

PUBLICATIONS OF  
THE UNIVERSITY OF EASTERN FINLAND



UNIVERSITY OF  
EASTERN FINLAND

## **Dissertations in Health Sciences**

**ELINA RAUTIAINEN**

# **Health service use, care costs, and associated care outcomes of patients with alcohol use disorder in North Karelia, Finland: A register-based study**



**HEALTH SERVICE USE, CARE COSTS, AND  
ASSOCIATED CARE OUTCOMES OF PATIENTS  
WITH ALCOHOL USE DISORDER IN NORTH  
KARELIA, FINLAND: A REGISTER-BASED STUDY**



Elina Rautiainen

**HEALTH SERVICE USE, CARE COSTS, AND  
ASSOCIATED CARE OUTCOMES OF PATIENTS  
WITH ALCOHOL USE DISORDER IN NORTH  
KARELIA, FINLAND: A REGISTER-BASED STUDY**

To be presented by permission of the Faculty of Health Sciences,  
University of Eastern Finland for public examination (Remote access)  
on February 5<sup>th</sup>, 2021, at 12 o'clock noon

Publications of the University of Eastern Finland  
Dissertations in Health Sciences  
No 606

University of Eastern Finland Institute of Public Health and Clinical Nutrition, School of  
Medicine, Faculty of Health Sciences  
2021

Series Editors

Professor Tomi Laitinen, M.D., Ph.D.

Institute of Clinical Medicine, Clinical Physiology and Nuclear Medicine  
Faculty of Health Sciences

Professor Tarja Kvist, Ph.D.

Department of Nursing Science  
Faculty of Health Sciences

Professor Ville Leinonen, M.D., Ph.D.

Institute of Clinical Medicine, Neurosurgery  
Faculty of Health Sciences

Professor Tarja Malm, Ph.D.

A.I. Virtanen Institute for Molecular Sciences  
Faculty of Health Sciences

Lecturer Veli-Pekka Ranta, Ph.D.

School of Pharmacy  
Faculty of Health Sciences

Distributor:

University of Eastern Finland

Kuopio Campus Library

P.O.Box 1627

FI-70211 Kuopio, Finland

[www.uef.fi/kirjasto](http://www.uef.fi/kirjasto)

Name of the printing office/kirjapaino

Grano, 2021

ISBN: 978-952-61-3694-3 (print/nid.)

ISBN: 978-952-61-3695-0 (PDF)

ISSNL: 1798-5706

ISSN: 1798-5706

ISSN: 1798-5714 (PDF)

Author's address: Institute of Public Health and Clinical Nutrition, School of Medicine  
University of Eastern Finland  
KUOPIO, FINLAND

Doctoral programme: Health Sciences

Supervisors: Professor Tiina Laatikainen, M.D.,Dr.Med.Sci.  
Institute of Public Health and Clinical Nutrition,  
School of Medicine  
University of Eastern Finland  
KUOPIO, FINLAND

Emeritus Professor Olli-Pekka Rynänen, M.D.,Dr.Med.Sci.  
Institute of Public Health and Clinical Nutrition,  
School of Medicine  
University of Eastern Finland  
KUOPIO, FINLAND

Reviewers: Professor Jyrki Korkeila M.D., Dr.Med.Sci.  
Department of Clinical Medicine  
University of Turku  
TURKU, FINLAND

Docent Tuuli Pitkänen, Ph.D.  
Department of Psychology  
University of Jyväskylä  
JYVÄSKYLÄ, FINLAND

Opponent: Professor Sami Pirkola, M.D., Dr.Med.Sci.  
Faculty of Social Sciences  
Tampere University  
TAMPERE, FINLAND





Rautiainen, Elina

Health service use, care costs, and associated care outcomes of patients with alcohol use disorder in North Karelia, Finland: A register-based study

Kuopio: University of Eastern Finland

Publications of the University of Eastern Finland

Dissertations in Health Sciences 606. 2021, 119 p.

ISBN: 978-952-61-3694-3 (print)

ISSNL: 1798-5706

ISSN: 1798-5706

ISBN: 978-952-61-3695-0 (PDF)

ISSN: 1798-5714 (PDF)

## ABSTRACT

Individuals with alcohol use disorders (AUDs) often have high social and health care needs. However, knowledge gaps exist regarding the service system's ability to identify and treat problems related to harmful alcohol use and dependence in Finland. This dissertation examined the social and health service use patterns of individuals with AUDs in relation to care outcomes by using regional electronic social and health care registers. Furthermore, associated direct care costs across the social and health service system were examined.

In Study I, treatment outcomes of continual AUD, death, and probability of achieving stable remission of a cohort of patients with an identified AUD (N = 396) were examined by following the cohort in time for 6 years (2011–2016). In Study II, the same cohort was examined and different factors, such as individual characteristics and service use frequencies, associated with care outcomes were identified. In Study III, the service resource use of patients with AUDs was compared with another resource-demanding chronic condition, type 2 diabetes. In Study IV, the care costs of different service use profiles were examined by identifying all the individuals (N = 5,136) aged 18 or older with an alcohol-related code marked in the electronic health registers in 2014. In Study V, different risk factors' direct effects on total care costs were examined in more detail, with a specific focus on the causal effect of achieving stable remission on the cost accumulation.

The results showed that individuals identified through registers systematically seem to have an advanced form of AUD. Despite the random sampling of the study participants, it was evident that alcohol-related International Classification of Diseases (ICD-10) codes had not been used unless the disease had reached a more severe stage. This also partly explains the high mortality rate (22.9%) identified among the working-age population in Study I. Of note, only 18.4% of patients achieved stable remission. Compared with age- and gender-matched type 2 diabetes patients, the hazard ratio for death was 7.5 for AUD patients. Frequent alcohol-related (ICD-10 code F10) visits to a primary care doctor were associated with increased risk of death, possibly indicating challenges in the treatment of AUDs in health centers. Contact with AUD or mental health services was associated with achieving stable remission. Patients with AUDs had more frequent visits to emergency services (odds ratio [OR] 8.89) and more frequent somatic

specialized care hospitalization periods (OR 11.30) compared with patients with type 2 diabetes. In Study IV, the 5-year mean care costs between 2014 and 2018 were examined; patients treated only with AUD services had 53% lower total care costs compared with those who remained outside AUD or mental health services. Most costs were accumulated from the specialized health care, and the costliest 10% of individuals accounted for 51.7% (65 million euros) of the total 5-year costs. The role of specialized AUD services and outpatient mental health treatment remained modest in the cost accumulation. Likewise, the results of Study V demonstrated how achieving stable remission has a cost-offsetting effect on the total cost accumulation: The proportion of the lowest cost quartile increased (42.86% vs 25.07%) and the high cost quartile (10.71% vs 26.27%) decreased compared with those who continued drinking during the 5-year follow-up period. Somatic comorbidity had the strongest effect on cost accumulation.

By using electronic social and health records, this dissertation provided new information on the social and health service use patterns and care costs of individuals with AUDs. Specifically, there are associations between access to AUD treatment and improved care outcomes and decreased care costs. These findings indicate that more attention should be paid to the timely treatment of somatic conditions among individuals with AUDs. Electronic health registers are an applicable although currently limited data source for the register-based examination of the effectiveness of the AUD service system. Structured recording of outcomes and quality measures could improve register-based service-system-wide effectiveness research and care of individuals with AUDs.

**Keywords:** alcohol use disorders; service use; electronic health records; care outcomes; cost of care

**Medical Subject Headings:** Alcoholism; Alcohol-Related Disorders/therapy; Outpatients; Comorbidity; Electronic Health Records; Health Services/statistics and numerical data; Mental Health Services/statistics and numerical data; Health Care Costs; Outcome Assessment, Health Care; Mortality, Premature; Finland

**National Library of Medicine Classification:** W 74, W 84.4, WM 274, WX 175

Rautiainen, Elina

Terveyspalveluiden käyttö, kustannukset ja hoidon päätetapahtumat potilailla, joilla on alkoholinkäyttöhäiriö: rekisteritutkimus Pohjois-Karjalasta

Kuopio: Itä-Suomen yliopisto

Publications of the University of Eastern Finland

Dissertations in Health Sciences 606. 2021, 119 p.

ISBN: 978-952-61-3694-3 (nid.)

ISSNL: 1798-5706

ISSN: 1798-5706

ISBN: 978-952-61-3695-0 (PDF)

ISSN: 1798-5714 (PDF)

## TIIVISTELMÄ

Alkoholia haitallisesti käyttävien ja alkoholiriippuvuuteen sairastuneiden ihmisten on aikaisemmissa tutkimuksissa tunnistettu tarvitsevan paljon sosiaali- ja terveyspalveluita. Kokonaiskuva palvelujärjestelmän kyvystä tunnistaa ja hoitaa alkoholin haitalliseen käyttöön ja riippuvuuteen liittyviä ongelmia on kuitenkin puutteellinen. Tämä väitöskirjatutkimus pyrki selvittämään alueellisten sähköisten sosiaali- ja terveydenhuollon potilas- ja asiakastietojärjestelmien tuottamien rekisteritietojen avulla alkoholia haitallisesti käyttävien ja alkoholiriippuvuuteen sairastuneiden henkilöiden sosiaali- ja terveyspalveluiden käyttöä suhteessa hoidon päätetapahtumiin. Lisäksi tässä työssä tutkittiin sosiaali- ja terveyspalveluiden käytön aiheuttamia suoria kustannuksia.

Osatutkimuksessa I tutkittiin potilaiden, joilla oli tunnistettu alkoholiongelma (N=396) hoidon päätetapahtumien esiintyvyyttä kuuden seurantavuoden aikana (2011–2016). Päätetapahtumina tarkasteltiin alkoholin ongelmakäytön jatkumista, kuolemia ja pysyvän remission saavuttamista. Osa-tutkimuksessa II tutkittiin eri tekijöiden, kuten taustamuuttujien ja palvelunkäytön frekvenssien yhteyttä hoidon päätetapahtumiin. Osatutkimuksessa III puolestaan verrattiin kahden paljon palveluita tarvitsevan potilasryhmän palvelunkäytön frekvenssejä, potilaiden, joilla on alkoholiongelma ja tyypin 2 diabeesta sairastavia potilaita, toisiinsa. Osatutkimuksessa IV eri palvelunkäytön profiilien suoria kustannuksia vertailtiin niiden yli 18-vuotiaiden henkilöiden välillä, joilta löytyi sähköisen potilastietojärjestelmän potilastiedoista alkoholiin liittyvä diagnoosi- tai käyntimerkintä (N=5,136). Osatutkimuksessa V tutkittiin eri riskitekijöiden syy-yhteyttä kustannusten kertymiseen sekä tutkittiin pysyvän remission vaikutusta yksilön sosiaali- ja terveyspalveluiden käytöstä aiheutuvien suorien kustannusten kumuloitumiseen.

Tulokset osoittavat, että sähköisistä potilastietojärjestelmistä tunnistetuilla henkilöillä oli pääsääntöisesti havaittavissa jo pitkälle kehittynyt alkoholiongelma ja useilla heistä oli lisäksi paljon muita sairauksia. ICD-10 diagnosipohjainen satunnaisotanta paljasti, että alkoholiin liittyviä diagnooseja ei juurikaan käytetä, ellei alkoholiongelma ole jo pitkälle edennyt. Tämä havainto myös osaltaan selittää osatutkimuksessa I tehtyä havaintoa tutkittavien korkeasta kuolleisuusasteesta (22,9 %). Vastaavasti pysyvän remission saavutti 18,4 % tutkittavista kuuden vuoden seuranta-aikana. Verrattaessa kuolleisuutta iän ja sukupuolen mukaan

vakioituun verrokkiryhmään, tyypin 2 diabetesta sairastaviin, havaittiin kuolleisuuden olevan yleisempää potilailla, joilla oli alkoholiongelmia, riskitehtävien suhteen (hazard ratio, HR) ollessa 7.5. Toistuvat suoraan alkoholista johtuvat käynnit (ICD-10 tautiluokituksen ryhmän F10 koodi päädiagnoosina) terveyskeskuslääkärin vastaanotolla olivat yhteydessä suurempaan kuolemanriskiin, mikä puolestaan viittaa mahdollisiin haasteisiin hoidon toteuttamisessa terveyskeskuksissa. Vastaavasti hoitokontakti mielenterveyden avopalveluihin oli yhteydessä pysyvän remission saavuttamiseen. Verratessa potilaiden, joilla oli alkoholiongelmia ja tyypin 2 diabetesta sairastavien potilaiden sosiaali- ja terveyspalveluiden käyttöä, havaittiin alkoholiongelmaisilla potilailla esimerkiksi runsaampaa päivystyksessä asiointia (OR 8.89) ja enemmän somaattisen erikoissairaanhoidon hoitajaksoja (OR 11.30). Neljännessä osatutkimuksessa hoidon suorien kustannuksien vuosilta 2014–2018 verrattiin eri palvelunkäytön profiilien välillä ja havaittiin, että yksistään päihdepalveluissa hoidossa olevilla oli 53 % matalammat keskimääräiset kustannukset verrattuna mielenterveys- ja päihdepalveluiden ulkopuolelle jääneisiin potilaisiin. Kaikissa palvelunkäytön profiileissa kustannuksia kertyi eniten erikoissairaanhoidosta. Kalleimman 10 prosentin osuus viiden vuoden seuranta-ajan kokonaiskustannuksista oli 51,7 % (65 miljoonaa euroa). Vastaavasti päihdepalveluiden ja mielenterveyden avopalveluiden osuus kustannusten kertymisestä oli vähäinen. Viides osatutkimus demonstroi remission vaikutusta kustannusten kehittymiseen. Pysyvän remission saavuttaneilla matalimpaan kustannuskvartaaliin kuuluvien osuus kasvoi (42,86 % vs. 25,07 %) ja korkeampaan kvartaaliin kuuluvien osuus vastaavasti laski (10,71 % vs. 26,27 %) verrattuna niihin, joilla alkoholiongelmia jatkui viiden vuoden seurannan aikana. Sen sijaan eniten kustannuksia lisäsi somaattinen oheissairastavuus.

Tämä tutkimus tuotti uutta tietoa henkilöiden, sosiaali- ja terveyspalveluiden käytöstä ja hoidon kustannuksista henkilöillä, joilla on alkoholiongelmia. Aineistona käytettiin alueellisia rekisteritietoja. Tutkimuksessa tunnistettiin päihdehoitoon pääsyn olevan yhteydessä parempiin hoidon päätetapahtumiin sekä matalampiin hoidon kokonaiskustannuksiin. Yhtä lailla kustannusten hillitsemiseksi tulisi oheissairastavuuden oikea-aikaiseen hoitoon panostaa nykyistä enemmän. Sähköisten potilastietojärjestelmien sisältämiä tietoja voidaan soveltaa tällä hetkellä vain rajoitetusti rekisteripohjaisessa päihdepalvelujärjestelmän vaikuttavuuden tutkimisessa. Hoidon vaikuttavuus- ja laatumittareiden rakenteinen kirjaaminen tajoaisivat paremmat edellytykset rekisteripohjaiselle palvelujärjestelmätutkimukselle ja yksilöiden hyvälle hoidolle.

**Avainsanat:** alkoholinkäyttöhäiriö; palvelujen käyttö; sähköinen potilastietojärjestelmä; hoidon päätetapahtumat; hoidon kustannukset

**Yleinen suomalainen ontologia:** alkoholismi, alkoholiongelmat, hoitotarve, kustannukset, palvelutarpeet, potilastietojärjestelmät

**Luokitus:** W 74, W 84.4, WM 274, WX 175

# ACKNOWLEDGEMENTS

This study was carried out in the Institute of Public Health and Clinical Nutrition, Faculty of Health Sciences, Kuopio campus, University of Eastern Finland, during the years 2015–2020.

I would like to express my sincerest gratitude to my supervisors, Professor Tiina Laatikainen, M.D., Ph.D., and Emeritus Professor Olli-Pekka Ryyänen M.D., Ph.D. for their expertise and continuous support that has carried me through this study process. Thank you for all your guidance, time, and support, which have enabled me to grow as a researcher.

I warmly thank my co-authors, Professor Jussi Kauhanen, M.D., Ph.D., Docent Miika Linna, Ph.D., Eeva Reissel, M.D., Ph.D., and Päivi Rautiainen, M.D., Ph.D. for their constructive comments and advice. Pekka Kekolahti, Ph.D. is especially thanked for his knowledge and advice with Bayesian analysis.

I sincerely thank the pre-examiners of this doctoral thesis, Professor Jyrki Korkeila, M.D., Ph.D., and Tuuli Pitkänen, Ph.D. Your thoughtful comments and constructive criticism significantly improved this thesis. I am also grateful for Professor Sami Pirkola for accepting the invitation to be the opponent for public examination of this PhD thesis.

The first sub-studies of this thesis were undertaken while I worked as a visiting researcher, funded by the Finnish Foundation on Alcohol Studies, at the Alcohol, Tobacco and Addictions Unit at the Finnish Institute for Welfare and Health. Thereafter, this work was financially supported by the Doctoral School of Health Sciences, University of Eastern Finland and the IMPRO research consortium, led by Professor Tiina Laatikainen and funded by the Strategic research council at the Academy of Finland (grant no. 312703). I express my sincere gratitude to all these funding parties.

My most humble thanks go to everyone at the Alcohol, Tobacco and Addictions Unit at the Finnish Institute for Welfare and Health for warmly welcoming me as a visiting researcher in 2017 and for providing a supportive work environment during these years. Special thanks to Research Professors Pekka Hakkarainen and Pia Mäkelä for providing me the opportunity to pursue my goals as a researcher and for all the guidance to the phenomena of addictions.

I wish also to thank the IMPRO consortium researchers. I feel privileged that I have had the opportunity to work in such a great multidisciplinary consortium and learn from your expertise. I also want to thank Marja-Leena Lamidi for your statistical help. Special thanks to IMPRO coordinator Katja Wikström for your positive energy and all your advices during this journey. Special thanks also to research assistant Laura Kekäläinen who provided significant help with data collection.

My loving thanks go to my family and friends for being there to support.

Finally, I thank my spouse Timo for his endless support, patience, and encouragement.

Helsinki, 28 October 2020  
Elina Rautiainen



# LIST OF ORIGINAL PUBLICATIONS

This dissertation is based on the following original publications:

- I Rautiainen E, Rynnänen O-P and Laatikainen T. Care outcomes and alcohol-related treatment utilisation profiles of patients with alcohol-use disorder: A prospective cohort study using electronic health records. *Nordic J Stud Alcohol Drugs* 35(5):329-343, 2018.
- II Rautiainen E, Rynnänen O-P, Reissell E, Kauhanen J and Laatikainen T. Alcohol-related social and health service use patterns as predictors of death and remission in patients with AUD. *J Subst A Treat* 96:65-74, 2019.
- III Rautiainen E, Rynnänen O-P, Rautiainen P and Laatikainen T. How individuals with alcohol problems use social and health care services in Finland? Comparison of service use patterns between two high-need patient groups: alcohol use disorder patients and type 2 diabetic patients over 6 years. Submitted to *Nordic Studies on Alcohol and Drugs*.
- IV Rautiainen E, Linna M, Rynnänen O-P and Laatikainen T. Do the costs of AUD-related health and social care services vary across patient profiles? *J Stud Alcohol Drugs*, 81, 2: 144-151, 2020.
- V Rautiainen E, Rynnänen O-P, Laatikainen T and Kekolahti P. Factors Associated with 5-Year costs of Care among a Cohort of Alcohol Use Disorder Patients: A Bayesian Network Model. *Healthcare Informatics Research*, 26, 2: 129-145, 2020.

The publications were adapted with the permission of the copyright owners.





# CONTENTS

<b>ABSTRACT</b> .....	<b>7</b>
<b>TIIVISTELMÄ</b> .....	<b>9</b>
<b>ACKNOWLEDGEMENTS</b> .....	<b>11</b>
<b>1 INTRODUCTION</b> .....	<b>19</b>
<b>2 REVIEW OF THE LITERATURE</b> .....	<b>21</b>
2.1 CONCEPTUAL FRAMEWORK.....	21
2.2 DEFINITION OF ALCOHOL USE DISORDERS .....	23
2.3 ETIOLOGY OF ALCOHOL USE DISORDERS.....	23
2.3.1 Etiological models of alcohol use disorders .....	23
2.3.2 Neurobiology of alcohol use disorders.....	24
2.3.3 Genetic etiology of alcohol use disorders.....	25
2.3.4 Typologies of AUDs and treatment matching.....	26
2.4 ALCOHOL CONSUMPTION PATTERNS AND ALCOHOL USE DISORDERS .....	
IN FINLAND.....	27
2.4.1 Alcohol consumption patterns and risk of alcohol use disorders and other health conditions .....	28
2.4.2 Prevalence of alcohol use disorders .....	28
2.5 DEFINITION OF ALCOHOL USE DISORDER TREATMENT .....	29
2.6 LEGISLATIVE BASIS FOR TREATMENT OF ALCOHOL USE DISORDERS .....	29
2.7 QUALITY CRITERION FOR TREATMENT OF ALCOHOL USE DISORDERS .....	31
2.8 EVIDENCE BASED TREATMENT OF ALCOHOL USE DISORDERS .....	32
2.9 TREATMENT OF INDIVIDUALS WITH SEVERE ALCOHOL .....	33
2.10 CLINICAL COURSE OF ALCOHOL USE DISORDERS AND ASSOCIATED OUTCOMES.....	34
2.10.1 Alcohol use disorders and mortality risk.....	35
2.10.2 Alcohol use disorders and probability of remission .....	36
2.11 ALCOHOL USE DISORDERS AND HEALTH SERVICE USE .....	37
2.11.1 Use of specialized addiction services .....	38
2.11.2 Factors associated with the use of specialized addiction services .....	39
2.11.3 Register studies on alcohol use disorders and health service use patterns.....	40
2.11.4 Health service use patterns as predictors of care outcomes .....	40
2.12 ALCOHOL USE DISORDERS AND COSTS OF CARE .....	41
2.13 SUMMARY OF PREVIOUS RESEARCH .....	43
<b>3 AIMS OF THE STUDY</b> .....	<b>45</b>
<b>4 SUBJECTS AND METHODS</b> .....	<b>47</b>
4.1 STUDY SUBJECTS, SETTING, AND GENERAL STUDY DESIGN.....	47
4.1.1 Studies I, II, and V cohort .....	47
4.1.2 Study cohort III.....	48
4.1.3 Study cohort IV.....	48
4.2 REGISTERS USED .....	49
4.3 MEASURES OF OUTCOMES.....	49
4.3.1 Care outcome status .....	49
4.3.2 Total care costs.....	50

4.4	COVARIATES.....	50
4.4.1	Enabling factors .....	54
4.4.2	Predisposing factors / Social problems.....	54
4.4.3	Need factors / Clinical variables .....	54
4.4.4	Health service use variables .....	55
4.5	STATISTICAL METHODS.....	56
4.6	ETHICAL CONSIDERATIONS.....	58
<b>5</b>	<b>RESULTS .....</b>	<b>61</b>
5.1	ALCOHOL USE DISORDER CARE OUTCOMES AND HELP SEEKING .....	
	PATTERNS.....	62
5.2	QUALITY OF THE ALCOHOL TREATMENT SYSTEM .....	64
5.3	EQUITY IN ACCESS TO CARE .....	67
5.4	CARE COSTS.....	70
<b>6</b>	<b>DISCUSSION .....</b>	<b>79</b>
6.1	SUMMARY OF MAIN RESULTS.....	79
6.2	ADDRESSING THE COMPLEX SOCIAL AND HEALTH CARE NEEDS .....	
	OF INDIVIDUALS WITH ALCOHOL USE DISORDERS .....	80
6.3	EQUITY OF THE TREATMENT SYSTEM: OVERALL HEALTH SERVICE USE .....	
	AND CARE OUTCOMES.....	82
6.4	EFFECTIVENESS ASPECTS OF THE ALCOHOL TREATMENT SYSTEM: CAN WE.....	
	AFFORD NOT TO PROVIDE TREATMENT?.....	83
6.5	METHODOLOGICAL CONSIDERATIONS .....	84
6.5.1	Electronic social and health records .....	84
6.5.2	Strengths and limitations.....	86
<b>7</b>	<b>CONCLUSIONS.....</b>	<b>89</b>
	<b>REFERENCES.....</b>	<b>91</b>
	<b>APPENDICES .....</b>	<b>113</b>

# ABBREVIATIONS

AUD	Alcohol use disorder	OR	Odds ratio
ANB	Augmented naïve Bayes	PHC	Primary health care
APR	Ambulatory and Primary Care-Related Patient Groups	P-GT	Plasma glutamyl transferase
CI	Confidence interval	P-ALT	Plasma alanine aminotransferase
CBT	Cognitive-behavioural therapy	P-AST	Plasma aspartate aminotransferase
DRG	Diagnosis-Related Groups	P-ALP	Plasma alkaline phosphatase
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders	SBM	Socio Behavioral Model
EHR	Electronic health record	SDG	United Nations Sustainable Development Goal
E-MCV	Mean corpuscular volume	S-DST	Serum desialotransferrin
HILMO	National health register	SES	Socio-economic status
HR	Hazard ratio	SPAT	Finnish classification of functions and procedures in outpatient primary health care
HSU	Health service use	SUD	Substance abuse disorder
ICD-10	International Statistical Classification of Disease	T2DM	Type two diabetes
ICPC2	International Classification of Primary Care	TSF	12 step oriented treatment
MET	Motivation enhancing therapy	WHO	World Health Organisation
MH	Mental health		



# 1 INTRODUCTION

Alcohol use disorders (AUDs) are common in the Finnish society. In the health care context, they are often defined as chronic and relapsing conditions affected by several genetic, psychological, societal, and intergenerational factors (Dennis & Scott, 2007; Schuckit, 2009; van den Brink & Kiefer, 2020). Although the Finnish social and health care service system is based on universalism and access to adequate care is a universal right based on a Finnish constitutional act (731/1999), inequalities in access to adequate care exist in many patient groups, including patients with alcohol problems. The current fragmented alcohol treatment system, with notable regional variations, further creates challenges for effective treatment and also for the examination of social and health service use patterns and care costs for patients with alcohol problems.

Previous international studies have identified that individuals with AUDs often exhibit excess use of social and health care services, especially emergency services, and thus they are often considered to be an expensive patient group (Laramée et al., 2013; Leskelä et al., 2013; Miquel et al., 2018). On the other hand, previous research has shown that only a minority of individuals have access to specialized addiction or mental health services. In Finland, there are knowledge gaps regarding the alcohol-related health service use patterns across the treatment system in relation to care outcomes in this patient group. In recent years, the improvement of electronic health record (EHR) systems has opened new opportunities to examine social and health care service use through register data. This is an important opportunity because population surveys tend to underestimate alcohol consumption and its associated harms.

Person-centered health data enables an outcome-based approach in health service research and thus a better understanding on how different factors affect the care outcomes. This information is required to improve the quality of care and performance of treatment systems. EHRs provide real-world data that can be used to assess the performance of a health system among different patient groups, including patients with AUDs (Alemi et al., 2018; Tai et al., 2012; Wu et al., 2016). Furthermore, EHRs provide the possibilities to identify real-world social and health service use patterns (Ghitza et al., 2011). In addition to examining the use of different services, EHRs enable research on continuity of care and associations between frequent visits to different professional groups and care outcomes. The role of the multidisciplinary social and health workforce is essential in the care of chronic conditions such as AUDs (Fortman et al., 2020; Morgan et al., 2019; Segal & Leach, 2011; Wagner, 2000).

This dissertation examined the social and health service use patterns of individuals with AUDs and aimed to identify associations between social and health service use patterns and long-term care outcomes. Furthermore, the care costs of patients with an identified AUD were examined by using EHRs and social care client databases. This study was conducted in North Karelia, which is one of the first regions in Finland to have adopted a uniform patient information system across social and health care services, a factor that facilitates system-wide service use research.



## 2 REVIEW OF THE LITERATURE

### 2.1 CONCEPTUAL FRAMEWORK

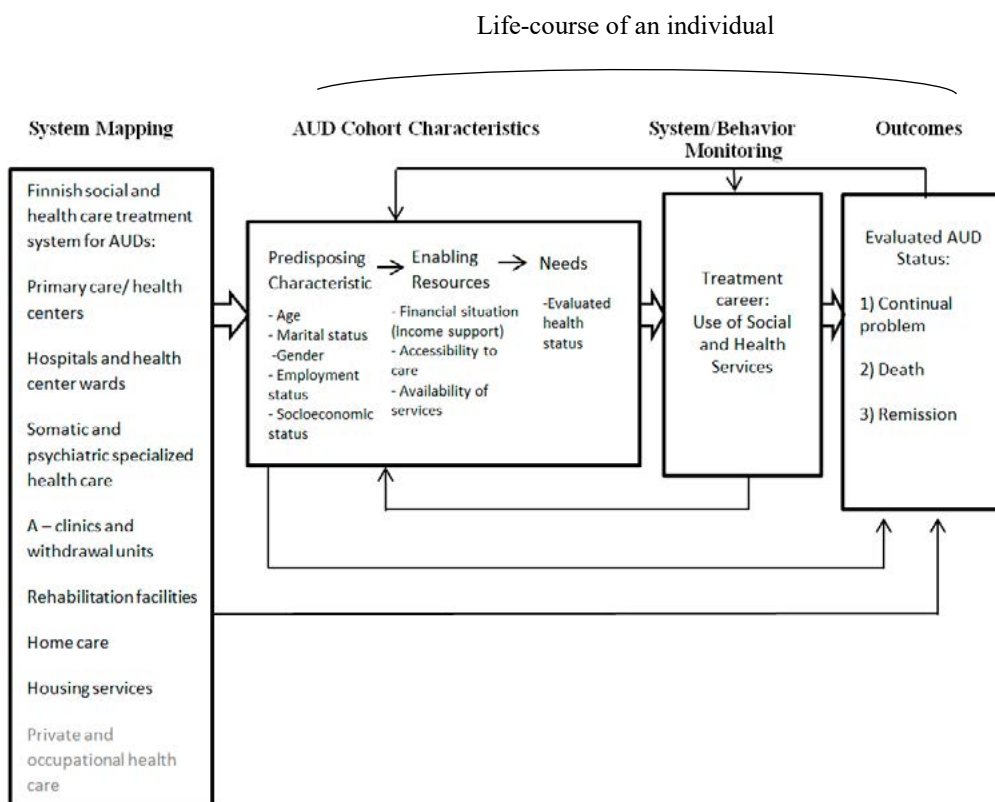
The conceptual framework of this dissertation was influenced by the life course approach by Ben-Shlomo and Kuh (2002), Elder (1985), and Hser et al. (2007). In chronic disease epidemiology, a life course approach is used to examine time-related causal links between different exposures during the life course and chronic disease outcomes (Ben-Shlomo & Kuh, 2002; Lynch & Smith, 2005). The roots of the life course paradigm lie in the social research of human lives in the 1960s and 1970s (Alwin, 2012; Elder et al., 2003). Long-term patterns of stability and change in relation to events, transitions, and trajectories across the life span are the essence of the life course approach (Alwin, 2012; Elder, 1985, 17). In a health service use context, the life course approach is often seen as a framework to understand the dynamic social processes of treatment (Pescosolido & Boyer, 2010); for example, Hser et al. (2007) applied the life course approach to study drug use trajectories. Hser (2007) incorporated the concepts of illness career developed by Pescosolido (1991) and treatment career developed by Hser et al. (1997) together with concepts of criminology (Laub & Sampson, 1993) to form a longitudinal dynamic approach, with the aim to identify key factors associated with transitions in the course of addiction and its treatment. In this dissertation, the life course approach was used as a guiding framework to understand and conceptualize etiological and epidemiological aspects and the clinical course of AUDs.

The treatment of AUDs is dependent on the surrounding society and its values; hence, individuals' treatment career across their life course is inseparably integrated with the current treatment system and policies defined by the society. Babor et al. (2008) described a public health approach to study service systems for people with substance use disorders (SUDs). This treatment-system-wide conceptual model enables a detailed examination of health service use across different services and identification of mediators and moderators of an effective treatment system, such as system quality aspects. Thus, the treatment system approach enables integration of access, economy, continuity of care, and effectiveness perspectives in health service use research (Babor et al., 2008), all of which are elements studied in this dissertation.

This dissertation further builds on Andersen's sociobehavioral model (SBM) to model health service use and care outcomes. The SBM is a structural model that identifies predisposing, enabling, and need factors that predict health service utilization, which are further associated with care outcomes. Predisposing factors include individual characteristics such as age, marital status, gender, employment status, and socioeconomic status, among others. The most commonly used enabling factors are financial situation, education, accessibility to care, and availability of medical services. Whereas need factors relate to evaluated or perceived health status (Andersen, 1995; Babitsch et al., 2012), the SBM aims to understand the use of services by focusing on the influence of the system and issues of access to care (Andersen, 1995).

This dissertation balances between a public health approach and social and health services research scope. On the one hand, AUDs were approached from the public health perspective

and the clinical course of AUDs was conceptualized through the life course approach. On the other hand, social and health service use was not just seen as one determinant of health. From the social and health services perspectives, the research scope was adapted to the ideology that the treatment course, i.e., health service use patterns, together with predisposing and enabling factors such as age, marital status, gender, employment status, and socioeconomic status mediate the clinical course and care outcomes. It has been hypothesized that different services and social and health care professionals across the treatment system have varying impacts on the care outcomes, and competence related to treatment of AUDs and other mental health problems is essential. Respectively, treatment system quality and effectiveness monitoring can be conducted by examining the costs of services. The conceptual framework of this dissertation is presented in Figure 1.



**Figure 1.** Conceptual framework of the dissertation: Individual characteristics, health service use patterns and care outcomes and their associations in individuals with alcohol use disorders (AUDs) – Influenced by the Integrated model of Andersen Behavioral Model (Emerging Model – phase 4: Access to Medical Care) and Treatment system approach by Babor et al. (2008).



## **2.2 DEFINITION OF ALCOHOL USE DISORDERS**

Within the disease-management framework used in health care settings, alcohol use disorders (AUDs) have been defined as often chronic, lifelong conditions requiring ongoing care (Proctor & Herschman, 2014). The Diagnostic and Statistical Manual of Mental Disorders (4th ed.; DSM-IV; American Psychiatric Association [APA], 1994) and the International Statistical Classification of Disease (ICD-10), developed by the World Health Organization (WHO), both include alcohol abuse, harmful use, and alcohol dependence in the definition of AUDs. In the diagnostic criteria, alcohol abuse and harmful use include alcohol causing physical, mental, social, or legal harm, without symptoms of dependence. Both the ICD-10 and the DSM-IV define alcohol dependence as including elements of craving, tolerance, and withdrawal; impaired control; negative emotions; and persistence of use despite the presence of harms. In the most recent Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; APA, 2013), alcohol abuse and alcohol dependence have been integrated into a single AUD category with mild, moderate, and severe subclassifications and the presence of symptoms defines the severity of AUD (ICD-10; DSM-IV; DSM-5; National Institutes of Health [NIH], 2016, 2019).

A diagnosis-based approach to define AUDs has been criticized as a substance-centered approach that does not sufficiently consider the role of self-regulation problems and psychological control attempts behind addictive behaviors (Brinkman et al., 1982; Taipale, 2017). Furthermore, establishing a diagnosis for a cyclic process that often develops slowly during the life course has its challenges. Thus, for effective treatment of AUDs, a broader biopsychosocial approach including biological, behavioral, and social context components is required (van den Brink & Kiefer, 2020, 498–504). In this dissertation, service use and care costs of individuals with alcohol problems were examined through EHRs, in which recording conditions and reasons for contact are based on diagnosis information; hence, diagnosis-based definitions of AUDs have been adapted.

## **2.3 ETIOLOGY OF ALCOHOL USE DISORDERS**

### **2.3.1 Etiological models of alcohol use disorders**

The etiology of AUDs is complex and there are several etiological models of addiction that aim to capture the multidimensional nature of AUDs, including the brain disease model, the psychoanalytic model, the motivational and sociocultural models, social learning models, and the biopsychosocial model of addiction, among others. The brain disease model emphasizes the biological foundation of addiction and the role of genetic factors (Koob, 2003; Koob & Volkow, 2016; Levey et al., 2014), whereas the psychoanalytic model identifies psychostructural deficiencies in object relations. According to this model, a fragile self is supported by defensive grandiosity, and weaknesses in the ego cause an inability to manage affect and impulse. Thus, addiction is seen as a behavioral attempt to compensate for the structural defects (Donovan, 1986; Khantzian, 2003). For instance, the self-medication hypothesis by Khantzian (1990) identifies addictive behavior as an attempt to self-medicate for a range of psychiatric problems and painful emotional states. A neuropsychanalytic approach

has recently incorporated neurobiological methods to the traditional psychoanalytic approach, thus adapting neuroscience as the basic science of psychoanalysis (Johnson & Flore Mosri, 2016; Solms & Turnbull, 2011).

The etiology of AUDs may also be conceptualized through a developmental learning model as a phase of individual development that highlight learning trajectory and habitual patterns of thinking and feeling (Lewis, 2017). In the cognitive behavioral model, Marlatt (1985) defined addictive behaviors based on social learning theory as learned coping models and proposed that cognitive biases are related to self-efficacy, i.e., the ability to abstain, as well as to the expectations of the effects of the used substance. In clinical practice, Marlatt's relapse prevention model has been widely applied to improve coping strategies of individuals' in high-risk situations (du Plessis, 2014; Marlatt, 1985).

Conceptualizing AUDs as a choice through processes related to decision-making and motivation is another etiological approach (Heyman, 2013; Pickard et al., 2015); in that case, an AUD is seen as a choice despite potentially dangerous outcomes. A person is thought to discount distant goods and prefer immediately available goods instead (Heyman, 2013). The neurobiological basis can also be found in choice models because dopamine has a role in estimating the extent of different outcomes, action planning, and motivation. These theories consider that if alcohol becomes the focus of a destructive pattern of behavior, individuals always have the capacity to improve their behavior as a function of changes in their options (Heyman, 2013; Pickard et al., 2015). Furthermore, the psychological impact of society, which forms and molds the desires and choices of its members, should also be noted. From a wider perspective, a sociocultural model focuses on identifying how cultural standards, perceptions, and different institutions influence on individual behaviors (Hester & Miller, 2003). This perspective considers addiction as a sociocultural phenomenon (du Plessis, 2014; Room, 1985).

Currently, there is no consensus on the ontology of addiction between different etiological models (du Plessis, 2014). However, the biopsychosocial model of addiction aims to extend and incorporate the previous models by recognizing different psychological, social, and societal factors as essential components of addiction (Becoña, 2018; Engel, 1977; Koski-Jännes, 2004; Skewes & González, 2013). This compound model has implications in treatment settings because it understands that each individual accessing services has a unique set of aspects, opportunities, and constraints, all of which are influenced by biological, psychosocial, structural, and environmental processes shaped during one's life course. In a biopsychosocial model, neurobiological processes are accompanied by psychological processes, which are facilitated by social circumstances, and addictive behavior is thought of as learning through immediate positive consequences. This activation of expectations concerning the positive effects (i.e., positive reinforcement) leads to habitual alcohol use that may eventually become compulsive (Koski-Jännes, 2004; Wise & Koob, 2014). Thus, addictive behavior is further maintained by repeated action despite the negative consequences, and various thoughts and beliefs further support addictive behaviors (Koski-Jännes, 2004).

### **2.3.2 Neurobiology of alcohol use disorders**

So far, many genetic, biological, environmental, psychological, and social factors have been associated with the risk of developing an AUD (Goldman et al., 2005; Schuckit, 2009).

However, very little is known about the neurobiological, genetic, and epigenetic predictors of the onset of AUDs (Witkiewitz et al., 2019; Zhu et al., 2019).

The neurobiological basis of AUDs is complex. Alcohol, as a psychoactive substance, affects several functions regulated by the central nervous system. Alcohol alters neural activity directly via ethanol-binding sites on several membrane receptors; it also has indirect effects on neurochemical and neuroendocrine systems, changes that further trigger reinforcing and stress-related effects (van den Brink & Kiefer, 2020, 498–504). Koob (2003) hypothesized that addiction progresses from impulsivity to compulsivity in a collapsed cycle that comprises three stages: preoccupation/anticipation, binge intoxication, and withdrawal/negative affect (Koob, 2003; Koob & Volkow, 2016). Wise (1988) emphasized the behavioral origin of addiction, which results from regular, predictable, and uninterrupted use that changes the brain. Brain changes have also been hypothesized to occur through the development of memory traces for the alcohol experience (Wise, 1988; Wise & Koob, 2014).

According to the neurobiological approach, repeated alcohol abuse activates the brain reward systems, including mesolimbic/mesocortical dopaminergic pathways, and initiates the development of addiction. Positive reinforcement is important in the early stage of alcohol use, when rewarding effects of alcohol are present and a habit develops. For individuals using alcohol for self-medication of affective disorders, negative reinforcement can also be important in early phases of use. In long-term alcohol abuse, the executive control of the prefrontal cortex weakens and the brain stress system sensitizes, which leads to negative states, both somatic and affective, that are alleviated by continuous alcohol use (Bromberg-Martin et al., 2010; Gilpin & Koob, 2008; Hyytiä, 2018; Koob & Volkow, 2016).

Neurobiological changes in the reward and stress systems have been hypothesized to increase vulnerability for the development of dependence and relapse in addiction. At the neurotransmitter level, the dysregulation of specific neurochemical mechanisms in specific brain reward circuits, such as the mesocorticolimbic dopamine system, corticotropin-releasing factor in the central nucleus of the amygdala, opioid peptides, serotonin, gamma aminobutyric acid A (GABA-A), glutamate, and also recruitment of brain stress systems, provide a negative motivational state that maintain addiction (Koob, 2003; Koob & Volkow, 2016; Wise & Koob, 2014). Indeed, the concept of stress is one overarching theme in many of the etiological models regarding the development and relapse of AUDs. Psychiatric disorders, including AUDs, can also be conceptualized as chronic distress states associated with neurobiological alterations in brain stress circuits, to which various genetic and environmental vulnerability factors contribute. This phenomenon is especially true with regard to severe AUD neuroadaptations that occur in stress and reward circuits; these changes have been hypothesized to underlie the increasing emotional distress that is often associated with AUDs (Brady & Sinha, 2005).

### **2.3.3 Genetic etiology of alcohol use disorders**

AUDs are polygenetic in nature and have notable phenotypic complexity (Goldman et al., 2005; Hart & Kranzler, 2015). It is known that genetic and environmental risk factors jointly determine the risk of AUDs through epigenetic gene–environment interactions. That is, epigenetic changes alter the physical structure of DNA through several mechanisms, including DNA methylation, which modifies the function of genes by adding a methyl group to DNA

bases, thus preventing gene expression. DNA methylation may have implications in stress response, metabolism, and immune function. However, the current knowledge of DNA methylation patterns is limited (Cecil et al., 2015).

In general, environmental factors are thought to affect the expression of a gene or genotype through mechanisms such as environmental restrictions and social control. Environmental restrictions include factors such as restricted availability of alcohol and social norms promoting abstinence. It has been hypothesized that social control in restrictive environments mediates low levels of alcohol consumption, whereas in a permissive setting, a full range of genotypes manifests (Schuckit, 2009; Shanahan & Hofer, 2005; Young-Wolff et al., 2011). Social context has been suggested to act as a stressor that sensitizes individuals with genetic risk to the harmful environmental stressors (Levey et al., 2014; Rende & Plomin, 1992; Young-Wolff et al., 2011; Zhu et al., 2019).

The role of genetic factors has been estimated to account for approximately 40%–60% of the risk of developing an AUD (Schuckit, 2009). The estimated genetic heritability is approximately 50% (Hart & Kranzler, 2015; Köhnke, 2008; Verhulst et al., 2015). Previous studies have identified several candidate genes for alcoholism, including genes relevant to signal transduction and transmission of nerve impulses that alter anxiety, mood, and cognition (Levey et al., 2014). Evangelou et al. (2019) also suggested a shared genetic mechanism underpinning the regulation of alcohol intake and development of neuropsychiatric disorders, such as schizophrenia. Polymorphisms in genes coding alcohol-metabolizing enzymes, such as alcohol dehydrogenase and aldehyde dehydrogenase, have been identified to cause alcohol sensitizing effects and to decrease the risk of AUDs (Schuckit, 2009). Nevertheless, despite the notable proceedings in the research field, still very little is known of the neurobiological, genetic, and epigenetic predictors of the onset of AUD (Witkiewitz et al., 2019; Zhu et al., 2019).

#### **2.3.4 Typologies of AUDs and treatment matching**

Many researchers during the last decades have aimed to identify subtypes of AUD patients and to target specific mechanisms responsible for patterns of behavior to match individuals with optimal treatment strategies (Leggio et al., 2009). One of the most cited divisions was created in 1981 by Cloninger and colleagues. With a study population comprising adopted sons of alcoholics, Cloninger proposed a binary division of alcohol dependency into subtypes I and II based on the personality of the alcohol-dependent patients. Type I is characterized by late onset, typically after the age of 25 years, influence of childhood family environment, tendency to self-medicate with alcohol, and desire to avoid harm. Type I patients generally have a better response to treatment. Conversely, type II primarily affects men and is associated with a strong genetic influence. This subtype is characterized by early-onset (before age of 25 years), the inability to abstain, persistent antisocial behavior, and generally poor response to treatment (Cloninger et al., 1981). Subsequent research has linked deficits in dopaminergic and serotonergic neurotransmitter systems and single nucleotide polymorphisms in the neuropeptide Y gene with the type II typology (Leggio & Addolorato, 2008; Mantere et al., 2002; Mottagui-Tabar et al., 2005; Tiisonen et al., 1995; Tupala et al., 2003).

Many other typologies and classifications have been suggested to complement the original dichotomous typology (Babor et al., 1992; Del Boca & Hesselbrock, 1996; Lesch et al., 1988; Windle & Schneidt, 2004) based on the dimensions of problem severity, onset of use, family history of alcoholism, number of withdrawal symptoms, and craving. In addition, internalizing and externalizing personality traits and the number and severity of negative affects represent dimensions that further elaborate the AUD typology (Leggio et al., 2009; Schuckit & Smith, 2011; Trim et al., 2013). Nevertheless, AUDs are heterogeneous in nature and thus scientific understanding of the etiology remains a major challenge and has further implications to the effective treatment of AUDs (Witkiewitz et al., 2019). Current consensus considers that receiving any treatment is effective and a therapeutic alliance may play an important role in drinking outcomes after treatment (Connors et al., 1997).

## **2.4 ALCOHOL CONSUMPTION PATTERNS AND ALCOHOL USE DISORDERS IN FINLAND**

Finnish alcohol consumption patterns largely correspond to the eastern and northern European drinking patterns, which are characterized by high proportions of binge drinking, and beer and spirits are the most prevalent alcoholic beverages (Nordström & Skog, 2001; Popova et al., 2007). According to the Regional Health and Well-being Study conducted in 2012–2015, the prevalence of excess alcohol consumption (defined as 6+ AUDIT-C points in men and 5+ AUDIT-C points in women) in Finland was approximately 33%–38% among men and 20% among women (Viertiö et al., 2017).

The history of Finnish alcohol consumption patterns has been mediated by several societal and legislative changes, ranging from the prohibition period in 1919–1932 to the liberation of alcohol sales (i.e., medium-strength beer) in the 1960s, decreases in alcohol taxation in the 1990s and early 2000s, and, most recently, changes in alcohol legislation, including liberation of stronger alcoholic beverage (up to 5.5 vol%) sales in 2018. The drinking culture has changed dramatically during this time period; in particular, it became socially acceptable for women to consume alcohol after the 1960s alcohol reform and has increased rapidly since then. Excessive drinking became more prevalent in the 1970s and increased until the 2000s. In 2008, following several increases in alcohol taxation, total alcohol consumption started to decrease, and excessive drinking decreased for the first time since the 1960s. Total alcohol consumption in 2007 was nearly 12.7 liters of pure alcohol/citizen; it decreased to 10.8 liters in 2016 (Härkönen et al., 2017). Total alcohol consumption in Finland is among the highest in the Nordic region and approximately equal compared with other European countries (Karlsson, 2018). Of note, according to recent estimates, alcohol consumption in Finland is unevenly distributed: Approximately 10% of the Finnish population consumes half of the consumed alcohol (Mäkelä, 2018). A similar phenomenon has been identified in other countries (Landberg & Hübner, 2014; Stockwell et al., 2009).

### **2.4.1 Alcohol consumption patterns and risk of alcohol use disorders and other health conditions**

Harmful alcohol consumption patterns are a risk factor for developing an AUD (Greenfield et al., 2014), and harms related to alcohol show linear increase with the consumed volume (WHO, 2019). The volume of alcohol consumption is associated with several diseases due to a mechanism of accumulation of metabolic byproducts of alcohol in target organs (Rivas et al., 2013). The strongest relationship is between AUDs and cancer (Agardh et al., 2016; International Agency for Research on Cancer, 2012; Rehm et al., 2017a). Other diseases associated with alcohol consumption are liver diseases, infectious diseases, non-ischemic cardiovascular diseases, injuries, major depressive disorders, type I bipolar disorder, certain personality disorders, and anxiety disorders, dementia, and psoriasis, among others (Agardh et al., 2016; Grant et al., 2015; Holst et al., 2017; Kuussaari & Hirschovits-Gerz, 2016; Pirkola et al., 2005a; Rehm et al., 2017a, 2017b; Rivas et al., 2013). Furthermore, binge drinking patterns have been linked to several adverse health outcomes (Popova et al., 2007; Rehm et al., 2017a). Irregular heavy episodic drinking, defined as 60 or more grams of pure alcohol on at least one occasion at least monthly (WHO, 2018b), is associated with infectious diseases such as HIV/AIDS, diabetes mellitus, ischemic and non-ischemic heart diseases, stroke, liver diseases, and injuries (Rehm et al., 2017a). According to a Finnish estimate in 2016, approximately 8% of Finns have a high risk of long-term adverse health effects caused by alcohol consumption and 5% have an increased risk, totaling 564,000 individuals. Of note, 58% face either a long term health-related harm caused by alcohol consumption or the risk of experiencing harm caused by drunkenness (Mäkelä et al., 2018). Male gender, age of 45–54 years, and being divorced or unemployed are associated with increased risk of AUD (Pirkola et al., 2005a).

### **2.4.2 Prevalence of alcohol use disorders**

The total per capita alcohol consumption within a country is closely related to the national prevalence of AUDs (WHO, 2019). In 2016, the 12-month prevalence of AUDs was approximately 9% in the Finnish adult population (WHO, 2018a), which corresponds to the estimated AUD prevalence of 8.8% in the European Region adult population (WHO, 2018b). In the United States, the 12-month prevalence of AUDs was 13.9%, with a lifetime prevalence 29.1%. The 12-month prevalence of AUDs decreased in Finland between 2000 and 2011, from 10.8% to 7.5% (Peña et al., 2018). There are gender differences in AUD prevalence: It is higher in men than in women (Grant et al., 2015). In Finland, the 12-month AUD prevalence for men was 7.3% and for women it was 1.4% in a survey-based study (Pirkola et al., 2005a); the corresponding WHO estimates were 14.8% for men and 3.8% for women (WHO, 2018a). In Europe, the corresponding rates were 6.1% for men and 1.1% for women, (Rehm et al., 2005); in the United States, these values were 17.6% for men and 10.4% for women (Grant et al., 2015). However, there are significant variations among countries in the prevalence rates due to differences in cultural orientation (i.e., availability of alcohol) and the data sources and instruments used to assess AUDs (Rehm et al., 2005).

## **2.5 DEFINITION OF ALCOHOL USE DISORDER TREATMENT**

Alcohol treatment is defined in the Oxford dictionary as “professional treatment intended to help a person overcome or recover from alcohol addiction” (Oxford dictionary, 2019). Historically, the focus of AUD treatment in Finland has been on the social causes of the disorder. Social services have had an essential role in temperance education, and supervision and treatment have been based on minimizing harms to others (Mäkelä & Murto, 2012). During the last decades, the biopsychosocial approach to AUD treatment has gained more attention. This approach emphasizes different dimensions of human life, including the social and physical environments, social interactions, and interactions among these dimensions (Kuusisto & Ranta, 2020, 116–133; Satel & Lilienfeld, 2014; Szalavitz, 2017; Wiens & Walker, 2015). In addition, the treatment of AUDs has increasingly gained multiprofessional aspects and has gradually shifted from a social work context toward general health care services. From the health services context, AUDs have been increasingly identified as chronic and relapsing conditions (Dennis & Scott, 2007; Dennis et al., 2005) with a similar onset and course as other chronic conditions (McLellan et al., 2000). Furthermore, AUDs are heterogeneous in nature, with varying treatment trajectories; thus, moving toward a continuous and more personalized approach is important (Litten et al., 2015).

Recent empirical evidence has identified a care continuum across services as a cornerstone for successful AUD treatment (Blodgett et al., 2014; Maremmani et al., 2015; Pereira Gray et al., 2003). Thus, AUD treatment requires close collaboration among several services and care coordination (Hesse et al., 2007; Maremmani et al., 2015). Regular contact with primary care, specialized AUD services, and psychiatric treatment as needed are beneficial to achieve better treatment outcomes such as long-term remission (Parthasarathy et al., 2012). Receiving continuous care has also been associated with reductions in mental health symptoms (Grella et al., 2010).

## **2.6 LEGISLATIVE BASIS FOR TREATMENT OF ALCOHOL USE DISORDERS**

Although access to adequate care is a universal right based on a Finnish constitutional act (731/1999), the structural resources of alcohol treatment system are always defined by current treatment policies (Babor et al., 2008). Currently, municipalities are responsible for organizing the social and health care services, including services for substance abusers, by considering the local population needs (Act on Welfare for Substance Abusers 41/1986). At the time of enactment of this law, extensive treatment coverage and multiprofessional work with strong emphasis on the social work had been secured. However, since the 1990s, the role of medicine has gained a stronger role in the substance abuse treatment system (Kuusisto & Ranta, 2020). In 1993, reform of the central government system increased the autonomy of municipalities, leading to a more decentralized treatment system even by international standards, and a reduction in services for the most disadvantaged population. Thus, regression made apparent the structural stigma, which has negatively affected the provision of substance abuse treatment.

Currently, municipalities are autonomous with regard to how the treatment services are produced; thus, there is variation among regions and municipalities. In addition, marketization and medicalization phenomena combined with decreasing financial resources of the municipalities have shaped the alcohol treatment system to its current form. All this has led to a highly fragmented addiction treatment system (Figure 2), where general care level treatment is provided in health centers, occupational health care services, specialized care outpatient clinics, and in private health services. Specialized addiction services are provided by a-clinics, specialized health care substance abuse units, health center ward withdrawal services and other withdrawal units, housing services, and private service providers. This fragmented organization of primary health care, specialized mental health, substance abuse services, and social welfare services is a challenge to the treatment of AUDs from the perspective of care integration, continuity, and coordination.

Regulatory policies determine the resources available for the treatment of AUDs, including the number, type, and setting of treatment facilities, and the personnel who work in these services (Babor et al., 2008). Extensive legislation regulates the organization and provision of addiction services in Finland: The Health Care Act (1326/2010) and the Social Care Act (1301/2014) fundamentally regulate the organization of substance abuse services. Specialized services for substance abusers are defined in detail in the Social Care Act (1301/2014). The Act on Welfare for Substance Abusers (41/1986) outlines the organization of treatment and rehabilitation; the purpose of this act is to (1) prevent and reduce problematic alcohol use, (2) support the functionality of problem users and those affected by the problematic use, and (3) reduce social and health-related harms. The aforementioned act is further supported by the Act on Mental Health (1116/1990) and the Decree on Welfare for Substance Abusers (653/1986), which aim to improve services for substance abusers and strengthen the outpatient mental health service provision by highlighting the integral role of municipal health centers. Furthermore, the Alcohol Act (1102/2017), the New Act on Organising Alcohol, Tobacco and Gambling Prevention (523/2015), the Act on Health Care Professionals (559/1994), and the Act on Social Care Professionals (817/2015) further regulate the prevention and treatment of alcohol- and drug-related problems.

Treatment policies also mediate treatment system quality and effectiveness through equity, efficiency, and economic aspects (Babor et al., 2008). Patient rights, including the right to a client plan, are regulated by the Patient Act (785/1992) and the Social Care Customer Act (812/2000). Furthermore, government information steering guides the prevention and treatment of alcohol- and drug-related problems, including the national plan for mental health and substance abuse work (Mieli, 2009) that promotes integrated care in primary care settings. A Finnish quality criterion for the treatment of AUD patients and the Finnish Current Care Guidelines further aim at conceptualizing and improving AUD treatment.

In summary, the need-based municipal service provision has created challenges in Finland because the current legislation neither defines hierarchy for different needs nor defines which services respond to which needs. Thus, it has been proposed that future legislative reform on service provision should require service provision be organized based on the service users' rights instead of the current need-based responsibility, which often remains difficult to determine (Arajärvi, 2013).



	HEALTH CARE	SOCIAL WELFARE	SELF-HELP	OTHER
S P E C I A L I Z E D	Somatic specialized health care substance abuse service units	A-clinics and youth stations	Local A guild associations	Temperance education/work
	Psychiatric specialized health care substance abuse service units	Withdrawal units	AA groups and Al-Anon groups	Other substance abuse prevention work
	Health center wards withdrawal services	Rehabilitation facilities		Religious substance abuse treatment organisations
	Private health care	Housing services, shelters for alcoholics' and day centres		
L E V E L	Hospitals	Social services/welfare centres	General hobby groups and support groups	Church and other religious communities
	Health centers	Home help services	Family support and neighborly help	Crisis support
	Occupational health care	Family counselling		Voluntary sector associations
	Private health care			
G E N E R A L				

**Figure 2.** Finnish AUD treatment system (Based on the current care guidelines: Alkoholiongelman hoito: Käypä hoito -suositus. Translated by Elina Rautiainen)

## 2.7 QUALITY CRITERION FOR TREATMENT OF ALCOHOL USE DISORDERS

In 2002, the Ministry of Social Affairs and Health and the Association of Finnish Local and Regional Authorities published a joint recommendation concerning the quality of services for individuals with substance use problems. The central aim of these recommendations regarding the service system was to guide and support substance abuse work to be done within the social welfare and health care services, not only in special services for substance abusers. This quality criterion for the treatment of AUD patients identifies 11 conditions that should be met by the treatment facilities. Secondary prevention, including early identification and screening, should be implemented in primary care, and occupational health care as part of health check-ups. The criterion highlights the role of a continuous patient–doctor relationship because it contributes to secondary prevention outcomes and improves early detection of alcohol problems, especially among risk groups (STM, 2002).

As part of tertiary prevention harm reduction, including preparedness for acute poisonings and other conditions, acute care acts as a necessary starting point for follow-up treatment. Inpatient detoxification should be available along the care process. In addition, appropriate

measures and indicators of alcohol problems should be available and used, and most importantly, social and health care personnel should have required skills and training to treat AUD patients. (STM, 2002).

As psychiatric problems often co-occur, the possibility for psychiatric consultations should be made available when needed. The quality criterion also highlights the fundamental importance of care coordination: Somatic, psychiatric, and substance abuse treatment should be well organized to enable integrated care pathways, and any gaps between treatment and follow-up should be avoided. However, continuity of care among AUD patients is a known challenge, partly due to the inability or refusal of individuals to recognize a disorder that is clinically evident, which may be present in AUDs and other severe mental health conditions and may complicate adherence to treatment.

Furthermore, the third sector has been identified as an important actor and companion in the service provision. It is also essential that the treatment provider and social and health care personnel have adequate knowledge of these resources. Patients with severe AUDs should also receive adequate help with social security and housing services. Finally, there must be work to reduce stigmatizing attitudes because these harmful attitudes prevent the attachment to treatment (STM, 2002).

## **2.8 EVIDENCE BASED TREATMENT OF ALCOHOL USE DISORDERS**

The Finnish Current Care Guidelines have aimed to conceptualize and improve AUD treatment, as well as to strengthen the prevention and identification of alcohol problems in health care settings (Alkoholiongelmaisen hoito: Käypä hoito -suositus, 2015). Furthermore, the Council for Choices in Health Care in Finland (2020) has provided recommendations for the evidence-based treatment of alcohol dependence. Early identification of alcohol problems is the primary goal in social and health care services; interviewing is a central tool for the early detection. However, researchers have suggested that identification of AUD in social and health care settings is challenging because people tend to underestimate their alcohol consumption (Rydon et al., 1992).

For the secondary prevention of alcohol problems, structured mini-interviews, clinical examinations, and laboratory tests are used to identify harmful alcohol use and dependence. For mild AUDs, motivational interview has been identified as an effective treatment (Council for Choices in Health Care in Finland, 2020). Psychosocial treatment provides information and discussion support in the form of individual, couple, family, or group therapy. Psychosocial support is most commonly provided in the form of supportive interactions in regular treatment contact (Witkiewitz et al., 2019).

Clinical findings, including irregular heartbeat, anxiety, and injuries, may indicate problematic alcohol use; thus, clinical examinations and laboratory tests support the interview. Laboratory tests may be used in treatment motivation and in the estimation of treatment effectiveness. Mean corpuscular volume (MCV), serum desialotransferrin (DST), and plasma glutamyl transferase (GT) are especially useful tests: All may be used for the identification of problematic alcohol consumption (Alho, 2003; Alkoholiongelmaisen hoito: Käypä hoito -

suositus, 2015). DST and GT are used to assess the treatment response in alcohol-dependent individuals.

Psychosocial support is the cornerstone of AUD treatment; increasing awareness of the factors that maintain addictive thoughts, and supporting motivation for change and for finding alternative sources of meaningfulness in life are all means to support individuals to change their life course. There is also evidence that combining psychological treatment with medication may notably increase the treatment response (Alho, 2003; Alkoholiongelmaisien hoito: Käypä hoito -suositus, 2015). Medication is used to reduce withdrawal symptoms, anxiety, drinking, and craving. There are four subcategories for the medical treatment of AUDs: 1) aversion treatment including disulfiram; 2) anti-craving drugs, including opioid antagonists (i.e., naltrexone) and acamprosate; 3) antidepressants including selective serotonin reuptake inhibitors, buspirone, carbamazepine, and lithium; and 4) new antidepressants and other medicines, including gamma-hydroxybutyrate (Alho, 2003; Alkoholiongelmaisien hoito: Käypä hoito -suositus, 2015).

## **2.9 TREATMENT OF INDIVIDUALS WITH SEVERE ALCOHOL**

Marginalization is often present with a severe or advanced form of AUD (Holopainen, 2003; Kreek, 2011). Among marginalized individuals, changes in social relationships and treatment of AUD are especially important and affect the clinical course of AUDs. Thus, social and health services have an essential role in the prevention and treatment of alcohol problems, especially among this patient group (Holopainen, 2003). Advanced AUDs are chronic in nature and often associated with other psychiatric problems (Flensburg-Madsen et al., 2009; Lyons Readon et al., 2003). Especially polydrug users, with a co-occurring AUD and drug problem, often have heavy social and health service use, including repeated accidents and criminal activity (Darke et al., 2003; Holopainen, 2003).

Based on the above factors, the treatment of AUD among marginalized individuals is often challenging. In addition to treating acute care needs, social and health care personnel should cooperate to organize all the required treatments and support activities. It has been estimated that anamnesis may be delayed by 1.5 years due to problematic substance use behavior. Structured interviews, including the Addiction Severity Index (ASI), have been developed for this purpose. After the treatment of acute complications, the clinical status and co-occurring somatic and psychiatric conditions should be mapped and treated accordingly. Organization of detoxification is considered as a significant step because it enables forming a therapeutic relationship, although this may take several treatment attempts. After detoxification, rehabilitation and especially long-term outpatient treatment contact is equally essential to support an independent life. The social aspects also include relevant housing and income support. In addition to multiprofessional support, peer networks and mutual support groups are crucial networks (Holopainen, 2003).

## 2.10 CLINICAL COURSE OF ALCOHOL USE DISORDERS AND ASSOCIATED OUTCOMES

The clinical course of AUD as a psychiatric disorder may be defined as a “progression of changes in symptoms of the disorder following initiation of formal treatment” (Frank et al., 1991; Maisto et al., 2014). Previous research has to a large extent focused on changes in alcohol use and risk of relapse, yet the understanding of the clinical course of AUD remains incomplete, for example, regarding long-term life functioning (Maisto et al., 2014).

Chung and Maisto (2006) determined that change points during the clinical course of AUD include response to treatment, achieving remission, recovery, and recurrence, defined as the reappearance of symptoms. There are two crucial time points in recovery, namely 90 days following treatment initiation (Hunt et al., 1971) and 12 months after treatment completion (Maisto et al., 1998, 2002). Nevertheless, changes in alcohol consumption following treatment seem to be discontinuous and there are individual variations (Witkiewitz et al., 2007, 2010).

Several mediators and predictors of the clinical course of AUDs have been identified (Maisto et al., 2014). One of the key mediators is the severity of the disease (Boschloo et al., 2012). Individuals with severe AUD most often seek treatment and they are also more likely to have a chronic and relapsing course of the disorder (Tuithof et al., 2016; Witkiewitz et al., 2019). The persistence rate of alcohol dependence also seems to increase simultaneously with the severity rate. Among people with a current severe form of alcohol dependence, a persistence rate of 47%–78% and relapse rate of 25%–50% have been identified (Boschloo et al., 2012; Dennis et al., 2003; McKay & Weiss, 2001; McKay et al., 2006). For less severe AUD, the persistence of alcohol dependence remains at 22%–25% and the relapse rate is only 2%–9% (Boschloo et al., 2012). Recurrence of alcohol dependence has been estimated to be higher among individuals with comorbid depressive or anxiety disorders (Boschloo et al., 2012).

The key coping factor that influences the risk of relapse, according to the cognitive behavioral model of relapse, is high self-efficacy (Witkiewitz & Marlatt, 2004). In the etiology of the onset of relapse, many risk factors have been identified, such as negative affect states, increased craving, diminished motivation, low self-efficacy, interpersonal problems, and lack of coping efforts (McKay, 1999; Witkiewitz & Marlatt, 2004). Thus, a strong craving or poor impulse control may diminish an individual’s coping behavior in a high-risk situation (McKay et al., 2006). Furthermore, biological factors may play a role in moderating the risk for relapse, such as dysfunction in neurotransmitter systems and stress reactivity (Koob, 2003). It is noteworthy that there is no standard definition for relapse, although researchers have defined relapse as “any use at all after a period of abstinence” (McKay et al., 2006).

There have been myriad studies on measuring long-term outcomes and factors associated with these outcomes (Alves et al., 2017; Cohen et al., 2007; Krennek et al., 2017; Laudet et al., 2002; Trim et al., 2013; Vaillant, 2003). The following subsections focus on two major outcomes: the risk of death and the probability of achieving stable remission. One could argue that the probabilities of these two outcomes are of the greatest interest from individuals’ perspective, regardless of the condition in question.

### 2.10.1 Alcohol use disorders and mortality risk

AUDs are associated with an estimated 4–6-fold increase in all-cause mortality (Kendler et al., 2016; Plana-Ripoll et al., 2019). In treatment settings, individuals with an AUD have an estimated 24–28-year shorter average life expectancy compared with general population (Westman et al., 2015). The relative risk for all-cause mortality in clinical samples is higher among women (hazard ratio [HR] 3.63–4.57) than among men (HR 2.85–3.38) (Holst et al., 2017; Roerecke & Rehm, 2013). Alcohol-related deaths are 10 times more frequent among men compared with women (Rehm et al., 2004) due to the proportionally higher prevalence of AUDs among men (Grant et al., 2015). A recent study using a new method to assess life years lost identified the life expectancy for men to decrease by 14.84 years (95% confidence interval [CI] 14.70–14.99) and for women by 5.42 years (95% CI 5.36–5.48) after the SUD diagnosis compared with the general population. The advantage of this methodology is that it incorporates precise age at the onset of the disorder (Plana-Ripoll et al., 2019). Register studies on mortality risk associated with AUD are gathered in Appendix 1.

Compared with the general population, there is a 10-fold risk for mortality from liver cirrhosis and mental health disorders among AUD patients. The risk for fatal injuries is 7 fold higher and dying from cardiovascular diseases and diabetes is 2 fold higher compared with the general population (Roerecke & Rehm, 2014). Some researchers have estimated that half of AUD patients with severe medical comorbidity die during the first decade after AUD treatment (Hiroeh et al., 2008; Rivas et al., 2013). The higher mortality risk for clinical samples most likely reflects the greater severity of AUDs among individuals seeking treatment (Roerecke & Rehm, 2013) as well as a higher burden of physical comorbidities (Schoepf & Heun, 2015). Socioeconomic factors such as older age and being unmarried are also associated with increased risk of death among AUD patients (Timko et al., 2006).

In population surveys, all-cause mortality estimates are substantially lower compared with either clinical samples or the general population (Gorman et al., 2014; Roerecke & Rehm, 2013). A selective nonresponse bias may partly explain the observed lower mortality rates in population surveys, because non-participating men and women have 2–2.5 fold higher all-cause mortality compared with survey participants (Jousilahti et al., 2005). It has been estimated that demographic and socioeconomic factors account for a notable proportion of the total excess mortality of non-respondents (41% in men and 20% in women) and that non-respondents have both more severe health problems and excess alcohol use (Tolonen et al., 2010). A Finnish population study identified that only 8.8% of study participants with AUDs died after an 8-year follow-up period; this finding can be at least partly explained by the non-response (Markkula, 2012). Survey-based studies on mortality risk associated with AUD are gathered in Appendix 2.

AUD mortality is mediated by both predisposing factors early in one's life course as well as by the direct effect of an AUD (Kendler et al., 2016). Adverse childhood experiences, such as maltreatment and maternal alcohol problems, markedly increase the risk for problematic alcohol use (Hughes et al., 2017; Pirkola et al., 2005b). The importance of direct effects of AUDs increases with age and after a longer duration of an AUD (Kendler et al., 2016). In addition to the age effect, cohort and period effect influence alcohol mortality trends at population level (Kraus et al., 2015). A Finnish study examined mortality of men with alcoholism receiving treatment and found that 47% of the study participants died during the 16-year follow-up

(Saarnio, 2005). A more recent study by Pitkänen et al. (2020) identified a 28% mortality rate among treatment-seeking men and women with AUD or SUD during a 15-year follow-up. Socioeconomic status is associated with alcohol-related mortality (Herttua et al., 2007). In Finland, alcohol-related mortality is 3 times higher in lower educational and occupational classes compared with higher socioeconomic classes (Herttua et al., 2007; Mäkelä, 1999). Nevertheless, socioeconomic differences and somatic status only partially explain the increased mortality risk due to AUDs. Poor adherence to treatment (Markkula et al., 2012) and genetic risk factors (Kiiskinen et al., 2020) have been suggested to mediate the risk of death. Increasing treatment coverage is estimated to reduce alcohol-attributable mortality substantially (Rehm et al., 2013).

### **2.10.2 Alcohol use disorders and probability of remission**

The life-time cumulative probability of achieving remission is 90.6% for alcohol dependence in the general population (Lopez-Quintero et al., 2010). This natural remission is associated with life transitions such as parenthood and changing social roles (Cunningham et al., 2000; McCutcheon et al., 2014) and is enabled by social capital, which is characterized as having few social problems and a high degree of social support (Bischof et al., 2003; Hser & Anglin, 2011). Cunningham et al. (2000) described natural remitters as individuals who mature out of an AUD and also identified other groups of remitters, namely those with significant problems who required treatment.

Empirical evidence has shown that the remission rates vary substantially between the general and clinical populations and estimates of long-term recovery rates vary between 20% and 50% in treated populations. AUD severity seems to mediate whether an individual enters the clinical population, as evidence exist that the general population tends to have less severe AUDs compared with individuals in treatment (Anglin et al., 1997; Dennis et al., 2005; Sobell et al., 1996; Storbjörk & Room, 2008; Vaillant, 2003). Evidence has suggested that just 18.2% of patients with previous alcohol dependence achieve abstinence (Dawson et al., 2005). Furthermore, time aspects matter, and the odds of sustaining abstinence seem to increase cumulatively for the first 3 years of abstinence, but after 5 years only 5.8% had maintained abstinence (Dennis et al., 2007).

There is different terminology for defining recovery<sup>1</sup> from AUDs (Laudet, 2008), which creates challenges for interpreting research results on recovery rates. Empirical evidence on recovery rates may vary, depending on whether total abstinence is the only accepted definition for the recovery or whether managed use is also included in the definition (Hser & Anglin, 2011; Laudet, 2007, 2008). White (2007) suggested the term remission, defined as no longer meeting the diagnostic criteria for abuse or dependence, to be used together with the term

---

<sup>1</sup> The Oxford dictionary defines recovery as “the cure or healing of an illness.” In the context of addiction, the American Society of Addiction Medicine (2001) defines recovery as “absence of physical and psychological dependence, including commitment to sobriety.” In 2005, the National Summit on Recovery consensus definition identified recovery as “a process of change through which an individual achieves abstinence and improved health, wellness, and quality of life” (Center for Substance Abuse Treatment, National Summit on Recovery, 2005). White (2007) defined recovery as “a process and a sustained status, with essential aspects such as social support, voluntarism, active management of continued vulnerability to such problems, and development of a healthy, productive, and meaningful life.”

recovery. Given that AUDs are chronic and relapsing conditions, in this dissertation the Oxford dictionary definition of remission as “disappearance of symptoms or cessation of the activity of a disease for a period” was used.

The relationship between remission and predictive factors, such as demographic, socioeconomic, and health factors, has been widely studied. Researchers have identified that the remission rate increases with age and varies across age groups, with younger individuals (18–29 years old) being less likely to remit from alcohol dependence (Bland et al., 1997; McCutcheon et al., 2014; Pirkola et al., 2005a; Sartre et al., 2012). According to a 50-year follow-up study, the median age for remission was 48 years for men (Mattisson et al., 2018). There are currently no long-term estimates for remission in women, although in general, female gender is associated with a higher probability of remission (Sartre et al., 2012). Other socioeconomic factors such as being married, higher income status, and higher educational level are associated with increased probability to remit from alcohol dependence (Lopez-Quintero et al., 2010; Trim et al., 2013). By contrast, a family history of SUDs and mental health comorbidity are negatively associated with the course of illness and the probability of achieving remission (Lopez-Quintero et al., 2010; Hall et al., 2009).

From the life course perspective, replacing alcohol with a nonpharmacological substitute, forming new relationships, social support, and involvement in spiritual programs may act as turning points and trigger remission through increased awareness and shifts in cognitive-emotional patterns. These remodified patterns of seeing, interpreting, and approaching things are thought to create motivation to achieve remission and to protect individuals against relapse (Dennis et al., 2007; Hser & Anglin, 2011; Mattisson et al., 2018; Sartre et al., 2012). Thus, social and community support has been identified as an important factor for long-term recovery among treated individuals (Laudet et al., 2002; McCutcheon et al., 2014; Moos, 2007b). Furthermore, there is evidence that receiving treatment predicts recovery initiation and effective AUD treatment improves the prognosis for remission (Mattisson et al., 2018; Moos & Moos, 2006, 2007a, 2007b 2018; Moos et al., 2000; Scott et al., 2003). There is evidence that negative consequences of AUD can motivate an individual toward remission (Laudet et al., 2002). Among men, severe mental health disorders, such as delirium tremens and organic disorder, are associated with increased probability of achieving remission (Mattisson et al., 2018).

## **2.11 ALCOHOL USE DISORDERS AND HEALTH SERVICE USE**

As mentioned previously, AUDs are commonly represented in the social and health care settings due to several health-related and social harms caused by excess alcohol consumption. Nevertheless, several studies have identified that only a small proportion of individuals with AUDs use alcohol-treatment services (Cohen et al., 2007; Grant et al., 1997; Rehm et al., 2015; Roerecke & Rehm, 2014; Watkins et al., 2001; Witkiewitz et al., 2019; Wu et al., 2003); thus, there is a notable treatment gap for AUDs. Furthermore, previous research has identified multiple service use and high treatment dropout levels as characteristic to the social and health service use patterns of AUD patients (Andersson et al., 2018; Cohen et al., 2007; Dawson et al., 2012; Mowbray et al., 2015). Individuals’ with AUDs also often seek treatment from non-

specialist services such as primary care physicians (Cohen et al., 2007; Dawson et al., 2012; Mowbray et al., 2015).

The existing treatment system and availability and accessibility of services modify treatment use (Vanderplasschen et al., 2007). In Finland, knowledge of the patterns of overall alcohol-related social and health service use as well as continuity of care among individuals with AUDs is currently limited, especially in relation to care outcomes. How individuals with AUDs use social and health services has been traditionally estimated by using cross-sectional population survey data on intoxicant-related cases in the Finnish social welfare and health care system gathered on a single day. Correspondingly, the national health register (Hilmo) data have been used to examine hospitalizations. However, because the information on diagnoses of the primary health care visits in the national social and health care registers are currently not comprehensive, the estimates of the number of alcohol-related visits currently remain an underestimation of the true prevalence (Kuussaari et al., 2012). Under-recording alcohol-related diagnoses is another challenge (Seppä & Mäkelä, 1993) that continues to complicate the use of national register data for research purposes. The following subsections present existing empirical evidence on the associations of AUDs and health service use patterns across treatment systems.

### **2.11.1 Use of specialized addiction services**

Although the treatment coverage of SUDs is one of the United Nations Sustainable Development Goal (SDG) indicators, previous studies have noted that services providing treatment for SUDs are heavily underutilized and the majority of individuals with AUDs are not receiving adequate care for their addiction. In Finland, there is notable regional variation in service provision and availability for substance abusers. Thus, the service use is also focused on different domains of the service system, depending on the regional treatment system. Samposalo et al. (2018) noted that the need for substance abuse services remains poorly understood in Finland. Heinälä et al. (2001) estimated that 78% of individuals with alcohol dependence had no previous alcohol treatments. Laaksonen et al. (2013) identified that 71% of treatment seeking individuals with alcohol dependence had sought some sort of medical treatment for their alcohol problems.

Epidemiological studies in Europe have provided AUD treatment rate estimates that vary between 10.0% and 17.7% (Manthey et al., 2016a; Rehm et al., 2015c, 2016). In a cross-sectional study conducted in the primary care settings in several European countries, AUD treatment rate estimates varied around 22%, with notable variations in the treatment prevalence estimates among European countries (Rehm et al., 2015b). In addition, the U.S. National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) identified that individuals with AUDs were more likely to receive mental health treatment (20%) than AUD treatment (8%) (Edlund et al., 2012).

According to U.S. estimates, only approximately 14% of the patients with AUDs use alcohol treatment services (Cohen et al., 2007). The WHO World Mental Health Survey published in 2019 identified that only 11% of the household survey respondents with alcohol or illicit drug abuse or dependence received SUD treatment in the past year, and SUD treatment was more common among those with comorbid mental disorder compared with those having



only SUD (18.1% vs 6.8%). This WHO survey also examined minimally adequate treatment; the researchers defined it as having four or more annual SUD treatment visits to health care professionals or six or more visits to a non-health care professional. Among the treated SUD cases, the majority (84.0%) with comorbid mental health and SUD problems received minimally adequate treatment compared with those having only a SUD problem (68.3%) (Harris et al., 2019).

### **2.11.2 Factors associated with the use of specialized addiction services**

Several studies have identified barriers associated with the access to AUD care, such as social stigma and identification of AUDs in health care settings, which cause delays in treatment initiation (Grant, 1997; Gilchrist et al., 2011; Kessler et al., 1998, 2001; Keyes et al., 2010; Manthey et al., 2016a; Mojtabai et al., 2002, 2014; Rehm et al., 2016; Saunders et al., 2006).

Furthermore, problem awareness mediates the use of specialized addiction services. In a previous WHO study by Degenhardt et al. (2017), only 43.1% of the individuals with an SUD in high-income countries recognized a treatment need. Of those individuals, 61.3% made at least one visit to a service provider, and of them, only a minority (35.3%) received minimally adequate treatment. Thus, perceiving the need for treatment is a major barrier for obtaining adequate treatment, among other factors including access to treatment and treatment compliance (Degenhardt, 2017; Mojtabai et al., 2011; Probst et al., 2015). In a study conducted in the United States, Mojtabai and Crum (2013) identified that individuals who perceived a need for treatment were more than 3 times likely to receive SUD treatment compared with those with no perceived need. Factors associated with recognizing a need for treatment are increased problem severity, comorbid mental health disorders, and being older (Edlund et al., 2009; Grella et al., 2009; Hedden & Gfroerer, 2011).

Male gender, being single, having a low educational or income level, and having a mood disorder or illicit-drug use disorder have been identified as predictors of receiving alcohol treatment (Cohen et al., 2007; Dawson et al., 2012; Edlund et al., 2012; Rehm et al., 2015c; Twomey et al., 2015). Previous studies have estimated that the majority (80%) of individuals entering SUD treatment have a comorbid psychiatric disorder (Dennis et al., 2005; Kessler et al., 1996). Rehm et al. (2015c) also identified that the daily drinking level, anxiety, and the number of inpatient nights during the previous six months predicted receiving treatment. Nevertheless, Ilgen et al. (2011) noted that prior research findings on characteristics of treatment users have inconsistencies due to estimated differences in the definition of treatment use (i.e., lifetime treatment use or new episodes of care) and differences in sampling (i.e., general population or treatment samples).

Finnish studies on intoxicant-related cases in the Finnish social welfare and health care systems have continuously identified that the majority of clients of specialized addiction services are middle-aged men, live alone, belong to a lower socioeconomic status, and have a deprived background (Kaukonen, 2000). This observation resembles the historical roots of the Finnish SUD treatment system, which has focused on deprived individuals with many social problems.

### **2.11.3 Register studies on alcohol use disorders and health service use patterns**

Social and health service use of individuals with AUDs is often estimated by using survey data. Nevertheless, population surveys are prone to selection bias, a phenomenon that can potentially cause inaccurate results, because non-participants are assessed to have a higher risk of alcohol-related diseases and increased risk for hospitalization and death compared with survey respondents (Gorman et al., 2014; Jousilahti et al., 2005; Karvanen et al., 2016). In recent years, the utilization of register data has opened new opportunities to examine health service use patterns of AUD patients across treatment systems. For instance, a Dutch study identified increased somatic health service use for cardiovascular and respiratory-related reasons (OR 1.56,  $p < 0.001$ ), as well as due to infectious diseases (OR 1.30,  $p < 0.001$ ), injuries and accidents (OR 1.67 and 4.04, respectively,  $p < 0.001$ ) among SUD patients compared with age- and gender-matched control population (de Weert-van Oene et al., 2017).

Two Canadian studies using register data across the health service system have associated co-occurring AUD and mental health problems with increased health service use and treatment episodes (Graham et al., 2017; Kêdoté et al., 2008). Graham et al. (2017) examined the average annual health service use by using administrative databases and noted that individuals with both mental health and substance abuse problems were the most frequent users of all types of medical services, including primary care (OR 5.59), emergency care (OR 5.94), and hospitalization (OR 7.82), compared with controls. Kêdoté et al. (2008) noted that the health service use rates were highest in patients with comorbid severe mental illness and SUD.

In a study conducted in the United States, Ford et al. (2004) identified, by using medical record data, that high primary care service users had elevated rates of substance abuse (OR 4.3) compared with mid-range utilizers. Furthermore, addictive disorders were predictors of emergency care use due to accidents and primary care cancellations (Ford et al., 2004).

Of note, the majority of register-based studies have focused on hospitalizations. For example, Miquel et al. (2018), in a study conducted in Catalonia, identified that inpatient admissions were the lowest for abstainers compared with moderate or heavy drinkers. Padyab et al. (2018) identified, based on the register data, that prior mental health hospitalization is a predictor of future mental-health-related hospitalization. Among psychiatric patients, having a comorbid SUD is associated with increased hospitalization rates and psychiatric emergency department contacts (Jorgensen et al., 2018). A Danish prospective health care register study identified that individuals hospitalized for alcohol-related problems such as intoxication, harmful use, or dependence had 10 times higher subsequent psychiatric admission rate and 3 times higher somatic admission rate compared with general population (Askgaard et al., 2019). Primary care registers and social care data remain less utilized due to challenges in data availability and quality (Ketola et al., 2019; Mölläri & Saukkonen, 2019).

### **2.11.4 Health service use patterns as predictors of care outcomes**

The overall knowledge of the associations of care outcomes and previous longitudinal social and health care service utilization across treatment system among patients with AUDs is limited. One of the most ambitious trials regarding service use and alcohol-related outcomes was established in 1997, when Project MATCH aimed to match non-marginalized alcohol-dependent individuals ( $N = 1726$ ) with the most suitable treatment option. The researchers

compared three different treatment options: motivation enhancing (MET), cognitive behavioral therapy, and 12-step-oriented therapy provided as outpatient treatment. The project did not find significant differences, although cognitive behavioral therapy performed well for individuals with mental health problems. Thus, the research focus has begun to shift toward general factors associated with treatment (Babor & Del Boca, 2003; Ilgen & Moos, 2005; Project MATCH Research Group, 1998). For example, since then the quality of the treatment alliance experienced by the patient has been identified to predict positive clinical outcomes independent of different psychotherapy orientations (Ardito & Rabellino, 2011).

Previous studies have identified that regular contact with primary care, receiving specialized AUD services and psychiatric treatment as needed, and longer treatment duration are beneficial to achieve better treatment outcomes such as long-term remission (Mertens et al., 2005, 2008, 2012; Parthasarathy et al., 2012; Ray et al., 2005). McKay et al. (2005, 2009) identified that continuous care was associated with better treatment outcomes and higher alcohol abstinence rates up to two years after the treatment. A study conducted in the United States identified that treatment in Alcoholics Anonymous combined with specialty addiction services was associated with improved treatment outcomes (Mowbray et al., 2015). Long-term follow-up studies have also identified an association between frequent outpatient intervention and treatment contact with lower mortality rate (Kristenson et al., 2002; Noda et al., 2001; Timko et al., 2006).

Individuals who are hospitalized for alcohol-related problems have a higher cumulative all-cause mortality risk. For men, the higher cumulative all-cause mortality risk is 29% (95% CI 28–30); for women, the risk is 26% (95% CI 24–27) (Askgaard et al., 2019). A Finnish register study by Paljärvi et al. (2016) identified that middle-aged employed individuals who later died due to alcohol-related reasons had approximately 7.4 hospital admissions several years before death, but less than 33% had an alcohol-related hospital admission five years prior to death. Thus, these results indicate that individuals with alcohol problems are indeed in contact with social and health service system prior to death, and thus the opportunity for intervention exists.

## **2.12 ALCOHOL USE DISORDERS AND COSTS OF CARE**

In addition to extensive individual harm and negative public health effects, AUDs have a strong economic impact on societies. Harmful alcohol use and alcohol dependence are associated with heavy disease burdens and excess use of social and health services, and thus patients with AUDs have been identified as one of the most expensive client groups in many developed countries (de Weert-van Oene, et al., 2017; GBD 2015 Risk Factors Collaborators, 2016; Graham et al., 2017; Laramée et al., 2013; Leskelä et al., 2013; Miquel et al., 2018). In Europe, the overall economic burden of alcohol is estimated to vary between 40 and 58 billion euros (Effertz & Mann, 2013; Gustavsson et al., 2011). In Finland, the most recent cost estimates are from 2010, when the total societal costs attributable to alcohol were approximately 1.3 billion euros (Jääskeläinen, 2012). However, these calculations are based on different costing methodologies and thus are not fully comparable.

International costing methodologies often emphasize a cost of illness approach, which compares the costs caused by a certain disease with costs of eradication of that disease. It is

unlikely that AUDs will be eradicated; thus, in the Finnish context, the cost analyses have focused on calculating the cost effect of harms caused by alcohol consumption to the society, including health and crime expenditures, labor and productivity costs, and sometimes also an estimate of non-financial welfare costs or intangible costs (Jääskeläinen, 2012; Møller & Srdan, 2010). Furthermore, the cost of illness approach does not consider the varying health service use patterns at the individual level. Miquel et al. (2018) suggested using real-world data obtained from the routine medical records linked to economic data in analyses. Furthermore, cost-evaluation literature examining effectiveness or cost-effectiveness of interventions often utilizes randomized controlled trials as a study design to evaluate mean cost differences. By contrast, the health econometrics approach uses observational data to model factors, such as health status, that are associated with individuals' mean care costs. There are several methods for modeling cost data, including normal distribution methods such as ordinary least squares; single distribution generalized linear models; survival methods, such as Cox proportional hazards regression; Markov chain methods; and Bayesian belief networks (Mihaylova et al., 2011).

Based on research findings on care cost studies from Sweden and Finland, the majority of the direct costs of social and health care accumulate from social care services. In Finland, housing services comprise a large portion of the costs associated with AUD treatment (Jarl et al., 2008; Leskelä et al., 2013; Tammi & Stenius, 2014). For instance, in the city of Oulu, 47% of the annual average costs of patients treated in substance use services accumulated from social care housing services (Leskelä et al., 2013). In health care settings, inpatient care accounted for 35% of the direct health care costs, and outpatient and primary care costs accounted for 30% each (Jarl et al., 2008).

There is empirical evidence that alcohol-dependent patients have 50% higher primary care mean costs compared with those without alcohol dependence (Manthey et al., 2016b). Excess social and health care costs are also accumulated from inpatient treatment and formal long-term care among alcohol-dependent individuals (Dams et al., 2018). A Canadian study by Graham et al. (2017) compared the overall health care costs between patients with SUDs, mental health problems, or both with those without such problems. According to the results, patients with comorbid mental health and SUD problems had 3 times higher average costs compared with those without any mental health or SUD problems. Other researchers have examined factors associated with excess social and health care costs among patients with AUDs and have identified that a comorbid psychiatric diagnosis increases the cost and use of services (Hoff & Rosenheck, 1999; Parthasarathya & Weisner, 2005). Furthermore, psychiatric and medical severity and demographic factors such as older age and female gender are also associated with increased inpatient costs (Graham et al., 2017; Parthasarathy & Weisner, 2005).

AUD treatment improves patient outcomes and diminishes the total care costs, as well as the costs to society (Blöse & Holder, 1991; Goodman et al., 2000; Holder & Blöse, 1986; Parthasarathy & Weisner, 2005; Parthasarathy et al., 2001, 2012; Salomé et al., 2003). Receiving addiction treatment decreases post-treatment service use frequency, especially among individuals who achieve long-term abstinence (Hoffmann et al., 1993; Holder & Blöse, 1992; Zywiak et al., 1999). Furthermore, continuity of care is associated with decreased care costs and not receiving continuous care has been associated with increased inpatient and emergency room service use and, thus, increased costs (Parthasarathy et al., 2012). Nevertheless, there is also

some evidence that the health care costs may increase after the initial treatment (Godfrey et al., 2004) and that the average care costs are higher among abstinent individuals compared with those who have relapsed, due to continuous care required to maintain abstinence (Parthasarathy & Weisner, 2005). A detailed examination of care costs across the treatment system requires extensive individual level register data, which is not currently available in many countries, especially in primary care settings.

## **2.13 SUMMARY OF PREVIOUS RESEARCH**

There is extensive life-course epidemiological literature on the clinical course of AUDs and associated outcomes. The current evidence has summarized AUDs in clinical settings as biopsychosocial disorders with variable clinical courses associated with several individual determinants and care outcomes. According to the empirical evidence, many societal and individual factors mediate the AUD course. Furthermore, life events and social support during individuals' life course play a notable role in the clinical outcomes. There is extensive evidence that AUDs are associated with increased risk of death and the probability of achieving stable remission is low among treated individuals. Nevertheless, AUD treatment is an important mediator of the AUD clinical course, especially among marginalized individuals.

AUD treatment is often challenging due to the chronic nature of the disorder. There is myriad treatment research literature on the efficacy of different treatment options and on treatment matching strategies, but the mediators and moderators of AUD treatment effects are not yet fully understood. Nevertheless, based on the best available knowledge, the Finnish Current Care Guidelines, quality criterion, and extensive legislation have aimed to define the basis for high-quality AUD treatment. Current empirical evidence has identified a care continuum across services as a cornerstone of efficient AUD treatment. It requires close collaboration between different services and care coordination to ensure that the often complex social and health care needs are met. Regular contacts with primary care, specialized AUD services, and psychiatric treatment as needed are key components in achieving better treatment outcomes.

Equity aspects in access to care remain problematic, and empirical evidence has systematically shown that only a minority of individuals with AUDs receive treatment for substance abuse problems. Instead, the use of multiple services and high treatment dropout levels are characteristics of the social and health service use patterns of patients with AUD. Due to the treatment gap and co-occurring comorbidities, individuals with AUDs also often seek treatment from non-specialist services such as primary care physicians. Thus, health and social care professionals across the treatment system have an essential role in the identification of the problem and in motivating and helping individuals to seek appropriate treatment. Unfortunately, there is evidence that social and health care personnel continue to carry stigmatizing attitudes toward working with patients with alcohol or other SUDs; this phenomenon forms yet another barrier to treatment seeking.

From the economic perspective, individuals with AUDs are considered to be a high-need patient population with complex social and healthcare demands and are high-cost patients who

present excess use of services. Nevertheless, a cost offset pattern has been identified following AUD treatment and systems that operate efficiently are identified as effective and cost-saving.

In Finland, patients with AUDs have been identified as an expensive patient group, but there is currently no evidence on national treatment cost offset effects. Furthermore, service use patterns of individuals with AUDs across the social and health service system remain understudied. EHRs provide interesting opportunities to study effectiveness and quality aspects of the current treatment system and international studies using these data sources continue to emerge. However, the full potential of the regional Finnish social and health care registers has not yet been extensively utilized in addiction research.

### 3 AIMS OF THE STUDY

The overall aim of this dissertation was to examine treatment system effectiveness and quality aspects. More specifically, the aim was to examine the alcohol-related social and health service use patterns of individuals with AUDs and to explore how service use and care costs have differed according to long-term care outcomes and in relation to other chronic conditions, by using EHR data from joint municipal authority for North Karelia social and health services (Siun sote).

The specific aims were:

- 1) To describe the AUD care outcomes and help-seeking patterns measured as alcohol-related social and health service use across treatment system (Study I);
- 2) To describe associations between alcohol-related social and health service use patterns and care outcomes as a measure of quality of alcohol treatment system (Studies II and IV);
- 3) To compare overall social and health service use of AUD patients with another resource demanding chronic condition, type two diabetes (T2DM), as a measure of equity in care (Study III);
- 4) To examine the effectiveness of the alcohol treatment system, measured as direct mean care costs of different treatment use profiles of patients with AUDs (Study IV); and
- 5) To examine the direct effect of risk factors to care costs and roles of stable remission to cost accumulation (Study V).





## 4 SUBJECTS AND METHODS

### 4.1 STUDY SUBJECTS, SETTING, AND GENERAL STUDY DESIGN

The study subjects were identified based on the ICD-10 diagnosis codes in EHRs used in the joint municipal authority for North Karelia social and health services (Siun sote) in Finland and the cohorts were followed over time. Data were linked across treatment system from the specialized care registers, primary care registers, and AUD service and social care client registers to examine the social and health service use and care outcomes of individuals with AUDs. In Studies I and II, a random cohort of working-age (18–65 years) individuals with AUDs (N = 396) were identified by using simple random sampling based on alcohol-related ICD-10 codes, and their EHR notes from 2011 to 2016 were manually reviewed to understand the characteristics of the cohort and to acquire in-depth understanding on the nature of the alcohol-related social and health care service use patterns. In Study III, a cohort of T2DM patients (N = 792) was used as a reference group to compare the social and health service use frequencies and care outcomes. In Study IV, all North Karelian individuals aged  $\geq 18$  years with alcohol-related contact with health services were identified from EHRs and followed from 2014 to 2018. In Study V, the original cohort (Study I) was used for years 2012–2016 (N = 363), and the costs data was added to the analysis.

At the beginning of this study in 2015, North Karelia had approximately 165,000 inhabitants, and the alcohol-related mortality in the region (39.7/100,000 inhabitants) was above the national average (35.3/100,000 inhabitants). In North Karelia, services for substance abusers were provided between 2011 and 2016 through two alternative pathways based on the place of residence of the patient. In three municipalities, including the region's largest municipality, the city of Joensuu, specialized addiction services were bought from a private service provider (Sovatek), which provided all the addiction services, including outpatient a-clinic services, short term inpatient care, and longer-term rehabilitation. In the remaining 10 municipalities, the treatment was organized in primary health care centers and specialized care for addictions was provided at the psychiatric facility. In some of these municipalities, primary care health centers included mental health clinics and nurses who had specialized in alcohol and drug-related problems, and health center wards provided short term detoxification. Nevertheless, all the service providers used the same EHR system. Due to the differences in treatment provision in the municipalities, and because these patients also moved to get better services, this study did not examine the service use at the municipal level, but rather as a total amount of services consumed.

The general design was a cohort study. Random sampling was retrospectively conducted and the cohorts were followed prospectively.

#### 4.1.1 Studies I, II, and V cohort

A total of 6,246 individuals with an alcohol-related ICD-10 code marked as a primary or secondary diagnosis for any visit for primary or specialized care in the EHR register in 2011 or

2012 were retrospectively identified. After excluding the residents of municipalities outside North Karelia, a total of 5,778 individuals remained. The proportion of working-age individuals (18–65 years) was 3,935, which is approximately 4.1% of the working-age population in North Karelia. Alcohol-related visits included the following ICD-10 codes: G312, G405, G4050, G4051, G4052, G621, I426, K292, F100, F101, F102, F103, F104, F105, F106, F108, F109, K860, K700, K701, K702, K703, K704, K709, T510, T511, T512, T513, T518, T519, X45, and X69. Mitchell et al. (2012) and Abidi et al. (2018) had identified underdiagnosis and under-registration of AUD diagnoses; thus, a broad set of alcohol-related diagnoses were used in this study. The aim was to avoid sampling bias—only collecting information from those in active treatment, which might have happened if only F10 codes (ICD-10) had been included, and thus those outside active treatments would potentially have been missed.

A random cohort of 407 individuals was formed for detailed examination of EHRs. At this stage, all patients with no sufficient EHR records available were excluded ( $n = 11$ ), because it would not have been possible to reliably estimate their AUD status. Thus, the final study cohort included 396 individuals. The cohort was followed prospectively in time for 6 years, from January 2011 to December 2016. In Study V, only data from 2012 to 2016 was used ( $n = 363$ ), excluding those who died in 2011–2012.

#### **4.1.2 Study cohort III**

For Study III, the original Studies I, II, and V cohort, consisting of working-aged (18–65 years old) patients with AUD ( $n = 396$ ) was supplemented with a cohort of T2DM patients without AUD ( $n = 792$ ), who were used as a reference group. For each AUD patient, two age- and gender-matched T2DM control patients without an AUD were procured. The age- and gender-matched T2DM patients were randomly selected from a larger T2DM cohort ( $n = 10,204$ ) previously collected in the North Karelia region

#### **4.1.3 Study cohort IV**

The Study IV cohort comprised all individuals ( $N = 5,136$ ) identified from the EHR system, based on ICD-10 alcohol-related diagnoses, the Finnish classification of functions, and procedures in outpatient primary health care (SPAT) codes, and the International Classification of Primary Care (ICPC2) codes. Study subjects had either an alcohol-related visit for primary care or specialized care, including one of the following ICD-10 codes: G312, G405, G4050, G4051, G4052, G621, I426, K292, F100, F101, F102, F103, F104, F105, F106, F108, F109, K860, K700, K701, K702, K703, K704, K709, T510, T511, T512, T513, T518, T519, X45, or X69; or SPAT-codes 1309 (substance abuse-related guidance), 1344 (guidance related to addiction services), 1227 (addiction rehabilitation), 1247 (outpatient detoxification), or 1274 (mini-intervention); or ICPC2 code P15 or P16 (alcohol misuse, short- and long-term) recorded in their EHRs between 2014 and 2016. To compare the direct mean social and health care costs of the service use profiles, the study subjects were divided into four categories: 1) those using only specialized AUD services, 2) those using only mental health services, 3) those using both AUD and mental health services, or 4) those using only somatic outpatient and specialized health care services and who received no AUD or mental health treatment. The follow-up period for all individuals with an identified AUD was 5 years, starting from 2014.

## 4.2 REGISTERS USED

This study was based on EHR data gathered from the municipal primary and specialized care databases between 2011 and 2018. The EHR data were supplemented with data gathered from the social services client databases in the joint municipal authority for North Karelia social and health services (Siun sote), for the years 2011–2016.

North Karelia was one of the first areas in Finland to introduce a structured, integrated EHR system (Mediatri) across municipalities in primary and specialized care, as well as in specialized AUD services and adult social work. This system enables a thorough analysis of health service use patterns, including all visits to health and social care professionals as well as laboratory measures, procedures, and treatment episodes. These data were complemented with municipal social services client database (ProConsona) data on income support.

By using linked primary and secondary care EHRs and municipal social services client databases simultaneously, it was possible to examine thoroughly social and health service utilization and factors associated with outcomes of death and remission. Municipal social services client databases had not been extensively utilized together with EHR data in register-based alcohol-related social and health service use research before this study.

## 4.3 MEASURES OF OUTCOMES

### 4.3.1 Care outcome status

The main outcome variable in Studies I and II was the care outcome at the end of the follow-up period. The data were divided into three mutually exclusive categories: 1) dead, 2) present AUD, and 3) AUD in remission. Outcome variables were manually collected from the EHR notes, except the date of death, which was automatically linked to the EHR from the Finnish Population Register Center. In Studies III and IV, death was the only care outcome measure.

In Studies I and II, individuals were classified in the present AUD group if they had (a) visits to health services with a ICD-10 diagnosis code F10 as the main diagnosis and (b) health professionals' notes on the harmful use of alcohol or dependence in the EHR in each year of the follow-up period.

In Studies I and II, remission was defined as sustained abstinence or managed use; short abstinence periods that lasted for a maximum of few months were excluded. The time estimate of AUD remission was based on health professionals' notes and diagnosis information. Specifically, the EHR notes systematically identified the patient as abstinent or managing his or her use and provided a time estimate of the remission or managed use, or the patient had an ICD-10 diagnosis code F1020–F1023, which indicates sustained remission. In case of mixed or unclear drinking status between the health professionals' notes, the patient was assessed as having a present and active AUD.

### 4.3.2 Total care costs

The cumulative mean care costs were used as the main outcome in Studies IV and V. In Study IV, cost data were gathered from two sources:

(1) Direct costs from specialized care were derived from the central hospital's cost accounting systems for the years 2014 and 2018 by using Diagnosis-Related Groups (DRG) based on the Finnish version of the Nordic Classification of Surgical Procedures codes for diagnostic and treatment procedures and the corresponding Nordic Diagnosis-Related Groups patient classifications.

(2) Direct costs from primary care were calculated using patient-level data, including diagnosis and activity information. These data were grouped using the Ambulatory and Primary Care-Related Patient Groups (APR) grouper software, which is a grouping system (equivalent to DRG) that is used in hospital care (Linna et al., 2018). First, the batch grouper assigned each patient contact to one APR group. Following the grouping procedure, every contact in the patient data was assigned a cost weight, based on the APR group, indicating the relative consumption of resources. The cost weights were obtained from the national standard price lists for primary care contacts (Kapiainen et al., 2014). Direct costs from primary care inpatient care, social care, long-term housing, and home care were calculated by using unit cost estimates for social care contacts. Bed days were derived from the Finnish price list for unit costs of health care services.

In Study V, total costs for the years 2012–2016 were derived from the EHR cost accounting database, including all hospitalizations and outpatient costs and primary care, social care, long-term housing, and home care costs.

## 4.4 COVARIATES

Covariates and outcome measures of the five studies are presented in Table 1. All covariates and outcomes were selected based on the literature review and within the limits of information available from EHRs. Covariates and outcome measures of the five sub-studies are presented in Table 1. All covariates and outcomes were selected based on literature review and within the limits of information available from EHRs.

**Table 1.** Covariates and outcome measures used in the studies.

<b>Study</b>	<b>Variables</b>	<b>Definition</b>	
<b>Study I</b>	<b>Predisposing factors, socioeconomic variables, need factors, and clinical variables</b>	Gender	Gender: male or female
		Age	Age groups: 18–24, 25–34, 35–44, 45–54, or 55–64 years
		Comorbidity	Number of comorbidities: (1) none, (2) one, or (3) $\geq 2$ (indicating multimorbidity)
		Mental health comorbidity	ICD-10 codes F00–F99 (mental and behavioral disorders), excluding F10 codes
		Permanent alcohol use disorder	ICD-10 codes F100, F101, F102, F103, F104, F105, F106, F108, or F109 (mental and behavioral disorders due to alcohol use)
	<b>Social and health service use variables</b>	Alcohol-related service use Study subjects were profiled according to the patterns of alcohol-related service use: (1) only mental health contact, (2) specialized AUD service contact, or (3) no specialized AUD contact. There were also profiled based on the most frequent pattern of alcohol-related service use:	
	<b>Outcomes</b>	Care outcome after 6-year follow-up (1) dead, (2) present AUD, or (3) AUD in remission.	
<b>Study II</b>	<b>Predisposing factors, socioeconomic variables, and social problem variables</b>	Gender	Gender: male or female
		Age	Age groups: 18–24, 25–34, 35–44, 45–54, or 55–64 years
		Marital status	Marital status: single, divorced, widowed, married, or in cohabitation Binary variables (yes or no) were collected manually from EHRs according to whether the study participant had any such mentions within the 6-year period.
	<b>Enabling factors, financial status</b>	Unemployment status, homelessness, illicit drug use, criminal record, and drunk driving Income support data were obtained from the municipal social services client databases as a binary variable (yes or no)	

<b>Study</b>	<b>Variables</b>	<b>Definition</b>	
	<b>Need factors, clinical variables</b>	Comorbidity	Number of comorbidities: (1) none, (2) one, or (3) $\geq 2$ (indicating multimorbidity)
		Mental health comorbidity	ICD-10 codes F00–F99 (mental and behavioral disorders), excluding F10 codes
		Permanent alcohol use disorder	ICD-10 codes F100, F101, F102, F103, F104, F105, F106, F108, or F109 (mental and behavioral disorders due to alcohol)
		Laboratory measures	Laboratory measures were calculated as a yearly mean number of measures, by considering the eligibility time of the study subjects. The measures collected were: serum desialotransferrin (S-DST), plasma glutamyl transferase (P-GT), plasma alanine aminotransferase (P-ALT), plasma aspartate aminotransferase (P-AST), plasma alkaline phosphatase (P-ALP), and mean corpuscular volume (E-MCV).
	<b>Social and health service use variables</b>	Alcohol-related visit frequencies to different social and health care professionals (nurses, doctors, psychologists, and social workers) in (1) primary care, (2) specialized AUD services, (3) primary-care-level mental health services, and (4) specialized health care services	Alcohol-related health care service utilization was defined as having one of the following ICD-10 codes as the main diagnosis for the visit: F100, F101, F102, F103, F104, F105, F106, F108, or F109. Primary care doctor visits for mental health reasons were defined as having an ICD-10 code F01–F99 (excluding F10 codes) as the main diagnosis for the visit.
	<b>Outcomes</b>	(1) Risk of death (2) Probability of AUD remission	(1) Date of death retrieved from EHRs (2) EHR notes systematically indicating stable remission
<b>Study III</b>	<b>Predisposing factors, socioeconomic variables, need</b>	Gender Age Comorbidity	Gender: male or female Age groups: $<45$ or $\geq 45$ years Number of comorbidities: (1) none, (2) one, or (3) $\geq 2$ (indicating

<b>Study</b>	<b>Variables</b>		<b>Definition</b>
	<b>factors, and clinical variables</b>	Mental health comorbidity	multimorbidity) ICD-10 codes F00–F99 (mental and behavioral disorders), excluding F10 codes
	<b>Social and health service use variables</b>	Overall social and health service use frequencies by professional group, use of dental care, physiotherapy, and mental health services	Annual average number of visits to different social and health care professionals and treatment periods in primary and specialized care. Primary care professionals included medical doctors, registered nurses, public health nurses, psychologists and social workers. Dental care service use included visits to all dental care professionals, including dentists and dental hygienists. Physiotherapy service use included visits to physiotherapists, and mental health service use included visits to all nurses and doctors working in mental health services.
	<b>Outcomes</b>	Risk of death	Date of death retrieved from EHRs
<b>Study IV</b>	<b>Predisposing factors, socioeconomic variables</b>	Gender Age	Gender: male or female Age groups: 18–24, 25–34, 35–44, 45–54, 55–64, or ≥ 65 years
	<b>Need factors, clinical variables</b>	Comorbidity	Number of comorbidities: (1) none, (2) one, or (3) ≥ 2 (indicating multimorbidity)
	<b>Social and health service use variables</b>	Service use profile: (1) only AUD service use, (2) only mental health service use, (3) both AUD and mental health service use, or (4) no AUD or mental health service use	All contacts and treatment periods with social and healthcare services of the four service use profiles
	<b>Outcomes</b>	(1) Cumulative cost of care (2) Risk of death (3) Risk of ending up as an expensive patient	(1) Calculated based on EHR data (2) Date of death retrieved from EHRs (3) Ending up in the costliest 10% of all patients
<b>Study V</b>	<b>Predisposing factors, socioeconomic variables, and social problem variables</b>	Gender Age Marital status Unemployment status,	Gender: male or female Age groups: 18–24, 25–34, 35–44, 45–54, or 55–64 years Marital status: (1) single, divorced or widowed or (2) married, cohabitation Binary variables (yes or no) were collected manually from EHRs,

Study	Variables	Definition
	homelessness, illicit drug use, criminal record, and drunk driving	according to whether the study participant had any such mentions within the 6-year period.
	<b>Enabling factors and financial status</b>	Income support data were obtained from the municipal social services client databases as a binary variable (yes or no)
	<b>Need factors and clinical variables</b>	Comorbidity Number of comorbidities: (1) none, (2) one, or (3) $\geq 2$ (indicating multimorbidity) Mental health comorbidity Permanent ICD-10 codes F00–F99 (mental and behavioral disorders), excluding F10 codes
	<b>Social and health service use variables</b>	Specialized healthcare costs Total 5-year specialized health care costs retrieved from EHRs Primary healthcare costs Total 5-year primary healthcare costs retrieved from EHRs
	<b>Outcomes</b>	Cumulative 5-year mean care costs Calculated based on EHR cost accounting data for each patient

Note. AUD, alcohol use disorder; EHR, electronic health record; ICD-10, International Classification of Diseases.

#### 4.4.1 Enabling factors

Socioeconomic variables included in all studies were age and gender. These were the only variables directly retrievable through EHRs. Marital status and unemployment status were manually collected from the EHR notes.

#### 4.4.2 Predisposing factors / Social problems

In Studies II and V, variables indicating social problems, including homelessness, illicit drug use, criminal record, and drunk driving, were collected manually from EHRs as binary variables (yes or no), according to whether the study participant had any such mentions within the 6-year period. Income support data were obtained from the municipal social services client databases.

#### 4.4.3 Need factors / Clinical variables

Information regarding comorbidity was used also as a covariate in all studies. Permanent diagnoses were classified into three groups according to number of comorbidities: (1) none, (2) one, or (3)  $\geq 2$  (indicating multimorbidity). Mental health comorbidity was defined as permanent ICD-10 codes F00–F99 (mental and behavioral disorders), excluding F10 codes,



collected from the routinely compiled EHR statistics. A permanent alcohol diagnosis was defined as ICD-10 codes F100, F101, F102, F103, F104, F105, F106, F108, or F109 (mental and behavioral disorders due to alcohol use). Laboratory measures (Study II) were used to identify and assess AUD care and included serum desialotransferrin (S-DST), plasma glutamyl transferase (P-GT), plasma alanine aminotransferase (P-ALT), plasma aspartate aminotransferase (P-AST), plasma alkaline phosphatase (P-ALP), and mean corpuscular volume (E-MCV). Laboratory measures were calculated as a yearly mean number of measures, taking into account the eligibility time of the study subjects.

#### **4.4.4 Health service use variables**

In Study I, the study subjects were profiled by outcome group according to their patterns of alcohol-related service use. The required information was derived from the EHR notes. First, all notes mentioning alcohol use for the years 2011–2016 were manually collected and further classified. Patients were then assigned into three groups according to their health service use patterns. These groups were: (1) only mental health contact, (2) specialized AUD service contact, or (3) no specialized AUD contact. Alcohol-related health service contacts were then further classified into mutually exclusive groups according to contact type mode, to identify the alcohol-related service use profile. The mutually exclusive groups in specialized AUD treatment were: (1) having only visits to AUD services, (2) having AUD visits and treatment periods, or (3) having only drivers' license monitoring visits due to drunk driving. The mutually exclusive groups for those not in AUD treatment were: (1) only visits in specialized care for alcohol-related somatic reasons, (2) several detoxifications in primary care and no recorded treatment compliance, (3) several alcohol-related intoxications and/or accidents, (4) only several alcohol-related ambulance consultations, (5) severe alcohol-related somatic problems and no recorded treatment compliance, or (6) an identified chronic AUD and minimal health service use and no recorded treatment compliance.

To examine the association between alcohol-related social and health care service use frequency and the care outcomes (Study II), alcohol-related visit frequencies to different social and health care professionals were collected and controlled. Alcohol-related health care service utilization was defined as having one of the following ICD-10 codes as the main diagnosis for the visit: F100, F101, F102, F103, F104, F105, F106, F108, or F109. Alcohol-related social and health service use variables comprised (1) primary care services, including alcohol-related (F10) doctor visits and alcohol-related inpatient treatment episodes in a primary care ward; (2) specialized AUD services, including doctor visits, nurse visits, social worker visits, detoxification treatment, rehabilitation, evaluation periods, housing rehabilitation, interval treatment, crisis treatment, and sobriety support; 3) primary care level mental health services, which were mental health units that operated as part of health centers, including doctor visits and nurse visits in mental health units; and 4) somatic specialized care visits, including alcohol-related (F10) doctor visits and alcohol-related inpatient treatment episodes, as well as doctor, nurse, psychologist, and social worker visits for specialized psychiatric treatment.

Primary care doctor visits for mental health reasons were also gathered as separate variables, defined as having an ICD-10 code F01–F99 (excluding F10–F19 codes), as the main diagnosis for the visit. In addition, visits to psychologists in primary care and the information regarding

institutionalization, defined as long-term inpatient treatment or sheltered housing, were collected from EHRs.

To compare overall service use frequencies of AUD and T2DM patients in Study III, the annual average number of visits to different primary care professionals, specialized care doctor visits, and treatment periods in primary and specialized care were examined. Primary care professionals included medical doctors, registered nurses, public health nurses, psychologists, and social workers. The use of dental care, physiotherapy, mental health, and specialized AUD services was also examined. Dental care service use included visits to all dental care professionals, including dentists and dental hygienists; physiotherapy service use included visits to physiotherapists; mental health service use included visits to all nurses and doctors working in mental health services; and specialized AUD service use included visits to nurses and doctors working in AUD services. Frequent contact was defined as 1+ or 3+ visits per year, depending on the service domain.

## **4.5 STATISTICAL METHODS**

The characteristics of the study populations are presented as counts with percentages. The statistical significance of difference in categorical variables between the outcome groups was tested with chi-square, Fischer's exact, and Kruskal–Wallis tests. Social and health service use was measured as a yearly mean number of visits, by considering the eligibility time of the study subjects. The eligibility time in years was calculated within a 6-month accuracy for each person until death or the end of follow-up, and the yearly mean number of visits for the 6-year follow-up was calculated by dividing the cumulative number of visits by the eligibility time, to compare the outcome groups. Analyses in Studies I–IV were performed using IBM SPSS Modeler (version 18.0, SPSS Inc, Chicago, IL, USA) and IBM SPSS Statistics 24 (SPSS Inc, Chicago, IL, USA). Analyses in Study V was performed using the Bayesialab 9.0 tool.

### **Study I**

Descriptive statistics were used to compare the socioeconomic and clinical variables and specialized AUD and mental health service uses of the outcome groups. Service use was measured as a yearly mean number of visits. The chi-square, Fischer's exact, and Kruskal–Wallis tests were used for the group comparisons. Alcohol-related service use profiles were created by manually assessing the alcohol-related EHR notes and identifying (1) if the person had used AUD services, (2) mental health services, or (3) if none, the most common type of alcohol-related contact with social and health care services.

### **Study II**

The chi-square, Fischer's exact, and Kruskal–Wallis tests were used to compare the care outcome groups. Bivariate and multivariate Cox regression analyses were used to further examine factors associated with risk of death and the probability of remission. In the Cox regression analysis, the observed outcome is the time from the beginning of the study until the

occurrence of the event, i.e., care outcome, and the HR measures the effect of an intervention on an outcome. In the proportional hazards model, a set of predictors, here service use frequencies and demographic factors, are used to predict cumulative hazard function to determine whether service use or demographic factors had an effect on individuals' hazard of outcome (Aiken et al., 2008; Urach et al., 2016). In the regression analyses, all the variables were tested separately in a bivariate model, and those with  $p < 0.05$  were further included in a multivariable model. Backward elimination excluded statistically insignificant variables from the final multivariate models. Multivariate analysis, with death as the outcome variable, was adjusted for marital status, number of permanent diagnoses, drunk driving, doctor visits to specialized AUD clinics, social worker visits, mental health service doctor visits, and alcohol-related primary care doctor visits. Multivariate analysis with remission as the outcome variable was adjusted for institutional care, specialized AUD clinic nurse visits, rehabilitation at specialized AUD clinics, mental health nurse visits, alcohol-related primary care doctor visits, other mental-health-related primary care doctor visits, alcohol-related doctor visits to specialized AUD clinics, and the number of DST laboratory measurements. A log minus log plot was used for the validation of a proportional hazard assumption. The results of the Cox regression analyses are presented with HRs and 95% CI limits.

### **Study III**

Differences in social and health service use frequencies between the groups were described using the chi-square and Fischer's exact tests. Group differences in the visit density to social and health services were examined using logistic regression analyses, considering the T2DM group as the reference group. The risk of death was examined using Cox regression analysis.

### **Study IV**

Differences in the mean direct care costs of the service user profiles were compared using the chi-square test and a generalized linear model with a gamma distribution. A log link function was used to control for skewedness of the health care cost data, because the cost data is known to have a heavier right tail. This method has been shown to perform well on heavy-tailed data (Mihaylova et al., 2011). The risk of death and the risk of ending up as an expensive patient were examined using multivariate logistic regression.

### **Study V**

In Study V, statistical analysis was based on a Bayesian network approach to identify causal effects of different risk factors on care costs. A non-causal augmented naïve Bayesian (ANB) network model was built to examine the directional relationship between several risk factors and care costs: An ANB model represents dependence between variables in a probabilistic model (Kekolahti, 2019; Ryyänen et al., 2018). The Bayesian network is based on a directed acyclic graph (DAG) from which both direct and indirect effects and common causes can be observed. A DAG comprises nodes that represent variables and arcs or lines that represent associations between the nodes, including a graph of the probability distribution of each

variable. A Bayesian network allows fixing one or several variable values to demonstrate their common effect on other variables, including the target variable (Ryynänen et al., 2018).

In Study V, the supervised learning method with a minimum description length (MDL) score using an ANB was applied to construct a non-causal Bayesian network, supplemented with expert intervention to verify the correctness of causal directions. MDL is used to select a model regardless of the complexity and restrictive assumptions of the data sample distribution. The idea of MDL is that by extracting redundancy from data, the underlying regularities in the data can be uncovered and the model that provides the shortest description of the data should be chosen (Myung, 2001). To avoid local minima, a significant obstacle to successful training of the network, the ANB search was supplemented with data perturbation, which adds random noise to the weight of each observation in the dataset. Continuous variables were discretized using a convenience distribution for the variable age with 10-year intervals. The variables implying costs were discretized to quarters (i.e., 25% of observations for each class). To find the optimal complexity of the model in the ANB learning phase, a structural coefficient analysis was performed as part of the MDL scoring, and a structural coefficient value of 0.6 was used in the analysis. The structural coefficient is a measure of the amount of expected change in an outcome given one-unit change in the causal variable, while other variables are fixed.

Given that the true causal network between variables and the target variable was not known, the modified disjunctive confounder criteria (DCC) was used to estimate direct causal effect of a variable on the target variable from the non-causal Bayesian network (VanderWeele & Shpitser, 2011; VanderWeele, 2019). DCC is used to control for each variable that is a cause of the treatment (or exposure), target, or both. In a modified DCC, two additional criteria are added: discarding instrumental variables and including proxy variables for unmeasured common causes of treatment or exposure.

Following the DCC, the probabilistic effect of AUD remission in 2012 (continual AUD vs remission) was examined by fixing marginal distributions of all other independent variables, except the AUD status in 2012, to 100%. The model gives the values of the outcome in a hypothetical case that an individual had an AUD remission. Jouffe's proprietary likelihood matching (PLM) algorithm was used to estimate the independent variables' causal effect on the target while holding others constant (Conrady et al., 2014).

A sensitivity analysis among variables was applied to identify the how the combination of variable values had maximal or minimal effects on the target variable. Sensitivity analysis with tornado diagrams was used and is presented separately for each value of the outcome variable.

## **4.6 ETHICAL CONSIDERATIONS**

The studies in this dissertation were approved by the Research Ethics Committee of the Northern Savo Hospital District (DNo. 410/13.02.00/2015). According to the European Union General Data Protection Regulation, social and health care register data is considered to be sensitive data and is subject to particularly strict rules. Register data can be used for scientific purposes, but register studies require permission from the registrar. Permission to use register data was received from the Finnish Institute for Welfare and Health (DNo.

THL/1676/5.05.00/2015) and from the Joint Municipal Authority for North Karelia Social and

Health Services (DNo. 101/13.00.01.01/2017). This study was based only on registry information; thus, study participants were not contacted. Only the necessary information required to answer the study questions was gathered.



## 5 RESULTS

The baseline characteristics of the cohorts are presented in Table 2. All study participants in Cohort 1 fulfilled the definition of having an AUD and were described in the health professionals' notes as either presenting the signs of harmful alcohol use, with mentions of various somatic and/or mental health-related harms caused by alcohol, or as being dependent on alcohol and undergoing varying treatment paths. Thus, the random sampling from EHRs mostly captured individuals having an advanced form of AUD described in their EHR records.

**Table 2.** Characteristics of the cohorts.

	Study I, II, III, V (Cohort 1, n=396)			Study IV (Cohort 2, n=5136)			Study III (age and gender matched T2DM controls, n=792)		
	n	%	P	n	%	P	n	%	P
<b>Age</b>			<0.001			<0.001			<0.001
18-24	16	4		647	12,6		258	32,6	
25-34	44	11,1		701	13,7				
35-44	69	17,4		667	13,0				
45-54	148	37,4		1085	21,1		534	67,4	
55-64	119	30,1		1351	26,3				
65+	0	0		684	13,3				
<b>Gender</b>			<0.001			<0.001			<0.001
Male	295	74,5		3650	71,1		590	74,5	
Female	101	25,5		1486	28,9		202	25,5	
<b>Multimorbid</b>			<0.001			<0.001			0.008
Yes	218	55,1		4052	78,9		469	59,2	
No	178	49,9		1084	21,1		323	40,8	
<b>AUD diagnosis</b>			<0.001			<0.001			<0.001
Yes	128	32,3		2779	54,1		0	0	
No	268	67,7		2357	45,9		792	100	
<b>Mental health diagnosis</b>			<0.001			<0.001			<0.001
Yes	87	22		2248	43,8		107	13,5	
No	309	78		2888	56,2		685	86,5	
<b>Marital status (n=332)</b>									
Single	140	42,2	<0.001						
Married/cohabitation	97	29,2							
Divorced/widow	95	28,6							
<b>Income support</b>			<0.001						
Yes	270	68,2							
No	112	28,3							
Missing	14	3,5							
<b>Homeless</b>									
Yes	27	6,8	<0.001						
No	369	93,2							
<b>Unemployment period</b>			<0.001						
Yes	190	48,1							
No	124	31,3							
Missing	82	20,7							
<b>Relative died</b>			<0.001						
Yes	37	9,3							
No	326	82,3							
Missing	33	8,3							
<b>Criminal background</b>			<0.001						
Yes	77	19,4							
No	319	80,6							
<b>Drunk driving</b>			<0.001						
Yes	74	18,7							
No	322	81,3							

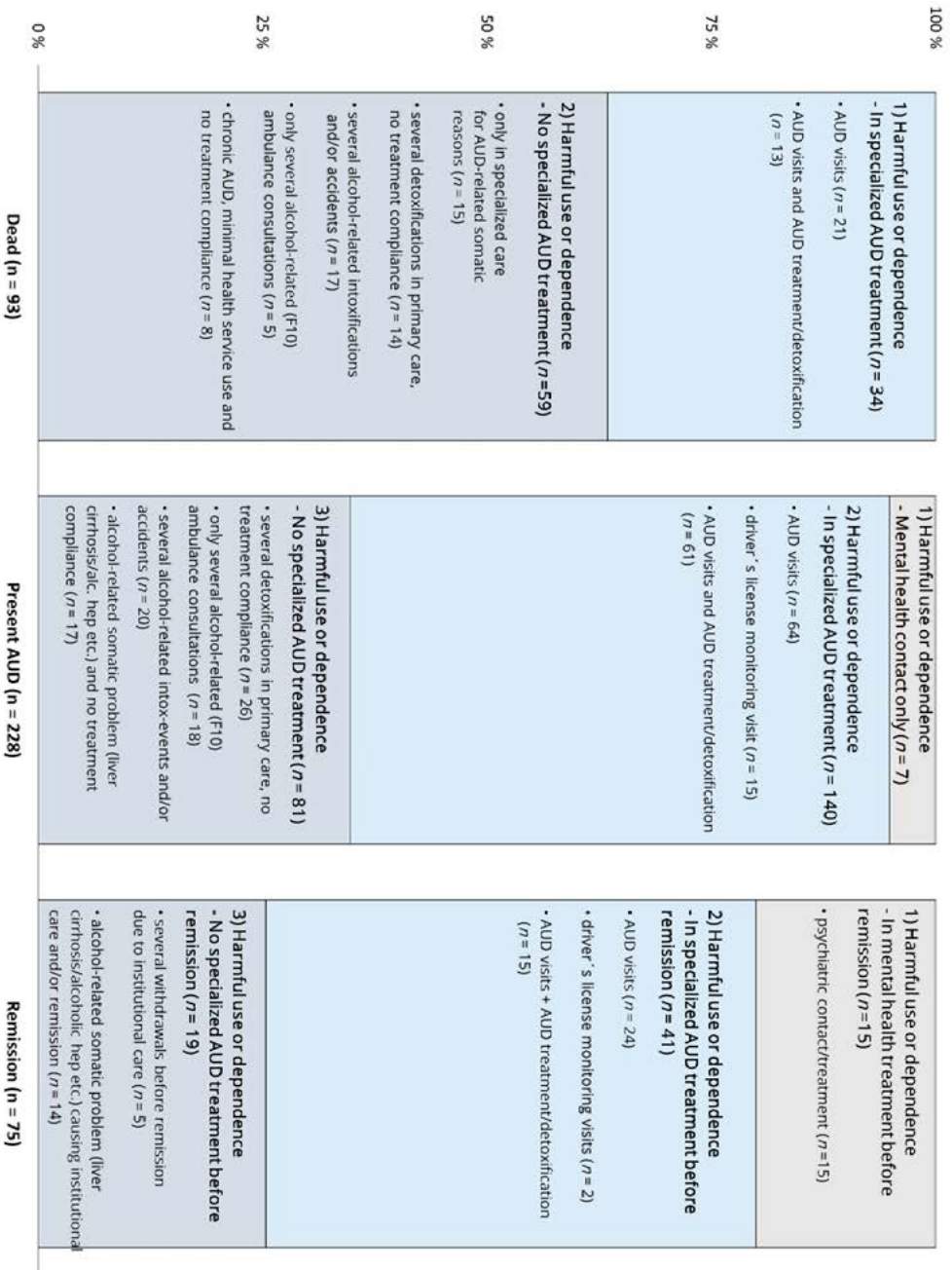
## 5.1 ALCOHOL USE DISORDER CARE OUTCOMES AND HELP SEEKING PATTERNS

In Study I, AUD care outcomes were examined with regard to alcohol-related social and health service use patterns across the treatment system. There was a 22.9% mortality rate at the end of the 6-year follow-up, and the stable remission rate was 18.4%. The most prevalent outcome was continual AUD (56%).

Mapping the alcohol-related contacts with service systems provides an overview of the existing services where the individuals extended their help seeking. This approach also estimates treatment coverage and gaps in the access to treatment. In Study I, the alcohol-related service use patterns (Figure 3) varied according to the care outcome groups. AUD treatment coverage was only 39.8% among those who had died during the follow-up period. The majority (63.4%) of those who died remained outside specialized AUD services. Their help-seeking extended to other parts of the service system, including (1) specialized care due to alcohol-related somatic complications, (2) primary care health center wards due to detoxify without any recorded compliance with treatment, (3) emergency care due to recurrent intoxications and accidents, (4) several ambulance consultations due to alcohol-related issues but no actual treatment contact, and (5) occasional health service utilization, but no recorded compliance with treatment, although the individual had been diagnosed with chronic alcoholism.

Examination of the help-seeking patterns of those with a continual AUD at the end of the follow-up period ( $n = 228$ ) showed that 61.4% had contact with specialized AUD services. Only one third of the patients with an AUD had not received treatment in specialized AUD services. They were characterized in EHRs as having (1) several withdrawals in the primary care setting and no commitment to any AUD treatment, (2) several ambulance consultations for alcohol-related reasons, but these contacts did not result in referral to treatment, (3) recurrent alcohol-related intoxications and/or accidents, or (4) chronic alcohol-related somatic disorder diagnosis but no recorded compliance with any treatment. By contrast, treatment coverage was highest among those who achieved stable remission; the majority of those individuals were using either specialized AUD services or received care in mental health services, where their AUD was also treated.





**Figure 3.** Alcohol-related service use patterns according to outcome group. Note. AUD, alcohol use disorder

## 5.2 QUALITY OF THE ALCOHOL TREATMENT SYSTEM

The quality of the regional alcohol treatment system was examined through the associations between alcohol-related social and health service use patterns and care outcomes in Studies I, II, and IV.

The use of services addressing the care needs was examined with regard to care outcomes in Study II. Alcohol-related service use associated with care outcomes was considered to be a measure of quality of the current regional service provision system. First, the association between social and health service use, predisposing socioeconomic and need-based clinical factors, and remission were examined (Table 3). Overall, contact with a mental health nurse (HR 1.22, 95% CI 1.02–1.46,  $p = 0.034$ ), visits to the primary care doctor for mental health reasons (HR 1.55, 95% CI 1.13–2.13,  $p = 0.007$ ), rehabilitation in specialized AUD services (HR 6.75, 95% CI 2.27–20.11,  $p < 0.001$ ), frequently measured serum DST value (HR 1.27, 95% CI 1.16–1.39,  $p < 0.001$ ), and institutional care (HR 1.55, 95% CI 1.33–1.81,  $p < 0.001$ ) were associated with increased probability of achieving stable remission. Socioeconomic variables were not associated with remission.

Frequent alcohol-related visits to a primary health care doctor were associated with decreased likelihood of achieving remission (HR 0.65, 95% CI 0.46–0.92,  $p = 0.016$ ), as were the alcohol-related somatic specialized care doctor visits (HR 0.54, 95% CI 0.35–0.83,  $p < 0.005$ ).

Death of a working-age individual with AUD can be seen as an indicator of insufficient service provision or an indicator of quality issues. Table 4 shows the findings with regard to whether health service use variables or socioeconomic and clinical characteristics were associated with the risk of death. Visits to a specialized AUD services doctor (HR 0.36, 95% CI 0.21–0.60,  $p < 0.001$ ) or a mental health services doctor (HR 0.50, 95% CI 0.26–0.96,  $p = 0.04$ ) decreased the risk of death. By contrast, frequent alcohol-related visits to a primary care doctor were associated with increased risk of death (HR 1.67, 95% CI 1.28–2.18,  $p < 0.001$ ). Drunk driving (HR 0.28, 95% CI: 0.13–0.62,  $p = 0.002$ ) and the number of permanent diagnoses were related to decreased risk of death, particularly in the cases with multimorbidity, defined as  $\geq 2$  permanent diagnoses (HR 0.19, 95% CI 0.11–0.33,  $p < 0.001$ ).

**Table 3.** Clinical and health service use-related variables associated with remission among patients with alcohol use disorder.

	Model 1*			Model 2**		
	HR	95% CI	p	HR	95% CI	p
Institutional care	1.58	1.37–1.83	< 0.001	1.55	1.33–1.81	<0.001
Permanent F10 diagnosis	0.35	0.20–0.64	0.001	.	.	.
AUD services detoxification	0.28	0.08–0.92	0.036	.	.	.
AUD services rehabilitation	1.76	0.60–5.17	0.303	6.75	2.27–20.11	0.001
AUD services nurse visit	0.88	0.73–1.05	0.14	0.85	0.70–1.03	0.09
Mental health services doctor visit	1.85	1.43–2.39	< 0.001	.	.	.
Mental health services nurse visit	1.36	1.15–1.60	< 0.001	1.22	1.02–1.46	0.034
Primary health care doctor visit (F10)	0.53	0.38–0.74	< 0.001	0.65	0.46–0.92	0.016
Primary health care doctor visit (F)	1.89	1.48–2.41	< 0.001	1.55	1.13–2.13	0.007
Primary health care inpatient (F10 diagnosis)	0.59	0.41–0.84	0.003	.	.	.
Specialized care doctor visit (F10 diagnosis)	0.42	0.28–0.62	< 0.001	0.54	0.35–0.83	0.005
Specialized care inpatient treatment (F10 diagnosis)	0.56	0.37–0.85	0.007	.	.	.
Specialized care psychiatrist visit (excluding F10)	1.33	1.16–1.52	< 0.001	.	.	.
Laboratory measurement S-DST count	1.26	1.15–1.37	< 0.001	1.27	1.16–1.39	< 0.001
Laboratory measurement ETOH count	0.99	0.97–0.99	0.04	.	.	.
Laboratory measurement E-MCV count	1.05	1.03–1.06	< 0.001	.	.	.
Laboratory measurement P-ALT count	1.07	1.04–1.10	< 0.001	.	.	.

Note. \* Model 1 is a bivariate model. \*\* Model 2 is a multivariate model, adjusted for institutional care, specialized AUD services nurse visits, rehabilitation in specialized AUD services, mental health nurse visits, alcohol-related doctor visits in primary health care, other mental-health-related doctor visits in primary health care, alcohol-related doctor visits in specialized care, and number of S-DST laboratory measure. AUD, alcohol use disorder; CI, confidence interval; E-MCV, mean corpuscular volume; HR, hazard ratio; P-ALT, plasma ala.ne aminotransferase; P-GT, plasma glutamyl transferase; S-DST, serum desialotransferrin.

**Table 4.** Socioeconomic, clinical, and health service use-related variables associated with risk of death among patients with alcohol use disorder

	Model 1*			Model 2**		
	HR	95% CI	p	HR	95% CI	p
Marital status						
Married/cohabitation (Ref)			0.007		0.011	0.011
Single	1.85	1.06–3.24	0.031	2.19	1.21–3.96	0.010
Divorced/widowed	0.79	0.39–1.59	0.502	1.13	0.54–2.37	0.738
Number of permanent diagnoses						
0 (Ref)			< 0.001			< 0.001
1	0.54	0.32–0.93	0.026	0.30	0.16–0.56	< 0.001
2+	0.35	0.22–0.56	< 0.001	0.19	0.11–0.33	< 0.001
Drunk driving	0.37	0.18–0.77	0.008	0.28	0.13–0.62	0.002
Unemployment	0.57	0.35–0.92	0.022	.	.	.
AUD services doctor visit	0.49	0.31–0.76	0.001	0.36	0.21–0.60	< 0.001
AUD services nurse visit	0.76	0.65–0.91	0.002	.	.	.
AUD services social worker visit	0.37	0.16–0.85	0.019	0.32	0.13–0.81	0.016
AUD services rehabilitation	0.41	0.18–0.93	0.034	.	.	.
Mental health services doctor visit	0.44	0.25–0.79	0.005	0.50	0.26–0.96	0.036
Mental health services nurse visit	0.77	0.62–0.96	0.017	.	.	.
Primary health care doctor visit (F10)	1.30	1.04–1.61	0.020	1.67	1.28–2.18	< 0.001
Primary health care doctor visit (F)	0.62	0.44–0.88	0.008	.	.	.
Specialized care psychiatrist visit (excluding F10)	0.68	0.48–0.96	0.029	.	.	.
Specialized care psychiatric nurse visit (excluding F10)	0.64	0.46–0.88	0.006	.	.	.
Laboratory measurement S-DST count	0.68	0.52–0.88	0.003	.	.	.

Note. \* Model 1 is a bivariate model. \*\* Model 2 is a multivariate model, adjusted for marital status, number of permanent diagnoses, drunk driving, doctor visits in specialized AUD services, social worker visits, doctor visits in mental health services, and alcohol-related doctor visits in primary health care. AUD, alcohol use disorder; Ref, reference condition; S-DST, serum desialotransferrin.

In Study IV, the risk of death was examined with regard to the treatment use profile by using a larger cohort (Table 5). Receiving AUD treatment (OR 0.56), mental health treatment (OR 0.63), or both (OR 0.41) were all associated with a diminished odds of death. Of note, multimorbidity was not associated with death in Study II or IV.

**Table 5.** Comparison of the risk of death during the 5-year follow-up of between different treatment service use profiles.

	<b>OR</b>	<b>95% CI</b>	<b>p</b>
AUD treatment only	0.56	0.41–0.77	< 0.001
MH treatment only	0.63	0.50–0.80	< 0.001
AUD and MH treatment	0.41	0.32–0.54	< 0.001
Neither AUD nor MH treatment	Ref		
Age range (years)			
18–24	0.04	0.02–0.09	< 0.001
25–34	0.13	0.09–0.21	< 0.001
35–44	0.19	0.13–0.28	< 0.001
45–54	0.34	0.26–0.45	< 0.001
55–64	Ref		
Gender			
Male	1.77	1.43–2.20	< 0.001
Female	Ref		
Multimorbidity			
Yes	0.94	0.74–1.18	0.589
No	Ref		

Note. A multivariate model, adjusted for treatment profile, age group, gender, and multimorbidity ( $\geq 2$  permanent ICD10 diagnoses), was used. AUD, alcohol use disorder; CI, confidence interval; MH, mental health; OR, odds ratio; Ref, reference condition.

### 5.3 EQUITY IN ACCESS TO CARE

In Study III, the current treatment system was monitored and quantitative data on social and health service use frequencies of working-age AUD patients and T2DM patients were compared to identify possible differences in equal access to adequate care (Table 6). Health service use was defined as either 1+ or 3+ average annual visits, or any contact with the service in question, depending on the service type. AUD patients were almost 9 times more likely to have frequent visits to the emergency room. In addition, hospitalizations in specialized care (OR 11.30) and somatic visits to specialized care setting doctors (OR 4.13), as well as frequent primary healthcare doctor visits due to trauma (OR 16.27), were significantly more common in the AUD group compared with T2DM patients. The mental health comorbidity prevalence was 22% for AUD patients and 13.5% for T2DM patients. The multimorbidity prevalence was 52.5% for AUD patients and 59.2% for T2DM patients.

**Table 6.** Odds for frequent health service use for patients with AUD compared with patients having type 2 diabetes.

		<b>OR</b>	<b>95% CI</b>	<b>p</b>
<b>PRIMARY HEALTH CARE</b>				
All doctor visits				
	AUD	3.30b	2.50–4.30	< 0.001
	T2DM (reference)	1.00		
	Age ≤ 45 years (Ref > 45)	1.17	0.87–1.57	0.28
	Male (Ref female)	0.76	0.56–1.03	0.07
Trauma doctor visits				
	AUD	16.27a	7.30–36.26	< 0.001
	TDM (Ref)	1.00		
	Age ≤ 45 years (Ref > 45)	0.74	0.42–1.31	0.30
	Male (Ref female)	1.32	0.68–2.59	0.41
Mental health doctor visits				
	AUD	6.57c	4.79–9.02	< 0.001
	T2DM (Ref)	1.00		
	Age ≤ 45 years (Ref > 45)	0.40	0.29–0.54	< 0.001
	Male (Ref female)	0.73	0.52–1.02	0.79
Public health nurse visits				
	AUD	0.22b	0.09–0.57	< 0.01
	T2DM (reference)	1.00		
	Age ≤ 45 (Ref >45)	1.48	0.76–2.89	0.25
	Male gender (Ref female)	1.03	0.53–2.01	0.93
Physiotherapy visits				
	AUD	1.66a	1.21–2.29	< 0.01
	T2DM (Ref)	1.00		
	Age ≤ 45 years (Ref > 45)	2.17	1–49–3.17	< 0.001
	Male (Ref female)	0.79	0.56–1.12	0.18
Primary health care hospitalizations				
	AUD	16.10a	9.85–26.15	< 0.001
	T2DM (Ref)	1.00		
	Age ≤ 45 years (Ref > 45)	2.30	1.45–3.67	< 0.001
	Male (Ref female)	1.58	0.98–2.55	0.06
<b>DENTAL CARE</b>				
Dental care visits, all				
	AUD	0.98a	0.75–1.28	0.88
	T2DM (Ref)	1.00		
	Age ≤ 45 years (Ref > 45)	0.74	0.57–0.96	< 0.05
	Male (Ref female)	0.76	0.57–1.01	0.05
<b>MENTAL HEALTH SERVICES</b>				
All mental health visits				
	AUD	3.60c	2.73–4.76	< 0.001
	T2DM (Ref)	1.00		
	Age ≤ 45 years (Ref > 45)	0.40	0.30–0.53	< 0.001

	Male (Ref female)	0.55	0.40–0.74	< 0.001
Mental health nurse visits				
	AUD	1.51 <sup>b</sup>	1.00–2.29	< 0.05
	T2DM (Ref)	1.00		
	Age ≤ 45 years (Ref > 45)	0.42	0.28–0.62	< 0.001
	Male (Ref female)	0.54	0.35–0.82	< 0.01

### SPECIALIZED CARE

#### Somatic hospitalizations

	AUD	11.30 <sup>b</sup>	5.45–23.41	< 0.001
	T2DM (Ref)	1.00		
	Age ≤ 45 years (Ref > 45)	0.96	0.53–1.80	0.90
	Male (Ref female)	2.97	1.24–7.10	< 0.05

#### Psychiatric hospitalizations

	AUD	7.20 <sup>c</sup>	4.45–11.65	< 0.001
	T2DM (Ref)	1.00		
	Age ≤ 45 years (Ref > 45)	0.32	0.21–0.50	< 0.001
	Male (Ref female)	0.77	0.47–1.24	0.28

#### Emergency room doctor visits

	AUD	8.89 <sup>b</sup>	4.39–18.00	< 0.001
	T2DM (Ref)	1.00		
	Age ≤ 45 years (Ref > 45)	0.49	0.27–0.88	< 0.05
	Male (Ref female)	0.97	0.50–1.89	0.94

#### Somatic doctor visits

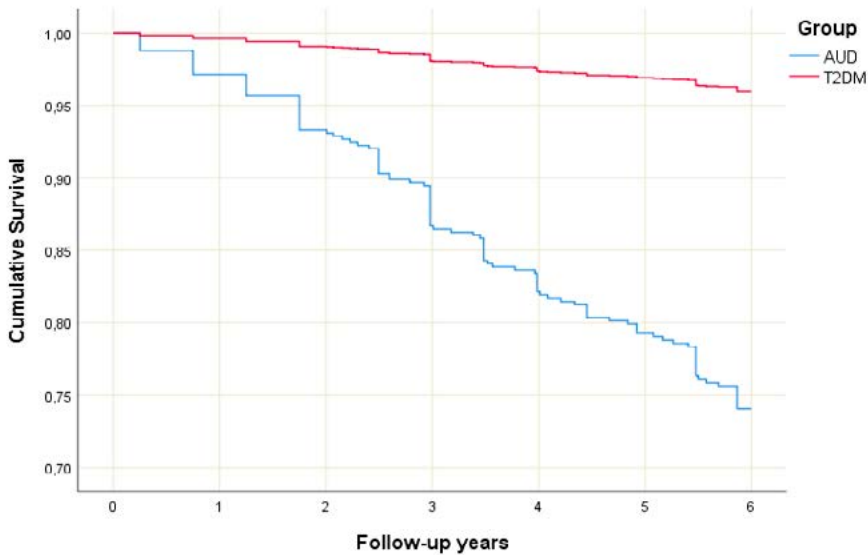
	AUD	4.13 <sup>b</sup>	3.11–5.49	< 0.001
	T2DM (Ref)	1.00		
	Age ≤ 45 years (Ref > 45)	0.90	0.67–1.22	0.49
	Male (Ref female)	0.77	0.56–1.06	0.11

#### Psychiatric doctor visits

	AUD	7.41 <sup>a</sup>	4.05–13.55	< 0.001
	T2DM (Ref)	1.00		
	Age ≤ 45 years (Ref > 45)	0.24	0.14–0.42	< 0.001
	Male (Ref female)	0.63	0.35–1.11	0.11

Note. AUD, alcohol use disorder; CI, confidence interval; OR, odds ratio; T2DM, type 2 diabetes mellitus. The superscript letters indicate: a 1+ annual visits; b 3+ annual visits; c any contact with the service.

The death rates between the groups also differed: 23.5% for AUD patients and 4.8% for T2DM patients ( $p < 0.001$ ). After adjusting for the age group and gender, the death hazard was markedly higher (HR 7.5, 95% CI 4.98–11.30) for AUD compared with T2DM patients. The cumulative survival curve is presented in Figure 4.

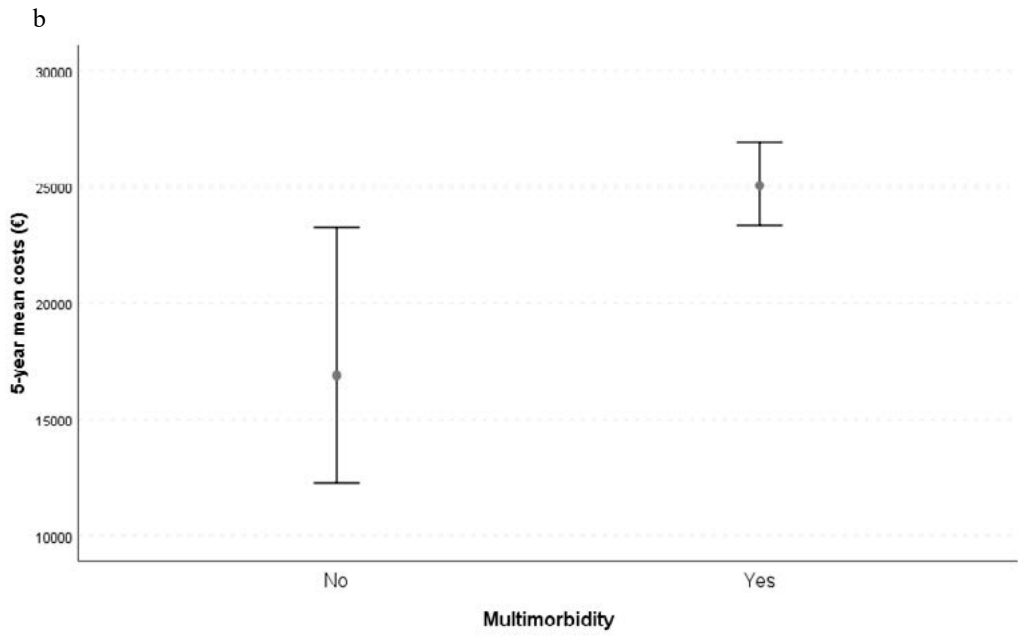
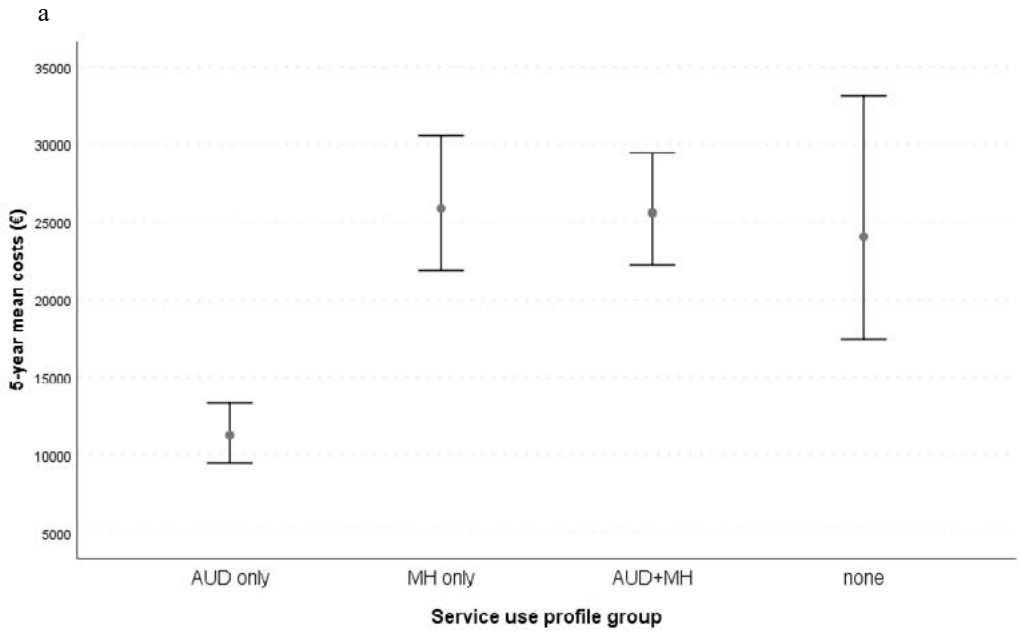


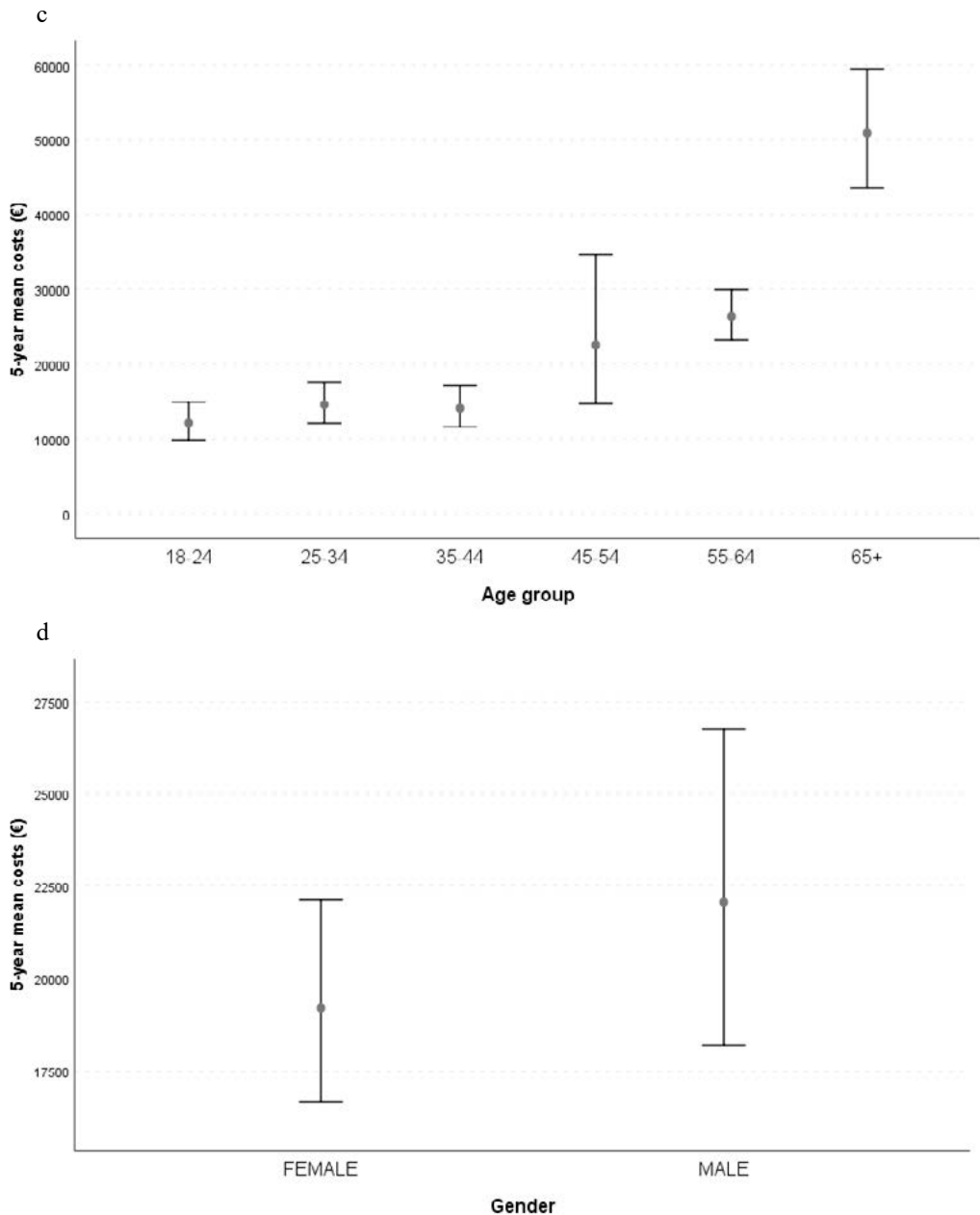
**Figure 4.** Cumulative survival of the AUD and T2DM patients.

## 5.4 CARE COSTS

In Study IV, the treatment system mapping focused on the economic qualities of the current treatment system. The impact of alcohol treatment on the total care costs in individuals with AUDs was examined and the direct 5-year mean care costs were compared among four service use profiles. The mean costs per patient were 20,573 euros, after adjusting for age, gender, multimorbidity, and total time alive during the 5-year follow-up period. However, the total costs of the follow-up varied: receiving only AUD treatment decreased the total costs of the 5-year follow-up by 12,778 euros compared with those receiving no treatment (Figure 5).

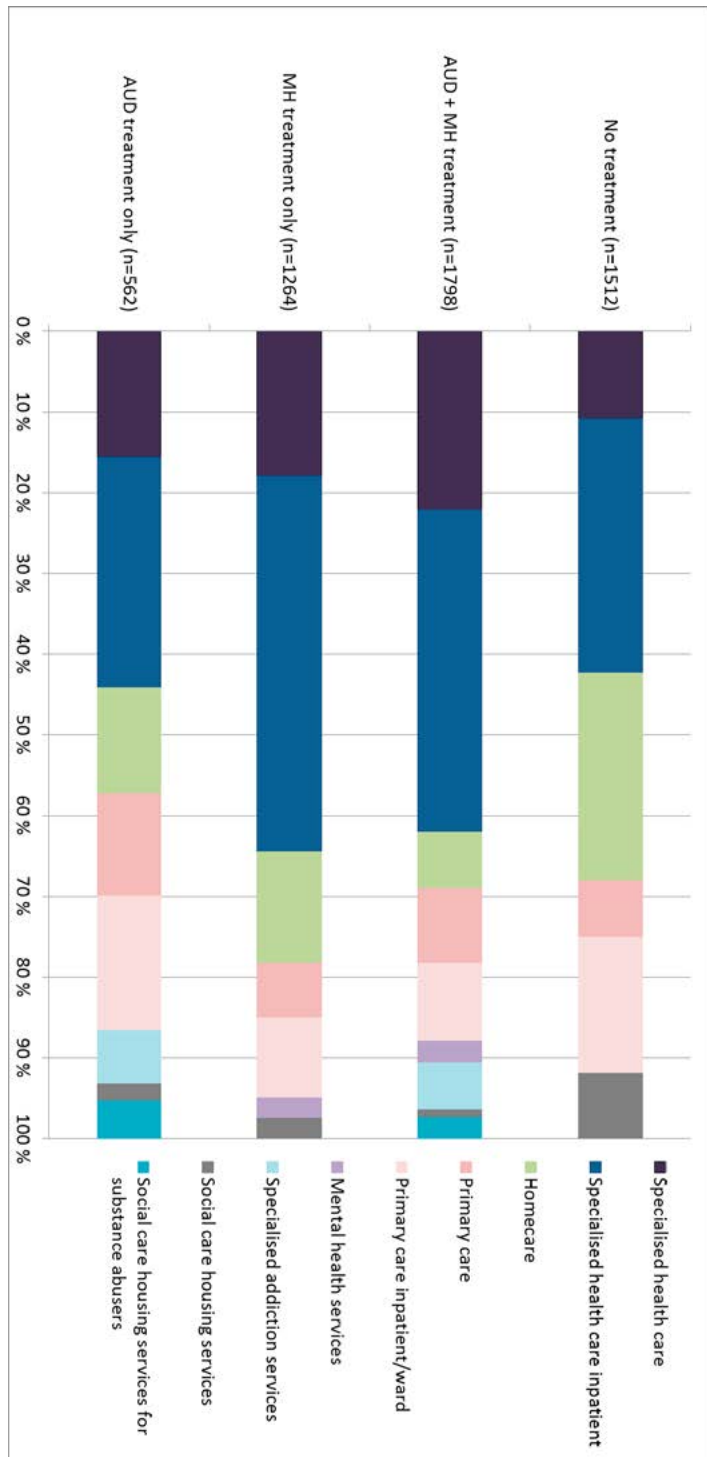






**Figure 5.** Generalized linear model with a gamma distribution and a log link function analyses of the 5-year mean costs according to (a) service user profiles, (b) multimorbidity, (c) age groups, (d) gender. Error bars represent 95% confidence intervals. Abbreviations: AUD, alcohol use disorder; MH, mental health.

In each group, most costs accumulated from specialized health care services. Emergency room service use costs were highest among those treated with both AUD and mental health services. Home care and social care housing service costs were highest among those receiving no treatment and among those receiving mental health treatment only (Figure 6).



**Figure 6.** Cost accumulation for the service use profiles according to service domains for the 5-year follow-up period.

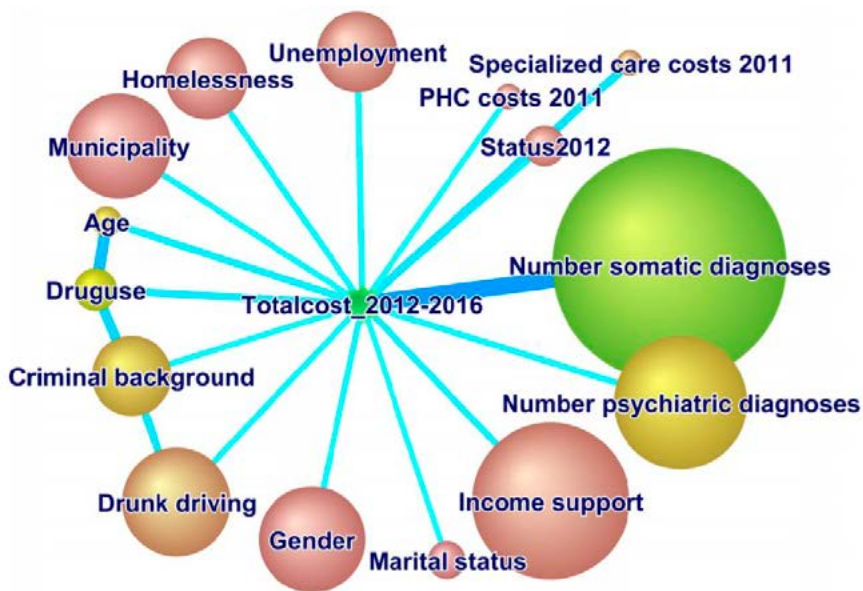
In addition, the outcome of ending up in the most expensive 10% of patients was examined (Table 7). Receiving treatment with mental health services (OR 1.72) or both mental health and AUD services (OR 1.81) was associated with ending up in the most expensive 10% of patients compared with those receiving no such treatment. Furthermore, the male gender (OR 1.38) and multimorbidity (OR 3.63) both increased the odds of becoming an expensive patient. Receiving only AUD treatment was associated with decreased odds of becoming an expensive patient.

**Table 7.** Comparison of the risk of ending up as an expensive patient during the 5-year follow-up of different treatment service use profiles.

		<b>OR</b>	<b>95% CI</b>	<b>p</b>
AUD treatment only		0.45	0.27–0.74	< 0.01
MH treatment only		1.72	1.33–2.23	< 0.001
AUD and MH treatment		1.81	1.39–2.37	< 0.001
Neither AUD nor MH treatment		Ref		
<b>Age</b>				
	18–24	0.17	0.11–0.25	< 0.001
	25–34	0.16	0.11–0.24	< 0.001
	35–44	0.18	0.12–0.26	< 0.001
	45–54	0.17	0.12–0.23	< 0.001
	55–64	Ref		
<b>Gender</b>				
	Male	1.38	1.11–1.72	< 0.01
	Female	Ref		
<b>Multimorbidity</b>				
	Yes	3.63	2.47–5.33	< 0.001
	No	Ref		

Note. Binary logistic regression, adjusted for age, gender, multimorbidity, service use profile and follow-up days. AUD, alcohol use disorder; CI, confidence interval; MH, mental health; Ref, reference condition.

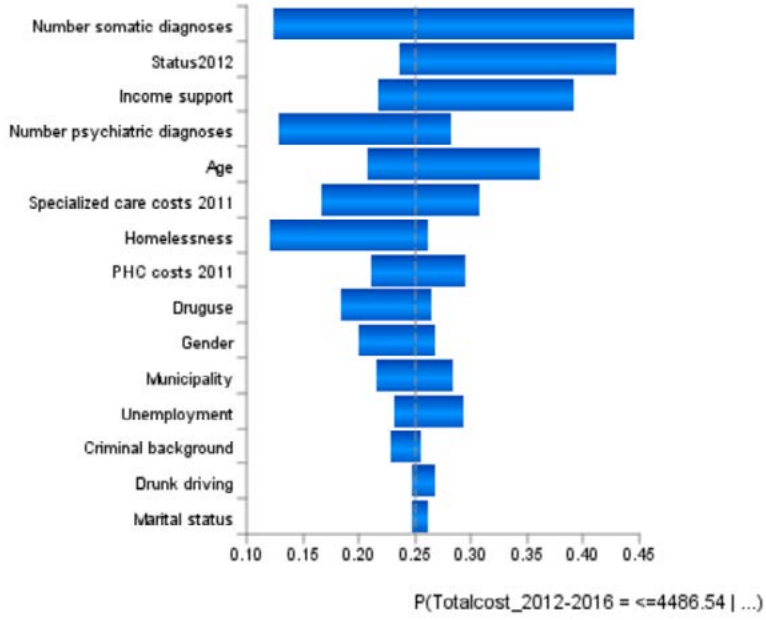
In Study V, the direct effect of different risk factors on the cost accumulation was examined using a non-causal ANB network model and modified disjunctive confounder criterion. Figure 7 shows that in general, the number of somatic diagnoses was the most significant contributor to the cumulative 5-year costs. Two or more somatic conditions increased the mean care costs to over 26,000 euros during the 5-year study period.



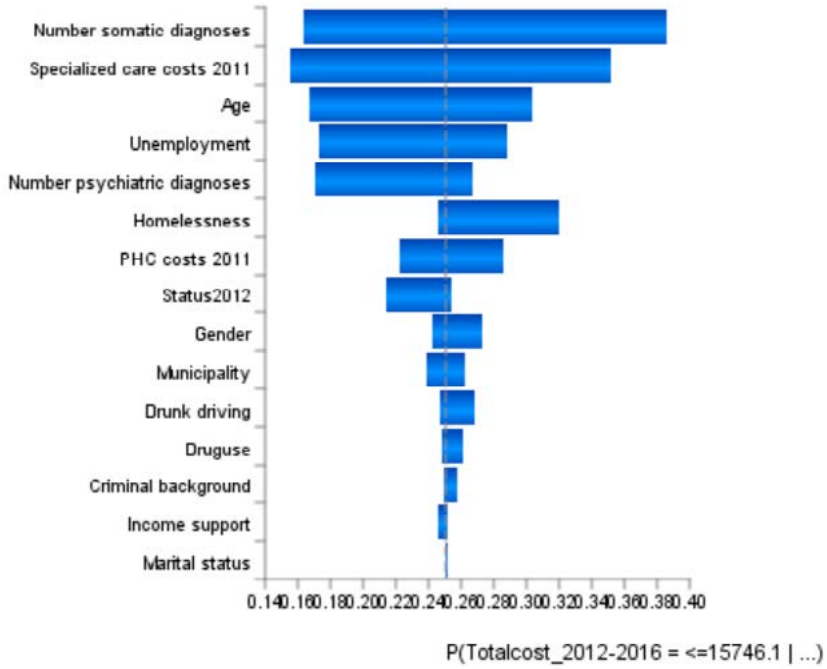
**Figure 7.** The augmented naïve Bayesian model of factors associated with the total costs. The node sizes express each variable’s direct effect on the target node. The node colors indicate node force, with green being the highest, red being the lowest, and yellow in between. The lines between nodes indicate the relationship between them (Kullback–Leibler divergence).

Sensitivity analysis with tornado diagrams (Figure 8) reflects the variable impact of different factors on the target variable intervals, i.e., total care costs quartiles. Need factors, measured as a high number of chronic conditions and baseline status (Status2012) had the strongest direct effect in the lowest cost quartile. For the very high cost value (> 46,864 euros) of the target interval, the role of specialized care costs, psychiatric comorbidity, and age had the strongest impact; the role of baseline status remained infinitesimal. Other predisposing socioeconomic factors such as gender, marital status, or unemployment status did not play a significant role in the cost accumulation. Likewise, illicit drug use, criminal record, or drunk driving did not have notable effect on total costs. However, homelessness increased the total care costs in the high-cost category (panel 2). Enabling factors included financial status, measured through the income support variable, which increased the costs only in the low-cost category.

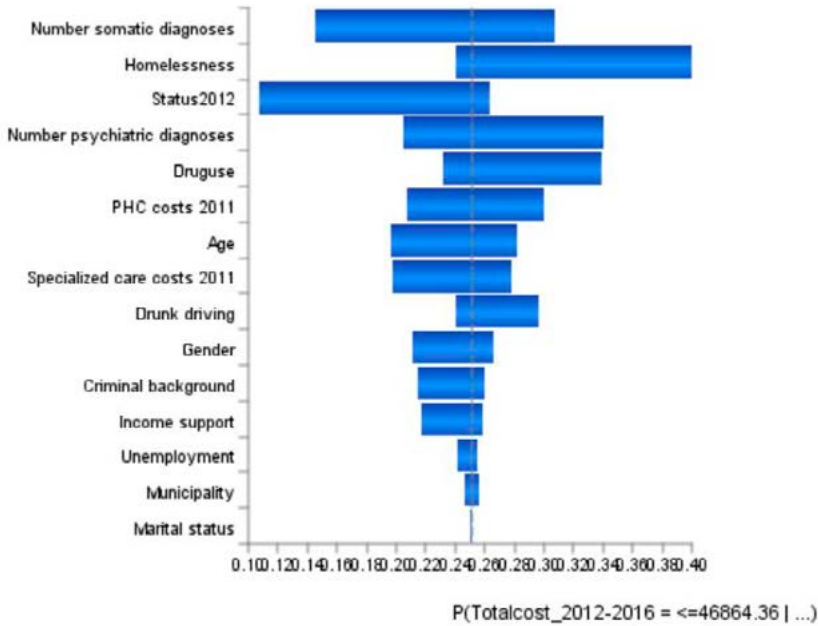
Panel 1



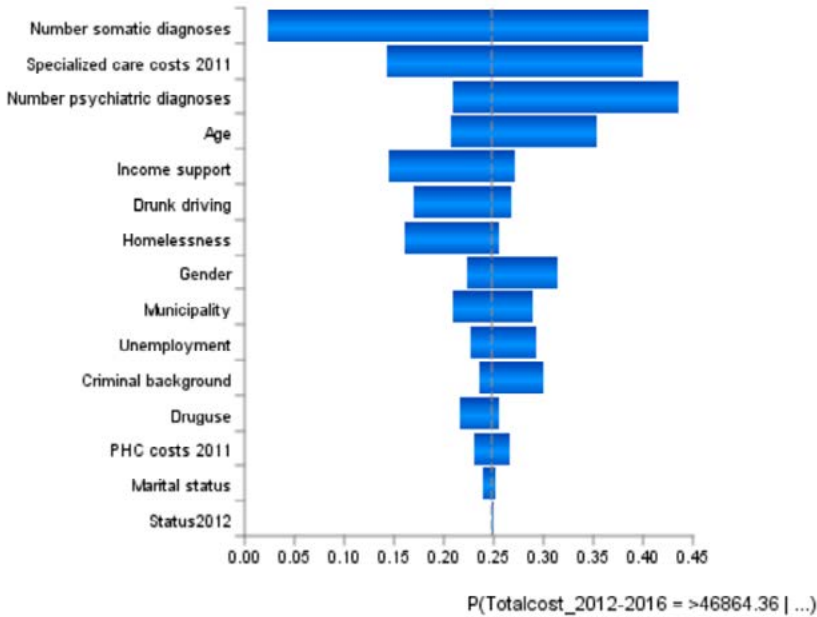
Panel 2



Panel 3

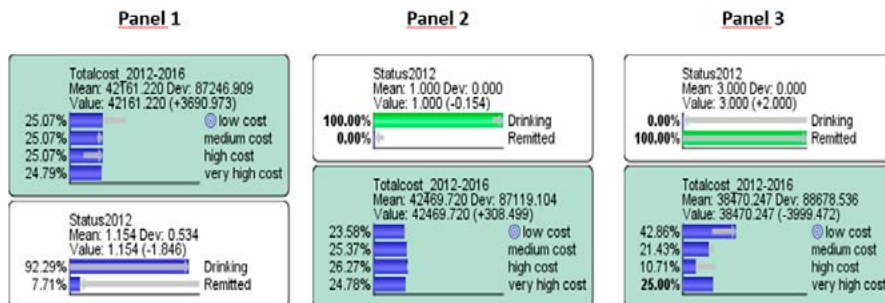


Panel 4



**Figure 8.** Tornado diagrams showing variables that have strongest impacts on the outcome variable. Bars pointing to the right represent a positive impact, while bars pointing to the left the negative impact. Panel 1 shows the effect on the low cost value of the outcome variable, panel 2 on medium cost, panel 3 on the high cost, and panel 4 on the very high cost. Abbreviation: PHC, primary health care.

A specific interest was to estimate the causal effect of achieving remission to the cost accumulation. First fixing the target variable to a value of 1 (continuous drinking) and then to a value of 3 (remitted) produced the causal effect of achieving stable AUD remission. According to the results, long-term remission had a causal cost-offset effect on the total costs (Figure 9). The proportion of the lowest cost quartile increased among remitters compared with current drinkers (42.86% vs 25.07%). Furthermore, the high-cost quartile decreased (10.71% vs 26.27% for remitters compared with current drinkers).



**Figure 9.** Panels showing variables Totalcost\_2012–2016 (total costs of care) and Status2012 (continuous drinking versus remitted). In panel 1, both variables are unfixed. Panel 2 shows the distribution of costs in the outcome variable Totalcost\_2012–2016 when the variable Status2012 is fixed for the value Drinking = 100% and all other variables are fixed to original distribution. In panel 3, the variable Status2012 is fixed for the value Remitted = 100%, demonstrating the change in costs (Totalcost\_2012–2016).



## 6 DISCUSSION

This study examined social and health service use and cost of care of AUD patients in North Karelia by using combined EHR data and social services client database information. The aim of this study was to examine how service use and care costs differed according to long-term care outcomes, how service use patterns differed from another chronic patient group (T2DM patients), from which parts of the treatment system the costs accumulated, and to evaluate the causal effect of different risk factors on the total cost of care. The findings from this study provide insights into the current state of the Finnish need-based social and health service system from one of the hospital districts.

### 6.1 SUMMARY OF MAIN RESULTS

A major finding in this dissertation is that working-age individuals with AUDs identified through EHRs had a high risk (22.3%) of dying during the study period (2011–2016) in the North Karelia region. Compared with another chronic and resource-demanding patient group, T2DM patients, the HR for death was 7.5 ( $p < 0.001$ ). The probability of achieving stable remission was 18.4% during the 6-year follow-up. Individuals were characterized in the EHR notes as having several social, health, and legal problems, and an advanced form of AUD.

Treatment-system-wide mapping of the alcohol-related contacts provided an overview of the help-seeking patterns and estimates of treatment coverage and gaps in the access to treatment. Examination of alcohol-related service use patterns revealed that of those who died, the vast majority (58.1%) had not used specialized AUD services. Instead, these individuals had several alcohol-related visits in other parts of the somatic health care service system, including the emergency room. Those who achieved stable remission had more frequent contact with AUD services, mental health services, or both.

The quality of the alcohol treatment system was examined in Study II through associations between alcohol-related and mental-health-related service use patterns and the care outcomes of death and remission. When examining yearly visit frequencies to different social and health care professionals and their association with care outcomes, there was an association between frequent visits to mental health professionals and achieving stable remission. Thus, it seems that integrating mental health treatment to AUD treatment is beneficial. In addition, frequent serum DST measurement, controlling for alcohol consumption, was associated with stable remission and could be considered a proxy measure for continual care. Frequent alcohol-related primary care doctor visits were associated with increased risk of dying. AUD treatment availability, difficulties in treatment access, as well as low treatment compliance may partly explain this observation. However, more research on this association is needed to understand whether the observation is associated with health professionals' skills, stigma, or other possible factors.

In Study III, equity of care aspects were examined through comparison of overall health service use of AUD patients with another chronic and progressive disorder associated with stigmatizing attitudes, namely T2DM. The results revealed differences in the health service

system response to the care needs of the two chronic patient groups, despite the rather similar comorbidity statuses. Compared with T2DM patients, AUD patients were more frequently hospitalized and had more emergency care visits and primary care doctor visits. T2DM patients had more frequent public health nurse contacts.

The regional alcohol treatment system was also examined from the perspective of cost accumulation. The results showed that those treated only in AUD services had the lowest mean care costs, and they were unlikely to become expensive patients compared with other service use profiles. It was evident that AUD patients treated in mental health services had higher total care costs and a higher probability of ending up in the costliest 10% of patients compared with individuals treated only with AUD services. Those remaining outside AUD and mental health treatment had 47% higher total care costs compared with individuals treated only with AUD services. These observations reflect the complexity of treating co-occurring mental health and AUD problems. Individuals with co-occurring AUD and mental health problems most likely have higher service needs compared with those treated only with AUD services. However, remaining outside these services was both expensive and also associated with an increased risk of death.

In Study V, the direct effect of different risk factors, including achieving stable remission, was modeled. The proportion of the lowest cost quartile increased among individuals who achieved stable remission compared with individuals with continued AUD (42.86% vs 25.07%), and the high-cost quartile decreased (10.71% vs 26.27%), findings that indicate a favorable effect of remission to cost accumulation. However, the number of somatic diagnoses was the most significant contributor to the cumulative 5-year care costs.

## **6.2 ADDRESSING THE COMPLEX SOCIAL AND HEALTH CARE NEEDS OF INDIVIDUALS WITH ALCOHOL USE DISORDERS**

Alcohol-related social and health service use across the treatment system can be seen as a measure of needs assessment and care quality. Structural resources and system qualities contribute significantly to the effectiveness of alcohol treatment services (Babor et al., 2008) and use of services (Andersen, 1995); thus, service use and treatment need is ideally assessed locally (Hirschovits-Gerz et al., 2019). This study demonstrated that the principles of universalism are not fully met in the regional alcohol treatment service system. Indeed, not all individuals with AUDs currently receive equally adequate treatment in a timely manner.

Babor et al. (2008) defined qualities of effective services to comprehend abstinence promotion and relapse prevention and to address substance-related issues such as mental health problems and social problems (including employment issues and criminal behavior). Furthermore, a variety of treatment programs and available services should meet patients' diverse care needs at various phases of their treatment course (Hser & Anglin, 2011). Care quality can be measured as the impact of services on individuals and conceived in terms of improved care outcomes such as a diminished death rate and prevalence of morbidity or social problems (Babor et al., 2008). Andersen (1995) noted that service utilization needs to be examined in the context of care outcomes. Indeed, the results of this study indicate that receiving treatment in AUD and/or mental health services is associated with an increased

probability of stable remission, and remission decreases the care costs. A remaining challenge is that only a minority of individuals have access to these services, a phenomenon that has been identified in many previous studies (Cohen et al., 2007; Edlund et al., 2012; Harris et al., 2019; Manthey et al., 2016a; Rehm et al., 2015c, 2016).

This dissertation identified that among those remaining outside of AUD and mental health treatment, many are treated in somatic health care services without referral to AUD or mental health services. Only some of these individuals had a recorded comment in their EHR with regard to a lack of treatment compliance. Hence, the Study II results regarding help-seeking from a primary care doctor for AUD seem discouraging, because frequent alcohol-related visits to a primary care doctor were associated with an increased risk of death. This finding raises concerns with regard to the ability of primary care services to treat complex AUDs, which has been one of the aims in the national treatment policy. Furthermore, primary care, in the role of the gatekeeper in the current treatment system, is prone to stigmatizing attitudes, which affect quality of care (Vaccari et al., 2020). Healthcare professionals' stigmatizing attitudes are not only a barrier to treatment access but may also reduce the quality of medical attention by leaving physical symptoms undetected (Lawrence & Kisely, 2010). In addition, physicians' pessimistic attitudes regarding the abilities of patients with mental health problems to adhere to treatment are affected by stigma (Corrigan et al., 2014). However, the identified high mortality rate (22.3%) of working-age individuals in North Karelia also reflects the challenging phenomena of the clinical course of AUD with which the entire alcohol treatment system, with its limited resources, continues to struggle (Graham et al., 2017; Kendler et al., 2016; Moos et al., 2004; Rehm et al., 2009; Room et al., 2005; WHO, 2014b).

Changes in the alcohol treatment system during the past decades have shifted the emphasis of AUD treatment provision from social services toward general health services (Kuusisto & Ranta, 2020). Previous studies on intoxicant-related cases in the Finnish the social welfare and health care systems have identified that alcohol-related contacts occur predominantly in social services (Kaukonen, 2000, 142), although notable regional variation has begun to emerge (Kuussaari et al., 2017). In this dissertation, the majority of the individuals in Studies I and II received income support; thus, they had contact with social services. However, adult social work visits in health care settings were scarce: Only 11.6% of AUD patients had such contacts. Individuals with AUDs were extensive users of health care services and had a high prevalence of multimorbidity, and their help-seeking extended to specialized and primary care services. Major costs also accumulated specifically from specialized health care. High somatic comorbidity contributed significantly to the excess costs in Study V, indicating that the care of somatic conditions should also be improved among this patient group.

The results of this study provided insights with regard to how the current, predominately health-orientated, regional treatment system manages to identify and treat AUDs. Given that many individuals with addiction require continuous care and multiple treatment episodes to achieve long-term remission, an effective treatment delivery system needs to incorporate strategies to sustain long-term treatment effectiveness (Hser & Anglin, 2011). Based on the results in this thesis, providing AUD services together with mental health treatment has the potential to improve long-term treatment outcomes. Attention should be paid to the performance and care outcomes in primary care settings, especially highlighting the role of social and health care personnel operating at the primary care level, who should have required

skills and training to treat AUD patients according to the Finnish Current Care Guidelines. Care coordinators' roles to enable and support integrated care pathways should be further developed. An AUD treatment paradigm shift toward care of other mainstream chronic illnesses could improve the continuity of care and evaluation of recovery process (McLellan et al., 2005; Watkins et al., 2003).

### **6.3 EQUITY OF THE TREATMENT SYSTEM: OVERALL HEALTH SERVICE USE AND CARE OUTCOMES**

According to Andersen (1995), "equitable access to services occurs when demographic and need variables account for most of the variance in utilization." However, previous studies have identified that inequalities in health care provision for people with severe mental illness can be attributed to a combination of systemic issues, including separation of mental health services from general health services, and issues related to health care providers, including stigmatizing attitudes toward mental illness (Lawrence & Kisely, 2010; Rivera-Segarra et al., 2019). Previous studies have identified that structural challenges, including user fees and problems in access to services, especially concern individuals with a low socioeconomic position (Manderbacka et al., 2012).

All illnesses and chronic conditions should be treated equally in the service system. In Study III, the overall social and health service use frequencies of AUD patients were compared with another chronic patient group, namely T2DM patients. Comorbidity patterns, which were hypothesized to indicate evaluated care needs, were identified as rather similar and multimorbidity was in fact more prevalent among T2DM patients. However, underdiagnosing chronic conditions among AUD patients seemed to be present: The findings indicate that AUD patients had significantly more visits to primary care doctors (OR 3.30) and more somatic visits (OR 4.13) and hospitalizations (OR 11.30) in specialized care, and a higher risk of death (HR 7.5), compared with T2DM patients. These identified high cumulative visit densities to different parts of the treatment system reflect the complex care needs of AUD patients. However, limited structural resources also contribute to limited access to specialized AUD services. Thus, the following questions arise: Are the provided services timely and adequate? Is even frequent use of general services insufficient to replace the lack of mental health and AUD services?

Furthermore, the current service delivery system lacks an interconnection among different service providers, a deficit that creates challenges for the continuity of care. It should also be noted that high visit frequency does not necessarily denote continuity of care. According to Hser & Anglin (2011), "multiple treatment periods in a continuing care arrangement produce more favorable outcomes than non-coordinated treatment." The results of this study showed that T2DM patients had frequent contact with public health nurses, a finding that might indicate a more coordinated care approach. For example, a systematic review conducted by Atlantis et al. (2014) identified that collaborative care significantly improved depression and glycemic outcomes among adults with comorbid depression and diabetes. There should be similar efforts to develop coordinated continuous care for the treatment of AUD patients in health care settings because the treatment has become increasingly organized in primary care. The higher mortality

risk (HR 7.5) of AUD patients compared with age- and gender-matched T2DM patients with similar comorbidity status highlights this urgent need.

In fact, measures indicating coordination of care, such as identified key workers, the total number of follow-up contacts, and continuous contact with relevant services, have already been proposed as quality indicators for people with serious mental illness (Kronenberg et al., 2017). Integration of social and health care services has been suggested to address the inequities in health care access and treatment for SUDs (Richardson et al., 2019).

## **6.4 EFFECTIVENESS ASPECTS OF THE ALCOHOL TREATMENT SYSTEM: CAN WE AFFORD NOT TO PROVIDE TREATMENT?**

The death rate and morbidity prevalence indicate the effectiveness of the treatment system. In this study, the approach was to examine how receiving AUD treatment, mental health treatment, or both versus receiving no such treatments was associated with the risk of death and ending up as an expensive patient. The majority of the total costs accumulated from specialized care, primary care inpatient treatment, and homecare. This finding corresponds with a German study that examined cost accumulation in alcohol-dependent patients treated in psychiatric care. Those authors reported 4,349 euros (95% CI 4129–4566) in excess direct costs over a 6-month period. These direct costs were particularly caused by inpatient treatment and formal long-term care (Dams et al., 2018). In this dissertation, the 5-year cumulative mean care costs were lowest among those receiving only AUD treatment after adjusting for age, gender, and multimorbidity. Receiving only AUD treatment was associated with a decreased probability of ending up as an expensive patient or dying. Individuals receiving only AUD treatment also had the lowest cost accumulation from the specialized care services, including emergency room services, compared with other groups. One possible explanation is that these individuals are attached to the treatment system early, before social and health problems have accumulated. However, the use of anonymous services, such as Alcoholics Anonymous group attendance, may mediate the association between AUD treatment and cost accumulation. Bogenschutz et al. (2014) identified that promoting a 12-step intervention may increase treatment attendance. In Study IV, participation in Alcoholics Anonymous groups was not studied because this information is not available through registers. Nevertheless, more research is needed to better understand the mechanisms of Study IV's findings.

In North Karelia, the average net costs per individual were 3,606 euros in 2018, of which specialized care accounted for 34%, primary care outpatient services 11%, and primary care inpatient services 6%. AUD and mental health service costs were over 50 million euros in 2017, which is a small proportion compared with the approximately 190 million euro costs of somatic specialized care. The treatment periods in hospitals due to substance use are above the national average in North Karelia (THL, 2019). In this dissertation, among individuals with AUD, an even more notable proportion of cost accumulation (40%–60%) was attributable to specialized health care service use. Smeets et al. (2020) noted that health systems should focus on the population with the highest care use to achieve the largest potential for improved value and to increase the value of delivered care (Smeets et al., 2020). A Canadian study (Hensel et al., 2016) identified a high burden of mental illness and addiction among high-cost medical service

users and stated that addressing the prevalence of these disorders may have implications for cost savings and health outcomes. The results of this dissertation strengthen these clinical implications.

Study II strengthened the previous research findings, specifically that receiving treatment in mental health services is associated with better care outcomes (Mattisson et al., 2018; Moos & Moos, 2006, 2007a, 2007b; Moos et al., 2000; Scott et al., 2003), but the Study IV results also demonstrated that receiving both AUD and mental health treatment costs more, which is contrary to the many previous studies that identified a cost offset pattern after the AUD treatment (Blöse & Holder, 1991; Goodman et al., 2000; Holder & Blöse, 1986; Parthasarathy & Weisner, 2005; Parthasarathy et al., 2001, 2012; Salomé et al., 2003). However, receiving no treatment in AUD or mental health settings is equally expensive and associated with adverse care outcomes, such as increased risk of death. An Australian study estimated that evidence-based care for AUDs lowers the costs caused by harmful use but increases the costs for alcohol dependence care (Corry et al., 2004). Evidence from Study V regarding the role of remission on cost accumulation demonstrated that achieving AUD remission notably decreased the future cost accumulation in social and health care services, although harmful use and dependence were not examined separately. Furthermore, a previous study by Aldridge et al. (2016) noted that patients with heavy drinking days after alcohol treatment had 66.4% higher healthcare costs compared with abstinent individuals.

Study V further provided some insights with regard to the causes of excess costs by examining the direct effect of different predisposing, enabling, and need factors on cost accumulation. Of the enabling and predisposing factors, receiving income support had a cost-increasing effect only among those with the lowest total care costs, and factors indicating social problems, such as illicit drug use, drunk driving, or criminal background, did not have a significant role in the cost accumulation, except for homelessness, which increased the costs in the high-cost category. Consistent with previous research (Goodman et al., 1996), the results indicate that comorbidity had the strongest role in the cost accumulation. Thus, it seems that the excess care costs identified among marginalized individuals are mainly due to comorbidity. However, EHR data quality may bias the results regarding predisposing and enabling factors because they may not always be recorded. Nevertheless, there is an evident need for incorporating strategies to improve the care of somatic conditions within the health sector.

To conclude, the results of this study indicate that treatment with AUD services is effective both from economic aspects as well as from the care outcomes perspective. Thus, increasing the timely provision of AUD services could lead to cost savings in other domains of the social and health care service system.

## **6.5 METHODOLOGICAL CONSIDERATIONS**

### **6.5.1 Electronic social and health records**

EHRs contain data collected primarily for clinical documentation and billing purposes. However, it is also a rich source for clinical and public health research. For the secondary use of EHR data, the information accuracy, completeness, and ease of extraction remain particular

issues to be addressed in research using EHRs as a data source (Wassermann, 2011). Despite the structural possibilities for data recording, a narrative data form is often preferred by clinicians to describe patients' problems (Wassermann 2011), which was also noted in this dissertation.

The sampling based on the alcohol-related ICD-10 codes mainly captured individuals with severe AUDs in the cohort for Studies I, II, III, and V. In the Study IV cohort, the sampling was broader and included individuals who also used AUD services and alcohol-related ICPC2 and SPAT codes. The EHR data quality was verified by manually reviewing the EHR notes of the first cohort and manually collecting all the alcohol-related notes from EHRs. Although the results are not generalizable to all individuals with AUDs, the identified individuals likely represent those who often remain outside survey studies. Thus, registers provide an opportunity to examine social and health service use of those often thought as survey non-respondents (Kopra et al., 2018). The characteristics of the study cohorts were similar to a recent Finnish investigation that compared national health care registers and surveys as data sources on alcohol problems. That study characterized individuals identified in registers as prevalently men, middle aged, and more often having basic education only and being non-employed (Mäkelä et al., 2021).

Data collection from EHRs included predisposing individual factors such as age, marital status, gender, employment status, and enabling factors such as income support as an indicator of financial situation and service use frequencies as a measure of accessibility to care. Predisposing factors indicating social problems, including drug use, criminal background, and drunk driving, were collected as dichotomous background variables, even though EHR notes are not the primary source for these data. However, it was thought that these factors are important to consider when planning individuals' treatment and would be recorded in the notes as potential mediators of the clinical course. The quality of EHRs is equivocal regarding the examination of these factors, which is one limitation of this study.

Another challenge was that data on predisposing or enabling factors is currently not recorded in a structured format, thus requiring handpicking from the EHR notes, which is a second identified challenge for the data quality and usability (Castillo et al., 2015). The same challenge was faced in the outcome variable identification. There was a clear picture drawn from the notes regarding remission status, but often it was not possible to identify the exact month of achieving stable remission; thus, a crude time estimate was used. To enable systematic monitoring of AUD treatment in relation to care outcomes, a structured recording of EHR notes is required. The third identified challenge in this dissertation is related to the structured recording of AUDIT scores. Structured coding was enabled in EHRs, but during the six-year follow-up, it was rarely used; instead, the AUDIT test results were coded in the notes and sometimes also in paper forms, which were unreachable for this dissertation. Thus, systematic data collection on the AUDIT test results was not possible. In addition, the proportion of missing diagnoses decreases data quality. In this study, the challenge of missing diagnoses (23.7%) was solved by manually reviewing all the visits with missing diagnosis (N = 1,435) and further classifying them as alcohol-related or other causes. The ambiguous use of alcohol-related ICD-10 codes has also been identified in other Finnish studies (Pitkänen et al., 2020).

In the future, systematic and structured recording of the drinking status would enable quality measures of the AUD treatment, as well as the ability to monitor better the proportion of the

excess drinkers remaining outside AUD treatment. During the time period when this study was conducted, approximately 29% of working-age individuals in North Karelia (20–64 years) used alcohol in excess (Sotkanen, 2019), which translates to approximately 26,000 individuals. The national prevalence of AUDs in 2016 was approximately 9% (WHO, 2018a), which translates in North Karelia to approximately 13,000 individuals with AUDs. However, in Study IV, only 5,136 individuals were identified through EHRs as having alcohol problems. Given that the diagnosis coverage for doctor visits in Siun sote is almost 100% (THL, 2020), this finding indicates that despite good overall diagnosis coverage, the recording of alcohol problems is avoided or disregarded, perhaps due to stigma related to these diagnoses. Under-recording AUDs had been identified years earlier (Seppä & Mäkelä, 1993) and was confirmed in this dissertation. A previous survey study reported that only a few of those identified as exceeding the drinking guidelines sought help for alcohol problems during the previous year (Viertiö et al., 2017). Thus, it seems that the treatment system continues to struggle to identify people with AUDs and to provide early treatment, before problems have accumulated. Unfortunately, under-recording continues to confound national statistics and, thus, complicate the understanding of the AUD prevalence and treatment research. The findings from this dissertation highlight the importance of better capturing and structuring substance-use-related events. Furthermore, systematic recording of predisposing factors would most likely enhance the quality-improvement work related to access to adequate care.

### **6.5.2 Strengths and limitations**

Although AUDs are a remarkable public health condition in Finland, structured recording of moderate AUDs or hazardous alcohol consumption remains modest in health care settings.

Performing a treatment-system-wide examination of individuals with AUDs' cumulative service use over time using an observational study design is challenging, because the treatment profiles of individuals may reflect different dynamic processes. In this dissertation, the cumulative effect of service use was examined by assessing past service use according to care outcome (e.g., stable remission) at a later time. A non-randomized study design was the only ethical way to investigate care outcomes, and it also reflects the real-life situation of this patient group.

An observational study design based on EHR data is also subject to selection bias and confounding factors. For example, disease severity and complexity affect service use and care outcomes. Furthermore, measured and unmeasured factors may influence care outcomes, which cannot be adjusted in regression analyses (Castille et al., 2015; Wassermann, 2011). In this study, regression analyses were used to describe associations between service use and care outcomes, and Bayesian network analysis was used to examine causal effects of different risk factors on costs and effect of remission on cost accumulation. However, the variable quality of EHR notes remains an identified challenge for the interpretation of the results. A lack of uniform severity measures in EHRs is a limitation with regard to the use of EHRs for research purposes.

The main limitation of this study is the accuracy of the data, as discussed earlier in section 6.5.2. Previous studies have found that paper records have only moderate correlation with what has actually occurred in the medical encounter. Researchers have emphasized that the least



reported factors (30%) are patient history and physical examinations performed (Rethans et al., 1994; Wassermann, 2011). Furthermore, long-term care plans had not been recorded electronically; thus, it was not possible to examine effect of the actual care plans, and instead visit densities were examined.

Another notable limitation of this study is the incompleteness of the patient story. The only systematically extractable outcome from the EHR registers is the date of death. Current registering practices do not allow systematic and structured extraction of other essential care outcomes such as remission status or quality of life measures; instead, these measures require manual data collection, which is subject to biased interpretation of the notes. However, outcome measures are important indicators of the care quality, and appropriate structured indicators and measures should be developed and implemented nationwide. Unfortunately, the current recording practices do not allow for the examination of the relapsing pattern of the course of the AUD. Thus, in this dissertation only individuals who achieved a stable remission were identified and examined, leaving the continual AUD group to heterogeneously comprise individuals with ranging motivation, including those with short abstinence periods and those with no recorded motivation to stop harmful drinking.

Certain limitations also exist for the use of statistical methods in the examination of highly skewed visit and cost data. Regression models are commonly used to examine which variables influence the outcome variable. Survival analysis is particularly applicable with regard to EHR data when the duration of time is of interest and events occur over time. In this dissertation, Cox regression analysis, a generalized linear model with a gamma distribution, and an ANB network model were used because they can address the skewedness of the data and are applicable to count data. However, the extent to which EHR information was utilized could have been more comprehensive. For example, the incidence of new diseases and conditions could have been included in the analyses and in addition to visit densities, more thorough analysis of service use variation over time would have added to the understanding of the care pathways of individuals with AUDs. Alternatively, the qualitative approach used in Study I provided more detailed qualitative information of the service use patterns that was not directly possible to gather from the registers. Researchers have suggested combining qualitative aspects to the quantitative methods to gain a more thorough understanding of the phenomena.



## 7 CONCLUSIONS

The presented treatment-system-wide examination of cumulative alcohol-related service use and costs over time among individuals with AUDs provided new insights with regard to the relationship between AUD treatment courses and care outcomes in a Finnish context in one of the hospital districts. To better understand factors associated with quality and effectiveness of the service system in treating AUDs, treatment-system-wide data are required. North Karelia has a high alcohol-related mortality and an established uniform regional EHR system, a factor that enabled the use of longitudinal data on service system research. This dissertation identified that EHR registers currently only capture individuals with more severe and complicated AUDs, and thus the results are not generalizable to all individuals with alcohol problems. Structured recording of outcomes and quality measures could improve register-based effectiveness research in the future. However, the main findings of this dissertation imply that specialized AUD and mental health services continue to play an essential role in achieving better outcomes, and remaining outside these services was both expensive and also associated with an increased risk of death. This dissertation also demonstrated a cost-offset pattern after remission among individuals with identified severe AUDs. In other words, achieving stable remission decreased the cost accumulation compared with those with a continual AUD. The findings from this dissertation may help in the development of future social and health care services.

In the Finnish social and health service system, the provision of specialized AUD services has continued to decrease and the recent trend has been to shift treatment focus toward primary care services. However, there are questions regarding the ability of the current primary care service system to effectively treat AUDs. Researchers have extensively demonstrated that individuals with AUDs have high care needs, and more complex care needs lead to higher costs. This dissertation examined service use and care costs in relation to care outcomes and identified better treatment outcomes associated with the use of specialized AUD and mental health services. Remaining outside of these services was associated with high total care costs, fragmented somatic service use, and increased risk of death. This register study was not able to specify reasons for remaining outside services and whether they related to availability and accessibility issues or treatment compliance. Thus, future research should examine causal reasons for remaining outside AUD and mental health services.

The following suggestions for future research are proposed based on the findings from this dissertation.

1. Patient-reported outcome measures among patients with AUDs should be examined to enable development of patient-centered quality measures.
2. The role of service integration on the service use and care costs should be examined to improve the future treatment coverage and care outcomes.

3. Examination of social and health care professionals' attitudes toward individuals with AUDs and the possible association of these attitudes with treatment attachment and care outcomes.
4. Causal reasons for remaining outside AUD treatment should be examined, and to what extent stigmatizing attitudes inhibit the access to AUD services should be explored.

Given that AUDs continue to be prevalent in the Finnish society and the current need-based treatment provision system has its struggles, it would be important to recall that the universal social and health care service system should be able to provide effective and high-quality treatment regardless of the condition or disease. The design of an effective treatment service system requires system-wide conceptualization inclusive of social welfare and general health care. AUD treatment is effective but it is insufficient on its own. If the somatic conditions are not simultaneously treated, the care costs cannot be contained. Thus, it is important to consider integrating AUD and mental health treatment to general health services, to enable holistic care and to ensure that somatic conditions and mental health problems can be addressed simultaneously. Truly multiprofessional teamwork, however, requires further discussions regarding the etiological understanding of AUDs among professional groups, because conflicting views may hinder cooperation and affect care quality. As Andersen (1995) stated, health services make a difference for the better, or sometimes for the worse, for a society and its people. This is especially true for chronic conditions such as AUDs, and the emphasis should be on making a difference for the better.

## REFERENCES

- Act on Health Care Professionals (559/1994) Available at <https://www.finlex.fi/fi/laki/ajantasa/1994/19940559>. Accessed 7 Jan 2019.
- Act on Mental Health (1116/1990) Available at <https://www.finlex.fi/fi/laki/ajantasa/1990/19901116>. Accessed 7 Jan 2019.
- Act on Social Care Professionals (817/2015) Available at <https://www.finlex.fi/fi/laki/alkup/2015/20150817>. Accessed 7 Jan 2019.
- Act on Welfare for Substance Abusers (41/1986) Available at <https://www.finlex.fi/fi/laki/ajantasa/1986/19860041>. Accessed 7 Jan 2019.
- Alcohol Act (1102/2017) Available at <https://www.finlex.fi/fi/laki/ajantasa/2017/20171102>. Accessed 7 Jan 2019.
- Agardh, E.E., Danielsson, A.-K., Ramstedt, M., Ledgaard Holm, A., Diderichsen, F., Juell, K., Vollset, S.E., Knudsen, A.K., Kinge, J.M., White, R., Skirbekk, V., Mäkelä, P., Forouzanfar, M.H., Coates, M.M., D.C., Naghavi, M. & Allebeck, P. 2016. Alcohol-attributed disease burden in four Nordic countries: a comparison using the Global Burden of Disease, Injuries and Risk Factors 2013 study. *Addiction* 111: 1806-1813.
- Aiken, L.S., West, S.G. & Taylor, A.B. 2008. Correlation Methods/ Regression models. In McKay, D. (ed.) *Handbook of Research Methods in Abnormal and Clinical Psychology*. Fordham University, USA, 79-87.
- Aldridge, A.P., Zarkin, G.A., Dowd, W.N. & Bray, J.W. 2016. The relationship between end-of-treatment alcohol use and subsequent healthcare costs: Do heavy drinking days predict higher healthcare costs. *Alcoholism: Clinical and Experimental Research* 40: 1122-8.
- Alemi, F., Avramovic, S. & Schwartz. 2018. Electro.c Health Record-Based Screening for Substance Abuse. *Big Data* 6: 214-224.
- Alho, H. 2003. Alkoholiriippuvuuden hoito, in Salaspuro, M., Kiiianmaa, K & Seppä, K. (ed.) *Päihdelääketiede. Duodecim 2. uudistettu painos*. Jyväskylä: Gummerus Kirjapaino Oy, 249-236.
- Alves, P., Sales, C. & Ashworth, M. 2017. Does outcome measurement of treatment for substance use disorder reflect the personal concerns of patients? A scoping review of measures recommended in Europe. *Drug and Alcohol Dependence* 179: 299-308.
- Alwin, D.F. 2012. Integrating varieties of life course concepts. *Journal of Gerontology: Psychological Sciences* 67: 206-20.
- American Society of Addiction Medicine 2001. *Patient placement criteria for the treatment of substance use disorders*. Chevy Chase, MD: American Society of Addiction Medicine.
- Andersen, R.M. 1995. Revisiting the behavioral model and access to medical care: does it matter? *Journal of Health and Social Behavior* 36: 1-10.
- Andersson, H.W., Steinsbekk, A., Walderhaug, E., Otterholt, E. & Nordfjaern, T. 2018. Predictors of dropout from inpatient substance use treatment: A prospective cohort study. *Substance Abuse* 12: 1178221818760551.

- Anglin, M.D., Hser, Y-I., Grella, C.E. 1997. Drug addiction and treatment careers among clients in the Drug Abuse Treatment Outcome Study (DATOS). *Psychology of Addictive Behaviors* 11: 308–323.
- Arajärvi, P. 2013. Pääsy sosiaalihuollon päihdepalveluihin [Access to social welfare substance abuse treatment services]. In J. Moring, V. Bergman, E. Nordling, J. Markkula, A. Partanen, & M. Soikkeli (Eds.) *Kansallinen mielenterveys- ja päihdesuunnitelma 2009–2015 – Monipuolista sisällöllistä ja rakenteellista kehittämistä 2012 [Plan for mental health and substance abuse work for 2009–2015 – diverse substance and structural development 2012]*. Tampere, Finland: Institute for Health and Welfare, Paper 15/2013, 29–35. Available at <http://www.julkari.fi/handle/10024/114817>. Retrieved 30 Nov 2018.
- Ardito, R.B. & Rabellino, D. 2011. Therapeutic Alliance and Outcome of Psychotherapy: Historical excursus, measurements, and prospects for research. *Frontiers in Psychology* 2: 270.
- Askgaard, G., Leon, D.A., Deleuran, T. & Tolstrup, J. 2019. Hospital admissions and mortality in the 15 years after a first-time hospital contact with an alcohol problem: A prospective cohort study using the entire Danish population. *International Journal of Epidemiology* 49: 94-102.
- Atlantis, E., Fahey, P. & Foster, J. 2014. Collaborative care for comorbid depression and diabetes: a systematic review and meta-analysis. *BMJ Open* 4: e004706.
- Babitsch, B., Gohl, D. & vonLengerke, T. 2012. Re-revisiting Andersen’s Behavioral Model of Health Services Use: a systematic review of studies from 1998–2011. *Psychosomatic Medicine* 9: Doc11.
- Babor, T.F., Hofmann, M.I., DelBoca, F.K., Hesselbrock, V., Meyer, R.E., Dolinsky, Z.S., et al. 1992. Types of alcoholics, I. Evidence for an empirically derived typology based on indicator of vulnerability and severity. *Archives of General Psychiatry* 49: 599–608.
- Babor, T.F. & Del Boca, F.K. (eds.) 2003. *Treatment matching in alcoholism*. Cambridge, United Kingdom: Cambridge University Press; 2003. 1-238.
- Babor, T., Stenius, K. & Romelsjö, A. 2008. Alcohol and drug treatment systems in public health perspective: Mediators and moderators of population effects. *International Journal of Methods in Psychiatric Research* 17: S50-S59.
- Becoña, E. 2018. Brain disease or biopsychosocial model in addiction? Remembering the Vietnam Veteran Study. *Psicothema* 30: 270-275.
- Ben-Shlomo, Y. & Kuh, D. 2002. A life course approach to chronic disease epidemiology: Conceptual models, empirical challenges and interdisciplinary perspectives. *International Journal of Epidemiology* 31: 285-293.
- Bischof, G., Rumpf, H.-J., Hapke, U., Meyer, C. & John, U. 2003. Types of natural recovery from alcohol dependence: A cluster analytic approach. *Addiction* 98: 1737-1746.
- Bland, R., Newman, S. & Orn, H. 1997. Age and remission of psychiatric disorders. *Canadian Journal of Psychiatry* 42: 722–729.
- Blodgett, J.C., Maisel, N.C., Fuh, I.L., Wilbourne, P.L. & Finney, J.W. 2014. How effective is continuing care for substance use disorders? A meta-analytic review. *Journal of Substance Abuse Treatment* 46: 87-97.

- Blose, J.O., & Holder, H.D. 1991. The utilization of medical care by treated alcoholics: Longitudinal patterns by age, gender, and type of care. *Journal of Substance Abuse* 3: 13–27.
- Bogenschutz, M.P, Rice, S.L, To.gan, J.S, Vogel, H.S, Nowinski, J., Hume, D. & Arenella, P.B. 2014. 12-step facilitation for the dually diagnosed: a randomized Clinical trial. *Journal of Substance Abuse Treatment* 46: 403-11.
- Boschloo, L., Vogelzangs, N., van den Brink, W., Smit, J.H., Beekman, A.T.F. & Penninx, B.J.H. 2012. Predictors of the 2-year recurrence and persistence of alcohol dependence. *Addiction* 107: 1590-1598.
- Brady, K.T & Sinha, R. 2005. Co-Occurring Mental and Substance Use Disorders: The Neurobiological Effects of Chronic Stress. *The American Journal of Psychiatry* 162: 1483-1493.
- van den Brink, W. & Kiefer, F. 2020. Alcohol use disorder. In Geddes, J.R., Andreasen, N.C. & Goodwin, G.M. (eds.) *New Oxford Textbook of Psychiatry*. United Kingdom: Oxford University Press. Third Edition, 498-504.
- Brinkman, P., Rabinowitz, V.C., Karuza Jr, J., Coates, D., Cohn, E. & Kidder, L. 1982. Models of helping and coping. *American Psychologist*, 37:368-384.
- Bromberg-Martin, E.S., Matsumoto, M. & Hikosaka, O. 2010. Dopamine in motivational control: rewarding, aversive, and alerting. *Neuron* 68: 815- 834.
- Carvalho, A.F., Heilig, M., Perez, A., Probst, C. & Rehm, J. 2019. Alcohol use disorders. *Lancet* 394: 781-792.
- Castillo, E.G., Olfson, M., Pincus, H.A., Vawdrey, D. & Stroup, S. 2015. Electronic Health Records in Mental Health Research: A framework for developing valid research methods. *Psychiatric Services* 66: 2.
- Cecil, C.A.M., Walton, E. & Viding, E. 2015. DNA methylation, substance use and addiction: A systematic review of recent animal and human research from a developmental perspective. *Current Addiction Reports* 2: 331-346.
- Center for Substance Abuse Treatment. National Summit on Recovery. 2005. Conference Report. DHHS Publication No. (SMA) 07-4276. Rockville, MD: Substance Abuse and Mental Health Services Administration, 2007. Available at [https://www.samhsa.gov/sites/default/files/partnersforrecovery/docs/Summit\\_Rpt\\_1.pdf](https://www.samhsa.gov/sites/default/files/partnersforrecovery/docs/Summit_Rpt_1.pdf). Accessed 30 Nov 2019.
- Chung, T. & Maisto, S.A. 2006. Relapse to alcohol and other drug use in treated adolescents: Review and reconsideration of relapse as a change point in Clinical course. *Clinical Psychology Review* 26: 149–161.
- Cloninger, C.R., Bohman, M., & Sigvardsson, S. 1981. Inheritance of alcohol abuse. Cross-fostering analysis of adopted men. *Archives of General Psychiatry* 38: 861–868.
- Cohen, E., Feinn, R., Arias, A. & Kranzler, H.R. 2007. Alcohol treatment utilization: Findings from the National Epidemiological Survey on alcohol and related conditions. *Drug and Alcohol Dependence* 86: 214-221.
- Connors, G.J., Carroll, K.M., DiClemente, C.C., Longabaugh, R. & Donovan, DM. 1997. The therapeutic alliance and its relationship to alcoholism treatment participation and outcome. *Journal of Consulting and Clinical Psychology* 65: 588-598.

- Corry, J., Sanderson, K., Issakidis, C., Andrews, G. & Lapsley, H. 2004. Evidence-based care for alcohol use disorders is affordable. *Journal of Studies on Alcohol* 65: 521-529.
- Council for Choices in Health Care in Finland, 2020. Riippuvuussairauksien hoidon ja kuntoutuksen psykososiaaliset menetelmät. Palveluvalikoimaneuvoston suositus. Available at: [https://palveluvalikoima.fi/documents/1237350/26040988/Alkoholiriippuvuus\\_suositus\\_valmis.pdf/0884f1e0-6334-91a5-3035-a193f00b3d30/Alkoholiriippuvuus\\_suositus\\_valmis.pdf?t=1593581522914](https://palveluvalikoima.fi/documents/1237350/26040988/Alkoholiriippuvuus_suositus_valmis.pdf/0884f1e0-6334-91a5-3035-a193f00b3d30/Alkoholiriippuvuus_suositus_valmis.pdf?t=1593581522914) Accessed 16 Sep 2020.
- Cunningham, J.A., Lin, E., Ross, H.E. & Walsh, G.W. 2000. Factors associated with untreated remissions from alcohol abuse or dependence. *Addictive Behaviors* 25: 317-321.
- Dams, J., Buchholz, A., Kraus, L., Reimer, J., Scherbaum, N., Konnopka, N. & König, H.H. 2018. Excess costs of alcohol-dependent patients in German psychiatric care compared with matched non-alcohol-dependent individuals from the general population: a secondary analysis of two datasets. *BMJ Open* 8: e020563.
- Darke, S., Ross, J., Teesson, M. & Lynskey, M. 2003. Health service utilization and benzodiazepine use among heroin users: Findings from the Australian Treatment Outcome Study (ATOS) *Addiction* 98: 1129-1135.
- Dawson, D.A., Grant, B.F., Stinson, F.S., Chou, P.S., Huang, B., Ruan, W.J. 2005. Recovery from DSM-IV alcohol dependence: United States, 2001-2002. *Addiction* 100: 281-292.
- Dawson, D.A., Goldstein, R.B. & Grant, B.F. 2012. Factors associated with first utilization of different types of care for alcohol problems. *Journal of Studies on Alcohol and Drugs* 73: 647-656.
- Decree on Welfare for Substance Abusers (653/1986) Available at <https://finlex.fi/fi/laki/ajantasa/1986/19860653>. Accessed 7 Jan 2019.
- Degenhardt, L., Glantz, M., Evans-Lacko, S., Sadikova, E., Sampson, N., Thornicroft, G., et al. 2017. Estimating treatment coverage for people with substance use disorders: an analysis of data from the world mental health surveys. *World Psychiatry* 16: 299-307.
- Del Boca, F.K. & Hesselbrock, M.N. 1996. Gender and alcoholic subtypes. *Alcohol Health and Research World* 20: 56-62.
- Dennis, K.L., Scott, C.K. & Funk, R. 2003. An experimental evaluation of recovery management check-ups (RMC) for people with chronic substance use disorders. *Evaluation and Program Planning* 26: 339-352.
- Dennis, K.L., Scott, C.K., Funk, R. & Foss, M.A. 2005. The duration and correlates of addiction and treatment careers. *Journal of Substance Abuse Treatment* 28: S51-S62.
- Dennis, K.L., Foss, M.A. & Scott, C.K. 2007. An eight-year perspective on the relationship between the duration of abstinence and other aspects of recovery. *Evaluation Review* 31: 585-612.
- Dennis, M. & Scott, C.K. 2007. Managing addiction as a chronic condition. *Addiction Science and Clinical Practice* 4: 45-55.
- de Weert-van Oene, G.H., Termorshuizen, F., Buwalda, V.J., Heerdink, E.R. 2017. Somatic health care utilization by patients treated for substance use disorders. *Drug and Alcohol Dependence* 178: 277-284.



- Donovan, J.M. 1986. An etiologic model of alcoholism. *American Journal of Psychiatry* 143: 1-11.
- duPlessis, G.P. 2014. An integral ontology of addiction. A multiple object as a continuum of ontological complexity. *Journal of Integral Theory and Practice* 9: 38–54.
- Edlund, M.J., Booth, B.M. & Feldman, Z.L. 2009. Perceived need for treatment for alcohol use disorders: results from two national surveys. *Psychiatric Services* 60: 1618–1628.
- Edlund, M.J., Booth, B.M. & Han, X. 2012. Who seeks care where? Utilization of mental health and substance use disorder treatment in two national samples of individuals with alcohol use disorders. *Journal of Studies on Alcohol and Drugs* 73: 635-46.
- Elder, G.H. 1985. *Life course dynamics: Trajectories and transitions, 1968-1980*. Ithaca, NY: Cornell University.
- Elder G.H., Johnson M.K., Crosnoe R., 2003. The Emergence and Development of Life Course Theory. In Mortimer, J.T. & Shanahan, M.J. (eds.) *Handbook of the Life Course*. *Handbooks of Sociology and Social Research*. Boston, MA: Springer.
- Effertz, T., & Mann, K. 2013. The burden and cost of disorders of the brain in Europe with the inclusion of harmful alcohol use and nicotine addiction. *European Neuropsychopharmacology* 23: 742–748.
- Engel G.L. 1977. The need for a new medical model. *Science* 196: 129-136.
- Evangelou, E., Ntritsos, G., Pazoki, R., & Koskeridis, F. 2019. New alcohol-related genes suggest shared genetic mechanisms with neuropsychiatric disorders. *Nature Human Behaviour* 3: 950-961.
- Finnish Constitutional Act (731/1999)
- Flensburg-Madsen, T., Mortensen, E.L., Knop, J., Becker, U., Sher, L. & Grønbaek, M. 2009. Comorbidity and temporal ordering of alcohol use disorders and other psychiatric disorders: results from a Danish register-based study. *Comprehensive Psychiatry* 50: 307-314.
- Ford, J.D., Trestman, R.L., Steinberg, K., Tennen, H. & Allen, S. 2004. Prospective association of anxiety, depressive, and addictive disorders with high utilization of primary, specialty and emergency medical care. *Social Science & Medicine* 58: 2145-2148.
- Fortmann, A.L., Walker, C., Bargel, K., Robacker, M., Morrissey, R., Ortwine, K., Loupasi, I., Lee, I., Hogrefe, L., Strohmeyer, C. & Philis-Tsimikas, A. 2020. Care team integration in primary care improves one-year Clinical and financial outcomes in diabetes: A case for value-based care. *Population Health Management Ahead of print*.
- Frank, E., Prien, R.F., Jarrett, R.B., Keller, M.B., Kupfer, D.J., Lavori, P.W. & niWeissman, M.M. 1991. Conceptualization and rationale for consensus definitions of terms in major depressive disorder: Remission, recovery, relapse, and recurrence. *Archives of General Psychiatry* 48: 851–855.
- GBD 2015 Risk Factors Collaborators. 2016. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2015: A systematic analysis for the Global Burden of Disease Study 2015. *The Lancet* 388: 1659–1724.
- Ghitza, U.E., Sparenborg, S. & Tai, B. 2011. Improving drug abuse treatment delivery through adoption of harmonized electronic health record systems. *Substance Abuse and Rehabilitation* 2: 125-131.

- Gilchrist, G., Moskalewicz, J., Slezakova, S., Okruhlica, L., Torrens, M., Vajd, R., & Baldacchino, A. 2011. Staff regard towards working with substance users: a European multi-centre study. *Addiction* 106: 1114-1125.
- Gilpin, N.W. & Koob, G.F. 2008. Neurobiology of alcohol dependence. Focus on motivational mechanisms. *Alcohol research and health* 31:185-195.
- Godfrey, C., Stewart, D. & Gossop, M. Economic analysis of costs and consequences of the treatment of drug misuse: 2- year outcome data from the National Treatment Outcome Research Study (NTORS). *Addiction* 99: 697-707.
- Goldman, D., Oroszi, G. & Ducci, F. 2005. The genetics of addictions: uncovering the genes. *Nature Reviews Genetics* 6: 521-532.
- Goodman, A.C., Nishiura, E., Hankin, J.R., Holder, H.D. & Tilford, J.M. 1996. Long-Term Alcoholism Treatment Costs. *Medical Care Research and Review* 53: 441-464.
- Goodman, A.C., Tilford, J.M., Hankin, J.R., Holder, H.D., & Nishiura, E. 2000. Alcoholism treatment offset effects: An insurance perspective. *Medical Care Research and Review* 57: 51-75.
- Gorman, E., Leyland, A.H., McCartney, G., White, I.R., Katikireddi, S.V., Rutherford, L., & Gray, L. 2014. Assessing the representativeness of population-sampled health surveys through linkage to administrative data on alcohol-related outcomes. *American Journal of Epidemiology* 180: 941-948.
- Graham, K., Cheng, J., Bernards, S., Wells, S., Rehm, J., Kurdyak, P. 2017. How much do mental health and substance use/addiction affect use of general medical services? Extent of use, reasons for use, and associated costs? *Canadian Journal of Psychiatry* 62: 48-56.
- Grant, B.F. 1997. Barriers to alcoholism treatment: reasons for not seeking treatment in a general population sample. *Journal of Studies on Alcohol* 58: 365-371.
- Grant, B.F., Goldstein, R.B., Saha, T.D., Chou, S.P., Jung, J., Zhang, H., Pickering, R.P., Ruan, W.J., Smith, S.M., Huang, B. & Hasin, D.S. 2015. Epidemiology of DSM-5 alcohol use disorder: Results from the National Epidemiologic Survey on Alcohol and Related Conditions III. *JAMA Psychiatry* 72: 757-66.
- Greenfield, T.K., Ye, Y., Bond, J., Kerr, W.C., Nayak, M.B., Kaskutas, L.A., Anton, R.F., Litten, R.Z. & Kranzler, H.R. 2014. Risks of alcohol use disorders related to drinking patterns in the U.S. general population. *Journal of Studies on Alcohol and Drugs* 75: 319-327.
- Grella, C.E., Karno, M.P., Warda, U.S., Moore, A.A. & Niv, N. 2009. Perceptions of need and help received for substance dependence in a national probability survey. *Psychiatric Services* 60: 1068- 1074.
- Grella, C.E., Stein, J.A., Weisner, C., Chi, F. & Moos, R. 2010. Predictors of longitudinal substance use and mental health outcomes for patients in two integrated service delivery systems. *Drug and Alcohol Dependence* 110: 92-100.
- Gustavsson, A., Svensson, M., Jacobi, F., Allgulander, C., Alonso, J., Beghi, E., . . . Olesen, J. 2011. Cost of disorders of the brain in Europe 2010. *European Neuropsychopharmacology* 21: 718-779.
- Hall, W., Degenhardt, L. & Teesson, M. 2009. Understanding comorbidity between substance use, anxiety and affective disorders: Broadening the research base. *Addictive Behaviors* 34: 526-530.

- Harris, M., Glantz, M., Sampson, N., Al-Hamzawi, A., Alonso, J., Bruffaerts, R., et al. 2019. Cross-national patterns of substance use disorder treatment and associations with mental disorder comorbidity in the WHO world mental health surveys. *Addiction* 114: 1446–1459.
- Hart, A.B. & Kranzler, H.R. 2015. Alcohol dependence genetics: Lessons learned from Genome-Wide Association Studies (GWAS) and Post-GWAS Analyses. *Alcoholism: Clinical and Experimental Research* 39: 1312-1327.
- Health Care Act (1326/2010). Available at <https://www.finlex.fi/fi/laki/ajantasa/2010/20101326>. Accessed 7 Jan 2019.
- Hedden, S.L. & Gfroerer, J.C. 2011. Correlates of perceiving a need for treatment among adults with substance use disorder: results from a national survey. *Addictive Behaviors* 36: 1213–1222.
- Heinälä, P., Alho, H., Kiiänmaa, K., Lönnqvist, J., Kuoppasalmi, K. & Sinclair J.D. 2001. Targeted use of naltrexone without prior detoxification in the treatment of alcohol dependence: A factorial double-blind, placebo-controlled trial. *Journal of Clinical Psychopharmacology* 21: 287–292.
- Hensel, J.M., Taylor, V.H., Fung, K. & Vigod, S.N. 2016. Rates of mental illness and addiction among high-cost users of medical services in Ontario. *Canadian Journal of Psychiatry* 61: 358–366.
- Herttua, K., Mäkelä, P. & Martikainen, P. 2007. Differential trends in alcohol-related mortality: A register-based follow-up study in Finland in 1987-2003. *Alcohol & Alcoholism* 42: 456–464.
- Hesse, M., Vanderplasschen, W., Rapp, R.C., Broekaert, E. & Fridell, M. 2007. Case management for persons with substance use disorders. *Cochrane Database Syst Rev* 17: CD006265.
- Hester, R.K. & Miller, W.R. 2003. *Handbook of alcoholism treatment approaches: Effective alternatives*, (3rd ed.). New York: Pearson Education, Inc.
- Heyman, G. 2013. Addiction and choice: theory and new data. *Frontiers in Psychology* 4:31.
- Hiroeh, U., Kapur, N., Webb, R., Dunn, G., Mortensen, P.B. & Appleby, L. 2008. Deaths from natural causes in people with mental illness: A cohort study. *Journal of Psychosomatic Research* 64: 275–283.
- Hoff, R.A. & Rosenheck, R.A. 1999. The cost of treating substance abuse patients with and without comorbid psychiatric disorders. *Psychiatric Services* 50: 1309-1315.
- Hoffmann, N.G., DeHart, S.S. & Fulkerson, J.A. 1993. Medical care utilization as a function of recovery status following chemical addictions treatment. *Journal of Addictive Diseases* 12: 97-108.
- Holder, H.D., & Blose, J.O. 1986. Alcoholism treatment and total health care utilization and costs. A four-year longitudinal analysis of federal employees. *JAMA* 256: 1456–1460.
- Holder, H.D. & Blose, J.O. 1992. The Reduction of Health Care Costs Associated With Alcoholism treatment: A 14-year Longitudinal Study. *Journal of Studies on Alcohol* 53: 293-302.
- Holopainen, A. 2003. Päihdeongelma ja sosiaalinen syrjäytyminen. In Salaspuro, M., Kiiänmaa, K. & Seppä, K. (ed.) *Päihdelääketiede. Duodecim 2. uudistettu painos*. Jyväskylä: Gummerus Kirjapaino Oy, 265-272.

- Holst, C., Schurmann Tolstrup, J., Sørensen, H.J. & Becker, U. 2017. Alcohol dependence and risk of somatic diseases and mortality: a cohort study in 19 002 men and women attending alcohol treatment. *Addiction* 112: 1358-1366.
- Hser, Y.I., Anglin, M.D., Grella, C., Longshore, D & Prendergast, ML. 1997. Drug treatment careers. A conceptual framework and existing research findings. *Journal of Substance Abuse Treatment* 14: 543-58.
- Hser, Y.I., Longshore, D. & Anglin, M.D. 2007. The life course perspective on drug use: a conceptual framework for understanding drug use trajectories. *Evaluation Review* 31: 515-47.
- Hser, Y-I. & Anglin, M.D. 2011. Addiction Treatment and Recovery Careers. In Kelly J.F. & White, W.L. (ed.) *Addiction Recovery Management: Theory, Research and Practice*, 9-29.
- Hughes, K., Bellis, M.A., Hardcastle, K.A., Sethi, D., Butchart, A. & Mikton, C. 2017. The effect of multiple adverse childhood experiences on health: a systematic review and meta-analysis. *Lancet* 2: PE356-E366.
- Hunt, W.A., Barnett, L.W., Branch & L.G. 1971. Relapse rates in addiction programs. *Journal of Clinical Psychology* 27: 455-456.
- Hyytiä, P. 2018. Addiktio neurobiologia. *Duodecim* 134: 2031-8.
- Härkönen, J., Savonen, J., Virtala, E. & Mäkelä, P. Suomalaisten alkoholinkäyttötavat 1968-2016. 2017. Juomatapatutkimuksen tuloksia. THL raportti 3/2017.
- Ilgen, M. & Moos, R. 2005. Deterioration Following Alcohol-Use Disorder Treatment in Project MATCH. *Journal of Studies on Alcohol* 66: 517-25.
- Ilgen, M.A., Price, A.M., Burnett-Zeigler, I., Perron, B., Islam, K., Bohnert, A.S.B. & Zivin, K. 2011. Longitudinal predictors of addictions treatment utilization in treatment-naïve adults with alcohol use disorders. *Drug and Alcohol Dependence* 113: 215-221.
- International Agency for Research on Cancer. 2012. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans 100E: Personal Habits and Indoor Combustions. Lyon, France: International Agency for Research on Cancer.
- Jarl, J., Johansson, P., Eriksson, A., Eriksson, M., Gerdtham, U. G., Hemström, O., . . . Room, R. 2008. The societal cost of alcohol consumption: An estimation of the economic and human cost including health effects in Sweden, 2002. *European Journal of Health Economics* 9: 351-360.
- Johnson, B. & Flores Mosri, D. 2016. The Neuropsychanalytic Approach: Using Neuroscience as the Basic Science of Psychoanalysis. *Frontiers in Psychology* 7: 1459.
- Jorgensen, K.B., Nordentoft, M. & Hjorthoj, C. 2018. Association between alcohol and substance use disorders and psychiatric service use in patients with severe mental illness: A nationwide Danish register-based cohort study. *Psychological Medicine* 48: 2592-2600.
- Jousilahti, P., Salomaa, V., Kuulasmaa, K., Niemelä, M., & Vartiainen, E. 2005. Total and cause specific mortality among participants and non-participants of population based health surveys: A comprehensive follow-up of 54 372 Fin.sh men and women. *Journal of Epidemiology & Commu.ty Health* 59: 310-315.
- Jääskeläinen, M. 2012. Päihdehaittakustannuslaskennan menetelmät. Esimerkkinä vuoden 2010 päihdehaittakustannuslaskenta. Available at [https://www.julkari.fi/bitstream/handle/10024/90813/URN\\_ISBN\\_978-952-245-742-4.pdf?sequence=1](https://www.julkari.fi/bitstream/handle/10024/90813/URN_ISBN_978-952-245-742-4.pdf?sequence=1). Accessed 30 Nov 2018.

- Kapiainen, S., Väisänen, A., & Haula, T. 2014. Terveysten- ja sosiaalihuollon yksikkökustannukset Suomessa vuonna 2011. Available at [http://www.julkari.fi/bitstream/handle/10024/114683/THL\\_RAPO3\\_2014\\_web.pdf?sequence=1&isAllowed=y](http://www.julkari.fi/bitstream/handle/10024/114683/THL_RAPO3_2014_web.pdf?sequence=1&isAllowed=y). Accessed 10 May 2019.
- Karlsson, T. 2018. Mitä tilastot kertovat suomalaisten alkoholinkäytöstä ja sen haitoista? In Mäkelä, P., Härkönen, J., Lintonen, T., Tigerstedt, C. & Warpeus, K. (eds.) Näin Suomi juo. Helsinki: Juvenes Print – Suomen yliopistopaino Oy, 15-25.
- Karvanen, J., Tolonen, H., Härkönen, T., Jousilahti, P. & Kuulasmaa, K. 2016. Selection bias was reduced by recontacting nonparticipants. *Journal of Clinical Epidemiology* 76: 209–217.
- Kaukonen, O. 2000. Päihdepalvelut jakautuneessa hyvinvointivaltiossa. Research reports. National Research and Development Centre for Welfare and Health: 107, 101-105, 142.
- Kêdoté, M.N., Brousselle, A. & Champagne, F. 2008. Use of health care services by patients with co-occurring severe mental illness and substance use disorders. *Mental Health Substance Use* 1: 216–27.
- Kekolahti, P. 2019. Bayesian network analysis of mobile service and device usage. Doctoral dissertations 201/2019. Department of Communication and Networking, Aalto University. Helsinki: Unigrafia Oy.
- Kendler, K.S., Ohlsson, H., Sundquist, J., Sundquist, K. 2016. Alcohol use disorder and mortality across the lifespan: A longitudinal cohort and co-relative analysis. *JAMA Psychiatry* 73: 575–581.
- Kessler, R.C., Nelson, C.B., McGonagle, K.A., Edlund, M.J., Frank, R.G. & Leaf, P. 1996. The epidemiology of co-occurring addictive and mental disorders: Implications for prevention and service utilization. *American Journal of Orthopsychiatry* 66: 17-31.
- Kessler, R.C., Olfson, M. & Berglund, P.A. 1998. Patterns and predictors of treatment contact after first onset of psychiatric disorders. *American Journal of Psychiatry* 155: 62-9.
- Kessler, R.C., Aquilar-Gaxiola, S., Berglund, P.A. et al. 2001. Patterns and predictors of treatment seeking after onset of a substance use disorder. *JAMA Psychiatry* 58: 1065-1071.
- Ketola, E., Pitkänen, V., Huvinen, S. & Seppälä, T. 2019. Koko Suomen perusterveydenhuollon asiakaskirjo on nyt kuvattu. *Suomen Lääkärilehti* 74: 2027-30.
- Keyes, K.M., Hatzenbuehler, M.L., McLaughlin, K.A., et al. 2010. Stigma and treatment for alcohol disorders in the U.ited States. *Am J Epidemiol* 172: 1364–1372.
- Khantzian, E.J., Halliday, K.S. & McAuliffe, W.E. 1990. Addiction and the vulnerable self. Modified dynamic group therapy for substance abusers. New York: The Guilford Press.
- Khantzian, E.J. 2003. Understanding addictive vulnerability: an evolving psychodynamic perspective. *Neuro-Psychoanalysis* 5: 5-21.
- Kiiskinen, T., Mars, N.J., Palviainen, T., Koskela, J., Rämö, J.T., Ripatti, P., Ruotsalainen, S., FinnGen, GSCAN Consortium, Palotie, A., Madden, P.A.F., Rose, R.J., Kaprio, J., Salomaa, V., Mäkelä, P., Havulinna, A.S. & Ripatti, S. 2020. Genomic Prediction of Alcohol-Related Morbidity and Mortality. *Transl Psychiatry* 10: 23.
- Koob, G.F. 2003. Neuroadaptive mechanisms of addiction: studies on the extended amyglada. *European Neuropsychopharmacology* 13: 442-452.
- Koob, G.F. 2008. A role for brain stress system in addiction. *Neuron*, 59: 11-34.

- Koob, G.F. & Volkow, N.D. 2016. Neurobiology of addiction: a neurocircuitry analysis. *Lancet Psychiatry* 3:760-773.
- Kopra, J., Mäkelä, P., Tolonen, H., Jousilahti, P., & Karvanen, J. 2018. Follow-up data improve the estimation of the prevalence of heavy alcohol consumption. *Alcohol and Alcoholism* 53: 586-596.
- Koski-Jännes, A. 2004. In Search of a Comprehensive Model of Addiction. In P. Rosenqvist, J. Blomqvist, A. Koski-Jännes & L. Öjesjö (eds.) *Addiction and life course. Nordic drug and alcohol studies* 44.
- Kraus, L., Østhus S., Amundsen E., Piontek D., Härkönen J., Legleye S., Bloomfield K., Mäkelä P., Landberg J. & Törrönen J. 2015. Changes in mortality due to major alcohol-related diseases in four Nordic countries, France and Germany between 1980 and 2009: A comparative age-period-cohort analysis. *Addiction* 110:1443-52.
- Kreek, M.J. 2011. Extreme marginalization: Addiction and other mental health disorders, stigma, and imprisonment. *Ann N Y Acad Sci* 1231: 65-72.
- Krenek, M., Prince, M. A., Maisto, S. A. 2017. Life events and alcohol use disorder Clinical course: Modeling the dynamic association. *Drug and Alcohol Dependence* 180: 137–143.
- Kristenson, H., Osterling, A., Nilsson, J. & Lindgarde, F. 2002. Prevention of alcohol-related deaths in middle-aged heavy drinkers. *Alcoholism: Clinical and Experimental Research* 26: 478–484.
- Kronenberg, C., Doran, T., Goddard, M., Kendrick, T., Gilbody, S., Dare, C.R., Aylott, L. & Jacobs, R. 2017. Identifying primary care quality indicators for people with serious mental illness: a systematic review. *British Journal of General Practice* 67: e519-e530.
- Kuusisto, K. & Ranta, J. 2020. Psykososiaalisen päihdetyön asema Suomessa 1900-luvulta nykypäivään. In *Sosiaalityön käänneet*. Moilanen, J., Annola, J. & Satka, M. (ed.) *SoPhi* 144: Jyväskylän yliopisto, 112–140.
- Kuussaari, K., Ronkainen, J-E., Partanen, A., Kaukonen, O. & Vormaa, H. 2012. Kuntoutuksesta katkaisuun. Päihdetapauslaskenta palvelujärjestelmän kuvaajana. *Yhteiskuntapolitiikka* 77: 640- 655.
- Kuussaari, K., & Hirschovits-Gerz, T. 2016. Co-occurrence of substance use related and mental health problems in the Finnish social and health care system. *Scandinavian Journal of Public Health* 44: 202–208.
- Kuussaari, K., Kaukonen, O., Partanen, A., Samposalo, H. & Vormaa, H. 2017. Päihdepalveluiden rakenteen ja työnjaon maakunnittaiset erot vuonna 2015. *Yhteiskuntapolitiikka*, 82: 262-273.
- Alkoholiongelmaisen hoito: Käypä hoito -suositus, 2015. Suomalaisen Lääkäriseuran Duodecimin ja Päihdelääketieteen yhdistyksen asettama työryhmä. Helsinki: Suomalainen Lääkäriseura Duodecim. Available at [www.käypähoito.fi](http://www.käypähoito.fi) Accessed 30 Nov 2012.
- Köhnke, M.D. 2008. Approach to the genetics of alcoholism: A review based on pathophysiology. *Biochemical Pharmacology* 75: 160–177.
- Laaksonen, E., Vuoristo-Myllys, S., Koski-Jännes, A. & Alho, H. 2013. Combining medical treatment and CBT in treating alcohol-dependent patients: Effects on life quality and general well-being. *Alcohol and Alcoholism* 48: 687–693.

- Landberg, J. & Hübner, L. 2014. Changes in the relationship between volume of consumption and alcohol-related problems in Sweden during 1979–2003. *Alcohol and Alcoholism* 49: 308–316.
- Laramée, P., Kusel, J., Leonard, S., Aubin, H.J., François, C., & Daeppen, J.B. (2013). The economic burden of alcohol dependence in Europe. *Alcohol and Alcoholism* 48: 259–269.
- Laub, J.H. & Sampson, R.J. 1993. Turning points in the life course: Why change matters to the study of crime. *Criminology* 31 (3): 301–25. In Tonry, M.H. (ed.) *Understanding desistance from crime. Crime and justice: A review of research*. Chicago: University of Chicago Press, 2001 1-69.
- Laudet, A.B., Savage, R. & Mahmood, D. 2002. Pathways to Long-Term Recovery: A Preliminary Investigation. *Journal of Psychoactive Drugs* 34: 305-311.
- Laudet, A.B. 2007. What does recovery mean to you? Lessons from the recovery experience for research and practice. *Journal of Substance Abuse Treatment* 33: 243–256.
- Laudet, A.B. 2008. The road to recovery: Where are we going and how do we get there? Empirically driven conclusions and future directions for service development and research. *Substance Use & Misuse* 43: 2001-2020.
- Lawrence, D. & Kisely, S. 2010. Inequalities in healthcare provision for people with severe mental illness. *Journal of Psychopharmacology* 24: 61–68.
- Leggio, L. & Addolorato G. 2008. Serotonin transporter (SERT) brain density and neurobiological Cloninger subtypes model: A lesson by human autoradiography studies. *Alcohol and Alcoholism* 43: 148–150.
- Leggio L., Kenna, G.A., Fenton, M., Bonenfant, E. & Swift, R.M. 2009. Typologies of alcohol dependence. From Jellinek to genetics and beyond. *Neuropsychology Review* 19: 115–129.
- Lesch, O.M., Kefer, J., Lentner, S., Mader, R., Marx, B., Musalek, M., et al. 1988. The course of alcoholism. Long-term prognosis in different subtypes. *Forensic Science International* 36: 121–138.
- Leschner, A.I. 1997. Addiction is a brain disease, and it matters. *Science* 278: 45-7.
- Leskelä, R.L., Komssi, V., Sandström, S., Pikkujämsä, S., Haverinen, A., Olli, S. L., & Ylitalo-Katajisto, K. 2013. Paljon sosiaali- ja terveystalveluja käyttävät asukkaat Oulussa [Heavy users of social and health care services in the city of Oulu]. *Suomen Lääkärilehti* 48: 3163–3169.
- Levey, D.F., Le-Niculescu, H., Frank, J., Ayalew, M., Jain, N., Kirilin, B., Learman, R., Wi.ger, E., Rodd, Z., Shekhar, A., Schork, N., Kiefer, F., Wodarz, N., Muller-Myhsok, B., Dahmen, N., GESGA Consortium, Nöthen, M., Sherva, R., Farrer, L., Smith, A.H., Kranzler, H.R., Rietschel, M., Gelernter, J. & Niculescu, A.B. 2014. Genetic risk prediction and neurobiological understanding of alcoholism. *Translational Psychiatry* 4: e391.
- Lewis, M. 2017. Addiction and the brain: development, not disease. *Neuroethics*, 10: 7-18.
- Linna, M., Laine, J., Timonen, L., Åhman, H. & Tin Tin Htar, M. 2018. Exploring the costs of a 13-valent pneumococcal conjugate vaccination program for home care patients. *Current Medical Research and Opinion* 34: 2089-2094.
- Litten, R.Z., Ryan, M.L., Falk, D.E., Reilly, M., Fertig, J.B. & Koob, G.F. 2015. Heterogeneity of alcohol use disorder: Understanding mechanisms to advance personalized treatment. *Alcoholism: Clinical and Experimental Research* 39: 579-584.

- Lopez-Quintero, C., Hasin, D.S., Pérez de los Cobos, J., Pines, A., Wang, S., Grant, B.F. & Blanco, C. 2010. Probability and predictors of remission from life-time nicotine, alcohol, cannabis or cocaine dependence: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Addiction* 106: 657-669.
- Lynch, J. & Smith, G.D., 2005. A Life Course Approach to Chronic Disease Epidemiology. *Annual Review of Public Health* 26: 1-35.
- Lyons Reardon, M., Burns, A.B., Preist, R., Sachs-Ericsson, N. & Lang, A.R. 2003. Alcohol use and other psychiatric disorders in the formerly homeless and never homeless: Prevalence, age of onset, comorbidity, temporal sequencing, and service utilization. *Substance Use & Misuse* 38: 601-44.
- Maisto, S.A., McKay, J.R. & O'Farrell, T.J. 1998. Twelve-month abstinence from alcohol and long-term drinking and marital outcomes in men with severe alcohol problems. *Journal of Studies on Alcohol* 59: 591-598.
- Maisto, S.A., Clifford, P.R., Longabaugh, R. & Beattie, M. 2002. The relationship between abstinence for one year following pretreatment assessment and alcohol use and other functioning at two years in individuals presenting for alcohol treatment. *Journal of Studies on Alcohol*, 63: 397-403.
- Maisto, A., Kirouac, M. & Witkiewitz, K. 2014. Alcohol use disorder clinical course research: Informing clinicians' treatment planning now and in the future. *Journal of Studies on Alcohol and Drugs* 75: 799-807.
- Manderbacka K, Muuri A, Keskimäki I, Kaikkonen R, Elovainio M. Unmet need as a measure of access to health care. *Sosiaalilääketieteellinen aikakauslehti* 49: 4-12.
- Manthey, J., Gual, A., Jakubczyk, A., Pieper, L., Probst, C., Struzzo, P., Trapencieris, M., Wojnar, M. & Rehm, J. 2016a. Alcohol use disorders in Europe: A comparison of general population and primary health care prevalence rates. *Journal of Substance Use* 21: 478-484.
- Manthey, J., Laramée, P., Parrot, S. & Rehm, J. 2016b. Economic burden associated with alcohol dependence in a German primary care sample: a bottom-up study. *BMC Public Health* 16: 906.
- Mantere, T., Tupala, E., Hall, H., Sarkioja, T., Rasanen, P., Bergstrom, K., et al. 2002. Serotonin transporter distribution and density in the cerebral cortex of alcoholic and nonalcoholic comparison subjects: A whole-hemisphere autoradiography study. *The American Journal of Psychiatry* 159: 599-606.
- Maremmani, I., Cibin, M., Pa., P.P., Rossi, A. & Turchetti, G. 2015. Harm reduction as "Continuum Care" in alcohol abuse disorder. *International Journal of Environmental Research and Public Health* 12: 14828-148421.
- Markkula, N., Härkänen, T., Perälä, J., Partti, K., Peña, S., Koskinen, S., Saarni, S.I. 2012. Mortality in people with depressive, anxiety and alcohol use disorders in Finland. *British Journal of Psychiatry* 200: 143-149.
- Marlatt, A. (1985) Relapse prevention: Theoretical rationale and overview of the model. In Marlatt, A. & Gordon, JR. (eds.) *Relapse prevention*. New York: The Guilford Press, 3-70.
- Mattisson, C., Bogren, M., Horstmann, V., Öjesjö, L. & Brådvik, L. 2018. Remission from alcohol use disorder among males in the Lundby cohort during 1947-1997. *Psychiatry Journal* 16: eCollection. doi: 10.1155/2018/4829389.



- McKay, J.R. 1999. Studies of factors in relapse to alcohol and drug use: A critical review of methodologies and findings. *Journal of Studies on Alcohol* 60: 566-576.
- McKay, J.R. & Weiss, R.V. 2001. A review of temporal effects and outcome predictors in substance abuse treatment studies with long-term follow-ups: Preliminary results and methodological issues. *Evaluation Review* 25: 113-161.
- McKay, J.R., Franklin, T.R., Patapis, N. & Lynch, K.G. 2006. Conceptual, methodological, and analytical issues in the study of relapse. *Clinical Psychology Review* 26: 109-127.
- McKay, J.R. 2009. Continuing care research: What we have learned and where we are going. *Journal of Substance Abuse Treatment* 36: 131-145.
- McCutcheon, V.V., Kramer, J., Edenberg, H.J., Nurnberg, J.I., Kuperman, S., Schuckit, M.A., Heath, A.C. & Bucholz, K.K. 2014. Social Contexts of Remission from DSM-5 Alcohol Use Disorder in a High-Risk Sample. *Alcoholism: Clinical and Experimental Research* 38: 2015-2023.
- McLellan, A.T., Lewis, D.C., O'Brien, C.P. & Kleber, H.D. 2000. Drug dependence, a chronic medical illness: Implications for treatment, insurance, and outcomes evaluation. *JAMA* 284: 1689-1695.
- McLellan, T.A., McKay, J.R., Forman, R., Cacciola, J. & Kemp, J., 2005. Reconsidering the evaluation of addiction treatment: From retrospective follow-up to concurrent recovery monitoring. *Addiction* 100: 447-458.
- Mertens, J.R., Weisner, C. & Ray, G.T. 2005. Readmission among chemical dependency patients in private, outpatient treatment: Patterns, correlates and role in long-term outcome. *Journal of Studies on Alcohol* 66: 842-847.
- Mertens, J.R., Flisher, A.J., Satre, D.D. & Weisner, C.M. 2008. The role of medical conditions and primary care services in 5-year substance use outcomes among chemical dependency treatment patients. *Drug and Alcohol Dependence* 98: 45-53.
- Mertens, J.R., Kline-Simon, A.H., Delucchi, K.L., Moore, C. & Weisner, C.M. 2012. Ten-year stability of remission in private alcohol and drug outpatient treatment: Non-problem users versus abstainers. *Drug and Alcohol Dependence* 125: 67-74.
- Mieli, 2009. Mielenterveys- ja päihdesuunnitelma. Mieli 2009 –työryhmän ehdotukset mielenterveys- ja päihdetyön kehittämiseksi vuoteen 2015. Reports of the Ministry of Social Affairs and Health: 2009:3.
- Mihaylova, B., Briggs, A., O'Hagan, A. & Thompson, S.G. 2011. Review of statistical methods for analysing healthcare resources and costs. *Health Economics* 20: 897-916.
- Miquel, L., Rehm, J., Shield, K. D., Vela, E., Bustins, M., Segura, L., . . . Gual, A. 2018. Alcohol, tobacco and health care costs: A population-wide cohort study (n = 606 947 patients) of current drinkers based on medical and administrative health records from Catalo.a. *European Journal of Public Health* 28: 674-680.
- Mojtabai, R., Olfson, M., & Mecha.c, D. 2002. Perceived need and help-seeking in adults with mood, anxiety, or substance use disorder. *Archives of General Psychiatry* 59: 77-84.
- Mojtabai, R., Olfson, M., Sampson, N.A., Jin, R., Druss, B., Wang, P.S., et al. 2011. Barriers to mental health treatment: Results from the National Comorbidity Survey Replication. *Psychological Medicine* 41: 1751- 1761.

- Mojtabai, R. & Crum, R. M. 2013. Perceived unmet need for alcohol and drug use treatments and future use of services: results from a longitudinal study. *Drug and Alcohol Dependence* 127: 59–64.
- Mojtabai, R., Chen, L.Y., Kaufmann, C.N. & Crum, R.M. 2014. Comparing barriers to mental health treatment and substance use disorder treatment among individuals with comorbid major depression and substance use disorders. *Journal of Substance Abuse Treatment* 46, 2: 268–273.
- Moos, R. J., Finney, J.W., Federman, B. & Suchinsky, R. 2000. Specialty mental health care improves patients' outcomes: Findings from a nationwide program to monitor the quality of care for patients with substance use disorders. *Journal of Studies on Alcohol* 61: 704–713.
- Moos, R.H., Brennan, P.L., Schutte, K.K., Moos, B.S. 2004. High-risk alcohol consumption and late-life alcohol use problems. *American Journal of Public Health* 94: 1985–1991.
- Moos, R.H. & Moos, B.S. 2006. Rates and predictors of relapse after natural and treated remission from alcohol use disorders. *Addiction* 101: 212–222.
- Moos, R.H. & Moos, B.S. 2007a. Protective resources and long-term recovery from alcohol use disorders. *Drug and Alcohol Dependence* 86: 46–54.
- Moos, R.H. & Moos, B.S. 2007b. Treated and untreated alcohol-use disorders. Course and predictors of remission and relapse. *Evaluation Review* 31: 564–584.
- Morgan, P.A., Smith, V.A., Berkowitz, T.S.Z., Edelman, D., Van Houtven, C.H., Woolson, S.L., Hendrix, C.C., Everett, C.M., White, B.S. & Jackson, G.L. 2019. Impact of physicians, nurse practitioners, and physician assistants on utilization and costs for complex patients. *Health Affairs* 38:1028–1036.
- Mottagui-Tabar, S., Prince, J. A., Wahlestedt, C., Zhu, G., Goldman, D. & Heilig, M. 2005. A novel single nucleotide polymorphism of neuropeptide Y (NPY) gene associated with alcohol dependence. *Alcoholism, Clinical and Experimental Research* 29: 702–707.
- Myung, I.J. 2001. Computational Approaches to Model Evaluation. In Smelser, N.J. & Baltes, P.B. (ed.) *International Encyclopedia of the Social & Behavioral Sciences*, Reference Work, 2nd Edition, 2453–2457. <https://doi.org/10.1016/B0-08-043076-7/00589-1>
- Mäkelä, P. 1999. Alcohol-related mortality as a function of socio-economic status. *Addiction* 94: 867–886.
- Mäkelä, R. & Murto, L. 2013. Päihdehuollon palvelujärjestelmä. In Peltoniemi, T. (ed.). *Pääasiana alkoholi. Käyttö, haitat, hoito, politiikka nyt ja 2040*. Turku: Lundbeck.
- Mäkelä, P. 2018. I Miksi väestön kokonaiskulutuksella on merkitystä? In Mäkelä, P., Härkönen, J., Lintonen, T., Tigerstedt, C. & Warpeus, K. (eds.) *Näin Suomi juo - Suomalaisen muuttuvat alkoholinkäyttötavat*. Teema 29. Terveystieteiden tutkimuskeskus. Available at <http://urn.fi/URN:ISBN:978-952-343-146-1>. Accessed 30 Nov 2019.
- Mäkelä, P., Partanen, A., Kuussaari, K. & Rautiainen, E. 2021. Comparison of data sources on alcohol problems: an exploratory exercise using surveys vs. national healthcare registers. Accepted for publication in *Nordic Studies on Alcohol and Drugs*.
- Møller, L., Srdan, M. (eds.) 2010. Best practice in estimating the costs of alcohol – Recommendations for future studies. Copenhagen: World Health Organization Regional Office for Europe.
- Mölläri, K. & Saukkonen, S-M. 2019. Perusterveydenhuollon avosairaanhoidon vastaanoton asiakkaiden käyntisyöt vuonna 2018. THL Tilastoraportti: 19/2019.

- New Act on Organising Alcohol, Tobacco and Gambling Prevention (523/2015) Available at <https://www.finlex.fi/fi/laki/alkup/2015/20150523>. Accessed 7 Jan 2019.
- NIH, National Institute on Alcohol Abuse and Alcoholism 2016. Alcohol Use Disorder: A Comparison between DSM–IV and DSM–5. Available at <https://pubs.niaaa.nih.gov/publications/dsmfactsheet/dsmfact.pdf>. Accessed 22.2.2019 Accessed 20 Feb 2019.
- NIH, National Institute on Alcohol Abuse and Alcoholism 2019. Alcohol Use Disorder. Available at <https://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/alcohol-use-disorders>. Accessed 20 Feb 2019.
- Noda, T., Imamichi, H., Kawata, A., Hirano, K., Ando, T., Iwata, Y. & Yoneda, H. 2001. Long-term outcome in 306 males with alcoholism. *Psychiatry and Clinical Neurosciences* 55: 579–586.
- Nordström, T. & Skog, O-J. 2001. Alcohol and mortality: Methodological and analytical issues in aggregate analyses. *Addiction* 96: S5–S17.
- Oxford Dictionary 2019. Definition of recovery. Oxford Advanced Learner's Dictionary. Available at [sanakirja.fi/oxford\\_english/English-english/recovery](https://www.oxforddictionaries.com/oxford_english/English-english/recovery). Accessed 7 Jan 2019.
- Padyab, M., Armelius, B-Å., Armelius, K., Nyström, S., Blom, B., Grönlund, A-S., et al. 2018. Is clinical assessment of addiction severity of individuals with substance use disorder, using the addiction severity index, a predictor of future inpatient mental health hospitalization? A nine-year registry study. *Journal of Dual Diagnosis* 14: 187–191.
- Parthasarathy, S., Weisner, C., Hu, T. W., & Moore, C. 2001. Association of outpatient alcohol and drug treatment with health care utilization and cost: Revisiting the offset hypothesis. *Journal of Studies on Alcohol* 62: 89–97.
- Parthasarathy, S. & Weisner, C.M. 2005. Five-year trajectories of health care utilization and cost in a drug and alcohol treatment sample. *Drug and Alcohol Dependence* 80, 231-240.
- Parthasarathy, S., Chi, F. W., Mertens, J. R., & Weisner, C. 2012. The role of continuing care in 9-year cost trajectories of patients with intakes into an outpatient alcohol and drug treatment program. *Medical Care* 50: 540–546.
- Patient act (785/1992) Available at <https://finlex.fi/fi/laki/ajantasa/1992/19920785>. Accessed 7 Jan 2019.
- Peña, S., Suvisaari, J., Härkänen, T., et al. 2018. Changes in prevalence and correlates of alcohol-use disorders in Finland in an 11-year follow-up. *Nordic Journal of Psychiatry* 72: 512–520.
- Pereira Gray, D., Evans, P., Sweeney, K., Lings, P., Seamark, D., Seamark, C, Dixon, M. & Bradley, N. 2003. Towards a theory of continuity of care. *Journal of the Royal Society of Medicine* 96: 160- 166.
- Pescosolido, B. A. 1991. Illness careers and network ties: A conceptual model of utilization and compliance. In G. Albrecht, & J. Levy (Eds.), *Advances in medical sociology*. Greenwich, CT: JAI Press, 161-184.
- Pescosolido, B.A. & Boyer, C.A., 2010. Understanding the Context and Dynamic Social Processes of Mental Health Treatment. In Horwitz, A.V. & Scheid, T.L. (ed.) *A Handbook for the study of mental health: Social contexts, theories, and systems*. New York: Cambridge University Press, 420-438.
- Pickard, H., Ahmed, S.H. & Foddy, B. 2015. Alternative models of addiction. *Frontiers in Psychiatry* 6: 20.

- Pirkola, S.P., Isometsä, E., Suvisaari, J., Aro, H., Joukamaa, M., Poikolainen, K., Koskinen, S., Aromaa, A. & Lönnqvist, J.K. 2005a. DSM-IV mood-, anxiety- and alcohol use disorders and their comorbidity in the Finnish general population – Results from the Health 2000 Study. *Social Psychiatry and Psychiatric Epidemiology* 40: 1-10.
- Pirkola, S., Isometsä, E., Aro, H., Kestilä, L., Hämäläinen, J., Veijola, J., Kiviruusu, O. & Lönnqvist, J. 2005b. Childhood adversities as risk factors for adult mental disorders. Results from the Health 2000 study. *Social Psychiatry and Psychiatric Epidemiology* 40: 769–777.
- Pitkänen, T., Kaskela, T. & Levola, J. 2020. Mortality of treatment-seeking men and women with alcohol, opioid or other substance use disorders – A register-based follow-up study. *Addictive Behaviors* 105: 106330.
- Plana-Ripoll, O., BøckerPedersen, C., Agerbo, E., Holtz, Y., Erlangsen, A., Canudas-Romo, V., Kragh Andersen, P., Charlson, F.J., Christensen, M.K., Erskine, H.E., Ferrari, A.J., Moesgaard Iburg, K., Momen, N., Bo Mortensen, P., Nordentoft, M., Santomauro, D.F., Scott, J.G., Whiteford, H.A., Weyerer, N., McGrath, J.J., Daek, M. & Laursen, T.M. 2019. A comprehensive analysis of mortality-related health metrics associated with mental disorders: a nationwide, register-based cohort study. *Lancet* 394: 1827-35.
- Popova, S., Rehm, J., Patra, J., Zatonski, W., et al., 2007. Comparing alcohol consumption in central and Eastern Europe to other European Countries. *Alcohol and Alcoholism* 42: 465-473.
- Probst, C., Manthey, J., Martinez, A., Rehm, J. 2015. Alcohol use disorder severity and reported reasons not to seek treatment: A cross-sectional study in European primary care practices. *Substance Abuse Treatment, Prevention, and Policy* 10: 32.
- Project MATCH Research Group. 1998. Matching alcoholism treatments to client heterogeneity: Project MATCH three-year drinking outcomes. *Alcoholism: Clinical and experimental research* 22: 1300-1311.
- Ray, G.T., Weisner, C.M. & Mertens, J.R. 2005. Relationship between use of psychiatric services and five-year alcohol and drug treatment outcomes. *Psychiatric Services* 56: 164-171.
- Rehm, J., Room, R., Monteiro, M. et al. 2004. Alcohol use. In Ezzati M., Lopez AD., Rodgers, A. et al. (eds.). *Comparative Quantification of Health Risks. Global and Regional Burden of Disease Attributable to Selected Major Risk Factors*, Vol. 1. Geneva: World Health Organization, 1055-1057.
- Rehm, J., Room, R., van den Brink, W. & Jacobi, F. 2005. Alcohol use disorders in EU countries and Norway: An overview of the epidemiology. *European Neuropsychopharmacology* 15: 377-388.
- Rehm, J., Mathers, C., Popova, S., Thavorncharoensap, M., Teerawattananon, Y. & Patra, J. 2009. Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders. *Lancet* 373: 2223–2233.
- Rehm, J., Shield, K.D., Gmel G., Rehm MX. & Frick U. 2013. Modeling the impact of alcohol dependence on mortality burden and the effect of available treatment interventions in the European Union. *European Neuropsychopharmacology* 23: 89-97.
- Rehm, J., Anderson, P., Barry, J., et al. 2015a. Prevalence of and potential influencing factors for alcohol dependence in Europe. *European Addiction Research* 21: 6-18.

- Rehm, J., Allama, A., Eleks, Z., Jakubczyk, A., Manthey, J., Probst, C., Struzzo, P., Della Vedova, R., Gual, A. & Wojnar, M. 2015b. Alcohol dependence and treatment utilization in Europe – A representative cross-sectional study in primary care. *BMC Family Practice* 16: 90.
- Rehm, J., Manthey, J., Struzzo, P., Gual, A. & Wojnar, M. 2015c. Who receives treatment for alcohol use disorder in the European Union? A cross-sectional representative study in primary and specialized health care. *European Psychiatry* 30: 885-893.
- Rehm, J., Anderson, P., Manthey, J., Shield, K.D., Struzzo, P., Wojnar, M. & Gual, A. 2016. Alcohol use disorders in primary health care: What do we know and where do we go? *Alcohol and Alcoholism* 51: 422–427.
- Rehm, J., Gmel, G.E. Sr Gmel, G., et al. 2017a. The relationship between different dimensions of alcohol use and the burden of disease – An update. *Addiction* 112: 6.
- Rehm J., Probst C., Shield K.D. & Shuper P.A. 2017b. Does alcohol use have a causal effect on HIV incidence and disease progression? A review of the literature and a modelling strategy for quantifying the effect. *Population Health Metrics* 15: 4.
- Rende, R. & Plomin, R. 1992. Diathesis-stress models of psychopathology: A quantitative genetic perspective. *Applied & Preventive Psychology* 1: 177–182.
- Rethans, J.J., Martin, E. & Metsemakers, J. 1994. To what extent do clinical notes by general practitioners reflect actual medical performance? A study using simulated patients. *British Journal of General Practice* 44: 153-156.
- Richardson, A., Richard, L, Gunter, K. & Derrett, S. 2019. Interventions to integrate care for people with serious mental illness and substance use disorders: A systematic scoping review protocol. *BMJ Open* 9: e031122.
- Rivas, I., Sanvisens, A., Bolao, F., Fuster, D., Tor, J., Pujoi, R., Torrens, M., Rey-Joly, C. & Muga, R. 2013. Impact of medical comorbidity and risk of death in 680 patients with alcohol use disorders. *Alcoholism: Clinical and Experimental Research* 37, S1: E221-E227.
- Rivera-Segarra, E., Varas-Diaz, N. & Santos-Figueroa, A. 2019. “That’s all Fake”: Health professionals’ stigma and physical healthcare of people living with serious mental illness. *PLoS ONE* 14: e0226401.
- Roerecke, M. & Rehm, J. 2013. Alcohol use disorders and mortality: A systematic review and meta-analysis. *Addiction* 108: 1562-78.
- Roerecke, M. & Rehm, J. 2014. Cause-specific mortality risk in alcohol use disorder treatment patients: A systematic review and meta-analysis. *International Journal of Epidemiology* 43: 906–919.
- Room, R. 1985. Dependence and society. *British Journal of Addiction* 80:133–139.
- Room, R., Babor, T. & Rehm, J. 2005. Alcohol and public health. *Lancet* 365: 519–530.
- Rydon, P., Redman, S., Sanson-Fisher, R.W. et al. 1992. Detection of alcohol-related problems in general practice. *Journal of Studies on Alcohol* 53: 197-202.
- Ryynänen, O-P., Leppänen, T., Kekolahti, P., Mervaala, E. & Töyräs, J. 2018. Bayesian network model to evaluate the effectiveness of continuous positive airway pressure treatment of sleep apnea. *Healthcare Informatics Research* 24: 346-358.
- Saarnio, P. 2005. Alkoholistien kuolleisuus – tulokset kuudentoista vuoden seurannasta. *Duodecim* 121: 2099-103.

- Salomé, H.J., French, M.T., Scott, C., Foss, M. & Dennis, M. 2003. Investigating variation in the costs and benefits of addiction treatment: econometric analysis of the Chicago Target Cities Project. *Evaluation and Programme Planning* 26: 325-338.
- Samposalo, H., Kuussaari, K., Hirschovits-Gerz, T., Kaukonen, O., Partanen, A. & Vormaa, H. 2018. Tarpeenmukaiset palvelut kaikille? Päihdeasiakkaat sosiaali- ja terveydenhuollon palveluissa Kaakkois-Suomen ja Lapin alueilla. *Yhteiskuntapolitiikka* 83: 50-61.
- Sartre, D.D., Chi, F.W., Mertens, J.R., & Weisner, C.M. 2012. Effects of age and life transitions on alcohol and drug treatment outcome over nine years. *Journal of Studies on Alcohol and Drugs* 73: 459-468.
- Satel, S. & Lilienfeld, S.O. 2014. Addiction and the brain-disease fallacy. *Frontiers in Psychiatry* 4 141: 1-11.
- Saunders, S.M., Zygowicz, K.M. & D'Angelo, B.R. 2006. Person-related and treatment-related barriers to alcohol treatment. *Journal of Substance Abuse Treatment* 30: 261-70.
- Schoepf, D. & Heun, R. 2015. Alcohol dependence and physical comorbidity: Increased prevalence but reduced relevance of individual comorbidities for hospital-based mortality during a 12.5-year observation period in general hospital admissions in urban North-West England. *European Psychiatry* 30: 459-68.
- Schuckit, M. 2009. Alcohol-use disorders. *Lancet* 373: 492-501.
- Schuckit, M.A. & Smith T.L. 2011. Onset and course of alcoholism over 25 years in middle class men. *Drug and Alcohol Dependence* 113: 21-28.
- Scott, C.K., Foss, M.A. & Dennis, M.L. 2003. Factors influencing initial and longer-term responses to substance abuse treatment: A path analysis. *Evaluation and Program Planning* 26: 287-96.
- Segal, L. & Leach, M. 2011. An evidence-based health workforce model for primary and community care. *Implementation Science* 6: 93.
- Seppä, K. & Mäkelä, R. 1993. Alkoholin suurkuluttajat sairaalapotilaissa. *Suomen lääkärilehti* 48: 684.
- Shanahan, M.J. & Hofer, S.M. 2005. Social context in gene-environment interactions: Retrospect and prospect. *Journal of Gerontology: Psychological Sciences* 60: 65-76.
- Skewes, M. C., & Gonzalez, V. M. 2013. The biopsychosocial model of addiction. In Miller, P.M. (ed.) *Principles of addiction*. Vol. 1. *Comprehensive addictive behaviors and disorders*. San Diego, CA: Academic Press, 61-70.
- Smeets, R.G.M., Elissen, A.M.J., Kroese, M.E.A.L., Hameleers, N. & Ruwaard, D. 2020. Identifying subgroups of high-need, high-cost, chronically ill patients in primary care: A latent class analysis. *PLoS One* 29: e0228103.
- Sobell, L., Cunningham, J.A. & Sobell, M.B. 1996. Recovery from alcohol problems with and without treatment: Prevalence in two population surveys. *American Journal of Public Health* 7: 966-72.
- Social Care Act (1301/2014) Available at <https://www.finlex.fi/fi/laki/ajantasa/2014/20141301>. Accessed 7 Jan 2019.
- Social care customer act (812/2000) Available at <https://www.finlex.fi/fi/laki/ajantasa/2000/20000812>. Accessed 7 Jan 2019.
- Solms, M. & Turnbull, O.H. 2011. What Is Neuropsychoanalysis? *Neuropsychoanalysis* 13: 133-145.

- Sotkanet 2019. Alkoholia liikaa käyttävien osuus (AUDIT-C) (%), 20-64-vuotiaat. Available at <https://sotkanet.fi/sotkanet/fi/taulukko/?indicator=szY0iQQA&region=szb3BwA=&year=sy6rtDbX0zUEAA==&gender=m;f;t&abs=f&color=f&buildVersion=3.0-SNAPSHOT&buildTimestamp=201911131146>. Accessed 13 Nov 2020.
- STM 2002. Päihdepalvelujen laatusuosituksat. Sosiaali- ja terveysministeriön oppaita 2002:3. Available at <http://urn.fi/URN:NBN:fi-fe201309236197>. Accessed 30 Nov 2019.
- STM 2012. Sosiaali- ja terveydenhuollon kansallinen kehittämissuohjelma KASTE 2012–2015. Sosiaali- ja terveysministeriön julkaisuja 2012:1. Available at <http://urn.fi/URN:ISBN:978-952-00-3328-6>. Accessed 30 Nov 2019.
- Stockwell, T., Jinhui, Z. & Gerald, T. 2009. Should alcohol policies aim to reduce total alcohol consumption? New analyses of Canadian drinking patterns. *Addiction Research & Theory* 17: 135–151.
- Szalavitz, M. 2017. Squaring the Circle: Addiction, Disease and Learning. *Neuroethics* 10: 83–86.
- Storbjörk, J., & Room, R. 2008. The two worlds of alcohol problems: Who is in treatment and who is not? *Addiction Research and Theory* 16: 67– 84.
- Tai, B., Wu, L-T. & Clarck, HW. 2012. Electronic health records: Essential tools in integrating substance abuse treatment with primary care. *Subst Abuse Rehabilitation* 3: 1-8.
- Taipale, J. 2017. Vakiintunut väliaikaisratkaisu: addiktio, itsesäätely ja toistaminen. *Psykoterapia* 36:3.
- Tammi, T. & Stenius, K. 2014. Capabilities for handling complex substance abuse problems and its relationship to the treatment system: Using the DDCAT instrument to explore local treatment systems in Finland. *Nordic Studies on Alcohol and Drugs*, 31: 45-58.
- THL 2020. Tietokantaraportit. Käyntisytyt ja niiden kirjausasteet kuukausittain. Available at [https://sampo.thl.fi/pivot/prod/fi/avopika/pikarap02/summary\\_kayntisytyt?vuosi\\_0=429307&palveluntuottaja\\_0=349196&ammatti\\_0=110048&palvelumuoto\\_0=121032&yhteystapa\\_0=226693&kirjausasteet\\_0=3&icd\\_lkm\\_0=6&icpc\\_lkm\\_0=7#](https://sampo.thl.fi/pivot/prod/fi/avopika/pikarap02/summary_kayntisytyt?vuosi_0=429307&palveluntuottaja_0=349196&ammatti_0=110048&palvelumuoto_0=121032&yhteystapa_0=226693&kirjausasteet_0=3&icd_lkm_0=6&icpc_lkm_0=7#). Accessed 10 Jun 2020.
- Tiihonen, J., Kuikka, J., Bergström, K., Hakola, P., Karhu, J., Rynänen, O-P., et al. 1995. Altered striatal dopamine reuptake site densities in habitually violent and non-violent alcoholics. *Nature Medicine* 1: 654–657.
- Timko, C., Debenedetti, A., Moos, B.S. & Moos, R.H. 2006. Predictors of 16-year mortality among individuals initiating help-seeking for an alcoholic use disorder *Alcoholism: Clinical and Experimental Research* 30: 1711-1720.
- Tolonen, H., Laatikainen, T., Helakorpi, S., et al. 2010. Marital status, educational level and household income explain part of the excess mortality of survey non-respondents. *European Journal of Epidemiology* 25: 69–76.
- Trim, R.S., Schuckit, M.A. & Smith, T.L. 2013. Predictors of initial and sustained remission from alcohol use disorders: findings from the 30-year follow-up of the San Diego Prospective Study. *Alcoholism: Clinical and Experimental Research* 37: 1424-31.
- Tupala, E., Hall, H., Bergstrom, K., Mantere, T., Rasanen, P., Sarkioja, T., et al. 2003. Different effect of age on dopamine transporters in the dorsal and ventral striatum of controls and alcoholics. *Synapse* 48: 205–211.

- Twomey, C.D., Baldwin, D.S., Hopfe, M., Cieza, A. 2015. A systematic review of the predictors of health service utilisation by adults with mental disorders in the UK. *BMJ Open* 5: e007575 PMID:26150142.
- Urach, C., Zauner, G., Wahlbeck, K., Haaramo, P. & Popper, N. 2016. Statistical methods and modelling techniques for analysing hospital readmission of discharged psychiatric patients: A systematic literature review. *BMC Psychiatry* 16: 413.
- Young-Wolff, K.C., Enoch, M-A. & Prescott, C.A. 2011. The influence of gene-environment interactions on alcohol consumption and alcohol use disorders: A comprehensive review. *Clinical Psychology Review* 31: 800-816.
- Vaccari, P., Ramírez-Vielma, R., Saldivia, S., Cova, F., Vielma-Aguilera, A., Victoriano, V., Ulloa-Vidal, N. & Grandón, P. 2020. Stigma towards people with a diagnosis of severe mental disorder in primary healthcare centers: Perspectives of service users and health teams in Chile. *International Journal of Mental Health Systems* 14: 6.
- Vaillant, G. E. 2003. A 60-year follow-up of alcoholic men. *Addiction* 98: 1043–1051.
- Vanderplasschen, W., Wolf, J., Rapp, R.C. & Broekaert, E. 2007. Effectiveness of different models of case management for substance-abusing populations. *Journal of Psychoactive Drugs* 39: 81-95.
- Verhulst, B., Neale, M.C., & Kendler, K.S. 2015. The heritability of alcohol use disorders: A meta-analysis of twin and adoption studies. *Psychological Medicine* 45: 1061-72.
- Viertiö, S., Partanen, A., Kaikkonen, R., Härkänen, T., Marttunen, M. & Suvisaari, J. 2017. Palvelujen käyttö mielenterveyteen tai päihteiden käyttöön liittyvien ongelmien vuoksi Suomessa vuosina 2012–2015. *Duodecim* 133: 292-300.
- Wagner, EH. 2000. The role of patient care teams in chronic disease management. *BMJ* 26: 569-572.
- Wassermann, R.C. 2011. Electronic Medical Records (EMRs), epidemiology, and epistemology: Reflections on EMRs and future pediatric Clinical research. *Academic Pediatrics* 11: 280-287.
- Watkins, K.E., Burnam, A., Kung, F.Y. & Paddock, S. 2001. A national survey of care for persons with co-occurring mental and substance use disorders. *Psychiatric Services* 52: 1062-8.
- Watkins, K., Pincus, H.A., Tanielian, T.L. & Lloyd, J., 2003. Using the chronic care model to improve treatment of alcohol use disorders in primary care settings. *Journal of Studies on Alcohol* 64: 209-218.
- Westman, J., Wahlbeck, K., Laursen, T.M., Gissler M, Nordentoft, M., Hällgren, J., Arffman, M. & Östby, U. 2015. Mortality and life expectancy of people with alcohol use disorder in Denmark, Finland and Sweden. *Acta Psychiatrica Scandinavica* 131: 297-306.
- White, W.L. 2007. Addiction recovery: Its definition and conceptual boundaries. *Journal of Substance Abuse Treatment* 33: 229-241.
- WHO 2018a. Global alcohol report. Country profile: Finland. Retrieved from [http://www.who.int/substance\\_abuse/publications/global\\_alcohol\\_report/profiles/fin.pdf](http://www.who.int/substance_abuse/publications/global_alcohol_report/profiles/fin.pdf)
- WHO 2018b. Global status report on alcohol and health 2018. Retrieved from <https://apps.who.int/iris/bitstream/handle/10665/274603/9789241565639-eng.pdf?ua=1>
- WHO 2019. Alcohol use. Data and statistics. Retrieved from <http://www.euro.who.int/en/health-topics/disease-prevention/alcohol-use/data-and-statistics>



- Wiens, T.K. & Walker, L.J. 2015. The chronic disease concept of addiction: Helpful or harmful? *Addiction Research and Theory* 23: 309-321.
- Windle, M., & Scheidt, D. 2004. Alcoholic Subtypes: Are two sufficient? *Addiction* 99: 1508–1519.
- Wise, R.A. 1988. The neurobiology of craving: implications for the understanding and treatment of addiction. *Journal of Abnormal Psychology* 97:118–132.
- Wise, R.A. & Koob, G.F. 2014. The Development and Maintenance of Drug Addiction. *Neuropsychopharmacology* 39: 254–262.
- Witkiewitz, G.A. & Marlatt, K. 2004. Relapse Prevention for Alcohol and Drug Problems: That was Zen, this is Tao. *American Psychologist* 59: 224-235.
- Witkiewitz, K., van der Maas, H.L.J., Hufford, M.R. & Marlatt, G.A. 2007. Nonnormality and divergence in posttreatment alcohol use: Re-examining the Project MATCH data “another way.” *Journal of Abnormal Psychology* 116: 378–394.
- Witkiewitz, K., Maisto, S.A., Donovan, D.M. 2010. A comparison of methods for estimating change in drinking following alcohol treatment. *Alcoholism: Clinical and Experimental Research* 34: 2116–2125.
- Witkiewitz, K., Litten, R.Z. & Leggio, L. 2019. Advances in the science and treatment of alcohol use disorder. *Science Advances* 5: eaax4043.
- Wu, L.T., Ringwalt, C.L. & Williams, C.E. 2003. Use of substance abuse treatment services by persons with mental health and substance use problems. *Psychiatric Services* 54: 363-369.
- Wu, L.T., Brady, K.T., Spratt, S.E. et al. 2016. Using Electronic health record data for substance use screening, brief intervention, and referral to treatment among adults with type 2 diabetes: Design of a National Drug Abuse Treatment Clinical Trials Network study. *Contemporary Clinical Trials* 46: 30-38.
- Zhu, K., Yang T-H.O., Dorie, V. & Zheng, T. & Anastassiou, D. 2019. Meta-analysis of expression and methylation signatures indicates a stress-related epigenetic mechanism in multiple neuropsychiatric disorders. *Translational Psychiatry* 9: 32.
- Zywiak, W.H., Hoffmann, N.G., Hagberg, S.S., Floyd, A.S. & DeHart, S.S. 1999. Substance abuse treatment cost offsets vary with gender, age, and abstinence likelihood. *Journal of health care finance* 26: 33-39.



# APPENDICES

## APPENDIX 1. Longitudinal register studies and meta-analyses on the association between aud and risk of death.

Reference and setting	Main outcome and measure	Main results	Clinical relevance and recommendations
<b>All-cause mortality</b>			
Saarnio (2005) 16-year follow-up study of Finnish men with alcoholism (N=175).	Overall mortality.	47% of the study participants died during the 16-year follow-up. Majority of deaths (82%) were linked with alcohol. During the time period of economic regression in 1990s' death rates peaked.	Importance of long-term treatment follow-up was highlighted.
Roerecke & Rehm (2013)  Meta-analysis on all-cause mortality in people with alcohol use disorders, including 81 observational studies with 221 683 observed deaths among 853 722 people with AUD.	All-cause mortality.  Prospective and historical cohort studies including a comparison of AUD with a control group investigating all-cause mortality risk were included.	In men, the relative risk (RR) among clinical samples was 3.38 (2.98-3.84); in women it was 4.57 (3.86-5.42).	Treatment providers for AUD should be made aware of the high mortality risk, and incorporate preventive measures, such as standard screening for the most common somatic and mental comorbidities.
Schoepf & Heun (2015)  A 12.5-year observational study of effects of diseases on general hospital-based mortality in England, comparison of individuals with (N=23,371) and without alcohol dependence (AD) (N=233,710).	General hospital-based mortality.  Physical comorbidities that increased the risk of hospital-based mortality during the observation period were identified using multiple logistic regression analyses.	Hospital-based mortality rates were 20.4% in the AD sample and 8.3% in the control sample. Alcoholic liver disease (33.7%), hypertension (16.9%), chronic obstructive pulmonary disease (14.1%), and pneumonia (13.3%) were the most frequent diagnoses in deceased individuals with AD.	The excess of in-hospital deaths in general hospitals among individuals with AD is due to an increase of multiple physical comorbidities.

<p>Westman et al. (2015)</p> <p>A population-based register study including all patients admitted to hospital and diagnosed with alcohol use disorder (1,158,486 person-years) from 1987 to 2006 in Denmark, Finland and Sweden.</p>	<p>Mortality and life expectancy in people with AUD in Denmark, Finland and Sweden</p>	<p>People hospitalized with AUD died 24-28 years earlier than people in the general population.</p> <p>People hospitalized with AUD had an average life expectancy of 47-53 years (men) and 50-58 years (women).</p>	<p>Testing new preventive efforts is highlighted, with the aim of reducing alcohol-related harm in people with AUD. Also somatic care of people with AUD should be substantially improved.</p>
<p>Kendler et al. (2016)</p> <p>Prospective register-based cohort study including individuals born in Sweden 1940-1965.</p> <p>N= 131 895 males and 42 163 females with AUD.</p>	<p>Death obtained from the Swedish Death registry.</p>	<p>Mortality hazard ratio (HR) associated with AUD was 5.83 after controlling for sex, educational status and year of birth.</p> <p>Mortality HR varied with an inverted U-shaped function-by age and both predisposition to AUD and direct effect of AUD explain excess mortality associated with AUD.</p>	<p>Results have implications for developing interventions aiming to decrease AUD associated mortality.</p>
<p>Plana- Ripoll et al. (2019)</p> <p>Population-based cohort study in Denmark using register data of all people younger than 95 years and living in Denmark between 1995-2015.</p>	<p>All-cause mortality.</p> <p>Sex-specific and age-specific mortality rate ratios (MRRs) and life-years lost (LYLs) due to substance use disorders (SUDs). Data obtained from Danish registers.</p>	<p>Mortality rate of 3.91 (3.87–3.94) for SUDs was observed and shorter life expectancy with excess LYLs 14.84 years (14.70–14.99) for SUDs in men and 5.42 (5.36-5.48) in women compared with general population.</p>	<p>The findings highlight the need for coordinated care of general medical conditions of people with mental disorders to improve the life expectancy.</p>
<p>Pitkänen et al. (2020)</p> <p>Register-based follow-up study to compare the risk of death of individuals who had sought treatment for SUDs in Finland (N= 10,888) between 1990 and 2009.</p>	<p>Premature death.</p> <p>Treatment data were linked to national register data concerning education, hospitalizations and death by the year 2018.</p>	<p>Cumulative mortality rates during 1-, 5- and 15-year follow-up were 2.5% (n=271), 10.9% (n=1191) and 28.4% (n=3096). The mean age at death was 55.0 years for individuals with AUD-only.</p>	<p>Efforts should be made to improve access to treatment.</p>

<b>Cause specific mortality</b>			
<p>Hiroeh et al. (2008)</p> <p>National population-based cohort study. The 21-year cohort (1973-93) included 4.1 million Danish adults and was linked to national psychiatric and mortality registers.</p>	<p>Natural-cause mortality.</p> <p>Age-standardized mortality ratios (SMRs) were estimated versus the general population.</p>	<p>Alcoholism and drug misuse were important causes of premature mortality and SMRs greater than 200 were observed in men and women with alcoholism or drug abuse.</p> <p>The highest cause-specific SMRs were for nervous system diseases, gastrointestinal diseases and lung diseases.</p>	<p>Those involved in planning and providing mental health services should address the heightened need for physical health care in psychiatric patients.</p>
<p>Rivas et al. (2013)</p> <p>Hospital-based cohort of alcohol-dependent patients admitted for detoxification between 1999 and 2008 in Barcelona, Spain (N= 686). Clinical interviews and questionnaires combined with register data.</p>	<p>Medical comorbidity and mortality.</p> <p>Medical comorbidity of subgroups of AUD patients was assessed with the Cumulative Illness Rating Scale (Substance Abuse). Dates and causes of death were obtained from clinical records and death registers.</p>	<p>After median follow-up of 3.1 years 11.4% patients died. Severe medical comorbidity (HR 5.5, 95% CI: 3.02-10.07) was an independent risk factor for premature death. Organs/systems most affected were liver (99%), respiratory (86%), and cardiovascular (58%)</p>	<p>Systematic assessment of alcohol-related organ damage is relevant for the identification and treatment of individuals with alcohol dependence.</p>
<p>Roerecke &amp; Rehm (2014)</p> <p>Systematic review and meta-analysis. 17 prospective and historical cohort studies assessing cause-specific mortality risk from AUD patients (N= 28,087) compared with general population.</p>	<p>Cause-specific mortality among AUD patients. Pooled standardized mortality ratios (SMRs) were calculated.</p>	<p>SMRs after 10 years of follow-up among men were 14.8 (95% CI: 8.7–24.9) for liver cirrhosis, 18.0 (11.2–30.3) for mental disorders, 6.6 (5.0–8.8) for death by injury and around 2 for cancer and cardiovascular diseases. SMRs were substantially higher in women, with fewer studies available.</p>	<p>Efforts to reduce risk of death should be a priority, given that successful treatment reduces mortality risk substantially for this relatively common psychiatric disease.</p>
<p>Holst et al. (2017)</p> <p>Register-based matched cohort study, including individuals identified from the Copenhagen</p>	<p>Sex-specific risk of dying from the examined somatic 11 disease groups and 29 subgroups.</p>	<p>HRs were elevated for alcohol-related diseases but also for other diseases. 2.85 (2.77–2.92) and 3.63 (3.45–3.81) fold higher</p>	<p>Alcohol dependence is a risk factor for somatic disease.</p>

<p>Alcohol Cohort (N= 19 002 alcohol-dependent individuals) and randomly selected controls from the Danish Civil Registration System.</p>	<p>Information on somatic diseases was obtained from the Danish National Patient Registry and causes of death obtained from the Cause of Death Registry.</p>	<p>mortality hazard in men and women with alcohol dependence.</p>	
---	--	---	--

**Appendice 2.** Longitudinal survey studies on the association between AUD and risk of death

Reference and setting	Main outcome and measure	Main results	Clinical and societal implications
<p>Jousilahti et al. (2005)</p> <p>A prospective follow-up study using large population based health surveys from 1972, 1977, 1982, 1987, and 1992 (N= 54,372 men and women aged 25 to 64 years).</p>	<p>Total and cause specific mortality, including death related to alcohol.</p>	<p>HR for total mortality was 2.06 (1.87-2.27) among men and 2.56 (2.19-3.00) among women. Alcohol specific mortality was among men 3.10 (2.37-4.04) and among women 4.33 (2.10-8.94). In non-participating men HR for alcohol related mortality was 5.03 (3.78-7.06) and for women 6.88 (2.97-15.9).</p>	<p>Relative mortality difference between participants and non-participants increased between 1972 and 1992, which may show increased health related polarisation of the society over time.</p>
<p>Markkula et al. (2012)</p> <p>8-year follow-up study using a nationally representative sample of Finns aged 30-70 years (N= 6372).</p>	<p>Mortality associated with depressive, anxiety and alcohol use disorders and the principal causes of death.</p>	<p>Alcohol use disorders HR 1.72 (95% CI 1.10–2.71) were associated with mortality.</p> <p>8.8% of study participants with AUD died after 8-year follow-up.</p>	<p>Research and policy efforts should be directed towards the prevention, diagnosis and treatment of somatic conditions in people with mental disorders.</p>
<p>Gorman et al. (2014)</p> <p>Population-sampled health surveys (from 1995 to 2010) in Scotland linked to death and hospitalization records and compared with general population counterparts to assess</p>	<p>All-cause mortality.</p> <p>Directly age-standardized incidence rates of alcohol-related harm and all-cause mortality.</p>	<p>Survey-to-population rate ratio was 0.89 (95% CI: 0.83-0.96) for all-cause mortality.</p>	<p>All-cause mortality is greater among individuals residing in the most deprived areas, suggesting distortion in the estimated social gradient of these outcomes.</p>

---

nonresponse bias in  
alcohol-related  
outcomes.



## ORIGINAL PUBLICATIONS (I – V)



# I

## **Care outcomes and alcohol-related treatment utilisation profiles of patients with alcohol-use disorder: A prospective cohort study using electronic health records**

Rautiainen E, Ryyänänen O-P and Laatikainen T

Nordic J Stud Alcohol Drugs 35: 329-343, 2018



# Care outcomes and alcohol-related treatment utilisation profiles of patients with alcohol-use disorder: A prospective cohort study using electronic health records

Nordic Studies on Alcohol and Drugs

2018, Vol. 35(5) 329–343

© The Author(s) 2018

Article reuse guidelines:

[sagepub.com/journals-permissions](http://sagepub.com/journals-permissions)

DOI: 10.1177/1455072518783972

[journals.sagepub.com/home/nad](http://journals.sagepub.com/home/nad)**Elina Rautiainen**

University of Eastern Finland, Finland

**Olli-Pekka Rynnänen**

University of Eastern Finland, Finland

Kuopio University Hospital, Finland

**Tiina Laatikainen**

University of Eastern Finland, Finland

National Institute for Health and Welfare, Finland

Joint Municipal Authority for North Karelia Social and Health Services, Finland

**Abstract**

**Background:** We examined the probabilities of longitudinal care outcomes of working-aged patients with alcohol-use disorder (AUD) and their alcohol-related treatment utilisation patterns across the healthcare services, by using linked electronic health records. **Methods:** A random sample ( $n = 396$ ) of patients with alcohol-related visits to healthcare services in 2011–2012 was collected retrospectively from the electronic health record data in the North Karelia region of Finland and followed prospectively in time until the end of 2016. Data on care outcomes and alcohol-related healthcare use were gathered from the electronic health records. Three outcome groups were identified: (1) dead, (2) present AUD, and (3) remission. Group differences in alcohol-related health service use were compared. **Results:** At the end of the follow-up period,

Submitted: 15 March 2018; accepted: 22 May 2018

**Corresponding author:**

Elina Rautiainen, University of Eastern Finland, P.O. Box 1627, FI-70211 Kuopio, Finland.

Email: [elinara@uef.fi](mailto:elinara@uef.fi)Creative Commons Non Commercial CC BY-NC: This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 License (<http://www.creativecommons.org/licenses/by-nc/4.0/>)which permits non-commercial use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the SAGE and Open Access pages (<https://us.sagepub.com/en-us/nam/open-access-at-sage>).

an increased mortality rate of 22.9% was observed, and 18.4% had achieved stable remission, while for the majority (56%), the AUD remained. Most of those in remission had contact with either specialised AUD services or mental health services. Conversely, the majority of those who had died had no contact with specialised AUD services during the follow-up period. **Conclusions:** The electronic-health-record-based register analysis captured mainly individuals with advanced forms of AUD. An excess mortality rate and other negative health consequences were observed. Training providers to identify and treat earlier the less severe forms of AUD could have major benefit to patients and also reduce health system costs.

### Keywords

alcohol-use disorder, care outcomes, electronic health records, register study, treatment utilisation

Alcohol-use disorders (AUDs) cause excess mortality, disease burden and remarkable costs to society in the form of increased healthcare costs (Graham et al., 2017; Kendler, Ohlsson, Sundquist, & Sundquist, 2016; Moos, Brennan, Schutte, & Moos, 2004; Rehm et al., 2009; Room, Babor, & Rehm, 2005; WHO, 2014a). The estimated prevalence of AUDs is 7.5% in the European region adult population and 11.8% in the primary care setting (Manthey et al., 2016; WHO, 2014a). In Finland, the prevalence of AUDs is 7% in the adult population (WHO, 2014b) and 12-month prevalence of alcohol dependence is 3.9% (Pirkola, Poikolainen, & Lönnqvist, 2006).

Although AUDs are commonly represented in social and healthcare settings (Tai, Wu, & Clark, 2012), previous studies have revealed the treatment gap for AUDs is larger than in any other mental disorder (Roerecke & Rehm, 2014) and that only a minority of individuals with AUD use alcohol-treatment services (Cohen, Feinn, Arias, & Kranzler, 2007; Grant et al., 2004; Heinälä et al., 2001; Rehm et al., 2015; Watkins, Burnam, Kung, & Paddock, 2001; Wu, Ringwalt, & Williams, 2003). In Europe, treatment rate estimates of AUD vary between 10.0 and 17.7% (Manthey et al., 2016; Rehm et al., 2016). Several reasons for the low treatment rates have been identified, including different barriers to AUD care, such as social stigma and problem awareness (Grant, 1997;

Keyes et al., 2010; Probst, Manthey, Martinez, & Rehm, 2015), challenges in the identification of AUDs in healthcare settings (Manthey et al., 2016; Rehm et al., 2016) and unavailability of services (Saunders, Zygowicz, & D'Angelo, 2006), which are all causing delays in treatment initiation (Kessler et al., 2001; Kessler, Olfson, & Berglund, 1998). Long-term recovery rates in treated populations vary between 20 and 50% (Anglin, Hser, & Grella, 1997; Dennis, Scott, Funk, & Foss, 2005; Vaillant, 2003), while the mortality risk associated with AUD is 3.38 for men and 4.57 for women, in clinical samples (Roerecke & Rehm, 2013). Furthermore, people with AUD have approximately 24–28 years shorter life expectancy compared with the general population (Westman et al., 2015).

As AUDs are chronic relapsing disorders (Dennis & Scott, 2007; Hser, Anglin, Grella, Longshore, & Prendergast, 1997; McLellan, McKay, Forman, Cacciola, & Kemp, 2005), often with co-occurring mental health (MH) problems and varying treatment careers with several treatment episodes (Chi & Weisner, 2008; Kessler et al., 1996; Timko, Moos, Finney, Moos, & Kaplowitz, 1999), an extensive follow-up period is required to identify alcohol-related treatment utilisation profiles and care outcomes (Anglin et al., 1997). A plethora of literature exists on factors associated with long-term care outcomes (Cohen et al., 2007; Krenek, Prince, & Maisto, 2017; Laudet, Savage,

& Mahmood, 2002; Trim, Schuckit, & Smith, 2013; Vaillant, 2003). However, knowledge of the care outcomes regarding previous longitudinal alcohol-related treatment utilisation profiles across health services of patients with AUD is limited.

Prior studies on alcohol-related treatment utilisation profiles of those accessing treatment have identified that the majority of alcohol-dependent individuals have previously been in short-term inpatient treatment, one-third in long-term residential care and approximately 20% in detoxification (Anglin et al., 1997). Cohen et al. (2007) noted that around half of individuals with an alcohol abuse or dependence diagnosis received alcohol or drug rehabilitation and 38.4% received alcohol or drug detoxification. A previous study in Finland identified that only 35.5% of alcohol dependent individuals had previous treatment contact (Heinälä et al., 2001). In addition, Edlund, Booth, and Han (2012) assessed patterns and predictors of AUD and MH treatment use among individuals with AUDs and identified MH treatment as the more common treatment option. Additionally, substance-use disorder treatment has been associated with marked reductions in substance use and costs to society (Salomé, French, Scott, Foss, & Dennis, 2003).

In this article, we examine the possibilities of using electronic health records (EHRs) to estimate the probabilities of longitudinal care outcomes of AUD patients and their alcohol-related treatment utilisation patterns across the healthcare services. Electronic health records contain a remarkable amount of information on health and health-service use that can increase our understanding of AUD and MH treatment utilisation patterns and care outcomes of patients with AUDs (Bell et al., 2017; Lid, Eide, Dalen, & Meland, 2016; Tai et al., 2012; Wu et al., 2015). In Finland, primary healthcare EHR registers have not been used comprehensively in the previous register studies.

Thus, this register-based prospective cohort study ( $n = 396$ ) aimed to estimate the probability of different care outcomes, including

(1) death, (2) present AUD, and (3) AUD in remission. The alcohol-related treatment utilisation profiles of these outcome groups are described during a 6-year follow-up, by using manually evaluated linked primary and secondary care EHRs.

## Materials and methods

### *Data source and treatment system*

The EHR data were collected in the North Karelia region of Eastern Finland, for the years 2011–2016. The study was approved by the Research Ethics Committee of the Northern Savo Hospital District; consent was not obtained, as the study was based on registry information. North Karelia comprises 13 municipalities and has approximately 165,000 inhabitants. The same structured EHR system is used across the region in both primary and specialised care, as well as in specialised addiction services. In Finland, the social and health service system is decentralised and, currently, municipalities are responsible for organising social and healthcare services, including alcohol and drug treatment. The Welfare for Substance Abusers Act (41/1986) regulates addiction as well as MH services, and provision of these services can be organised as part of the primary healthcare services or as specialised addiction services, providing treatment for substance use disorders, including AUDs.

### *Study sample*

The study sample was formed retrospectively, based on the medical diagnoses (ICD-10 codes) in the EHR register; all the individuals with at least one alcohol-related visit (i.e., having an alcohol-related diagnosis as the main diagnosis or side diagnosis) in primary or specialised care between the years 2011–2012 were identified ( $n = 6246$ ). Alcohol-related visits included the following ICD-10 codes: G312, G405, G4050, G4051, G4052, G621, I426, K292, F100, F101, F102, F103, F104, F105, F106, F108, F109,

K860, K700, K701, K702, K703, K704, K709, T510, T511, T512, T513, T518, T519, X45, and X69. A broad set of alcohol-related diagnoses was used in the sampling, as previous studies have identified under diagnosing and under-recording of AUD diagnoses (Abidi, Oenema, van den Akker, & van de Mheen, 2018; Mitchell, Meader, Bird, & Rizzo, 2012). After excluding the residents of municipalities outside North Karelia, 5778 individuals remained. The number of the working aged (18–65 years) subjects was 3935 (approximately 4.1% of the working-age population of North Karelia), from which a random cohort of 396 individuals was formed for detailed examination of EHRs. The cohort was followed prospectively in time for 6 years, from January 2011 until December 2016.

### Measures

Alcohol-use disorders were defined to include alcohol abuse/harmful use and alcohol dependence, based on the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) and International Statistical Classification of Disease (ICD-10). All study subjects filled this definition at the baseline.

The data were divided into three mutually exclusive categories, according to the outcome status at the end of the follow-up period: (1) dead, (2) present AUD, and (3) AUD in remission. Data on outcome variables were manually collected from the EHR notes, except the date of death, which was automatically linked to the EHR from the population register centre. Based on the AUD definition, present AUD was defined as having alcohol-related visits (ICD-10 code F10 as main diagnosis) and health professionals' mentions of harmful use of alcohol or alcohol dependence in the EHR notes in each year of the follow-up period. Remission was defined as sustained abstinence or managed use, and short abstinence periods (max. few months) were excluded. Assessment of the time estimate in AUD remission was based on health professionals' notes and diagnosis information, i.e., the notes systematically

identified the patient as abstinent or managing their alcohol use and time estimate of the remission/managed use was given or the patient had ICD-10 diagnosis code F1020–F1023 indicating sustained remission. Furthermore, in case of mixed reviews between the health professionals' notes, the patient was assessed as having present AUD. Patients with no comments on alcohol status due to lack of yearly visits were excluded ( $n = 11$ ), as it would not have been possible to reliably estimate their outcome status.

Data on baseline measures (age, gender, permanent alcohol diagnosis or another permanent mental health diagnosis) and contact with specialised AUD services and MH services were collected from the routinely compiled EHR statistics. In the EHR, permanent diagnosis is used for chronic or long-term diseases that are considered to affect the care of the patient for a long time-period. These diagnoses remain in the EHR even after the disease is cured. Permanent alcohol diagnosis was defined as ICD-10 codes F100, F101, F102, F103, F104, F105, F106, F108, or F109 (mental and behavioural disorders due to use of alcohol) and permanent MH diagnosis as ICD-10 codes F00–F99 (mental and behavioural disorders), excluding F10 codes.

Study participants were profiled according to the patterns of alcohol-related service use, based on the information in the structured EHR notes. First, all notes mentioning alcohol use for the years 2011–2016 were manually collected and classified. Patients were assigned into three groups according to their health-service use patterns: (1) only mental health contact, (2) specialised AUD service contact, and (3) no specialised AUD contact. Alcohol-related health service contacts were then further classified into mutually exclusive groups according to contact type (primary or specialised care, etc.), to identify the alcohol-related service-use profile.

### Statistical analysis

IBM SPSS Modeler version 18.0 was used to derive the health-service use variables from the



EHR data, and IBM SPSS Statistics 24 was used in the statistical analyses. Descriptive statistics were used to compare the background variables, specialised AUD service use and MH service use of the outcome groups. Specialised AUD service use and MH service use were measured as a yearly mean number of visits, by considering the eligibility time of the study subjects; eligibility time was calculated within 6 months' accuracy for each person, and the yearly mean number of visits was divided by the eligibility time, in order to compare the outcome groups. For those with present AUD the follow-up time was 6 years, whereas for those who died or achieved remission, the follow-up time varied from 6 months to 6 years. The  $\chi^2$ , Fischer's exact and Kruskal–Wallis tests were used for the group comparisons.

## Results

### *Characteristics of the cohort*

The baseline characteristics of the cohort, according to the outcome status, are described in Table 1. The mean age was 47.5 years, and the proportion of women was 25%. The majority (68.2%) had received income support during the follow-up period. Permanent AUD diagnosis was recorded for 32.3%, and prevalence of other permanent MH diagnoses was 22%. In addition, only 9.8% of the study participants had co-morbid AUD and MH diagnosis recorded as a permanent diagnosis.

### *Outcome status*

A flow-chart of the outcome events is presented in Figure 1. A mortality rate of 22.9% was observed at the end of the follow-up, and the remission rate was 18.4%. The most prevalent outcome was present AUD (56%). Seven individuals experienced a short relapse after at least 1 year of abstinence. The cumulative outcome, according to the age groups, is presented in Figure 2.

### *Patterns of alcohol-related service utilisation*

Figure 3 shows the description of the alcohol-related health-service use patterns of the outcome groups. Alcohol-related health-service contacts were classified into mutually exclusive groups according to most prevalent contact type, to identify the alcohol-related service-use profile. All study participants filled the definition of AUD, and were described in the health professionals' notes as either alcohol abusers/harmful users, with mentions of somatic or mental harm caused by alcohol, or being alcohol dependent with varying treatment careers. Particular patterns of service use were observed; for instance, only 39.8% of those who had died had used specialised AUD services, i.e., having either visits to physician and/or nurse ( $n = 21$ ) or having additionally received detoxification and/or rehabilitation ( $n = 13$ ). Notably, the majority (58.1%) of the dead had not used specialised AUD services during the follow-up period. Instead, their alcohol-related visits occurred mainly in (1) *specialized care due to alcohol-related somatic complication* ( $n = 15$ ), while some had (2) *several detoxification treatments in primary care but no compliance with treatment* ( $n = 14$ ), whereas others were characterised as (3) *having recurrent intoxications and accidents* ( $n = 17$ ), and few had (4) *several ambulance consultations due to alcohol-related issues but no actual treatment contact* ( $n = 5$ ), and some were (5) *diagnosed with chronic alcoholism but had no compliance with treatment and minimal health-service utilisation* ( $n = 8$ ).

Examination of the characteristics of those with present AUD at the end of the follow-up period ( $n = 228$ ) revealed that 61.4% of the present AUD problem group had received treatment in specialised AUD services. This treatment was in the form of (1) *visits to AUD physician/nurse/social worker* ( $n = 64$ ), (2) *additionally receiving detoxification and/or AUD rehabilitation* ( $n = 61$ ), or (3) *were ordered into driver's license monitoring due*

**Table 1.** Baseline patient characteristics.

	Outcome 2016								p	Kruskall-Wallis (CI 95%)
	Present AUD (n = 228)		Dead (n = 93)		Remission (n = 75)		Total (n = 396)			
	n	%	n	%	n	%	n	%		
Age at baseline									0.570 <sup>a</sup>	< 0.001 p,d <sup>*</sup>
18–24 years	12	5.3	1	1.1	3	4.0	16	4.0		
25–34 years	28	12.3	7	7.5	9	12.0	44	11.1		
35–44 years	45	19.7	12	12.9	12	16.0	69	17.4		
45–54 years	89	39.0	33	35.5	26	34.7	148	37.4		
55–64 years	54	23.7	40	43.0	25	33.3	119	30.1		
Gender									0.294 <sup>a</sup>	
Male	165	72.4	75	80.6	55	73.3	295	74.5		
Female	63	27.6	18	19.4	20	26.7	101	25.5		
Permanent Dg F10									< 0.001 <sup>a</sup>	< 0.001 r,p <sup>*</sup>
Yes	89	39.0	26	27.9	13	17.3	128	32.3		
No	139	61.0	67	72.0	62	82.7	268	67.7		
Permanent Dg F (excl. F10)									< 0.050 <sup>a</sup>	< 0.050 p,d <sup>*</sup> < 0.050 d,r <sup>*</sup>
Yes	55	24.1	11	11.8	21	28.0	87	22.0		
No	173	75.9	82	88.2	54	72.0	309	78.0		
Income support									0.068 <sup>a</sup>	
Yes	163	71.5	59	63.4	48	64.0	270	68.2		
No	53	23.3	33	35.5	26	34.7	112	28.3		
Missing	12	5.2	1	1.1	1	1.3	14	3.5		
Contacts with AUD services									< 0.001 <sup>a</sup>	< 0.001 p,d <sup>*</sup>
0	70	30.7	54	58.1	40	53.3	164	41.4		
< 1	45	19.7	12	12.9	4	5.3	61	15.4		
1.0–2.9	47	20.6	12	12.9	12	16.0	71	17.9		
3.0–9.9	49	21.5	8	8.6	10	13.3	67	16.9		
10.0+	17	7.5	7	7.5	9	12.0	33	8.3		
Contacts with MH services									< 0.001 <sup>a</sup>	< 0.001 d,r <sup>*</sup> < 0.010 p,r <sup>*</sup>
0	128	56.1	65	69.9	32	42.7	225	56.8		
< 1	52	22.8	8	8.6	13	17.3	73	18.4		
1.0–2.9	29	12.7	9	9.7	12	16.0	50	12.6		
3.0–9.9	12	5.3	7	7.5	6	8.0	25	6.3		
10.0+	7	3.1	4	4.3	12	16.0	23	5.8		

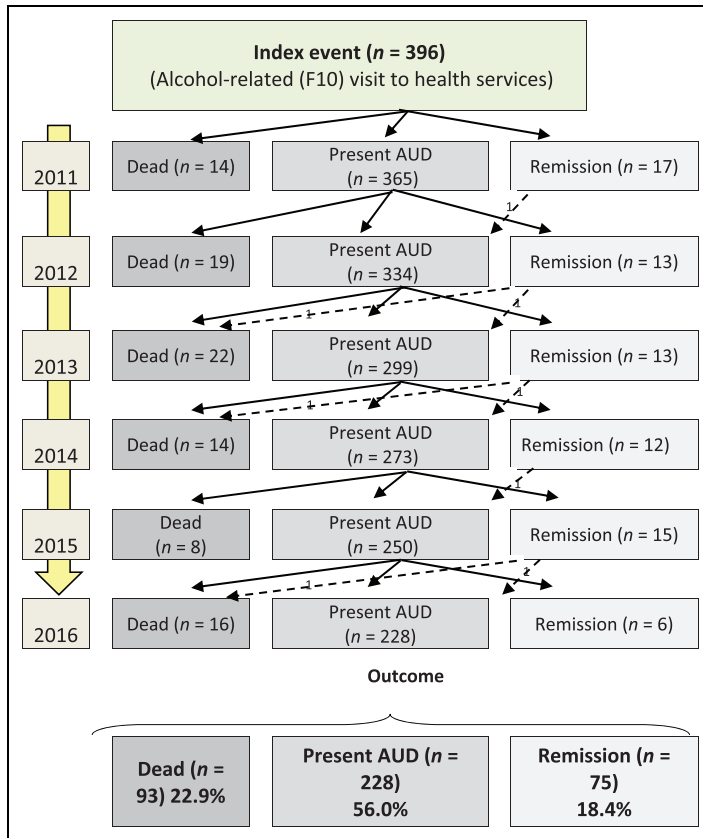
AUD = alcohol-use disorder; Dg F = ICD-10 codes F00-F99 (mental and behavioural disorders), excl. F10; MH = mental health.

<sup>a</sup>Pearson chi-square.

<sup>\*</sup>Kruskall-Wallis pairwise comparisons: p = present AUD problem; d = dead; r = remission.

to drunk driving ( $n = 15$ ). Approximately one-third of the patients in the present AUD problem group had not received treatment in specialised AUD services, although they had repeated mentions of alcohol abuse/harmful use in the EHRs. Instead, they had (1) several withdrawals in primary care setting and had no commitment to any AUD treatment ( $n = 26$ ),

(2) several ambulance consultations for alcohol-related reasons ( $n = 18$ ), which did not result in referral to treatment, (3) experienced recurrent alcohol-related intoxications and/or accidents ( $n = 20$ ), or had been (4) diagnosed with liver cirrhosis or other chronic alcohol-related somatic disorder but had no compliance with any treatment ( $n = 17$ ).

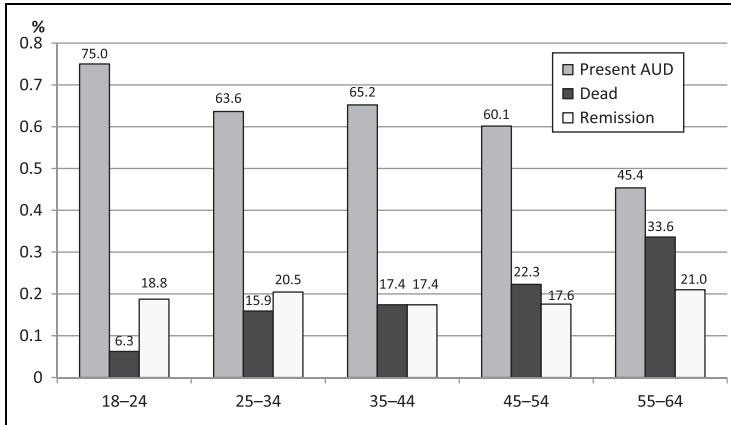


**Figure 1.** Flow-chart of outcome events during the follow-up. AUD = alcohol-use disorder.

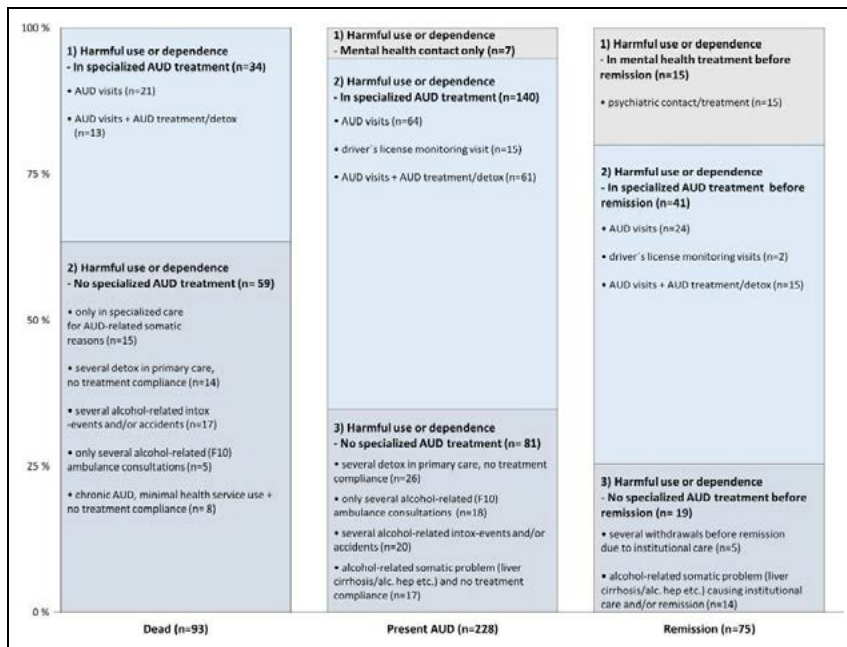
In contrast, most of those achieving remission were using either specialised AUD services or received care for MH reasons, and their AUD was treated simultaneously. Notably, approximately one-third of those in remission had not used specialised AUD services before achieving remission but *were institutionalised (i.e., located in long-term in-patient treatment, sheltered housing etc.)* (n = 5) or *had severe somatic health problems that forced abstinence* (n = 14).

**Specialised AUD service and MH service contact according to the outcome groups**

Table 2 presents the proportions of individuals having contact with either specialised AUD services, MH services or both. Slight differences in numbers compared with Figure 3 are explained by the differences in interpretation; those study subjects having merely cancelled and missed specialised AUD service visits (i.e., visits where the appointment time was not



**Figure 2.** Proportion of outcome status by age group. AUD = alcohol-use disorder.



**Figure 3.** Description of the patterns of alcohol-related service use according to outcome group. AUD = alcohol-use disorder.

**Table 2.** Electronic health record (EHR) register information on specialised alcohol-use disorder (AUD) contact and mental health (MH) service contact according to outcome groups.

AUD service contact	Present AUD (n = 228)			Dead (n = 93)			Remission (n = 75)		
	Mental-health contact			Mental-health contact			Mental-health contact		
	No	Yes	Total	No	Yes	Total	No	Yes	Total
No	N (%) 52 (22.8)	N (%) 18 (7.9)	N (%) 70 (30.7)	N (%) 40 (43.0)	N (%) 14 (15.1)	N (%) 54 (58.1)	N (%) 21 (28.0)	N (%) 19 (25.3)	N (%) 40 (53.3)
Yes	76 (33.3)	82 (35.9)	158 (69.3)	25 (26.9)	14 (15.1)	39 (41.9)	11 (14.7)	24 (32.0)	35 (46.7)
Total	128 (56.1)	100 (43.9)	228 (100.0)	65 (69.9)	28 (30.1)	93 (100.0)	32 (42.7)	43 (57.3)	75 (100.0)

used, as the study participant did not show up) were interpreted as not having contact with the service in question in Figure 3, whereas, in Table 2, the numbers are from the EHR registers. The number of visits may, therefore, appear exaggeratedly optimistic in the EHR, as the cancelled and missed visits are occasionally erroneously registered as actual visits. In addition, in the remission group, six individuals had specialised AUD nurse contact in primary care, but these visits in the EHRs were classified as regular primary healthcare visits.

## Discussion

This study had two aims. First, to examine the probabilities of death and remission of individuals with AUD and, second, to profile their alcohol-related health-service utilisation across the health-service system, by using data from the EHRs. We observed high mortality rate, relatively low AUD remission rate and highly fragmented AUD treatment utilisation patterns. Only one-quarter of the study participants had regular contact with specialised AUD services, i.e., three or more visits per year. Underutilisation of AUD services was prevalent, especially among those who later died. Moreover, underdiagnosis of AUD was identified, possibly indicating under-treatment of individuals with AUDs accessing health services.

A total of 3935 working-aged individuals with alcohol-related visits to health services in 2011–2012 were detected from the EHR, corresponding to approximately 4.1% of the working-age population of North Karelia. This proportion is less than the national prevalence of AUDs, which is about 7% of the adult population in Finland. Thus, these numbers reflect the current challenges to use alcohol-related diagnoses for less advanced AUDs, as has been noted in previous studies by Mitchell et al. (2012) and Abidi et al. (2018). We used a broad set of alcohol-related diagnoses in the sampling, as focusing only on F10 codes (ICD-10) would potentially have biased the sampling to those already in AUD treatment. A random

sample from the EHR mostly captured individuals receiving income support and having an advanced form of AUD described in their EHR records, possibly indicating a somewhat deprived background. It is known that individuals accessing treatment tend to have more severe AUD (Rehm et al., 2015), and that people with lower socioeconomic status experience greater alcohol-related consequences (Collins, 2016). Therefore, it is considered important to examine how the current social and healthcare system can address the care needs of those with a deprived background, regarding the AUD treatment.

After the 6-year follow-up, the following distribution of care outcomes was observed: over one-fifth of the study participants had died, and 18.4% were in remission, whereas the majority were still classified in the present AUD group. The increased probability of death concurs with the findings of previous studies (Kendler et al., 2016; Laramée et al., 2015; Roerecke & Rehm, 2013; Westman et al., 2015). However, the observed death rate was notably higher compared with a previous Finnish population study, in which 8.8% of individuals with AUD died after an 8-year follow-up period (Markkula et al., 2012). This difference may at least partly be explained by the different characteristics of the cohorts, as individuals with heavy alcohol use are unlikely to respond to population surveys. The proportion of individuals in remission corroborated the results described by Dawson et al. (2005). In that study, 18.2% of patients with previous alcohol dependence became abstainers, while the remission rate in our study remained low compared with general estimates of long-term recovery rates of 20–50% in treated populations (Anglin et al., 1997; Dennis et al., 2005; Vailant, 2003). Notably, one-quarter of the remissions resulted from institutionalisation. In our study, remission rate also remained stable across age groups. This finding contradicts those of previous studies identifying that remission rate increases with age and varies across age groups (Bland, Newman, & Orn, 1997;

Pirkola et al., 2006). All this may reflect the severity of the AUD in our study cohort. The large proportion of individuals with present AUD demonstrates the persistent nature of AUD, as previously noted in work conducted by Grella, Stein, Weisner, Chi, and Moos (2010).

Although the study participants were described in the EHR notes as heavy drinkers with a history of severe AUD, permanent AUD diagnosis was recorded for only 32.3% of the study participants and the prevalence of other permanent MH diagnoses was 22%. Also, just 9.8% of the study participants had co-morbid AUD and MH diagnosis recorded as a permanent diagnosis. These rates were lower than expected, raising a question of possible under-diagnosing and inadequate practices to record permanent diagnoses, as earlier studies have identified that most individuals with AUD who access treatment have higher levels of co-occurring MH and other co-morbidities (Flensburg-Madsen, Mortensen, Knop, Becker, & Gronbaek, 2009; Rehm et al., 2015). For instance, Kuussaari and Hirschovits-Gerz (2016) determined a 50% prevalence of co-occurring MH and substance-use-related problems, and a Swedish study estimated a 50–75% co-morbidity prevalence in an addiction-treatment population (Lundgren et al., 2014).

The EHR-based register analysis of alcohol-related health-service use patterns during the 6-year period revealed significant differences among the outcome groups. The majority of those who had died had not used specialised AUD services. Instead, they had made alcohol-related visits to specialised care, due to severe alcohol-related somatic complications or they had several intoxications, accidents and detoxifications in primary care, but active treatment attempts seemed to be lacking. Then there were those with alcohol-related ambulance consultations and minimal health-service use, and mention of low compliance with treatment was often recorded in their EHR notes, indicating a total drop-out from the service system. Respectively, in the present AUD group, the majority

received help for their AUD, although approximately only one-third had somewhat regular contact with AUD services, having a yearly mean number of three or more visits to specialised AUD services. Individuals achieving stable remission differed from the other outcome groups regarding the use of MH services. Mental health service use was most common among those in remission, even though no differences in the permanent MH diagnosis prevalence between those in remission and the present AUD group were observed. This finding agrees with the literature, identifying an association between the use of MH services and better addiction treatment outcomes (McLellan et al., 1996; Moos, Finney, Federman, & Suchinsky, 2000; Ray, Weisner, & Mertens, 2005).

### Limitations

The 6-year follow-up can only capture a certain period of the AUD treatment career, which should be noted when interpreting the results. Besides, despite the random selection of study subjects from the EHR registers, this research represents mostly individuals with an advanced-stage AUD and, naturally, the results are representative only in the North Karelia district. Although it is known that those with more severe AUD typically enter treatment, we were, nonetheless, expecting to find also those with less advanced AUD and emerging alcohol-related harms. This finding may indicate that the threshold for physicians to set an alcohol-related diagnosis is rather high.

In future research, other sampling methods should be considered to complement the ICD-10 diagnosis based sampling to identify patient cohorts with less advanced AUD from the EHRs. Text mining methods could provide useful tools to detect the presence of AUD.

The following issues arose during the analysis that should be addressed: (1) The data were available only for the years 2011–2016 as the EHR was established in 2010 and has been fully in use since 2011. Thereby, we were not able to

estimate prior service contacts. Also, those who died had less time to use specialised AUD services as those in other outcome groups. Although, we estimated that it would have been likely that treatment contacts would have been mentioned in the EHR even if the person died earlier, as the cohort included individuals with advanced forms of AUD. (2) Some errors in the number of registered AUD visits were detected; the appointed time was not always used, although these missed visits were registered as visits in the EHR registers, which led to exaggerated numbers for specialised AUD service utilisation if the service use was assessed only based on the register data. (3) The thorough examination of EHR notes revealed that alcohol-related diagnosis was not always recorded, although the patient was described as being intoxicated, raising a question as to whether only individuals with severe forms of AUD in the first place have alcohol-related diagnosis marked as a secondary diagnosis for the visits.

In this study, it was not possible to examine the duration of the AUD or whether the AUD was caused by MH problems or vice versa. Additionally, assessment of the AUD status was based on the clinicians' estimates. Furthermore, only one study subject had a score for the alcohol-use disorder identification test (AUDIT) recorded in the structured EHR, although references to AUDIT scores appeared in some of the notes indicating that AUDIT has been conducted but not recorded in a structured manner. Therefore, structured comparisons were not possible. Lastly, this study was not able to assess private health-service use or occupational health-service use provided by private service providers, as they use different EHR systems, though the proportion of these services was assessed as low, as only two private providers existed in one of the 13 municipalities and municipal health services provided the occupational health services in majority of the municipalities. In the future, a more detailed examination of alcohol-related social and health-service use across the treatment system

could potentially identify factors associated with different care outcomes. Furthermore, examination of geographical and socioeconomic equality in access to and use of care could provide important insights into AUD treatment research.

## Conclusions

Identification of AUD patients from the EHRs, based on the ICD-10 diagnosis information, mainly captures individuals with advanced forms of AUD, indicating that diagnosis of AUD is given only when the disease has reached an advanced state. The outcomes of the follow-up period reflected the serious and negative health consequences of an advanced AUD; a high mortality rate was observed, but also institutional care, detoxifications and alcohol-related somatic problems were common. Only a minority of those who had died had used specialised AUD services during the 6-year follow-up. Moreover, continuity of the specialised AUD service use varied: those achieving remission had higher AUD service utilisation rates and more visits to MH services, and vice versa. The observed advanced state of AUDs in this cohort, the low number of permanent AUD diagnoses and the relatively low frequency of AUD service contacts, especially among those who had died, raise questions of care quality and functionality of the current AUD treatment system. Training service providers to identify and treat earlier the less severe forms of AUD, combined with active treatment guidance and integrated care would most likely benefit this patient group and also reduce health-system costs. One effective way to enhance identification of AUD is the use of three first questions of the AUDIT test, as suggested in the Finnish Current Care Guidelines (2015). These findings may serve as a description of the present state of AUD treatment in one region of Finland, and inform the decision makers regarding the development of addiction service delivery systems in the forthcoming social and healthcare reform.

## Acknowledgements

We wish to thank research assistant Laura Kekäläinen for valuable help with the data collection, and senior data analyst Antti Rautiainen for SPSS Modeler training.

## Author's contributors

All the authors participated in planning and designing this study. E. Rautiainen performed all data management and analysis and drafted the article. T. Laatikainen and O.-P. Ryyänänen critically reviewed the document. All authors contributed to and have approved the final manuscript.

## Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Elina Rautiainen was supported by the Finnish Foundation for Alcohol Studies and by the University of Eastern Finland graduate school. This study also received funding from the Strategic Research Council at the Academy of Finland (consortium 312703).

## References

- Abidi, L., Oenema, A., van der Akker, M., & van de Mheen, D. (2018). Do general practitioners record alcohol abuse in the electronic medical records? A comparison of survey and medical record data. *Current Medical Research and Opinion*, *34*, 567–572.
- Anglin, M. D., Hser, Y.-I., & Grella, C. E. (1997). Drug addiction and treatment careers among clients in the Drug Abuse Treatment Outcome Study (DATOS). *Psychology of Addictive Behaviors*, *11*, 308–323.
- Bell, S., Daskalopoulou, M., Rapsomaniki, E., George, J., Britton, A., Bobak, M., ... Hemingway, H. (2017). Association between clinically recorded alcohol consumption and initial presentation of 12 cardiovascular diseases: Population based cohort study using linked health records. *BMJ*, *356*, j909.



- Bland, R., Newman, S., & Orn, H. (1997). Age and remission of psychiatric disorders. *Canadian Journal of Psychiatry*, *42*, 722–729.
- Chi, F. W., & Weisner, C. M. (2008). Nine-year psychiatric trajectories and substance use outcomes: An application of the group-based modeling approach. *Evaluation Review*, *32*, 39–58.
- Cohen, E., Feinn, R., Arias, A., & Kranzler, H. R. (2007). Alcohol treatment utilization: Findings from the National Epidemiologic Survey on Alcohol and Related Conditions. *Drug and Alcohol Dependence*, *86*, 214–221.
- Collins, S. E. (2016). Associations between socioeconomic factors and alcohol outcomes. *Alcohol Research*, *38*, 83–94.
- Dawson, D. A., Grant, B. F., Stinson, F. S., Chou, P. S., Huang, B., & Ruan, W. J. (2005). Recovery from DSM-IV alcohol dependence: United States, 2001–2002. *Addiction*, *100*, 281–292.
- Dennis, M., & Scott, C. (2007). Managing addiction as a chronic condition. *Addiction Science & Clinical Practice*, *46*, 45–55.
- Dennis, M. L., Scott, C. K., Funk, R., & Foss, M. A. (2005). The duration and correlates of addiction and treatment careers. *Journal of Substance Abuse Treatment*, *28*, S51–S62.
- Edlund, M. J., Booth, B. M., & Han, X. (2012). Who seeks care where? Utilization of mental health and substance disorder treatment in two national samples of individuals with alcohol use disorders. *Journal of Studies on Alcohol and Drugs*, *73*, 635–646.
- Finnish Current Care Guidelines. (2015). Alkoholiongelmaisen hoito. Lisätietoa. Alkoholinkäytön ongelmakäytön määrittelyt ja diagnoosit [Treatment of alcohol abuse. Additional information. Definitions and diagnoses of problematic alcohol use] Current Care Guidelines. Working group appointed by the Finnish Medical society Duodecim and the Finnish Society of Addiction Medicine. Helsinki, Finland: The Finnish Medical Society Duodecim. Retrieved from <http://www.kaypahoito.fi/web/kh/suosituksset/suositus?id=nix00353>
- Flensburg-Madsen, T., Mortensen, E., Knop, J., Becker, U., & Gronbaek, M. (2009). Comorbidity and temporal ordering of alcohol use disorders and other psychiatric disorders: Results from a Danish register-based study. *Comprehensive Psychiatry*, *50*, 307–314.
- Graham, K., Cheng, J., Bernards, S., Wells, S., Rehm, J., & Kurdyak, P. (2017). How much do mental health and substance use/addiction affect use of general medical services? Extent of use, reasons for use, and associated costs? *Canadian Journal of Psychiatry*, *62*, 48–56.
- Grant, B. F. (1997). Barriers to alcoholism treatment: Reasons for not seeking treatment in a general population sample. *Journal of Studies on Alcohol*, *58*, 365–371.
- Grant, B. F., Dawson, D. A., Stinson, F. S., Chou, S. P., Dufour, M. C., & Pickering, R. P. (2004). The 12-month prevalence and trends in DSM-IV alcohol abuse and dependence: United States, 1991–1992 and 2001–2002. *Drug and Alcohol Dependence*, *74*, 223–234.
- Grella, C. E., Stein, J. A., Weisner, C., Chi, F., & Moos, R. (2010). Predictors of longitudinal substance use and mental health outcomes for patients in two integrated service delivery systems. *Drug and Alcohol Dependence*, *110*, 92–100.
- Heinälä, P., Alho, H., Kiiänmaa, K., Lönnqvist, J., Kuoppasalmi, K., & Sinclair, J. (2001). Targeted use of naltrexone without prior detoxification in the treatment of alcohol dependence: A factorial double-blind, placebo-controlled trial. *Journal of Clinical Psychopharmacology*, *21*, 287–292.
- Hser, Y.-I., Anglin, M. D., Grella, C., Longshore, D., & Prendergast, M. L. (1997). Drug treatment careers: A Conceptual framework and existing research findings. *Journal of Substance Abuse Treatment*, *14*, 543–558.
- Kendler, K. S., Ohlsson, H., Sundquist, J., & Sundquist, K. (2016). Alcohol use disorder and mortality across the lifespan: A longitudinal cohort and co-relative analysis. *JAMA Psychiatry*, *73*, 575–581.
- Kessler, R. C., Aguilar-Gaxiola, S., Berglund, P. A., Caraveo-Anduaga, J. J., DeWit, D. J., Greenfield, S. F., ... Vega, W. A. (2001). Patterns and predictors of treatment seeking after onset of a substance use disorder. *Archives of General Psychiatry*, *58*, 1065–1071.

- Kessler, R. C., Nelson, C. B., McGonagle, K. A., Edlund, M. J., Frank, R. G., & Leaf, P. J. (1996). The epidemiology of co-occurring addictive and mental disorders: Implications for prevention and service utilization. *American Journal of Orthopsychiatry*, *66*, 17–31.
- Kessler, R. C., Olfson, M., & Berglund, P. A. (1998). Patterns and predictors of treatment contact after first onset of psychiatric disorders. *American Journal of Psychiatry*, *155*, 62–69.
- Keyes, K. M., Hatzenbuehler, M. L., McLaughlin, K. A., Link, B., Olfson, M., Grant, B. F., & Hasin, D. (2010). Stigma and treatment for alcohol disorders in the United States. *American Journal of Epidemiology*, *172*, 1364–1372.
- Krenek, M., Prince, M. A., & Maisto, S. A. (2017). Life events and alcohol use disorder clinical course: Modeling the dynamic association. *Drug and Alcohol Dependence*, *180*, 137–143.
- Kuussaari, K., & Hirschovits-Gerz, T. (2016). Co-occurrence of substance use related and mental health problems in the Finnish social and health care system. *Scandinavian Journal of Public Health*, *44*, 202–208.
- Laramée, P., Leonard, S., Buchanan-Hughes, A., Warnakula, S., Daepfen, J.-B., & Rehm, J. (2015). Risk of all-cause mortality in alcohol-dependent individuals: A systematic literature review and meta-analysis. *EBioMedicine*, *2*, 1394–1404.
- Laudet, A. B., Savage, R., & Mahmood, D. (2002). Pathways to long-term recovery: A preliminary investigation. *Journal of Psychoactive Drugs*, *34*, 305–311.
- Lid, T. G., Eide, G. E., Dalen, I., & Meland, E. (2016). Can routine information from electronic patient records predict a future diagnosis of alcohol use disorder? *Scandinavian Journal of Primary Health Care*, *34*, 215–223.
- Lundgren, L., Wilkey, C., Chassler, D., Sandlund, M., Armelius, B.-Å., Armelius, K., & Brännström, J. (2014). Integrating addiction and mental health treatment within a national addiction treatment system: Using multiple statistical methods to analyze client and interviewer assessment of co-occurring mental health problems. *Nordic Studies on Alcohol and Drugs*, *31*, 59–79.
- Manthey, J., Gual, A., Jakubczyk, A., Pieper, L., Probst, C., Struzzo, P., . . . Rehm, J. (2016). Alcohol use disorders in Europe: A comparison of general population and primary health care prevalence rates. *Journal of Substance Use*, *21*, 478–484.
- Markkula, N., Härkänen, T., Perälä, J., Partti, K., Peña, S., Koskinen, S., . . . Saarni, S.I. (2012). Mortality in people with depressive, anxiety and alcohol use disorders in Finland. *British Journal of Psychiatry*, *200*, 143–149.
- McLellan, A. T., McKay, J. R., Forman, R., Cacciola, C., & Kemp, J. (2005). Reconsidering the evaluation of addiction treatment: From retrospective follow-up to concurrent recovery monitoring. *Addiction*, *100*, 447–458.
- McLellan, A. T., Woody, G. E., Metzger, D., McKay, J., Durrell, J., Alterman, A. I., & O'Brien, C. P. (1996). Evaluating the effectiveness of addiction treatments: Reasonable expectations, appropriate comparisons. *The Milbank Quarterly*, *74*, 51–85.
- Mitchell, A. J., Meader, N., Bird, V., & Rizzo, M. (2012). Clinical recognition and recording of alcohol disorders by clinicians in primary and secondary care: Meta-analysis. *The British Journal of Psychiatry*, *201*, 93–100.
- Moos, R. H., Brennan, P. L., Schutte, K. K., & Moos, B. S. (2004). High-risk alcohol consumption and late-life alcohol use problems. *American Journal of Public Health*, *94*, 1985–1991.
- Moos, R. H., Finney, J. W., Fiederman, E. B., & Suchinsky, R. (2000). Specialty mental health care improves patient's outcomes: Findings from a nationwide program to monitor the quality of care for patients with substance use disorders. *Journal of Studies on Alcohol*, *61*, 704–713.
- Pirkola, S., Poikolainen, K., & Lönnqvist, J. (2006). Currently active and remitted alcohol dependence in a nationwide adult general population: Results from the Finnish health 2000 study. *Alcohol and Alcoholism*, *41*, 315–320.
- Probst, C., Manthey, J., Martinez, A., & Rehm, J. (2015). Alcohol use disorder severity and reported reasons not to seek treatment: A cross-sectional study in European primary care

- practices. *Substance Abuse Treatment, Prevention, and Policy*, 10, 32.
- Ray, G. T., Weisner, C. M., & Mertens, J. R. (2005). Relationship between use of psychiatric services and five-year alcohol and drug treatment outcomes. *Psychiatric Services*, 56, 164–171.
- Rehm, J., Allamani, A., Elekes, Z., Jakubczyk, A., Manthey, J., Probst, C., . . . Wojnar, M. (2015). Alcohol dependence and treatment utilization in Europe: A representative cross-sectional study in primary care. *BMC Family Practice*, 16, 90.
- Rehm, J., Anderson, P., Manthey, J., Shield, K. D., Struzzo, P., Wojnar, M., & Gual, A. (2016). Alcohol use disorders in primary health care: What do we know and where do we go? *Alcohol and Alcoholism*, 51, 422–427.
- Rehm, J., Mathers, C., Popova, S., Thavorncharoensap, M., Teerawattananon, Y., & Patra, J. (2009). Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders. *Lancet*, 373, 2223–2233.
- Roerecke, M., & Rehm, J. (2013). Alcohol use disorders and mortality: A systematic review and meta-analysis. *Addiction*, 108, 1562–1578.
- Roerecke, M., & Rehm, J. (2014). Cause-specific mortality risk in alcohol use disorder treatment patients: A systematic review and meta-analysis. *International Journal of Epidemiology*, 43, 906–919.
- Room, R., Babor, T., & Rehm, J. (2005). Alcohol and public health. *Lancet*, 365, 519–530.
- Salomé, H. J., French, M. T., Scott, C., Foss, M., & Dennis, M. (2003). Investigating variation in the costs and benefits of addiction treatment: Econometric analysis of the Chicago Target Cities Project. *Evaluation and Program Planning*, 26, 325–338.
- Saunders, S. M., Zygowicz, K. M., & D'Angelo, B. R. (2006). Person-related and treatment-related barriers to alcohol treatment. *Journal of Substance Abuse Treatment*, 30, 261–270.
- Tai, B., Wu, L.-T., & Clark, H. W. (2012). Electronic health records: Essential tools in integrating substance abuse treatment with primary care. *Substance Abuse and Rehabilitation*, 3, 1–8.
- Timko, C., Moos, R. H., Finney, J. W., Moos, B. S., & Kaplowitz, M. S. (1999). Long-term treatment careers and outcomes of previously untreated alcoholics. *Journal of Studies on Alcohol*, 60, 437–447.
- Trim, R. S., Schuckit, M. A., & Smith, T. L. (2013). Predictors of initial and sustained remission from alcohol use disorders: Findings from the 30-year follow-up of the San Diego prospective study. *Alcoholism, Clinical and Experimental Research*, 37, 1424–1431.
- Vaillant, G. E. (2003). A 60-year follow-up of alcoholic men. *Addiction*, 98, 1043–1051.
- Watkins, K. E., Burnam, A., Kung, F.-Y., & Paddock, S. (2001). A national survey of care for persons with co-occurring mental and substance use disorders. *Psychiatric Services*, 52, 1062–1068.
- Westman, J., Wahlbeck, K., Laursen, T. M., Gissler, M., Nordentoft, M., Hällgren, J., . . . Ösby, U. (2015). Mortality and life expectancy of people with alcohol use disorder in Denmark, Finland and Sweden. *Acta Psychiatrica Scandinavica*, 131, 297–306.
- WHO. (2014a). Global status report on alcohol and health 2014. Retrieved from [http://www.who.int/substance\\_abuse/publications/global\\_alcohol\\_report/msb\\_gsr\\_2014\\_1.pdf?ua=1](http://www.who.int/substance_abuse/publications/global_alcohol_report/msb_gsr_2014_1.pdf?ua=1)
- WHO. (2014b). Global alcohol report. Country profile: Finland. Retrieved from [http://www.who.int/substance\\_abuse/publications/global\\_alcohol\\_report/profiles/fin.pdf](http://www.who.int/substance_abuse/publications/global_alcohol_report/profiles/fin.pdf)
- Wu, L.-T., Ghitza, U. E., Batch, B. C., Pencina, M. J., Rojas, L. F., Goldstein, B. A., . . . Brady, K. T. (2015). Substance use and mental diagnoses among adults with and without type 2 diabetes: Results from electronic health records data. *Drug and Alcohol Dependence*, 156, 162–169.
- Wu, L.-T., Ringwalt, C. L., & Williams, C. E. (2003). Use of substance abuse treatment services by persons with mental and substance use problems. *Psychiatric Services*, 54, 363–369.





## **ELINA RAUTIAINEN**

---

Knowledge gaps exist regarding the service system's ability to identify and treat problems related to alcohol use disorders (AUDs) in Finland. This thesis studied service use and care costs of individuals with AUDs by using regional electronic social and health care registers. The presented treatment-system-wide examination of service use and costs over time among individuals with AUDs provided new insights with regard to the relationship between AUD treatment courses and care outcomes.



UNIVERSITY OF  
EASTERN FINLAND

**uef.fi**

**PUBLICATIONS OF  
THE UNIVERSITY OF EASTERN FINLAND**  
*Dissertations in Health Sciences*

ISBN 978-952-61-3694-3  
ISSN 1798-5706