are discriminating variables that predict the frequency of admission to detoxification facilities, including substance use disorder and behavioural addiction type, age, gender, place of residence, employment, marital status, detoxification completion, and transition to residential services. Although readmission to treatment is a common phenomenon, developing targeted interventions to promote success, improve treatment outcomes and optimize the use of public healthcare resources is prudent and timely.

Keywords: Detoxification, readmission, frequency of use, characteristics, Withdrawal management, Alberta, Canada

Introduction

Detoxification, with the primary goal of safe withdrawal from alcohol and drugs and reduction of the associated risks, is often a necessary first step along a continuum of care to recovery for many individuals (Amodeo et al., 2008; Kenne et al., 2010; Li et al., 2008; Running Bear et al., 2022). However, a significant number of individuals do not receive continued treatment after detoxification, which increases the likelihood of readmission to detoxification (Carrier et al., 2011; Li et al., 2008; Mark et al., 2006; McLellan et al., 2005; Spear, 2014; Van den Berg et al., 2015). This phenomenon is referred to as the detoxification "revolving door" (Mark et al., 2006, p. 439), multiple detoxifications (McLellan et al., 2005), or detoxification loop (Richman & Neumann, 1984).

Readmission poses a significant challenge to the healthcare system by putting pressure on the limited treatment capacity and resources (Chang et al., 2016; Kenne et al., 2010; Running Bear et al., 2022). It leads to significant system inefficiency as a small group of clients occupy the limited detoxification beds, thus reducing system access (McLellan et al., 2005; Running Bear et al., 2022). Detoxification is one of the most expensive-per-day forms of treatment (Haley et al., 2011), with an average cost ranging from $3,625 to $7,250 in Canada (Medical Detox Ontario, 2021) and a mean index admission cost of $1,779 in the USA (Quinn et al., 2017). This cost increases with the number of admissions (Quinne et al., 2017). The high cost of detoxification services, coupled with the health risks associated with rapid relapse, makes readmission to treatment a crucial indicator of inefficiencies in the substance use disorder and behavioural addiction treatment system (Carrier et al., 2011; Spear, 2014).

For many clients, detoxification immediately followed by treatment reduces the likelihood of one or more readmissions to detoxification (Carrier et al., 2011; McCarty et al., 2000) and prevents or delays subsequent readmission (Carrier et al., 2011; Daley et al., 2010; McLellan et al., 2005; Running Bear et al., 2022). However, for many clients who experience repeated withdrawal or relapse, detoxification-only services may become a frequent option (McLellan et al., 2005; Richman & Neumann, 1984). While repeated admission to detoxification services can reduce some personal harm for clients (Chutuape et al., 2001), their repeated use following relapse has been associated with cognitive impairment, particularly impairment of attention and executive function, leading to a longer recovery time (Duka & Stephens, 2014; Loeber et al., 2010).

There is no consensus regarding the measurement of readmission rates in the literature, mainly due to differences in several variables, including outcome definition, study populations,

treatment programs, and follow-up times (Chang et al., 2016; Van den Berg et al., 2015), which makes it difficult to compare the rates between studies. Moreover, there are no detoxification service guidelines or standards of practice in evaluating readmission at the national level or in Alberta, Canada, where our study was conducted (Meister et al., 2019). Previous research has shown readmission rates ranging from two or more admissions (Li et al., 2007; Running Bear et al., 2014; Spear, 2014; Van de Berg et al., 2015; Yedlapati & Stewart, 2018) to three or more admissions (McLellan et al., 2005), four or more admissions (Chang et al., 2016; Tomasson & Vaglum, 1998), and more in varied study periods.

There is no federal or provincial threshold for defining readmission, so our classification is based on various factors. Our classification is consistent with that of Tomasson and Vagum (1998), who defined a "revolving door career" (p.129) as four or more admissions and found that the development of such a career was rare in cases with fewer than four admissions. This classification was later adapted by Chang et al. (2016). Our data's distribution of admissions, which is skewed (as shown in Figure 1), further supports the use of this classification. Using Tomasson and Vagum's classification can also provide insight into the system's efficiency level in accommodating the most frequent detoxification clients. Given that addiction is a chronic disease and readmissions due to relapse are common, it is not as valuable to study every readmission; instead, exploring the most frequently admitted clients provides input for improving practices. According to Dennis et al. (2005), the median time from the first treatment episode to the last use is nine years, or 27 years from the first to the last use before recovery.

Addiction is a chronic illness that often requires multiple treatment or detoxification episodes to achieve long-term recovery (AHS, 2018; Lee et al., 2014; McKeganey et al., 2004; Van den Berg et al., 2015). An analysis of the frequency of utilization rates and predictors can

help inform services that target the specific needs of these individuals. Clients with more frequent admissions to detoxification services represent a small proportion of detoxification clients but account for a disproportionately higher rate of admissions (Chang et al., 2016; Li et al., 2007). For instance, Chang et al. (2016) found that 6% of clients admitted four or more times accounted for 23% of all detoxification facility admissions. Similarly, Li et al. (2007) showed that clients with multiple (more than one) admissions constituted 24% of all detoxification clients but accounted for 44% of all detoxification admissions.

Regardless of the conceptualization of readmission, our literature review demonstrated that clients who used multiple substance use disorders and behavioural addiction tended to have more readmissions (Callaghan & Cunningham, 2002; Tomasson & Vaglum, 1998), mainly if they used alcohol rather than opiates (Running Bear et al., 2022). Clients experiencing unstable housing (Callaghan, 2003; Running Bear et al., 2014; Silins et al., 2008), were unemployed (Callaghan & Cunningham, 2002; Running Bear et al., 2014), were single or unmarried (Callaghan & Cunningham, 2002), had a longer average length of stay (LOS) (Chang et al., 2016), and were urban residents (Carrier et al., 2011) had a higher risk of readmission. Clients who did not complete detoxification had higher readmission rates (Callaghan & Cunningham, 2002; Yedlapati & Stewart, 2018). Moreover, Mark et al. (2006) found that clients with repeated admissions to detoxification services were less likely to transition to treatment after detoxification. Conversely, Amodeo et al. (2008) found that clients with repeated admissions had a higher transition rate to treatment following detoxification.

There has been limited research on readmissions to detoxification in Canada, and no prior studies have been conducted in Alberta. The only two studies on readmission to detoxification in Canada were published over 15 years ago, and both were conducted in British Columbia

(Callaghan, 2003; Li et al., 2008). The lack of knowledge regarding client characteristics and program effectiveness makes it challenging for decision-makers to develop appropriate interventions to improve treatment outcomes (Li et al., 2007) and to establish service guidelines and standards of practice (Meister et al., 2019). Most studies have been conducted in a small proportion of single centres with diverse healthcare infrastructures and treatment policies (Gosh et al., 2022). Furthermore, these studies were not up-to-date or did not reflect the current realities in Alberta.

Our study aimed to distinguish clients with higher and lower frequency of admission to detoxification services in Alberta, Canada, among adult clients at government-owned and -funded detoxification facilities, using comprehensive Government of Alberta administrative data from 2015 to 2022. We aimed to determine the rates and identify predictors of high- and low-frequency utilization of publicly funded detoxification programs across Alberta from 2015 to 2022. The University of Alberta Research Ethics Board (REB) approved the study (protocol number: Pro00108773).

Methods

Study Setting and Design

This study retrospectively analyzed administrative data from the Addiction System for Information and Service Tracking (ASIST) database collected by Alberta Health Services (AHS) between the fiscal years (FY) 2015 and 2022. ASIST collects information on substance use disorder and behavioural addiction, demographics, detoxification admission and discharge dates, and the transition to residential services from five Alberta detoxification facilities. We restructured the dataset from the long format that includes data on each admission (n = 40,149)

into the wide format where each client's information is captured in one unique record (n = 20,215 clients).

Treatment Setting

Five residential detoxification facilities with a combined 116 beds are managed by healthcare professionals offering round-the-clock services (AHS, 2022a). Clients can undergo screening for admission to these facilities through phone calls or face-to-face meetings. Healthcare providers collect intake information for admission once they determine that detoxification is appropriate. If the intake personnel determine that detoxification is inappropriate, the client is provided with the most appropriate alternative treatment settings. Within 24 hours of admission to detoxification, healthcare staff create an individualized daily treatment plan in consultation with the client. A post-discharge plan also includes a discussion of follow-up plans and treatment recommendations. Based on the assessment, clients may also be prescribed opioid-agonist therapy and/or medication for alcohol or nicotine use (AHS, 2022a).

Study Population Characteristics

This study included the data of clients between 18 and 91 years of age, with a median age of 35.3 and a mean age of 37.7 years. Eleven mature minors (17 years old) were also included in the study, although these data could be typographical or data entry errors. Most clients were male (64.3%), single (60.1%), and unemployed (63.9%). The majority (71.6%) of admitted clients had used multiple (more than one) substance use disorder and behavioural addictions. Alcohol (27.3%), tobacco (14.9%), crystal meth (14.0%), and opiates (13.0%) were the most prevalent substance use disorders leading to detoxification admissions, considering all substance use disorders and behavioural addictions. Most clients (75.7%) utilized detoxification as a standalone service, while the remaining 24.3% transitioned to residential treatment following discharge from

detoxification. Most clients (88%) were admitted to detoxification between 1 and 3 times; the remaining 12% were admitted four or more times.

Measures

Outcome Variable. The dependent variable was the frequency of residential detoxification treatment (≤3 times vs. ≥ 4 times).

Independent Variables. The independent variables included demographic characteristics (education, marital status, age, gender, employment, and place of residence), healthcare use variables (completion status, LOS, transition to treatment, facilities used, and years of admission), and substance use disorder and behavioural addiction (primary substance use disorder and behavioural addictions of their choice and their count of substance use disorder and behavioural addiction). Table 7 provides details for these variables.

Statistical Methods

We performed bivariate statistics to characterize all clients. The chi-square test was used for categorical variables, and the Mann-Whitney U test was used for non-normally distributed continuous variables. We also calculated the effect size. We compared the outcomes of the high and low admissions groups. As the outcome variable was dichotomous (less vs. more frequent utilization), we performed a multivariate analysis using a binary logistic regression model. We calculated the odds ratios, 95% confidence intervals and *p*-values to identify the discriminating variables between the two categories, taking the less frequent user group as the reference category. We conducted all analyses using SPSS version 29. There was no evidence of multicollinearity as all variance inflation factor values were <5.

Missing Data Management

Our dataset had some missing independent variables, for which we used multiple imputations (MI) to obtain a complete dataset with more accurate estimates (Enders, 2013). MI is a suitable method for any missing pattern (Enders, 2010), and it outperforms other techniques, such as complete case analysis, single imputation case techniques, and pairwise deletion (Enders, 2013; Liu & De, 2016). Our dataset had missing values with uncertain causes, which made MI a reasonable choice (Enders, 2013). We used a fully conditional specification MI method, which is reliable and suitable for imputing large datasets containing categorical and continuous variables (Lee & Carlin, 2010; Liu & De, 2016). We only imputed independent variables related to education, employment, gender, marital status, urban/rural, and primary substance use disorder and behavioural addiction of concern. Several variables, including education, employment, gender, marital status, age, date of admission, date of discharge, facility zone, facility name, and service end reason, were used to predict imputed data. The final datasets were created using the logistic regression procedure in SPSS and the mode for categorical variables from the five MI datasets. The proportion of imputed values remained consistent with the original values.

Results

Our study involved 20,215 unique clients admitted 40,149 times to five residential detoxification facilities in Alberta. These five facilities had bed counts of 6, 8, 20, 40, and 42 beds. The mean number of admissions per client was 2, ranging from 1 to 64. Of all the clients, 62.9% were admitted only once. The remaining 37.1% accounted for 68% of all admissions (27,427).

To reduce the impact of extreme outliers, we reclassified readmission into admission frequencies. As a result, 17,814 (88%) were admitted 1-3 times, which we classified as a low

frequent utilization rate, while 2,401 (12%) were admitted more than three times, which we classified as a high frequent utilization rate, in keeping with Tomasson and Vagum's (1998) classification. Clients with a high frequent utilization rate (admitted four or more than four times) accounted for about 40% (n = 15,708) of the total admissions. The average number of admissions among clients with a low-frequency utilization rate was 1.4 (range: 1-3), with 17,814 clients admitted 24,441 times. On the other hand, the more frequent utilization group had a mean of 6.5 admissions (range: 4-64) per client (Figure 1). We conducted a more detailed analysis of the 12% of frequent utilizers and found that 1.6% of clients (314 individuals) had an average of 14 admissions, or 11.3% of all admissions (4524 total). In addition, 30 clients (with 934 admissions) had an average admission rate of 31 times per client.

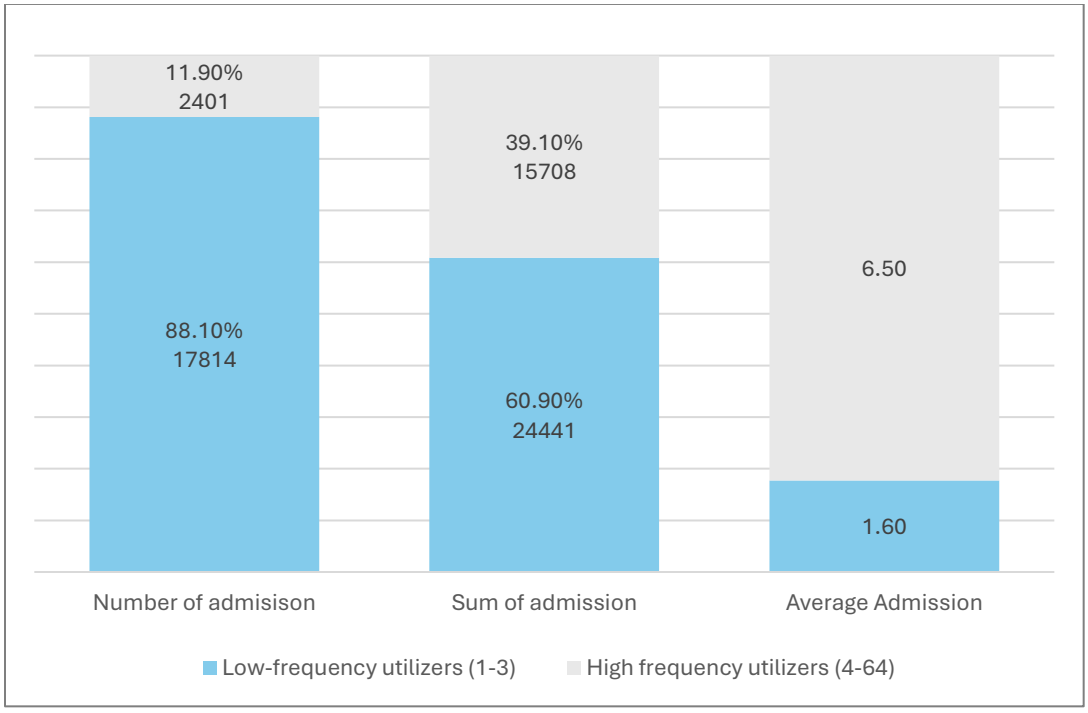

Figure 1: Distribution of Frequency of Admission (Low vs High).

Bivariate Analysis

Our bivariate analysis of chi-square and Mann-Whitney U tests (all statistically significant) demonstrated that there were more frequent detoxification utilizers among males

(12.4%) more so than females (10.9%); those with unstable employment (defined as moving between employed and unemployed status within the study period; 35.3%) than those who were employed (10.9%); and those who migrated between urban and rural areas (52.9%) than those from rural areas (5.9%). Married clients had a lower frequency of detoxification service use (9.6%) than single clients (12.2%), clients in unstable marriages (i.e., who changed their marital status within the study period) (38.4%), and clients who were divorced, separated and widowed (11.8%). In addition, more frequent detoxification use was demonstrated by clients whose primary substance use disorder included androgens (34%), barbiturates (30%), alcohol (13%), and crystal meth (12.5%), compared to clients who did not use these substances. Moreover, clients demonstrating the most frequent utilization of detoxification were those who used multiple (15.5%) rather than single (3.0%) substances.

We further compared the frequency of detoxification use between clients admitted for alcohol versus opiate use and found that clients who used opiates had a significantly lower frequency of detoxification utilization (11.5%, n = 453) than clients who used alcohol (13.1%, n = 1,450) ($p < 0.001$). The Mann-Whitney *U* test results showed that the more frequent service utilizers were slightly older (M = 37.93, SD = 11) than the less frequent service utilizers (M = 37.66, SD = 12). Moreover, a higher percentage of clients who utilized detoxification services more frequently were those who demonstrated a mix of completion and non-completion of detoxification services during the study period (47%) than those who completed (5%) or did not complete (2%) such services. Moreover, more frequent utilization of detoxification clients transitioned to residential treatment (34%) than those who did not transit to residential treatment (8%) after discharge from detox.

We compared the frequency of detoxification admission between clients admitted before and during the COVID-19 emergency declaration (between March 17, 2020 and December 17, 2021)[20]. The results showed that significantly more clients frequently utilized detoxification before the COVID-19 emergency was declared (14%, n = 715) than during the emergency (8%, n = 328) at $p < 0.001$. Table 7 shows a description of bivariate results.

Multivariate Analysis

The variables remaining in the final binary logistic model are presented in Table 5. Our model accurately predicted membership of the least and most frequent detoxification service group 96.9% and 52.7% of the time, respectively, with an overall predictive accuracy of 91.6%. The model explained 54.7% of the variance in the frequency of admission based on Nagelkerke R^2.

Substance Use Disorder and Behavioural Addiction

Clients who primarily used androgens (odds ratio [OR] = 3.12, $p < 0.001$) or barbiturates (OR = 2.22, $p < 0.001$) had significantly higher odds of more frequently utilizing detoxification services compared to those who did not use these substances. Conversely, clients had significantly lower odds of more frequent detoxification service utilization if their primary substance use disorder and behavioural addiction were amphetamine (OR = 0.58, $p < 0.001$), cocaine (OR = 0.55, $p < 0.001$), crystal meth (OR = 0.74, $p < 0.01$), inhalants (OR = 0.43, $p < 0.05$), marijuana (OR = 0.59, $p < 0.001$), opiates (OR = 0.80, $p < 0.01$), tobacco (OR = 0.63, $p < 0.001$), or tranquillizers (OR = 0.56, $p < 0.01$), as well as problem gambling (OR = 0.59, $p < 0.001$) compared to those who did not have those substance use disorders and behavioural

[20] The province of Alberta had a COVID-19 emergency declared between March 17, 2020 and December 14, 2021. The total number of days was 637 days. This is compared with the same number of days (from June 19, 2018, to March 16, 2020) before the COVID-19 emergency was declared.

addiction; and users of single rather than polysubstance use disorder and behavioural addiction (OR = 0.21, $p < 0.001$).

Table 5. *Factors Associated with the Frequency of Detoxification Service Utilization*

Variable	Exp(B)	95% C.I for EXP(B) Lower	Upper	Variable	Exp(B)	95% C.I for EXP(B) Lower	Upper
Average LOS	1.03**	1.01	1.06	Place of residence			
Age	1.01*	1.00	1.01	Rural [R]			
Primary substance use disorder and behavioural addiction				Urban	1.86***	1.50	2.31
Androgen (No[R])	3.12***	2.06	4.72	Migration between Urban-rural	5.54***	3.91	7.83
Barbiturates (No[R])	2.22***	1.83	2.7	Mono vs. multiple substance use disorder and behavioural addiction			
Inhalant (No[R])	0.43*	0.22	0.84	Poly-substance use disorder and behavioural addiction [R]			
Cocaine (No[R])	0.55***	0.47	0.68	Mono substance use disorder and behavioural addiction	0.21***	0.18	0.26
Tranquilizer (No[R])	0.56**	0.39	0.79	Admission Year			
Amphetamine(No[R])	0.58***	0.42	0.8	2019-2022[R]			
Marijuana (No[R])	0.59***	0.48	0.73	2015-2018	1.25**	1.06	1.47
Gambling (No[R])	0.59***	0.48	0.73	Both	6.74	5.74	7.92
Tobacco (No[R])	0.63***	0.56	0.72	Completion			
Crystal meth (No[R])	0.74***	0.64	0.85	Completion [R]			
Opiates (No[R])	0.80**	0.69	0.92	Non-completion	0.73*	0.57	0.93
Antidepressant (No[R])	0.62	0.36	1.05	Cycle between completion and non-completion	9.27***	8.10	10.60
Other addiction (No[R])	0.55	0.3	1.03	Employment			
Psychedelics (No[R])	0.92	0.52	1.61	Unemployed[R]			
Alcohol (No[R])	1.05	0.9	1.22	Employed	1.04	0.91	1.19
Educational levels				Unstable employment	1.60**	1.17	2.19
High School [R]				Marital status			
Less than high school	1.00	0.75	1.34	Single (unmarried)[R]			

Variable	Exp(B)	95% C.I for EXP(B) Lower	Upper	Variable	Exp(B)	95% C.I for EXP(B) Lower	Upper
Post Secondary	1.09	0.94	1.26	Divorced, Separated and Widowed	0.94	0.78	1.13
Facilities Utilized				Married	0.89	0.76	1.05
Facility 5[R]				Unstable Marriage	1.59*	1.10	2.28
Facility 1	1.98*	1.05	3.76	Gender			
Facility 2	0.35***	0.21	0.57	Male[R]			
Facility 3	0.87	0.71	1.07	Female	0.79***	0.70	0.90
Facility 4	0.69***	0.60	0.80	Transition to Treatment			
Combination of two or more	1.70***	1.40	2.05	Transition to residential treatment[R]			
***$P < 0.001$, **$p < 0.01$,* $p < 0.05$				Did not Transition to Treatment (Detox Alone)	0.40***	0.35	0.45
R- reference category							

Individual Variables

Female clients had lower odds of utilizing detox services more frequently (OR = 0.79, $p < 0.001$) than male clients. As the mean age of the clients increased, the odds of more frequent utilization of detoxification also increased (OR = 1.01, $p < 0.05$). Clients who had unstable jobs (i.e. a change in employment status during stay) (OR = 1.60, $p < 0.01$) and unstable marriages (i.e. a change in relationship status during stay) (OR = 1.59, $p < 0.05$) had higher odds of more frequent detoxification utilization than the unemployed and single (unmarried) clients. Clients who resided in urban areas (OR = 1.86, $p < 0.001$) or who moved between rural and urban areas (OR = 5.54, $p < 0.001$) were more likely to more frequently attend detoxification services than those who were residents of rural areas. Educational level was not significantly associated with the frequency of detoxification utilization.

Program and Institutional Variables

Clients who did not transition to residential treatment (OR = 0.40, $p < 0.001$) had lower odds of more frequent detoxification utilization than those who used detoxification as a

standalone service. Moreover, clients who cycled between completion and non-completion of detoxification had higher odds of frequent detoxification service utilization (OR = 9.27, $p < 0.001$) than those who completed their LOS. In contrast, clients who had not completed detoxification had lower odds of more frequent detoxification service utilization (OR = 0.73, $p < 0.05$) than those who completed detoxification. The clients discharged between FY2015 and 2018 (OR = 1.25, $p < 0.01$) were more likely to demonstrate utilization of more frequent detoxification services than those discharged between FY2019 and 2022. Moreover, clients admitted to detoxification Facility 1 (OR = 1.98, $p < 0.05$) and those who used two or more facilities (OR = 1.69, $p < 0.001$) had higher odds of more frequent utilization. Conversely, clients admitted into detoxification Facility 2 (OR = 0.35, $p < 0.001$) and Facility 4 (OR = 0.69, $p < 0.001$) had lower odds of more frequent utilization. A higher average LOS was associated with increased odds of frequent use of detoxification services (OR = 1.03, $p < 0.01$).

Discussion

Our study aimed to investigate the frequency of use and identify predictors of frequent service usage for five detoxification services across Alberta, Canada. Overall, 20,215 clients used detoxification facilities, with the number of admissions ranging from 1 to 64. We found that 88% (17,814) of clients were admitted between 1 and 3 times (defined as less frequent utilizers), while 12% (2,401) were admitted four or more times (defined as more frequent utilizers). However, 12% of the clients who were more frequent detoxification service utilizers (i.e. ≥ 4 admissions) accounted for about 40% of the total admissions. This phenomenon has previously been described as a "revolving door" in which a minority of clients repeatedly utilize detoxification services (Callaghan, 2003; Mark et al., 2006). This repeated usage puts considerable pressure on treatment services, particularly regarding resources and budgetary

realities (Chang et al., 2016; Kenne et al., 2010; Running Bear et al., 2022). Repeated usage is also associated with an increased risk of relapse, such as an overdose of opiates (Walley et al., 2020).

The 12% of clients who frequently utilized detoxification services was much higher than the previously reported 6% (Chang et al., 2016). Three studies reported a higher rate than ours, although there is a variation in the definition of frequency of admission and length of study. In two of these studies, the rate of clients being admitted three or more times within six months ranges from 14% (Carrier et al., 2011) to 15% within one year (McLellan et al., 2005). Yedlapati and Stewart (2018) reported that 20% of clients had two or more admissions within 30 days. In our study, we found that a small proportion of clients were disproportionately responsible for a high number of admissions to detoxification facilities. Upon conducting a more detailed analysis of the 12% of frequent users, it was found that 1.6% of clients (314 individuals) had an average of 14 or 11.3% of all admissions (4524 total) (Table 6). Our 37% readmission rate of clients with more than one admission, however, was around the median in comparison to eleven previous studies (Callaghan, 2003; Callaghan & Cunningham, 2002; Ghosh et al., 2022; Grzebinski et al., 2021; Li et al., 2007; Li et al., 2008; Mark et al., 2006; Running Bear et al., 2014; Spear, 2014; Van den Berg et al., 2015; Yedlapati & Stewart, 2018).

Table 6*. Comparison of the Number of Clients and Admission*

	Count of admission (N=40,149)					
Clients (n)	Min	Max	Mean	Total count of admission	Overall admission %	% of clients admitted (N=20,215)
314	10	64	14	4524	11.3	1.6
236	11	64	16	3744	9.3	1.7
30	21	64	31	934	2.3	0.15
10	31	64	44	439	1.1	0.05

Our analysis suggests that a small number of clients utilizing detoxification services disproportionately occupy limited detoxification beds multiple times, leading to inefficient use of resources and decreased access to treatment for other clients (McLellan et al., 2005) and representing considerable resource usage and, arguably, unsustainable associated system costs. A more significant question, however, is how these clients can be better supported to foster a trajectory more in line with their goals. Although limiting the number of detoxification admissions is impractical, either limiting the number of days between detoxification episodes, as in California (Stephenson, 2008 cited in Nosyk et al., 2014) or involving the most frequent service utilizers in additional interventions may be considered an option to decrease the cost of frequent admissions and allow more clients to use the limited admission space.

Primary Substance Use Disorder and Behavioural Addiction and Place of Residence

Primary substance abuse and gambling problems were significant predictors of the frequency of detoxification service utilizations. Clients who used androgens or barbiturates had higher odds of more frequent utilization of detoxification services. Conversely, clients were less likely to utilize detoxification services more frequently if they were struggling with gambling or with the use of amphetamines, cocaine, crystal meth, inhalants, marijuana, tobacco, opiates, or tranquillizers.

We also compared clients struggling with opiate and alcohol use because both substance use disorder and behavioural addictions have withdrawal management protocols at the study facilities (AHS, 2022b; 2023). We found that more clients were struggling with alcohol use than opiate use among the most frequent detoxification service utilizers, consistent with the results of previous studies (Chang et al.,2016; Running Bear et al., 2022). Life-threatening alcohol withdrawal (Day and Daly, 2021) may be one reason for the more frequent detoxification service

utilization compared to opiates. The higher rate of opiate users' non-completion in detoxification in our previous study (Mekonnen et al., n.d), coupled with opioid users' less frequent detoxification admissions, may be linked to the growing overdose rate in Alberta (Public Health Agency, 2023; Scace, 2023). We also found that clients who used multiple substance use disorder and behavioural addiction were more likely to be more frequent utilizers of detoxification services than those who used single substance use disorder and behavioural addiction, which is consistent with the results of a similar study conducted in Canada by Callaghan and Cunningham (2002).

During the research period, clients living in urban areas or who moved between urban and rural areas tended to utilize detoxification services more frequently than those living in rural areas. Rural residents may have more stable employment, higher employment rates, and a higher proportion of married clients, which can contribute to positive outcomes. As a result, rural clients may have a lower frequency of readmission, which is consistent with the results of another study (Ghosh et al., 2022). However, equally importantly, rural residents may be discouraged from utilizing detoxification services more frequently because they have limited availability or detox services may be located further away from rural residents.

Transition to Residential Treatment and Completion

We found that clients who utilized detoxification services more frequently were more likely to transition to residential treatment services following discharge from detoxification. Although from a system perspective, more frequent utilization of detoxification is an undesirable outcome, it may become a gateway to a better treatment outcome when transitioning to residential treatment (Lee et al., 2014). Moreover, repeat admissions demonstrate the chronic nature of addiction in which clients experience multiple admissions due to the frequency of

relapses during the recovery process. The outcome of our study aligns with the results of studies conducted by Amodeo et al. (2008) and Carrier et al. (2011). However, our findings contradict the results of a study by Mark et al. (2006), suggesting a lower probability of readmission among clients who transitioned to treatment(s). Our analysis showed that clients who cycled between detoxification completion and non-completion had higher odds of more frequently utilizing detoxification services. Clients who did not complete detoxification were less likely to be more frequent utilizers of detoxification services, which aligns with the results of previous research (Yedlapati & Stewart, 2018). In other words, clients who did not complete detoxification may be discouraged from using detoxification services again. Furthermore, our results indicate that more frequent utilization of detoxification services had a longer average LOS, consistent with the results of a study by Chang et al. (2016).

Our study demonstrated that not all frequent admissions are undesirable because clients who are more frequently admitted to detoxification have better chances of transitioning to treatment, which is one of the main goals of detoxification. Thus, more frequent admissions can have a positive outcome and may lead to a path to recovery, as Richman and Smart (1981) suggested. This view is consistent with the understanding that addiction is a chronic disease. Redesigning the delivery of detoxification services to reduce the frequency of admissions and facilitate detox-to-treatment transitions could minimize the costs of treatment and improve recovery outcomes for clients.

Socio-Demographic Variables

Our study results showed that females had lower odds of more frequent utilization of detoxification services, consistent with the results of earlier studies (Mark et al., 2006; Running Bear et al., 2022). This might be due to the higher percentage of female clients enrolled in post-

secondary education (25% vs. 23%) ($X^2_{[2]}$ (n = 20215 = 26.4, p<0.001). It might also relate to the lower rates of detoxification utilization among females (Gilbert et al., 2019), which may contribute to their lower rates of returning to detoxification facilities after relapse. Moreover, older clients had higher detoxification service utilization, consistent with previous studies (Callaghan & Cunningham, 2002; Mark et al., 2006). However, the odds ratio is close to one, and the bivariate difference was about three months, so this difference may not be practically significant. Our regression analysis demonstrated that clients with unstable marriages also had higher odds of being frequent utilizers of detoxification services. On the other hand, the bivariate analysis showed that married clients (9.6%) had the lowest rates of repeated admissions to detoxification facilities than the other marital status categories, consistent with the results of another study (Running Bear et al., 2022), suggesting that family involvement can reduce the risk of readmission. Additionally, we found that clients with unstable employment were more likely to utilize detoxification services more frequently than those with stable employment. This finding is unique and has not been documented in previous studies.

Time Period and Facilities Utilized

Our analysis showed that clients admitted for detoxification between 2015 and 2018 were more likely to utilize detoxification services more frequently than those admitted between 2019 and 2022. This finding is consistent with the results of our analysis that clients admitted before the COVID-19 pandemic had a higher frequency of utilization than those admitted during the pandemic. This difference could be due to the challenges posed by the pandemic, which made it more difficult for clients to be more frequently admitted because of the service disruptions and service provider fatigue during the pandemic (Kim et al., 2020; Mellis et al., 2021; Russel et al.,

2021). This difference could also be due to the longer follow-up period for first admitted clients between 2015 and 2018.

Our analysis revealed variations in the frequency of admissions to detoxification facilities. Clients who were admitted to detoxification Facility 1 and those who accessed multiple facilities were found to have high rates of utilization of detoxification services. On the other hand, detoxification Facility 2 and Facility 4 had lower odds of more frequent detoxification service utilizers. This difference might be due to clients' admission to multiple facilities, likely increasing the number of readmissions; however, further quasi-experimental or experimental studies are needed.

Strengths and Limitations

This study has several strengths, making it a significant contribution to the field. It is the first of its kind in Canada and can serve as a basis for future research. The study has identified a small group of detoxification clients who utilized limited beds multiple times and investigated the characteristics of these clients. The inclusion of multiple substance use disorders and behavioural addiction, findings on unstable marriage and employment, variations in frequency of utilization between facilities, and the impact of the COVID-19 pandemic are among the findings that add to the existing literature. The large sample size and multicentre data from routine patient care provided more reliable results than self-reported data (Evans et al., 2010; Van den Berg et al., 2015). Some limitations are that the study did not include those who accessed detoxification services outside AHS and clients who left on the same day they were admitted. The data for the study pertained only to clients who availed of provincial health services; no data pertaining to clients who availed of detoxification services in the community or privately run facilities were included. The transition to residential treatment was also limited to AHS residential treatments.

Therefore, the findings do not represent all the detoxification facilities in the province. Additional qualitative research exploring the perspectives of clients and service providers will also be beneficial in developing effective interventions and understanding the issue in-depth. It is also vital to interpret the results of our study with caution due to the high risk of type I errors caused by examining a large number of independent variables.

Conclusion

In this study, we analyzed the rates and correlates of clients admitted more frequently to residential detoxification facilities in Alberta. A small proportion of clients utilized detoxification services disproportionately compared to the others. Although more frequent admission is an undesirable outcome, our results show that more frequent utilizers of detoxification services have higher odds of transitioning to addiction treatment, which is one of the goals of detoxification. As a chronic disease, resolving addiction may require multiple admissions on the road to recovery. However, targeting the clients with frequently repeated admissions, with collaborative care planning, may help foster client success while lowering the number of readmissions so that the system can better serve clients wishing to detox as a first step in their journey. Future studies should include the perspectives of clients who have undergone detoxification and who experience multiple readmissions, as well as frontline and management personnel of detoxification facilities, to gain a more comprehensive understanding of program outcomes and client trajectories.

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Declarations

Ethical Approval

- This study was approved by the University of Alberta Research Ethics Board (REB) protocol No Pro00108773.

Competing interests

- The authors declare no competing interests.

Authors' contributions

- AM wrote the first draft of the manuscript, which all authors critically revised. All authors read and approved the final manuscript.

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Availability of data and materials

- The datasets generated and analyzed can not be shared due to the restrictions of the dataset owner.

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Table 7*. Description of Bivariate results – Lower Frequency Versus Higher Frequency Utilizers*

Variable	Entire sample		Lower Frequency		High Frequency		Chi-Square	Effect Size
	n	%	n	%	n	%		
Substance use disorder and behavioural addiction[21]								
Alcohol								
Yes	13729	68.30	11943	87.00	1786	13.00	46.89***	-0.06
No	6377	31.70	5762	90.40	615	9.60		
Androgen								
Yes	359	1.80	238	66.30	121	33.70	164.63***	0.09
No	19747	98.20	17467	88.50	2280	11.50		
Amphetamine								
Yes	1106	5.50	1029	93.00	77	7.00	27.60***	0.04
No	19000	94.50	16676	87.80	2324	12.20		
Antidepressant								
Yes	589	2.90	567	96.30	22	3.70	38.86***	0.04
No	19517	97.10	17138	87.80	2379	12.20		
Barbiturates								
Yes	1312	6.50	919	70.00	393	30.00	433.06***	0.15
No	18794	93.50	16786	89.30	2008	10.70		
Cocaine								
Yes	5025	25.00	4597	91.50	428	8.50	74.7***	0.06
No	15081	75.00	13108	86.90	1973	13.10		
Crystal meth								
Yes	7070	35.20	6187	87.50	883	12.50	3.11	
No	13036	64.80	11518	88.40	1518	11.60		
Gambling								
Yes	2556	12.70	2334	91.30	222	8.70	29.53***	0.04

[21] Missing 109 cases

Variable	Entire sample		Lower Frequency		High Frequency		Chi-Square	Effect Size
	n	%	n	%	n	%		
No	17550	87.30	15371	87.60	2179	12.40		
Inhalant								
Yes	362	1.80	347	95.90	15	4.10	21.32***	0.03
No	19744	98.20	17358	87.90	2386	12.10		
Marijuana								
Yes	2693	13.40	2524	93.70	169	6.30	94.94***	0.07
No	17413	86.60	15181	87.20	2232	12.80		
Opiates								
Yes	6565	32.70	5776	88.00	789	12.00	0.05	
No	13541	67.30	11929	88.10	1612	11.90		
Other Addiction								
Yes	258	1.30	242	93.80	16	6.20	8.19**	0.02
No	19848	98.70	17463	88.00	2385	12.00		
Psychedelics								
Yes	429	2.10	407	94.90	22	5.10	19.35***	0.03
No	19677	97.90	17298	87.90	2379	12.10		
Tobacco								
Yes	7501	37.30	6681	89.10	820	10.90	11.6**	0.2
No	12605	62.70	11024	87.50	1581	12.50		
Tranquillizer								
Yes	57	2.40	730	92.80	57	7.20	17.2***	0.03
No	2344	97.60	16975	87.90	2344	12.10		
Education								
Less than high school	927	4.60	821	88.60	106	11.40	0.497	
High school	14473	71.60	12740	88.00	1733	12.00		
Post-secondary	4815	23.80	4253	88.30	562	11.70		
Employment								
Employed	6923	34.20	6165	89.10	758	10.90	200.7***	0.1
Unemployed	12921	63.90	11409	88.30	1512	11.70		

Variable	Entire sample		Lower Frequency		High Frequency		Chi-Square	Effect Size
	n	%	n	%	n	%		
Unstable employment	371	1.80	240	64.70	131	35.30		
Gender								
Female	7214	35.70	6428	89.10	786	10.90	10.33**	0.02
Male	13001	64.30	11386	8760.00	1615	12.40		
Marital Status								
Divorced, Separated and Widowed	3018	14.90	2662	88.20	356	11.80	214.9***	0.1
Married	4773	23.60	4314	90.40	459	9.60		
Single	12140	60.10	10663	87.80	1477	12.20		
Unstable Marriage	284	1.40	175	61.60	104	38.40		
Completion status								
Completed	11170	55.80	10622	95.10	548	4.90	5338***	0.52
Not Completed	5106	25.50	5008	98.10	98	1.90		
Cycled between completion and non-completion	3744	18.70	1989	53.10	1755	46.90		
COVID-19								
Before Covid	5143	48.00	4428	86.10	715	13.90	2101.04***	0.44
Within Covid	4088	38.20	3760	92.00	328	8.00		
Both	1475	13.80	589	39.90	886	60.10		
Discharge year								
2015-2018	10366	51.30	9729	93.90	637	6.10	4897.27***	0.49
2019-2022	7156	35.40	6805	95.10	351	4.90		
Both	2693	13.30	1280	47.50	1413	52.50		
Facility								
Facility 1	290	1.40	275	94.80	15	5.20	1464.6***	0.27
Facility 2	679	3.40	642	94.60	37	5.40		
Facility 3	2944	14.60	2662	90.40	282	9.60		
Facility 4	7294	36.10	6687	91.70	607	8.30		
Facility 5	7971	39.40	7013	88.00	958	12.00		

Variable	Entire sample		Lower Frequency		High Frequency		Chi-Square	Effect Size
	n	%	n	%	n	%		
Combination of two or more	1037	5.10	535	51.60	502	48.40		
Residence								
Urban	17030	84.20	14987	88.00	2043	12.00	684.27***	0.18
Rural	2820	14.00	2655	94.10	165	5.90		
Migration between Urban and rural	365	1.80	172	47.10	193	52.90		
Single vs. polysubstance use disorder and behavioural addiction								
Single	5707	28.40	5534	97.00	173	3.00	601.66***	0.17
Poly	14399	71.60	12171	84.50	2228	15.50		
Alcohol and Opiates								
Alcohol	11089	55.20	9639	86.90	1450	13.10	82.08***	0.06
Opiates	3925	19.50	3472	88.50	453	11.50		
Alcohol and Opiates	2640	13.10	2304	87.30	336	12.70		
Neither alcohol nor opiate	2452	12.20	2290	93.40	162	6.60		

Chapter 5: Discussion of the Main Findings, Implications, Strengths and Limitaions

The main objective of this study was to estimate the rates and identify the predictors of detox completion and non-completion, transition to residential treatment from detox, and frequent use of detox services among clients admitted to five residential detoxification treatment services in Alberta. The analysis was based on socio-demographic information, program variables, and the number and types of primary substance use disorder and behavioural addiction. The key findings of this study indicate several important trends: there is a lower transition rate to treatment, with over a quarter of clients not completing their programs. Additionally, 12% of clients are considered frequent utilizers of services. Factors such as social determinants of health, specific substance use disorders, and addictive behaviours, along with program variables like length of stay and the types of facilities used, predict whether individuals complete treatment/non-complete, transition to residential treatment from detox, and how often they will utilize detox services.

Rates of Completion/Non-completion, Transition to Treatment, and Frequency of Admission

Completion/Non-Completion

This retrospective multicentre study demonstrated that more than half of clients (55.8%) completed detoxification than those who did not complete (25.5%) or cycled between completion and non-completion (18.7%). The result for completion was within the range of 37% to 94%, and the 25.5% non-completion rate was within the lower range of the reported range of 5%–63% observed in over 20 previous studies on completion and non-completion (Barnaby & Gibson, 2008; Berman et al., 2008; Blondell et al., 2007; Callaghan, 2003; Das et al., 2021; Dunsæd et al., 2016; Ford & Zarate, 2010; Hakansson & Hallen, 2014; Hogan et al., 2018; Li et

al., 2007; Ling et al., 2018; Nikolaou et al., 2017; Odenwald & Semrau, 2012; Pytell & Rastegar,2018; Sarkar et al., 2016; Sidana et al., 2023; Silins et al., 2008; Sofer et al., 2018; Sofin et al., 2017; Specka et al., 2011 and Timko et al., 2015). The sensitivity analysis of a dichotomous classification that yielded a completion rate of 69% and a non-completion rate of 31%, which was within the range of results from over 20 previous studies mentioned earlier (e.g., Specka et al., 2011; Timko et al., 2015). However, the discovery in this study of one non-completion for every 6.2 admissions is highly concerning and needs to be addressed by the provincial healthcare system.

This study added a third category of completion outcomes that must be treated separately: clients who alternately cycled between completion and non-completion who could have been misclassified in previous studies that used a binary outcome. This group of individuals, who alternate between completing and not completing detox, needs further investigation into its connection with a higher average number of admissions and a higher rate of frequent detox utilizers compared to those who have either fully completed or not completed their tasks, among other factors. The triple categorization of completion reflects the various challenges and multiple trajectories of recovery processes, as an individual may alternately complete and not complete detox due to the frequency of relapses before achieving sustained recovery. Addiction is considered a chronic condition, and in many cases, it requires continuous treatment, even after detoxification (Lash et al., 2001; Popovici et al., 2008). Often, it necessitates multiple detoxification and treatment attempts (AHS, 2018; Lee et al., 2014; McKeganey et al., 2004). It has been reported that a median duration of nine years exists between the first treatment episode and the last use and a median span of 27 years from the first to the last use (Dennis et al., 2005).

Transition to Residential Treatment

The assessment of transition rates to residential treatment following discharge from detoxification found that only 24.3% of clients received continuous services by transitioning from one or more of the five residential detoxification facilities to one or more of Alberta's five residential treatment facilities. In previous studies, the majority (up to 80%) of clients underwent detoxification without transitioning to residential treatment (Carroll et al., 2009; Specka et al., 2011; TEDS, 2020; Zhu & Wu, 2018). This low rate of transition suggests that most clients used detoxification to reduce harm (AHS, 2018, 2020) or considered detoxification a sufficient standalone service for managing withdrawal (McLellan et al., 2005; Tuten et al., 2007). This could also indicate that the available treatment beds were insufficient to accommodate clients seeking residential treatment. Given the longer stays in residential treatment and the shorter stays in detox services, the available residential treatment spaces (174 beds) could not accommodate all detox (116 beds) clients seeking treatment. Moreover, the 40-day median duration of the transition from detox to residential treatment is much longer than the recommended duration of time from discharge from detox to treatment: seven days by ASAM (ASAM, 2014), 14 days suggested by the Washington Circle (Lee et al., 2014), and 30 days used in a study by Ford & Zarate (2010) and Stein et al. (2009). However, this result should be interpreted with the understanding that the available data only covered the transition to residential treatment and did not encompass the transition to day outpatient treatment or other mutual self-help groups, which are important indicators of continuity of care services within the addiction treatment framework. The mean value of admissions to residential detoxification before a transition to residential treatment was three, and more than 40% of clients who transitioned to residential treatment had used residential treatment more than once. This illustrates the complexity of the treatment

ecology on the way to recovery and a call for an intervention to help clients achieve their desired goals and optimize resources.

Frequency of Residential Detoxification Service Utilizers

The current analysis revealed a highly skewed distribution, with 88.1% of clients admitted 1–3 times and 11.9% of the most frequent users admitted four or more times. Based on a detailed analysis of 12% of the most frequent users, 1.6% of clients (314 individuals) had an average of 14 (11.3%) of all admissions (4,524 in total). Moreover, 0.2% of clients (30 individuals) had an average admission count of 31 (2.3%) of all admissions (934 in total). These figures further demonstrate a highly skewed distribution of frequent users. Therefore, focusing on the group of users that are more frequently admitted to detoxification is rational for optimizing available resources (McLellan et al., 2005) and improving treatment outcomes rather than concentrating on every readmission. This 12% accounted for about 40% of total admissions, which is evidence of the "revolving door" phenomenon (Callaghan, 2003; Mark et al., 2006), in which a small number of individuals who utilized detoxification disproportionately occupy limited detoxification beds multiple times, leading to inefficient use of resources and decreased access to treatment for other clients (McLellan et al., 2005). The rate is much higher than that reported in a similar study by Chang et al. (2016). However, the 37% readmission rate of clients with more than one admission was around the median in comparison with the 11 previous studies (Callaghan, 2003; Callaghan & Cunningham, 2002; Ghosh et al., 2022; Grzebinski et al., 2021; Li et al., 2007; Li et al., 2008; Mark et al., 2006; Running Bear et al., 2014; Spear, 2014; Van den Berg et al., 2015; Yedlapati & Stewart, 2018). The non-completion, the lower transition to residential treatment, and the smaller proportion of clients disproportionately accounting for a significant proportion of admission may contribute to the unsustainability of healthcare spending,

which already accounts for 30%–40% of provincial and territorial budgets in Canada and continues to rise (CMA, 2022). In general, the rates of non-completion, transition to residential treatment, and most frequent utilizers of detoxification demonstrated insufficient use of resources and gaps in addressing the needs of clients struggling with addiction. However, these rates vary according to substance use disorder and behavioural addiction factors, socio-demographic characteristics, and program variables, which should be considered.

Predictors of the Three Program Outcomes

This section discusses the substance use disorder and behavioural addiction factors, sociodemographic characteristics, and program variables that predicted completion/non-completion, transition to residential treatment, and frequency of detoxification service utilization. Our discussion focuses on the odds ratio of variables with significance levels of <0.05 (Table 8).

Table 8. *Odds Ratio of Completion/Non-Completion, Transition to Residential Treatment, and Frequency of Utilization of Detoxification Services*

Variables	Completion			Non-completion			Cycle between completion and non-completion			Transition to residential treatment			Frequent utilization		
		95% C.I for Exp (B)			95% C.I for Exp (B)			95% C.I for Exp (B)			95% C.I for Exp (B)	
	Exp(B)	Lower	Upper	Exp(B)	Lower	Upper	Exp(B)	Lower	Upper	Exp(B)	Lower	Upper
Primary substance use disorder and behavioural addiction												
Alcohol (ref = No)	0.73***	0.65	0.81	1.10	0.97	1.25	0.97	0.88	1.06	1.05	0.90	1.22
Amphetamines (ref = No)	1.40**	1.13	1.73	1.23	0.98	1.53	0.94	0.79	1.10	0.58***	0.42	0.80
Androgen (ref = No)	0.81	0.52	1.27	0.92	0.63	1.35	1.42**	1.10	1.83	3.12***	2.06	4.72
Antidepressant (ref = No)	0.97	0.72	1.32	0.78	0.56	1.08	1.06	0.84	1.34	0.62	0.36	1.05
Barbiturates (ref = No)	1.70***	1.38	2.10	1.37**	1.13	1.66	1.21**	1.05	1.38	2.22***	1.83	2.70
Cocaine (ref = No)	0.89*	0.80	0.99	1.01	0.90	1.14	1.04	0.95	1.13	0.55***	0.47	0.68
Crystal meth (ref = No)	1.70***	1.52	1.90	1.69***	1.50	1.91	0.85***	0.78	0.93	0.74***	0.64	0.85
Gambling (ref = No)	0.11	0.97	1.33	1.02	0.86	1.21	1.23**	1.09	1.39	0.59***	0.48	0.73
Inhalant (ref = No)	0.44	0.81	1.62	1.03	0.71	1.50	1.35*	1.03	1.76	0.43*	0.22	0.84
Marijuana (ref = No)	0.78***	0.68	0.89	0.88	0.76	1.03	0.95	0.85	1.06	0.59***	0.48	0.73
Opiates (ref = No)	2.78***	2.49	3.09	2.35***	2.08	2.65	0.81***	0.74	0.88	0.80**	0.69	0.92
Other addiction (ref = No)	1.37	0.92	2.04	1.64*	1.10	2.44	0.96	0.70	1.32	0.55	0.30	1.03
Psychedelics (ref = No)	1.10	0.75	1.42	0.67*	0.46	0.97	1.19	0.92	1.54	0.92	0.52	1.61
Tobacco (ref = No)	0.99	0.90	1.11	1.17**	1.04	1.31	1.02	0.94	1.11	0.63***	0.56	0.72
Tranquilizer (ref = No)	1.71***	1.35	2.15	1.31*	1.01	1.69	0.91	0.75	1.10	0.56**	0.39	0.79
Mono Vs multiple substance use disorder and behavioural addiction												
Poly (ref)												
Mono	0.86*	0.76	0.98	0.73***	0.71	0.75	0.91	0.82	1.01	0.21***	0.18	0.26
Educational levels												
High school (ref)												
Less than high school	1.09	0.89	1.34	1.11	0.88	1.41	0.82*	0.69	0.98	1.00	0.75	1.34
Post Secondary	0.79***	0.71	0.88	0.81***	0.71	0.91	1.16**	1.06	1.26	1.09	0.94	1.26
Gender												

Variables	Completion			Non-completion			Cycle between completion and non-completion			Transition to residential treatment			Frequent utilization		
		95% C.I for Exp (B)			95% C.I for Exp (B)			95% C.I for Exp (B)			95% C.I for Exp (B)	
	Exp(B)	Lower	Upper	Exp(B)	Lower	Upper	Exp(B)	Lower	Upper	Exp(B)	Lower	Upper
Male (ref)												
Female	1.19***	1.09	1.31	1.21***	1.09	1.34	1.03	0.96	1.11	0.79***	0.70	0.90
Employment												
Unemployed **(**ref**)**												
Employed	0.76***	0.67	0.81	0.93	0.83	1.04	1.34***	1.24	1.45	1.04	0.91	1.19
Unstable employment	0.73**	0.30	0.82	1.22	0.91	1.63	1.53***	1.21	1.93	1.60**	1.17	2.19
Marital Status												
Single (Unmarried) (ref)												
Divorce, Separated, and Widowed	0.91	0.80	1.04	0.92	0.79	1.07	1.09	0.98	1.22	0.94	0.78	1.13
Married	0.87*	0.78	0.97	0.88*	0.77	1.00	1.11*	1.01	1.22	0.89	0.76	1.05
Unstable marriage	1.01	0.59	1.74	1.29	0.91	1.82	1.05	0.80	1.38	1.59*	1.10	2.28
Place of residence												
Rural (ref)												
Urban	1.28***	1.13	1.46	1.40***	1.19	1.65	0.72***	0.65	0.80	1.86***	1.50	2.31
Migrated between urban and rural	0.93	0.55	1.58	1.40	1.00	1.97	0.43***	0.33	0.55	5.54***	3.91	7.83
Age							0.99***	0.99	0.99	1.01*	1.00	1.01
Facilities Utilized												
Facility 5 (ref)												
Facility 1	0.87	0.66	1.64	0.76	0.45	1.30	0.58***	0.46	0.74	1.98*	1.05	3.76
Facility 2	22.65***	16.52	31.05	6.16***	4.43	8.56	0.64***	0.58	0.69	0.35***	0.21	0.57
Facility 3	1.15	1.00	1.34	1.07	0.90	1.27	0.36***	0.25	0.53	0.87	0.71	1.07
Facility 4	3.56***	3.2	3.96	1.77***	1.56	2.01	1.23***	1.10	1.37	0.69***	0.60	0.80
Combination of two or more facilities	2.78***	2.09	3.74	2.71***	2.23	3.30	1.30**	1.12	1.50	1.70***	1.40	2.05

Variables	Completion						Transition to residential treatment			Frequent utilization		
	Non-completion			Cycle between completion and non-completion								
		95% C.I for Exp (B)			95% C.I for Exp (B)			95% C.I for Exp (B)			95% C.I for Exp (B)	
	Exp(B)	Lower	Upper	Exp(B)	Lower	Upper	Exp(B)	Lower	Upper	Exp(B)	Lower	Upper
Admission Year												
2019-2022 (ref)												
2015 to 2018	0.76***	0.69	0.84	0.88*	0.78	0.99	1.14**	1.05	1.24	1.25**	1.06	1.47
Both	0.73**	0.59	0.90	1.32***	1.13	1.53	1.75***	1.56	1.97	6.74	5.74	7.92
LOS	0.39***	0.38	0.4	0.73***	0.71	0.75	1.10***	1.08	1.11	1.03**	1.01	1.06
Discharge Days												
Monday to Friday (ref)												
Saturday and Sunday	1.41***	1.27	1.57	0.79**	0.67	0.94						
Both	1.30**	1.07	1.56	2.25***	1.94	2.61						
Completion												
Completed												
Non-completion							0.35***	0.31	0.40	0.73*	0.57	0.93
Cycle between completion and non-completion							0.84**	0.76	0.93	9.27***	8.10	10.60
Readmission status												
Not readmitted (ref)												
Readmitted							2.13***	1.94	2.35			
Count of admission	0.77***	0.72	0.83	2.47***	2.36	2.58						
Transition to residential treatment												
Detoxification Only (ref=detoxification+residential treatment)												
Detoxification alone	2.45***	2.14	2.80	1.35***	1.20	1.51				0.40***	0.35	0.45

***p < 0.001, **p < 0.01, *p < 0.05

Sociodemographic Variables

Age, gender, marital status, employment, education, and place of residence were analyzed as predictors under socio-demographic determinants.

Education and Employment. The findings revealed that clients who had completed higher education with a post-secondary degree had lower odds of non-completion than those in secondary education, consistent with previous studies (de Weert-van Oene et al., 2007; Sofer et al., 2018; Sofin et al., 2017). Similarly, clients with higher levels of education were found to be more likely to transition to residential treatment than those with a high school education, consistent with the study by Timko et al. (2015). Clients who completed higher educational levels had better outcomes.

In addition to higher education being a predictor, being employed at the time of detoxication was also a predictor of success. Clients who were employed or had unstable employment had lower odds of not completing than those who were unemployed. These employment results are consistent with previous studies (Levola et al., 2021; Sofin et al., 2017), but no previous studies have established a relationship between unstable employment and completion. Similarly, employed clients, including those with unstable employment, were more likely than unemployed clients to transition to treatment. Consistent with our study, Ford and Zarate (2010) found a significant association between employment and transitioning to treatment, including an association between unstable employment and transition to treatment that had not been previously reported. These results suggest that transitioning to treatment or completing detoxification may motivate clients to seek employment, especially those transitioning from unemployment to employment or employed people being more likely to complete treatment because they want to keep their jobs. In the latter group, substance use

disorder and behavioural addictions or the expectation of employers that the employees would complete and seek treatment could contribute to their shift in employment status. Moreover, clients who had unstable employment had higher odds of frequent use, which has not been previously reported. This suggests that employed clients struggle with utilizing detoxification more frequently or that the motivation to be employed urged them to try to utilize detoxification frequently. The relationship between employment, whether stable or unstable, must be considered within the context of large capital recovery, which stipulates that recovery is a multi-dimensional and ecological phenomenon. In treatment settings other than detoxification, the literature suggests that substance use disorder treatment increases productivity due to new or resumed employment (Eddie et al., 2021) and protects against relapse (Walton & Hall, 2016). Conversely, people who go through addiction treatment could struggle to obtain employment (Eddie et al., 2021), which suggests a need to resolve barriers because employment could be an effective relapse prevention measure (Walton & Hall, 2016).

Gender. Compared with males, female clients were more likely not to complete detoxification, which is consistent with the study of Li et al. (2013) but contradicts the findings of Sofin et al. (2017). Further studies are recommended to study the reasons behind the variation in completion and non-completion rates across genders. Concurrently, this analysis revealed that females, compared with males, had lower odds of more frequent utilization of detoxification services, consistent with previous studies (Mark et al., 2006; Running Bear et al., 2022). This could be due to the higher percentage of females enrolled in post-secondary education (25% vs. 23%) ($X^2_{[2]}$ (n=20215 = 26.4, $p < 0.001$), which could also relate to the lower rate of detoxification utilization among females (Gilbert et al., 2019), thus contributing to their lower rates of returning to detoxification facilities after relapse. It is possible that females were more likely to be the

primary caregivers for children (Statistics Canada, 2022), which may have compelled them to return; however, this requires further study.

Marital Status. Married clients are more likely to complete detoxification services than single clients, which is supported by three previous studies (Cobos et al., 1997; Morgan & Dennis, 2022; Mutter & Ali, 2019). One study (Dayal et al.,2017) found a contrasting result, in which married clients had a higher non-completion rate than unmarried clients. Moreover, Barnaby and Gibson (2008) reported an insignificant relationship between completion and marital status. The present finding that married clients are more likely to complete detoxification and transition to residential treatment is consistent with the literature on the importance of couples' therapy in improving treatment outcomes, which has been widely researched in other treatments (Lee, 2014; Lee et al., 2022; Rowe, 2012; Sherrell & Gutierrez, 2014). Specifically, the caring involvement of significant others, the decrease in marital stress and overall life stress, and the improvement in emotion regulation increase the likelihood of entering treatment following detoxification and improve a range of other clinical outcomes (Lee, Ofori et al., 2022; O'Farrell et al., 2007, 2008). Conversely, clients with unstable marriages had higher chances of frequent utilization of detoxification, a notable finding from this study not previously reported.

Rural Versus Urban Locations. Clients who reside in urban areas had higher odds of non-completion than those in rural areas. The study also found that rural residents had higher odds of transitioning to treatment than urbanites and those who moved between urban and rural areas. These better outcomes may be due to the higher likelihood of marriage and, therefore, stronger social cohesion among rural residents (Burnette et al., 2021). In this study, clients who resided in urban areas or moved between urban and rural areas attended detox more frequently than rural residents. Rural residents had lower odds of being frequent users of detoxification, which is

consistent with the study by Ghosh et al. (2022). This is similar to the reasoning for the non-completion and transition to residential treatment. However, the limited availability of detox services in rural areas may prevent them from using detoxification services frequently.

Age. According to this study, as age increases, the odds of transitioning to residential treatment decrease, consistent with previous studies (Mark et al., 2002; Zhu & Wu, 2018), while the odds of frequent use of detoxification increase, consistent with previous research (Callaghan & Cunningham, 2002; Mark et al., 2006). However, the odds ratio for both transition and frequency of use are close to one, implying that age's effects might not be practically significant, thus highlighting the need for future research.

Multiple similarities in the patterns of results between non-completion and cycle of completion and non-completion in terms of education, gender, marital status, and place of residence were revealed in this study. However, this study recommended further study on the third category of completion—clients who cycled between completion and non-completion.

Program Variables

Program variables with odds ratios within the margin of errors include LOS, count of admission/readmission, transition to residential treatment, completion or non-completion, time period, and facilities utilized.

In this study, clients who completed detoxification had longer stays than those who did not, which is consistent with previous studies (David et al., 2022; Dayal et al., 2017; Hakansson & Hallen, 2014; Kovas et al., 2007; Ling et al., 2018; Sidana et al., 2023; Specka et al., 2011). A longer stay enhances completion outcomes, increases the likelihood of entering treatment (Running Bear et al., 2017), and extends the number of sober days (Ford & Zarate, 2010). The longer LOS among those who completed detoxification (Morgan & Dennis, 2022) indicates that

such clients had sufficient time to withdraw from substance use disorder and behavioural addictionand engage in discharge planning, including planning for a transition to residential treatment (Campbell et al., 2010; Carroll et al., 2009; Running Bear et al., 2017). Similarly, a longer LOS increased the odds of transitioning to treatment, consistent with previous studies (Campbell et al., 2010; Carroll et al., 2009; Running Bear et al., 2017), and the odds of more frequent utilization of detoxification, consistent with Chang et al. (2016).

Clients who did not complete treatment were admitted fewer times than clients who did, consistent with Kenn et al. (2010), which suggests that the clients who left treatment were discouraged from readmitting again. Although seeking multiple admissions may result in higher odds of completion and may not be a favourable outcome, this suggests that not all frequent admissions are undesirable. Our finding that clients with multiple admissions are more likely to transition to residential treatment suggests that repeated admission may lead to better treatment outcomes upon transitioning to residential treatment. Contradictory results were found on this point in previous studies. Whereas Timko et al. (2015) support this findings, Carrier et al. (2011) contradict them. Although repeated admission results in poorer treatment outcomes, addiction, as a chronic illness, may require multiple episodes of treatment on the road to recovery (AHS, 2022; Lee et al., 2014; Scott et al., 2005).

Clients who did not complete detoxification were less likely to enter residential treatment than those who completed it, consistent with previous studies (Ford & Zarate, 2010; Kenne et al., 2010; Specka et al.,2011). Their use of detoxification services could be intended to reduce harm without continuing treatment (Chutuape et al., 2001), or perhaps they erroneously believed that once their withdrawal symptoms had been resolved, they could manage their addiction without further treatment (McLellan et al., 2005).

Clients who attended detoxification more frequently were more likely to transition to residential treatment services, although this could be considered an undesirable detoxification outcome from the program providers' perspectives. This finding is consistent with previous studies (Amodeo et al., 2008; Carrier et al., 2011) and with the view expressed by Lee et al. (2014) that multiple admissions can become a gateway to residential treatment, which is the goal of detoxification. However, this contradicts Mark et al.'s (2006) findings, which indicate lower readmission odds among clients transitioning to residential treatment.

Clients who did not complete detox had lower odds of transitioning to residential treatment than did clients who completed it. Similarly, clients who did not complete detoxification were less likely to be highly frequent users of detoxification services, suggesting that these clients could be discouraged from using detox services again by their initial experience, which is consistent with previous results (Yedlapati & Stewart, 2018). However, clients who cycled between completion and non-completion had higher odds of being frequent utilizers of detoxification and lower odds of transitioning to residential treatment, which has not been studied previously.

Our study indicates that clients admitted between 2019 and 2022 were more likely not to complete their treatment than those admitted between 2015 and 2018. In addition, clients admitted between 2019 and 2022 had lower odds of transitioning to residential treatment. By contrast, clients admitted between 2015 and 2018 had higher odds of frequent service use than those admitted between 2019 and 2022. The higher odds of non-completion, lower odds of transition to residential treatment among clients admitted between 2019 and 2022, and higher odds of frequent detoxification service utilizers among those admitted between 2015 and 2018 could be attributed to the effects of the COVID-19 emergency and the policy differences in

2015–2018 when the New Democratic Party governed the province and in 2019–2022 when the United Conservative Party was in charge. This situation warrants further investigation.

The failure to complete detoxification could be associated with significant service delivery disruptions and the fatigue of service providers during the COVID-19 emergency (Kim et al., 2020; Mellis et al., 2021; Russell et al., 2021). Moreover, heightened substance uses disorder and behavioural addiction and relapses occurred during periods of public health restrictions implemented during the COVID-19 emergency (Barrio et al., 2021; Kim et al., 2020), which were associated with stress due to widespread job loss (Angus Reid Institute, 2020) and increased isolation caused by COVID-19 restrictions. These factors further affected the use of detox services and made it challenging for clients to transition to residential treatment, and clients could have faced difficulty using detoxification services more frequently due to service disruptions and provider fatigue (Kim et al., 2020; Mellis et al., 2021; Russell et al., 2021).

Consistent with previous studies, clients discharged on weekends had a higher likelihood of not completing detoxification than those discharged on weekdays (Blondell et al., 2006; Hogan et al., 2018; Li et al., 2013; Li et al., 2007). This may be due to clients' desire to attend weekend events (Li et al., 2013), as regular staff are off on weekends (Blondell et al., 2006), which may cause a pause in some programs. The results of clients who cycled between completion and non-completion on discharge days were contrary to those of clients who did not complete. The discovery of a lower transition rate among clients discharged on weekends (Saturday and Sunday) as opposed to weekdays (Monday to Friday) has never been reported previously, which requires further study. This may be related to this study's completion study results, which indicate that non-completing clients who had lower odds of transitioning to residential treatment were disproportionately discharged on weekends.

This study identified lower completion rates among clients admitted to two or more facilities, Facilities 2 and 4, but further research is needed to determine the reasons for this variation. On the contrary, clients admitted to two or more facilities and Facility 4 had higher odds of transitioning to residential treatment than Facility 5. Although further studies are needed to understand the disparities in the odds of transitioning to residential treatment, as a novel discovery, this study found that the rate of transition from detoxification to residential treatment services was higher when detox and residential treatment services were co-located in the same facility, contrary to Garnick et al. (2020). In addition, two-thirds of the detox facilities whose clients had the lowest odds of transitioning to residential treatment had the lowest count of detoxification beds, contradicting Campbell et al. (2010). However, this result needs to be replicated in more facilities and the reasons behind such disparities. Similar to the transition results, clients who used multiple detox facilities (more than one) had higher odds of frequently using detoxification. However, future studies should investigate the reasons behind the variations in the frequency of utilization of services at the other detox facilities (Facilities 1, 2, and 4).

This study also observed multiple similarities in clients who cycled between completion and non-completion and those who did not complete detoxification regarding LOS, facilities utilized, transition to residential treatment, and year of admission (2015–2018). Conversely, as the frequency of admission increased, the odds of cycling between completion and non-completion increased, contrary to the results of non-completion. As the third category is a new subject of research, this study recommends further study of clients who experience cycles of completion and non-completion.

Substance Use Disorder and Behavioural Addiction

There are variations in substance use disorder and behavioural addiction in completion/non-completion, transition to treatment, and frequency of utilization of detoxification. These differences may be related to management strategies rather than the substances themselves (Specka et al., 2011). Although the initial symptoms of withdrawal from many substance use disorders are similar, the severity of the complications varies afterwards (Kosten & O'Connor, 2003). This variation may call for the development of distinct protocols for different substance use disorders. In Alberta, opiates and alcohol have their own withdrawal management practices.

Our findings indicate that clients struggling with the use of alcohol, cocaine, or marijuana had higher odds of completion or were less likely not to complete detoxification, whereas clients who used opiates, crystal meth, barbiturates, amphetamines, or tranquillizers had higher odds of failing to complete detoxification services. The substance use disorders associated with the higher odds of non-completion were similar to those associated with cycling between completion and non-completion results, with the exception that the use of tobacco or other substance use disorder and behavioural addiction category was not counted as a case of detoxification non-completion. Clients who used psychedelics had lower odds of cycling between completion and non-completion. Not all of our results coincide with previously reported findings. Clients who used opiates (Callaghan & Cunningham, 2002; Li et al., 2013; Li et al., 2007; Sarkar et al., 2016; Silins et al., 2008; Zhu & Wu, 2018) and tranquillizers (Dayal et al., 2017) had lower odds of completion, whereas those who used alcohol had a higher likelihood of completion (Callaghan, 2003; Hogan et al., 2018; Li et al., 2007; Sarkar et al., 2016; Timko et al., 2015). The remaining

substance use disorder and behavioural addiction were not reported previously, including among clients who cycled between completion and non-completion.

Clients who primarily used opiates and crystal meth had a lower rate of transition to residential treatment but a higher likelihood of seeking detox services without transitioning to residential treatment. By contrast, problem gamblers and users of barbiturates, inhalants, and androgens had a higher chance of transitioning. Our analysis also found that clients using androgens and barbiturates had higher odds of being frequent users of detoxification services than those who did not have such substance use disorders. Amphetamines, barbiturates, crystal meth, and opiates were found to have different effects on completing treatment, transitioning to residential treatment, and the frequency of utilizing detox services. Opiates and crystal meth were associated with higher odds of non-completion, lower odds of transitioning to residential treatment, and lower frequency of use. Barbiturates were associated with higher odds of non-completion, transitioning to residential treatment, and frequent utilization of detoxification services. Conversely, amphetamines were linked to higher odds of non-completion and lower odds of frequent utilization of detoxification.

This study compared the outcomes of individuals using alcohol and opiates. Although withdrawal protocols have been established for both substances (AHS, 2022b, 2023), this study found that individuals detoxing from alcohol had higher rates of completion than those detoxing from opiates. In addition, this study found that individuals struggling with alcohol use had higher rates of transition to treatment than opiate users, which is a concerning finding consistent with Zhu and Wu's (2018) study. A further comparison indicates that the most frequent utilizers of detox programs were alcohol users rather than opiate users, which aligns with previous studies (Chang et al., 2016; Running Bear et al., 2022). The increasing number of opiate overdoses in

Alberta (Public Health Agency, 2023; Scace, 2023) may be linked to the heightened risk of overdosing among opiate users after detoxification as their drug tolerance decreases during their stay in detoxing (Walley et al., 2020; Wines et al., 2007) which may be linked to lower frequency of detoxification service utilization. This outcome could help explain the lower completion rates among clients detoxifying from opiates. It could also be associated with a lower rate of transitioning to residential treatment, as follow-up treatment is crucial for reducing overdose deaths (Stein et al., 2003; Strang et al., 2003; Walley et al., 2020). Conversely, the life-threatening effects of alcohol withdrawal (Day and Daly, 2021) may motivate clients to complete their detoxification, be admitted to further treatment, and utilize detoxification services more frequently.

As most clients used multiple substances (71.8%), providing a withdrawal management protocol could address polysubstance use, and developing specific management protocols for other substances could help clients withdraw safely. In our study, clients who used only a single substance had higher completion odds—a finding consistent with those of two other studies (Levola et al., 2021; Sofer et al., 2018). Individuals who had a mono substance use disorder and behavioural addictions were less likely to be non-completed, similar to the third cycle of completion and non-completion category. In addition, our study shows that clients who have multiple substance use disorders and behavioural addictions had a higher transition rate, which may be attributable to clients' feeling of urgency to seek treatment due to the use of multiple substances and the belief that residential treatment is the best option for recovery. Polysubstance use disorder and addictive behaviour were more likely to be frequent utilizers of detoxification services than single substance-use disorder and behavioural addictions, consistent with the study

by Callaghan and Cunningham (2002), which could be due to a response to the feeling of urgency of multiple substance use disorder and behavioural addictions.

Implications for Policy and Interventions

For many clients who have struggled with addiction, accessing detox services is the first step to recovery, followed by a transition to treatment (Amodeo et al., 2008; Kenne et al., 2010; Li et al., 2008; Running Bear et al., 2022). Public investment in detoxification programs is cost-effective in reducing harm to individuals struggling with addiction, their families, and society (Raistrick et al., 2006). In this recovery process, the three most essential program outcomes assessed in this dissertation were completion or non-completion, transition to residential treatment following discharge from detoxification, and frequent use of detoxification services.

One of the most significant findings of this dissertation is that a considerable 26% of clients did not complete detoxification. Additionally, a staggering 76% had never transitioned to residential treatment, and an alarming 12% were admitted to detox four or more times between FY (fiscal year) 2015 and 2022. Equally concerning is the third category of individuals (19%) who exhibit mixed completion and non-completion—a phenomenon that has not been studied previously and could result in misclassification under previous literature by using dichotomous categorization. These rates, which should not be overlooked, have profound implications for treatment policies and practices in Alberta.

Interventions aimed at improving completion outcomes, facilitating the transition to residential treatment, and focusing on frequent service users can enhance detoxification services and better support clients in recovering from addiction. The complexity of the treatment ecology is evident in the low rate of transitioning to residential treatment, the 12% rate of the most frequent utilizers of detox services, and the 40% rate of transitioned clients utilizing residential

treatment more than once. These findings highlight the need to consider the entire treatment process. For example, completion is a desirable outcome in treatment ecology. However, completion alone is not necessarily the end of withdrawal management services for clients who aim to recover by remaining abstinent. It must be succeeded by follow-up treatment. Otherwise, some of the clients who complete detox, as well as those who did not finish, return for more services, even though clients who complete detox may have enough time to navigate the risk of relapse and a better chance of transitioning to residential treatment.

The effort to improve treatment outcomes should begin at admission and continue through detoxification to enhance access to residential treatment facilities. The province of Alberta is changing the traditional care model to focus on recovery-oriented care for addiction and mental health (Alberta Mental Health and Addictions Advisory Council, 2022). This recovery-oriented system of care (ROSC) aims to promote progress in addressing addiction and psychosocial functioning (Laudet & Best, 2015; White et al., 2002). The ROSC is an important framework that provides a range of services to accommodate different pathways and approaches to recovery tailored to individuals' goals (White, 2002). Detoxification services could be a vital component of the ROSC, as individuals in recovery may still need to attend withdrawal management services; however, this depends on the amount of recovery capital. The ROSC accommodates the utilization of detoxification to reduce associated harm, pursue harm reduction, or continue abstinence-based treatment as part of their recovery. Recovery capital[22] is a central principle of the ROSC (Cloud & Granfield, 2008) that factors into the variation in clients' capability to recover from substance use disorder and behavioural addictions , among other

[22] Recovery capital indicates the sum of resources necessary to initiate and sustain recovery from substance misuse (Best and Laudet, 2010, p.2). It includes personal, social, physical, human, cultural and community recovery capital (Granfield & Cloud, 2008; White & Cloud, 2008).

factors. Thus, it would be beneficial to develop recovery capital constructs for various clients to reduce the high cost of treatment in Alberta. These clients may undergo treatment as outpatients (not currently available in Alberta), in residential settings, or as inpatients, and some may be able to withdraw in their own homes. Combining this assessment tool with clients' goals and intentions could address the higher non-transition rate and cases in which the majority of clients utilized detoxification for harm reduction. Such an approach would yield two groups of clients.

The first group, composed of clients who want to continue treatment based on their individual recovery goals, could undergo a dual-admission procedure. This admission would include both detoxification and treatment services, requiring better collaboration between detoxification and treatment facilities in the same areas. Shepherding clients from detoxification to treatment services would allow resources to be pooled to assist clients who have completed detox and facilitate their transition. Other program elements should align with each client's overall recovery plan. The second group would comprise individuals whose primary goal is not to abstain but to reduce the harms associated with their substance use disorder and behavioural addictions. This group may not need as many resources as the first group. Motivational interviewing techniques could be used to inspire individuals to change their intentions regarding recovery and treatment. This would help allocate the necessary resources to these groups. Moreover, as evidenced by the literature review, addiction is a chronic disease whereby clients go through a cycle of relapse, treatment re-entry, and recovery that lasts for several years (Dennis et al., 2005); one of the most effective ways to follow up with clients in cases like Alberta where the median duration of transition from detoxification to residential treatment is 40 days, implementing post-discharge monitoring and checkups as suggested by Scott et al. (20005) could

help to assist clients to maintain the outcomes of detoxification and to receive more treatment. Expanding outpatient services can help us achieve this.

One significant result of our study regarding treatment intervention is the importance of having detox services in close proximity to residential treatment. This proximity is essential for clients to have higher odds of transitioning to treatment outcomes, which is the ultimate goal of detoxification. The better treatment outcomes observed at facilities with co-located detoxification and residential treatment services suggest that co-location promotes effective referrals and transitional networking between these facilities. This may lead to the treatment system minimizing long waiting times and reducing repeated entries to care through an effective referral process between detoxification and substance use disorder and behavioural addiction treatment. However, the availability of treatment beds, among other factors, should also be considered to decrease the time between discharge from detoxification and initiation of treatment. The provincial government plans to expand treatment beds. This plan would help clients transition to treatment more effectively if treatment facilities were located alongside detoxification facilities. Research has shown that a 10% increase in treatment facilities leads to a 2% decrease in drug-related deaths and illnesses (Swensen, 2015).

Due to the differences in LOS between detoxification and treatment facilities, the capacity of available treatment beds must be much larger than that of detoxification beds. Our data also suggest that a mere increase in the number of beds may not yield the desired outcomes unless accompanied by an improvement in other program elements. However, it is inconclusive without including the perspectives of service providers and managers. Any investment in addiction treatment should prioritize targeted interventions based on the characteristics of clients

who use detoxification services. Our study of predictors could help customize and allocate the available resources and address the issues of individuals struggling with addiction. Improving strategies for managing withdrawal symptoms rather than merely focusing on the substance use disorder and behavioural addictions themselves (Specka et al., 2011) may help decrease the non-completion rate. In this regard, management strategies that help opiate users undergoing withdrawal remain in detox facilities until completion could help reduce overdoses and facilitate the transition to treatment since tolerance declines while in detox. Although the initial withdrawal symptoms are similar for different substances, which often include nausea, diarrhea, anxiety and insomnia (WHO, 2009), the severity of complications varies afterwards (Kosten & O'Connor, 2003), calling for withdrawal protocols tailored to specific substances or categories of substances. An evidence-informed withdrawal protocol could be developed for different substances, like opiates and alcohol. However, our research has consistently shown that opiate users are less likely to complete detoxification and transition to residential treatment following detox. Moreover, opiate users are more likely to abandon—and, unfortunately, have lower odds of repeatedly attending—detox, which implies lower odds of transitioning to residential treatment after discharge. Revising existing opiate protocols may improve completion rates, and increasing transitions may help decrease the growing rate of opiate overdoses in the province (Public Health Agency, 2023; Scace, 2023).

Our study indicated that couples play a vital role in improving completion outcomes and transition to residential treatment. Previous studies in other treatment areas show improved treatment outcomes in couples therapy (Lee, 2014; Lee & Ofori Dei, 2022; Sherrell & Gutierrez, 2014), which could be extended to detoxification. A more related study shows the importance of involving support from significant others to improve detoxification outcomes (O'Farrell et el.,

2007,2008). Little research has been conducted on the role of family intervention in detoxification outcomes, and none of these studies (O'Farrell et el., 2007,2008) were from Canada. This suggests the need for experimental or quasi-experimental research on couples' role in improving detoxification outcomes before integrating into detoxification interventions. Moreover, as employment is crucial in Canadian society, so are detoxification treatments. Our research suggests that providing support to improve clients' employment status could lead to better detoxification completion and a successful transition to treatment. Previous studies have shown that couples therapy can help individuals deal with job-related stress (Lee & Merali, 2022). Moreover, interventions to assist unemployed clients in finding employment may improve detoxification outcomes.

In general, these two variables—employment and couple relationships—highlight the social dimension of addiction. Couples and working clients tend to have healthier social circles, which can be an asset in improving treatment outcomes. Strong social relationships, of which couple relationships are the executive unit in a family (Lee, 2009,p.10) and their spillover impact on the family members and the community, are the bedrock of better treatment outcomes and fuel the desire to recover from addiction (Adams, 2008; Alexander, 2010; Lee, 2014), aligned with the intended policy shift of the government of Alberta towards recovery-oriented systems of care (ROSC) (Alberta Mental Health and Addictions Advisory Council, 2022). The findings of this thesis reinforce the significance of recovery capital in enhancing treatment outcomes. Our study found that certain aspects of recovery capital, such as employment and couple relationships, could be linked to address the multifaceted challenges associated with addiction (White & Cloud, 2008). This is consistent with the better outcomes observed among rural residents, who, on average, may enjoy stronger social cohesion than urban residents (Burnette et

al., 2021). Future research is needed on the relational support to detoxification service utilizers that would help the prevention and intervention efforts.

One of our findings concerns the repeated use of detoxification services. Although the frequent use of detox seems like a waste of resources and an undesirable outcome from a service provision perspective (Chang et al., 2016; Kenne et al., 2010; Running Bear et al., 2022), it is a normal part of chronic addiction due to the frequency of relapse. Our finding is that repeat detox users achieve better rates of completion and transition to treatment, which is a crucial part of recovery and aligns with the ultimate goals of detoxification. It also indicated that not every readmission is problematic. However, frequent detoxification services may not be the most efficient way of utilizing available resources. This underscores the challenge of the nonlinear nature of recovery from addiction, in which individuals attend detoxification services multiple times over the years (AHS, 2018; Lee et al., 2014; McKeganey et al., 2004; Van den Berg et al., 2005), and the need to focus on those clients most frequently admitted.

In recognition of the difficulties clients encounter with addiction, prioritizing the provision of interventions to the most frequent users would result in better outcomes than focusing on those who attend less frequently. Interventions should aim to reduce the high frequency of detoxification use while improving completion and transition outcomes. Focusing on the most frequent detox users could help optimize the distribution of available resources while reducing waste. Although limiting the number of detoxification admissions is impractical, either limiting the number of days between detox episodes, as in California (Stephenson, 2008, cited in Nosyk et al., 2014) or enrolling the most frequent detox users in additional interventions may help decrease the cost of frequent readmissions and allow more clients to use the limited available beds, however, lack of guideline on how to measure detox success in Alberta is a gap

that needs future study. An assessment tool could be developed to decide when the number of admissions in a year or lifetime should be limited. Such a tool could be used in combination with an admission intake list. This also needs to be linked to clients' intentions to attend detox during admission. Interventions that tailor services to meet individual needs and utilize navigators (Hodgkin et al., 2019), along with implementing trauma-informed care (Odenwald & Semrau, 2011), can significantly enhance program delivery and help reduce repeat utilization of services. Extending access to services and resources over the weekend and involving Concerned Significant Others (CSOs) when clients find their support beneficial can decrease repeated detoxification utilization. These strategies improve service delivery and enable the system to better assist clients seeking detoxification as the first step in their recovery journey.

Our analysis demonstrated that clients with shorter LOS and those discharged on weekends had worse treatment outcomes. This calls for developing interventions to increase LOSs and redesign program delivery on weekends to withstand the challenges that lead clients to relapse, such as participating in social events (Blondell et al., 2006). Alternatively, normal services could be made available on weekdays.

Strengths and Limitations

This province-wide sample, consideration of numerous correlates, and inclusion of clients who cycled between completion and non-completion effectively captures the complexities of addiction and treatment. Moreover, this is the first study in Canada to focus specifically on admission to residential treatment following discharge from detoxification, and it provides a solid foundation for future longitudinal follow-up studies. The study's identification of a small proportion of detox clients who use limited beds multiple times, along with its findings on polysubstance use disorder and behavioural addictions, the association of addiction with unstable

marriage and employment, variations in use frequency across facilities, and the impact of the COVID-19 pandemic, significantly contributes to the existing literature. These findings could provide valuable inputs for determining how we can effectively care for detoxification clients. The results also yield insights into the potential for future interventions to reduce the need for multiple admissions. Methodologically, this study adopted a comprehensive approach, including all clients without stringent inclusion or exclusion criteria carried over from routine patient care. This provided a more naturalistic dataset (Van den Berg et al., 2015) than if the data had been collected through self-reports (Evans et al., 2010). Furthermore, longitudinal administrative data are invaluable in investigating substance use disorder and behavioural addictions, a process in which changes unfold over a long time (Evans et al., 2010).

The data used for this study only reflect clients who used provincial health services and did not account for other detoxification services in the community or privately run facilities. In addition, this study only considered clients in residential treatment at AHS and did not include outpatient services. As a result, the findings do not represent all provincial detoxification facilities. It is important to interpret the results of our study with caution due to the high risk of type I error that results from examining a large number of independent variables. The lack of data on clients' ethnicity or cultural background limits understanding of their characteristics and interventions. Although the study could compare different facilities, it could not identify the characteristics responsible for the observed outcome differences. Therefore, it is strongly recommended to compare different facilities to address this issue in future experimental or quasi-experimental research. Additionally, qualitative research and further research on private and other non-governmental detoxification facilities could explore the perspectives of clients and service providers. This would help provide a more comprehensive understanding of the

detoxification process and its outcomes, outlining new avenues for research and exploration. To this end, our study has REB-approved guiding questions for clients, service providers, and managers of Alberta residential treatment facilities (Study ID Pro00108773, and amendment # Pro00108773_AME2); however, no client or enough service providers expressed their interest in participating in the research.

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Chapter Six: Conclusion

This study offers new insights into the rates and predictors of clients in three categories: (1) those who completed, failed to complete/ who cycled between completion and non-completion, (2) those who transitioned from detoxification to residential addiction treatment, and (3) repeatedly admitted to residential detoxification facilities in Alberta. These findings have implications for future research and the potential to help develop targeted interventions to improve the low transition rates for clients at risk of non-completion and the most frequent users of detoxification. Our study revealed that clients who cycled between completion and non-completion (19%) could have been misclassified in previous studies that used a binary outcome; however, this needs further study. Focusing on the social determinants of health, specifically improving employment and intervening with couples through couples therapy, can enhance treatment completion, increase transition to residential treatment, and reduce repeated use of detoxification services. Our comparison between substances and their protocols calls for a targeted intervention to reduce non-completion, encourage transfer to treatment, and address frequent use among opiate users, which may contribute to tackling opiate overdoses. Transitioning to residential or outpatient day treatment—the primary goal of detoxification—can be encouraged by co-locating with improved coordination between detox and addiction treatment facilities and ensuring the completion of detox programs. Although frequent readmission may be seen as an undesirable outcome, it provides an opportunity for clients to continue their recovery efforts. Thus, targeting clients with repeated admissions using collaborative care planning may help foster success while limiting the frequency of admission. The system could thereby better serve clients wishing to detox as a first step in their journey.

Any intervention should take into consideration that addiction is a chronic disease and that resolving this disease and achieving recovery may take multiple admissions to detoxification and treatment. Reforming detox services in alignment with the principles of recovery-oriented care systems may help improve the prevailing care system. Emphasizing the importance of continuing with treatment and tailoring detox programs based on individuals' harm reduction and abstinence goals can enhance treatment transitions and decrease non-completion. In addition, targeted interventions, such as motivational counselling, treatment navigators (Brolin et al., 2017; Schilling et al., 2002; Torres et al., 2020), and early involvement of the spouse to improve mutual understanding of the detox process to reduce anxiety and to set realistic expectations, along with early engagement in couples therapy in the treatment phase (Lee, 2014; Rowe, 2012), could help improve communication, emotion regulation and stress reduction to reduce future episodes of cycling between completion and non-completion. Future studies should include the perspectives of clients who undergo detoxification and frontline and management personnel to gain a more comprehensive understanding of program planning to improve outcomes and client trajectories.

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