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Using chi-Squared Automatic Interaction Detection (CHAID) modelling to identify groups of methadone treatment clients experiencing significantly poorer treatment outcomes

Emma L. Murphy, B.Sc., H.Dip. (Stats), Catherine M. Comiskey, B.A.(Mod), M.Sc., Ph.D. *

Trinity College Dublin, School of Nursing and Midwifery, Dublin 2, Ireland

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ABSTRACT

In times of scarce resources it is important for services to make evidence based decisions when identifying clients with poor outcomes. chi-Squared Automatic Interaction Detection (CHAID) modelling was used to identify characteristics of clients experiencing statistically significant poor outcomes. A national, longitudinal study recruited and interviewed, using the Maudsley Addiction Profile (MAP), 215 clients starting methadone treatment and 78% were interviewed one year later. Four CHAID analyses were conducted to model the interactions between the primary outcome variable, used heroin in the last 90 days prior to one year interview and variables on drug use, treatment history, social functioning and demographics. Results revealed that regardless of these other variables, males over 22 years of age consistently demonstrated significantly poorer outcomes than all other clients. CHAID models can be easily applied by service providers to provide ongoing evidence on clients exhibiting poor outcomes and requiring priority within services.

1. Introduction

National drug treatment outcome evaluation studies have been conducted across the globe from America (Simpson, 2003) to Australia (Teeson et al., 2006) to England (Gossop, Marsden, Stewart, Lehmann, & Strang, 1999; Jones et al., 2009), Scotland (Macintosh, Bloor, & Robertson, 2008) and Ireland (Comiskey & Cox, 2010; Comiskey et al., 2009; Cox & Comiskey, 2007). These studies have demonstrated that treatment works at the individual level, in terms of drugs, risk and health and at a community level in terms of crime and social functioning. These studies have used a range of advanced regression modelling techniques to provide further evidence on what treatment works for whom under what circumstances. At a more local level or in countries without national treatment outcome studies and in the process of scaling up services, service providers require ongoing evidence to make decisions on which clients need priority in terms of not reaching treatment outcome goals. These service provision decisions often have to be made on available data which may be simple categorical data with missing fields (Comiskey, O'Sullivan, & Milnes, 2012). CHAID (Van Diepen & Franses, 2006) is an alternative approach to multiple linear and logistic regression models of treatment outcomes and is especially useful when the data set is not well-suited to regression analysis due to perhaps violation of normality assumptions. The CHAID method has been recommended within addiction research but to date its use has been limited (Dennis, Perl, Huebner, & McLellan, 2000).

CHAID modelling is a so called classification or decision tree method (Van Diepen & Franses, 2006). Classification and regression trees are also known as recursive partitioning, segmentation trees or decision trees and are widely used either as prediction or exploratory tools. Their interest lies mainly in their capacity to detect and account for non linear effects on the response variable. A detailed critical background on the historical development of the method is provided elsewhere (Ritschard, 2010). Within substance use research the approach has not been widely used. There are some exceptions to this, the method has been used to derive a target level of Adolescent Community Reinforcement Approach exposure required for recovery from adolescent substance misuse (Garner et al., 2008). The method has also been used within the HIV and AIDS literature where the results of a CHAID analysis, were used to classify participants in a multisite prevention trial into several major risk groups, defined by sex trading behaviour, substance use, age, ethnicity, and gender (MIMH Multisite HIV Prevention Trial Group, 2012). The method has also been used to identify risks associated with HIV infection among young adult short-term injection drug users (Doherty, Garfein, Monterroso, Brown, & Vlahov, 2000).

The aim of the current research was to use the method to identify key characteristics of clients achieving successful methadone treatment outcomes where a successful outcome was defined as no heroin use in the last 90 days one year after recruitment to a new

* Corresponding author. Centre for Practice and Healthcare Innovation, Trinity College Dublin, School of Nursing and Midwifery, Dublin 2, Ireland. Tel.: +353 1 8962776; fax: +353 1 8963001.
E-mail address: catherine.comiskey@tcd.ie (C.M. Comiskey).

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treatment episode. The objective was to conduct four CHAID analyses modelling the interactions between the outcome and the four domains, client's social functioning, current and previous drug use, previous drug treatment history and client health characteristics. The null hypotheses were that there was no association between a successful outcome and each of the four domains. These four domains were chosen as they reflect the current drug treatment philosophy of the European Union's European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) which has clearly placed an emphasis not only on the need for treatment to demonstrate a reduction in drug use at the individual level but the additional need for recovery and social rehabilitation at the individual and community level (Sumnall & Brotherhood, 2012).

2. Materials and methods

2.1. Study design

This study was part of a national longitudinal study to evaluate drug treatment, the Research Outcome Study in Ireland, ROSIE (Comiskey et al., 2009). This study was the first national, longitudinal, prospective multi-site treatment outcome study in Ireland. ROSIE was designed, not as a randomised control trial with specific numbers of respondents allocated to a treated or control group within certain geographical locations, but as a study that reflects the availability and distribution of treatment service provision in Ireland. Ideally, all health regions would have been included in some capacity, however not all treatment modalities were available within all regions.

Consequently, only regions with available opiate services were included. ROSIE, therefore, reflects the availability and distribution of existing national treatment service provision in 2003, the time of recruitment. All agencies providing treatment to opiate users in Ireland were contacted and informed about the ROSIE study. Information was sought from services regarding the nature of the organisation and the range of services provided. Thereafter, all methadone clinics within the greater Dublin area that had the capacity to facilitate treatment-intake during the recruitment period were included in the site selection process. Many clinics outside Dublin were known to be full to capacity but these were still contacted for recruitment purposes. In addition, all General Practitioners (GPs) prescribing under the Methadone Protocol were informed of the research and their assistance in study recruitment was requested. GPs were contacted via the Central Treatment List and followed-up with telephone calls and letters. Treatment sites were purposively rather than randomly selected to reflect treatment provision.

2.2. Sample

In terms of participant eligibility, only those opiate users defined as presenting for a new treatment episode were recruited to ROSIE, where 'new treatment episode' was defined as incorporating those who had never presented for treatment before, those who had presented for this type of treatment previously but were not in receipt of this type of treatment in the last six months and those who had presented for other types of treatment previously. Inclusion criteria for participants were to (a) be over 18 years of age, (b) be starting a new treatment episode as defined above, (c) have used opiates, (d) be prepared to consent to the tracking/follow-up procedures and (e) be prepared to provide a range of locator information. Involvement in ROSIE was voluntary and it was made clear to potential respondents that refusal to participate would not affect the treatment received. Participants were informed that they could, at any time, withdraw from the study. Confidentiality was assured and individuals were informed that all answers and comments provided would remain anonymous. All participants provided signed informed consent. The study protocol received ethical approval from the National University of Ireland at Maynooth.

A total of 215 clients who were in a methadone programme were recruited to take part in the ROSIE study. These represented a national coverage rate of 17% of all methadone clients (Comiskey et al., 2009). Methadone programmes included out-patient programmes, residential programmes, hospital programmes and prisons. At one year post treatment intake 91% ($n = 196$) were followed-up and located and 78% ($n = 167$) completed a full interview. Of the 215 clients recruited, 156 were attending an out-patient methadone clinic for their treatment and 123 (79%) of these completed a follow-up interview. These 123 clients formed the sample for the CHAID modelling research question within this current study. The clients in receipt of methadone within a General Practitioner setting were not eligible for inclusion as the aim of the study was to identify key characteristics of groups of clients achieving successful methadone treatment outcomes and at intake the study had 34 GP's collaborating with 54 participants.

In order to ensure sufficient participants had been recruited a retrospective power analysis was conducted. If a medium difference (effective size) between the mean number of days used heroin in the last 90 days between intake and year one was assumed and if the probability of a type 1 error, α, was set at the standard value of 0.05 and the probability of a type 2 error, β, set at 0.20 (giving 80% power) then 64 participants were required at each time point. Similarly, if a chi-squared test was used to check for an association between the two dichotomous variables used heroin at intake and used heroin at year one, then, given the previous assumptions on probabilities of type 1 and 2 errors, a total of 87 participants would be required at each time point (Cohen, 1992). Given these calculations the achieved sample size of 123 participants while modest was deemed adequate.

2.3. Measures

The ROSIE research instrument was adapted from the Maudsley Addiction Profile (MAP) and the DORIS instrument. The MAP is a brief, interviewer-administered questionnaire for treatment outcome research applications that measures problems in the four domains of substance use: health risk behaviour, physical and mental health and personal/social functioning (Marsden et al., 1998). The DORIS instrument is an extension of the MAP and includes extra quantitative and qualitative components (personal communication, Neil McKeganey and Gordon Hay, Centre for Drug Misuse Research, Glasgow, 2002).The questionnaire relied on self-reporting, which is accepted as being valid and reliable for the collection of data on drug use, criminality and HIV risk behaviour (Darke, 1998; Del Boca & Noll, 2002).

2.4. Data analysis

Descriptive statistics are provided for outcomes at intake and at the one year follow-up interview. Paired t tests and the McNemar test (Agresti, 1996) was used as appropriate, to test for changes in outcomes between intake and one year follow-up interview. Given the dichotomous nature of the outcome variable and the amount of missing data, decision tree analysis proved to be a suitable model type to apply to this data. A particular type of decision tree analysis called Chi-Square Automatic Interaction Detector (CHAID) was applied following a process of considering the applicability of other model types.

CHAID was developed in South Africa (KASS, 1980), it is a heuristic decision tree modelling method. It is also widely used in marketing to segment customers into groups (SPSS, 2006) thereby providing customer profiles. Given that methadone maintenance clients are customers of the service they are attending, CHAID modelling is highly