Criminal convictions among patients in opioid maintenance treatment in Norway

A national cohort study

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Anne Bukten

Abstract

Background

The reduction of criminal activity is an important aspect of drug treatment. Opioid maintenance treatment (OMT) is one of the most widespread treatment approaches for opioid dependence, and over the past decades researchers have generally agreed that OMT reduces criminal activity. Several factors may affect treatment outcome. Patients retained in long-term and continuous treatment experience less involvement in criminal activity during OMT, while patients who drop out of OMT tend to relapse into higher levels of drug use and criminal activity. There is also research supporting a link between patient outcome and the manner in which treatment programme services are delivered. In Norway, criminal activity among patients in OMT and associations with long-term treatment has previously not been sufficiently studied. On this background, this thesis focuses on the investigation of criminal convictions among a national cohort of OMT patients.

Study aims

The specific aims of this thesis were to investigate criminal convictions among patients before, during, and after OMT and to explore how the long-term retention patterns were associated with criminal convictions. Furthermore, to investigate criminal convictions among patients in four different treatment regions in Norway, and to estimate the time-continuous probability of criminal activity during OMT transition periods.

Materials and methods

In this study, the Norwegian OMT patient register was cross-linked with the Norwegian crime register. The OMT patient register comprised information on all patients who applied for (n=3789) and subsequently started (n=3221) OMT in Norway between 1997 and 2003. The Norwegian crime register comprised detailed information on all crime cases, and included the date of the criminal event and the identified offender. Data from the national OMT register and the crime register were linked using a unique identification number assigned by the Norwegian state to all residents. The study included all registered criminal convictions for the cohort before, during, and after treatment.

Results

During the three years prior to OMT application, the cohort had more than 24 000 convictions. Almost 80% of all convictions were for acquisitive crimes and drug offences. Differences were found among those applying for treatment; almost 40% had no criminal convictions whereas 10% of the

sample was responsible for about 40% of all convictions in total. During treatment the overall rates of criminal convictions were reduced to less than half of pre-treatment levels. Patients retained in continuous and long-term treatment had the lowest rates of criminal convictions during OMT, whereas patients who left treatment had relatively high levels of convictions during treatment regardless of whether they returned to treatment or not. Patients who dropped out of treatment had high levels of criminal convictions during the periods out of OMT.

In the Central-Northern region more than 80% of patients were in continuous treatment compared to about 60% in the Eastern region. Regional differences were found in criminal convictions among patients in continuous treatment; compared to patients in the Eastern region, patients in the Southern and the Central-Northern region had respectively 44% and 81% less criminal convictions during treatment, and patients in the Western region had 60% more convictions.

During the years prior to onset of treatment, the probability of a criminal event in the cohort was relatively stable, at approximately 0.4% daily. About three months before initiation of OMT criminal activity started to decrease before stabilizing at the onset of OMT at a new, significantly lower level of approximately 0.2% per day. During the weeks before dropping out of treatment, criminal activity increased, up until the final day of treatment. After treatment, the higher levels of criminal activity were stable and high. The patterns during periods of transition were the same across gender, age and pre-treatment conviction levels.

Discussion and conclusion

During treatment the overall rates of criminal convictions were reduced to less than half of pre-treatment levels. Patients who left OMT relapsed to more criminal convictions when out of treatment, and this elevated probability of criminal convictions could be identified during a critical period in the months prior to drop out. The increased levels of criminal convictions may serve as a visible marker of other forms of risk behaviour, and it is essential that clinical staff offer support to OMT patients who are at particular risk for dropping out of treatment. Awareness of the process by which the programmes are delivered is essential for improving treatment effectiveness. Treatment centres known to provide OMT with a particular focus on psychosocial rehabilitation were found to have most improvement in terms of reductions in crime during treatment. Rapid expansion of the national OMT programme without accompanying sufficient resources to maintain high standards of treatment might represent a challenge in terms of optimal treatment delivery.

Norwegian summary

Bakgrunn

Personer med opioidavhengighet er ofte innovert i kriminalitet, og reduksjon av kriminalitet er å betrakte som en viktig målsetting ved behandling for rusavhengighet. Legemiddelassistert rehabilitering (LAR) er en av de mest evaluerte behandlingsmetodene rettet mot opioidavhengighet, og gjennom de siste tiårene har en rekke studier vært forholdsvis samstemte om at LAR-behandling er assosiert med redusert kriminalitet. Enkelte faktorer har likevel stor betydning for utfallet av LAR. Pasienter med høy retensjon og langvarig behandling har mindre kriminalitet under LAR, mens de pasientene som avslutter LAR ofte faller tilbake til rus og kriminalitet etter behandling. Det er også funnet assosiasjoner mellom måten LAR organiseres på og utfallet av behandling. I Norge har ikke forholdet mellom kriminalitet og langtids LAR-behandling vært tilstrekkelig studert. På bakgrunn av dette undersøkte vi sammenhengen mellom domfellelser og LAR i en nasjonal kohort av LAR-pasienter.

Forskningsspørsmål

Forskningsspørsmålene i denne studien var å undersøke domfellelser blant LAR-pasienter før, under og etter LAR-behandling, samt å undersøke sammenhengen mellom retensjonsmønster og domfellelser. Videre var det å undersøke domfellelser blant LAR-pasienter i fire ulike helseregioner i Norge, samt å estimere den tidskontinuerlige sannsynligheten for kriminalitet i ulike overganger av LAR-behandling.

Material og metode

I denne studien ble det norske LAR-registeret koblet med straffesaksregisteret. Det norske LAR-registeret inneholdt informasjon om alle pasienter som søkte (n=3789) og som deretter startet LAR-behandling (n=3221) i Norge i perioden 1997-2003. Straffesaksregisteret inneholdt detaljert informasjon om all registrert kriminalitet, samt gjerningsdato og gjerningsperson. Data fra det norske LAR-registeret og straffesaksregisteret ble koblet med fødsels- og personnummer, som tildeles alle som er registrert bosatt i Norge. Studien inkluderte alle registrerte domfellelser før, under og etter behandling.

Resultater

Gjennom de tre årene før søknad til LAR, hadde de som søkte behandling samlet mer enn 24 000 separate domfellelser. Nærmere 80% av domfellelsenene var for vinningsforbrytelser og

narkotikalovbrudd. Det ble funnet store forkjeller blant søkerne til LAR; ca 40% var ikke domfelt i den tre år lange perioden før LAR, mens en gruppe på 10% var ansvarlige for rundt 40% av alle domfellelsene til sammen. Under behandling var domfellelsesraten redusert med mer enn halvparten sammenlignet med raten forut for behandling. De pasientene som var i kontinuerlig behandling hadde de laveste domfellelsesratene under behandling, mens de pasientene som hadde avbrutt behandlingen hadde relativt høye domfellelsesrater under behandling, uavhengig om de kom tilbake til behandling eller ikke. Pasientene som forlot behandling hadde høye nivå av domfellelser i periodene utenfor behandling.

I region Midt-Nord var mer enn 80% i kontinuerlig behandling sammenlignet med i overkant av 60% i region Øst. Det ble funnet regionale forskjeller i domfellelsesrater for gruppen som var i kontinuerlig behandling; sammenlignet med pasienter fra region Øst hadde pasientene fra region Sør og Midt-Nord henholdsvis 44% og 81% mindre domfellelser under behandling, mens pasientene fra region Vest hadde 60% mer domfellelser under behandling.

I årene før oppsart av behandling var sannsynligheten for domfellelser relativt stabil, ved ca 0.4% per dag. Ved ca tre måneder før oppsart av LAR ble det registrert en gradvis nedgang i domfellelser, før nivået stabiliserte seg ved rund 0.2% per dag. I ukene før pasientene avsluttet LAR-behandling økte sannsynligheten for kriminalitet, helt frem mot den siste dagen av behandling. Etter avsluttet behandling, var sannsynligheten for kriminalitet relativt stabilt høy. Kriminalitetsmønstrene under overgangene av behandling var like, på tvers av kjønn, alder og nivå av domfellelser forut for behandling.

Diskusjon og konklusjon

Under LAR-behandling var nivået av domfellelser mer enn halvert sammenlignet med perioden på venteliste. Pasienter som avsluttet LAR, falt tilbake til mer kriminalitet utenfor behandling. Allerede i ukene før pasientene avsluttet LAR ble det registeret en kritisk periode i form av forhøyet risiko for kriminalitet. Det høye kriminalitetsnivået kan være en synlig markør på annen risikoatferd, og det er derfor viktig at klinikere identifiserer og tilbyr forsterket støtte til pasienter som er i særskilt risiko for drop-out. Oppmerksomhet rettet mot innholdet i behandlingsprosessen er viktig for å forbedre LAR. Behandlingssentrene som har mye fokus psykososial oppfølging var de sentrene som hadde de beste behandlingsresultatene, i form av kriminalitetsreduksjon. Rask ekspansjon av det nasjonale LAR-programmet uten nødvendig tilførsel av ressurser for å opprettholde en høy behandlingsstandard kan representere en utfordring i forhold til å kunne tilby optimal behandling.

List of papers

I. Bukten A, Skurtveit S, Stangeland P, Gossop M, Willersrud AB, Waal H, Havnes IA, Clausen T. Criminal convictions among dependent heroin users during a 3-year period prior to opioid maintenance treatment: A longitudinal national cohort study. Journal of Substance Abuse Treatment 2011; 41(4): 407-414.

II. Bukten A, Skurtveit S, Stangeland P, Gossop M, Waal H, Havnes IA, Clausen T. Engagement with opioid maintenance treatment and reductions in crime: a longitudinal national cohort study. Addiction 2012; 107(2): 393-399.

III. Bukten A, Skurtveit S, Gossop M, Waal H, Stangeland P, Clausen T. The influence of programme differences on crime reduction in opioid maintenance treatment. An analysis of regional patterns in Norway. Norsk Epidemiologi 2011; 21(1): 99-106

IV. Bukten A, Røislien J, Skurtveit S, Gossop M, Waal H, Clausen T. Crime during periods of transitions in opioid maintenance treatment: a national cohort study (Submitted).

Definitions

Dependence syndrome is defined as a cluster of behavioural, cognitive, and physiological phenomena that develop after repeated substance use. The dependence syndrome may be present for a specific psychoactive substance, for a class of substances, or for a wider range of pharmacologically different psychoactive substances. There may be evidence that return to substance use after a period of abstinence leads to a more rapid reappearance of other features of the syndrome than occurs with nondependent individuals (1). According to the ICD-10 diagnostic guidelines, a definite diagnosis of dependence should usually only be made if three or more of the following have been present together at some time during the last year (1):

- A strong desire or sense of compulsion to take the substance
- Difficulties in controlling substance-taking behaviour
- A physiological withdrawal state when substance use has ceased or have been reduced
- Evidence of tolerance
- Progressive neglect of alternative pleasures or interests because of psychoactive substance use
- Persisting with substance use despite clear evidence of overtly harmful consequences

Opioid maintenance treatment (OMT) is the designation for the pharmacotherapy for opioid dependence. When maintenance treatment was first introduced in Norway, it was called methadone maintenance treatment (MMT) as methadone was the only available medication at that time. Today, patients are treated with methadone, buprenorphine or buprenorphine-naloxone combinations and, hence, it is called OMT. In Norway the term OMT encompasses more than pure pharmacotherapy as psychosocial rehabilitation beyond medications has a key role in the treatment programme (2). A variety of terms have been used to describe pharmacotherapy for opioid dependence, including opioid substitution treatment (OST), medication assisted treatment (MAT), opioid treatment programme (OTP), and opioid replacement therapy (ORT). The treatment of opioid dependence with heroin is often referred to as heroin assisted treatment (HAT). The fact that pharmacotherapy for opioid dependence is known under such a variety of names, might reflect the fact that there have been multiple philosophies concerning the goals and purposes of treatment, as well as the fact that treatment is often organized differently across treatment settings.

1.0 Introduction

Background

The relationship between opioid dependence and criminal activity has been well established. Crime is an important factor both at the individual and societal level, and the reduction or elimination of crime is thus a central aspect of the treatment of dependence (3). In Norway, opioid maintenance treatment (OMT) has been available at a national level since 1998, and during 2011 there were more than 6000 patients in treatment. The Norwegian OMT programme has been widely researched and the current status points to several benefits (4-7). Nevertheless, the extent to which OMT offers crime reduction among opioid-dependent persons in Norway is not fully known. On this background, this thesis deals with criminal convictions before, during, and after OMT.

1.1 Opioid dependence

Opiates are the most harmful problem-drugs worldwide, and during 2009 the United Nations Office on Drugs and Crime estimated that approximately 16 million people globally had used opiates at least once in the past year, with an annual prevalence of 0.3%-0.5% (8). Heroin remains the most commonly used opiate, consumed by a vast majority of global users. In the European Union and Norway, the numbers of heroin users were estimated at approximately 1.3 million during 2009 (9). Injection remains a common route of administering opioids, and the number of injecting heroin users in Europe during 2008 was estimated to be between 750 000 and 1 million (10). In Norway the number of heroin users was estimated at 8 600 – 12 600 during 2008, of which about 90 percent injected heroin (11). European data suggest that while heroin use is decreasing, its associated harm still accounts for the greatest share of drug-related morbidity and mortality in the European Union (10).

About one quarter of persons who have ever tried heroin subsequently develop dependence (12). Opioid dependence is a chronic illness (13) characterized by a cluster of cognitive, behavioural and psychological features (14) and is diagnosed according to the criteria of the World Health Organization ICD-10 (1) and/or the American Psychiatric Association DSM-IV (15). Injecting heroin users are among those at highest risk of health problems from their drug use, e.g. premature death from drug overdose and blood-borne infections such as HIV and hepatitis C (12).

1.2 Heroin use and criminal activity

Heroin-dependent persons are frequently involved in criminal activity (16-19), and are most commonly associated with income-generating crimes, such as shoplifting, burglary and robbery (20-24). Previous research has found high levels of both drug use and criminal activity among individuals seeking treatment (24-28), and many have had a prison history (29). However, there are multiple pathways linking heroin use and criminal involvement and several models have been proposed to explain this connection (17;20;24;30). One often-assumed explanation for the association between heroin use and crime is that drug use leads to crime (31). Dependence can be characterized by both stable periods of abstinence and relapses into drug use (13;32), and periods of more intense drug use are associated with higher frequencies of crime (21;24;33;34) compared to periods of abstinence (33;35). The involvement in crime may thus be a manifestation of personal deterioration due to the disease of dependence (36).

Moreover, the development of a criminal lifestyle during younger years may be related to the severity of later periods of drug use (37;38). In a study investigating pre-addiction crime, it was found that dependent persons were often heavily involved in crime at an early age and that there was an escalation in criminal behaviour before the onset of dependency (38). Increased criminal involvement may thus further enhance a lifestyle of more dependence (39). High-rate offenders might achieve availability and high levels of illegal funds, which in turn may finance elevated levels of drug use, including multiple drug use (40).

On the other hand, it has been argued that the association between drug use and criminal activity is not directly causal, but rather correlated with a third or common variable (40). It is likely that a number of factors linked to early development or recent history might predispose certain individuals to high levels of involvement in both drug use and crime (40). Involvement in criminal behaviour has been found to be influenced by individual psychological characteristics (29;41), and research has indicated that criminal involvement among heroin users in methadone treatment was associated with the presence of antisocial personality disorder, borderline personality disorder and major depression (29).

However, the link between drugs and crime is neither simple nor universal. Many offenders are not involved in drugs, and many dependent heroin users do not commit any crime. The relationship between drugs and crime may vary from individual to individual and over time due to changing

circumstances. Even so, the consequences from criminal activity are experienced by the victims, their families, the criminal justice system and by society as a whole (42).

1.3 Opioid maintenance treatment

There are a variety of approaches to treating drug dependence, and treatment strategies for opioid dependence include abstinence-oriented treatment, maintenance-oriented treatment and combinations of the two approaches (43). Abstinence-oriented treatment comprise therapeutic communities and detoxification programmes, and continues to be a commonly offered treatment option in Scandinavia and many other parts of the world (44). Maintenance-oriented treatments include treatment medications like methadone, buprenorphine and buprenorphine-naloxone combinations (45). A solid base of research has shown that maintenance-oriented treatment is more successful in improving a number of outcomes compared to abstinence-oriented treatment (3;46;47). However, combinations of medications and behavioural therapies generally appear to be more effective than either approach used alone (43).

Methadone is a long-acting synthetic opioid medication (48). Although methadone is currently most widely known for its use in the treatment of opioid dependence, methadone was first synthesized as an analgesic prior to World War II (49). Today methadone also provides an effective analgesic agent with efficacy for patients who suffer from neuropathic pain, and for patients who experience inadequate pain relief or side effects with other opioids (48).

Clinical trials testing methadone for opioid dependence began during 1949 when Isbell and Vogel found methadone to be an effective medication for withdrawing dependents from heroin (49). The protocol at the time was, however, to discontinue methadone after a short tapering period, and follow-up studies in the 1950s and 1960s showed relapse rates of more than 90% after patients had left treatment (49). Long-term methadone maintenance treatment began as a research project in 1964 at the Rockefeller University Hospital when Dr. Vincent P. Dole and Dr. Marie E. Nyswander conducted a study stabilizing heroin-dependent patients with oral methadone hydrochloride (50). Rather than discontinuing methadone according to the protocol at that time, the research team maintained patients on methadone so that its effects could be evaluated (49). After the patients had reached the stabilization level (50 to 150 mg/day) it was possible to maintain them with a single, daily, oral ration, without further increase in dose. In their early study it was concluded that methadone gave a relief of narcotic hunger and that the induction of sufficient tolerance seemed to block the euphoric effect of an average dose of illegal heroin (50). Results from Dole and

Nyswander's pioneering studies revealed that patients had shown marked improvement for several parameters, including drug use, social functioning, education, employment and criminality (25;50).

Today, maintenance treatment combined with psychosocial assistance is found to be the most effective in treating people dependent on opioids (14;51). In most cases, treatment will be required in the long term or even throughout life. Such long-term treatment should not be considered a treatment failure, but rather a way of prolonging life and improving quality of life and the long-term process of change and recovery (13;14). Opioid maintenance treatment has been evaluated since its development in 1964 and has proven to be successful in improving a number of outcomes, including drug use (3;47;52), reducing the transmission of infectious diseases associated with heroin injection (12;46), mortality (4;53-58) and criminal activity (59-69).

Currently, OMT is the most widespread treatment approach for heroin dependence. In the United States the number of patients in maintenance treatment has increased from initially six patients during 1964 (49) to about 260 000 during 2006 (70). In the European Union and Norway, the European Monitoring Centre for Drugs and Drug Addiction estimated that about 670 000 received opioid maintenance treatment during 2008, which included approximately half of the heroin dependent population. The treatment coverage varies between the European countries, with national estimates ranging from less than 10% to more than 50% of heroin dependent persons (10).

1.4 The Norwegian opioid maintenance treatment programme

Compared with Denmark and Sweden where methadone treatment was introduced in the 1960s, the Norwegian OMT programme was introduced at a late stage. Throughout the 1970s and 80s, the use of medications in the treatment of substance abuse disorders was met by scepticism in Norway (11). At that time there was a strong belief that methadone condemned people to life-long dependence and that addiction should be met with drug-free treatment. Nevertheless, in 1994, a three-year pilot project providing methadone was set up in Oslo, and during 1997 the Norwegian parliament decided that methadone maintenance treatment for heroin dependent persons should be a part of the national treatment system (11). In 1998, the OMT programme was implemented and made available at a national level and integrated into the general health and social security system based on specialised regional centres (6;11). The provision of OMT in Norway has been centrally planned and controlled by the government. As such it constitutes a national programme, with a monopoly on admissions and subject to the same countrywide government standards (6). Patients apply to a regional OMT centre via their General Practitioner or social service centre. The General Practitioner

plays an important and integrated role in the Norwegian OMT system and, in 2010, 68% of patients were prescribed OMT medications by their General Practitioner, although all treatment initiations were conducted at the regional OMT centres (7).

The Norwegian OMT model aims to be a psychosocial oriented intervention where medications are to be used in order to support improvements in psychosocial functioning (6). The main goals for patients are long-term living arrangements and improved quality of life, a life without drug use and non-involvement with groups of other drug users, and establishment of a social network dominated by relatives and friends without substance abuse problems (5). Since the implementation of OMT, changing policies have regulated the programme. During initiation of OMT, the programme could be characterized as high-threshold and restrictive (71). Criteria for acceptance were based on severity and duration of opioid dependence, experience with abstinence-oriented treatment, and age. Patients were supposed to be 25 years of age or older, to have been dependent on heroin for 10 years or more, and to have undergone abstinence-oriented treatment. Patients with severe somatic or psychiatric diseases were prioritized (6;71).

According to the first national guidelines, termination of treatment could be either voluntary or involuntary. The absolute criteria for involuntary terminations were violence and threats, but patients could also be discharged due to continued substance abuse, lack of treatment cooperation and lack of rehabilitation efficacy (72). In a national report investigating the number of patients that had been involuntarily or voluntarily discharged from treatment by the end of 2003, it was reported that 6% of patients had moved (but were still included in the OMT system in another region), 14% had deceased, 19% had voluntarily ended treatment, and 60% were involuntarily discharged (73). Very few discharges were, however, made on the basis of the absolute criteria; most patients were discharged because of continued drug use and inadequate improvements in social rehabilitation. Following treatment termination, the only possibility for OMT was to apply for re-intake (6).

During 2010, new national OMT guidelines were introduced (2), and the admission criteria are now more liberal. Currently, the only absolute criterion for admission to treatment is opioid dependence, defined according to the ICD-10 (1) or DSM-IV criteria (15). The new guidelines are more directed towards increasing the clients' quality of life and more focused on harm reduction (11). Involuntary termination of treatment should now only be considered in cases when treatment, from a medical point of view, is considered harmful for the patient (7). From the initiation of OMT in 1998, the programme has expanded considerably, and by the end of 2010, a total of 6015 patients were in active OMT in Norway (7).

1.5 Opioid maintenance treatment and criminal activity

From its beginning in the 1960s, opioid maintenance treatment has been studied for medical safety and efficacy and today OMT is probably one of the most evaluated forms of treatment in the field of drug abuse treatment (46). The studies evaluating OMT have investigated not only medical and clinical issues, but also social factors (49). Several large-scale, prospective outcome studies have provided important information about drug users, their associated problems, the nature of involvement with treatment services, and our understanding of treatment outcomes. These studies have high costs, with regard to both founding and effort as well as data collection, but provide crucial data on the changes of drug use and other problems before, during, and after treatment.

Some of the largest prospective outcome studies have been initiated in the US. The first national multi-programme study, The Drug Abuse Reporting Program (DARP) was carried out during 1969-1973 (74;75) and was based on a prospective, longitudinal data acquisition process (74). The overall findings indicated that treatment in methadone maintenance programmes was effective in improving post-treatment outcomes related to drug use and criminality (74). The second study, the Treatment Outcome Prospective Study (TOPS) also presented longitudinal data on patients entering USA federally-funded drug abuse treatment programmes. Data were collected during 1979-1981. More than 40 percent of all clients reported some predatory illegal activity (assault, robbery, burglary, etc.) in the year before treatment; however more than 70 percent of these clients reported cessation of predatory illegal activity during methadone treatment (76). The Drug Abuse Treatment Outcome Study (DATOS) was a comprehensive, multi-site, prospective study of treatment effectiveness, and the third of a series of evaluations in the US. The study was carried out from 1991-1993 (28;77;78). Of the DATOS sample, almost 90% had ever been arrested, and more than 50% entered DATOS treatment under criminal justice supervision (28). Prevalence of drug use and other behaviours were evaluated one year prior to treatment, and after a 1-5 year follow-up period. After the 5-year follow-up, patients in methadone maintenance treatment exhibited a 50% reduction in criminal activities compared to pre-treatment levels (78).

The National Treatment Outcome Study (NTORS) was a prospective, longitudinal cohort study based on the design of the drug-treatment studies undertaken in the USA, and represented the first major multi-site study to be carried out in the UK (79;80). Clients were recruited during 1995 and follow-up data were collected at 1 year, 2-3 years and 4-5 years after treatment intake (79). Measures included drug and alcohol use, health risk behaviour, physical and psychological health symptoms, and criminal behaviour during the past three months. During the three months prior to intake, 50% of the

cohort reported some form of acquisitive crime, with a total of 27 787 individual offences (79). Reductions in criminal activity were among the most pronounced findings from the NTORS study. One year after intake to community methadone programmes there were major reductions in the numbers of crimes (81), and the reductions were maintained through 5 years of follow-up (61;82).

Conducted in three Australian states, the Australian Treatment Outcome Study (ATOS) was based on the NTORS study, and was the first large-scale prospective study of treatment entrants for heroin dependence that was conducted in Australia (27;62). The study included heroin users who were recruited to maintenance treatment, residential rehabilitation and detoxification programmes. Baseline data were collected between 2001-2002, with follow-up interviews conducted at 3, 12, 24 and 36 months post-baseline. When examining the 3-year impact of the ATOS study, there were major reductions in heroin use, psychopathology, injection-related health problems, and criminal activity following longer exposure to maintenance treatment (29).

A number of observational studies investigating the effect of OMT have been carried out in the Scandinavian countries. Research conducted in Sweden has concluded that treatment with buprenorphine and methadone was successful in the rehabilitation of heroin dependence (52;68). In a study investigating criminality among heroin users admitted to Stockholm's methadone maintenance treatment, the criminal convictions were reduced from 2.2 per person-year during the 4 years prior to treatment, to 0.5 convictions per person-year during treatment (68). Similarly, findings from Denmark have shown that methadone maintenance treatment was effective in reducing heroin use, injections and criminal activity (83). In a study investigating drug-dependent persons in methadone maintenance treatment, drug-free treatment, and psychiatric or psychological treatment, it was found that only those patients who had been under almost constant methadone treatment had experienced a significant reduction in mortality and criminal activity (84).

Despite the convincing findings from comprehensive observational studies, research has provided some contradictory evidence with respect to crime and opiate maintenance programmes. A recent systematic Cochrane review evaluating the literature on randomised trials, concluded that methadone maintenance treatment had no statistically significant effect on criminal activity compared with treatment that did not involve OMT (47). In the Cochrane review however, only three studies focusing on criminal activity met the inclusion criteria, and included a total sample of 363 individuals, distributed as 32 (85), 34 (26) and 301 (86) participants in each study. A limited number of randomised clinical trials on the efficacy of maintenance treatment on criminality combined with few participants in each study, may have contributed to the non-significant results.

1.6 Factors associated with treatment outcome

Several factors may affect treatment outcome, and researchers have attempted to identify and study those factors that might account for variability. Individual characteristics such as the presence of major depression, antisocial personality disorder and borderline personality disorder, being younger, male, and having a history of criminal activity prior to treatment entry have been consistently linked to poor treatment outcome (3;29;87).

Retention in treatment has been found to be an important factor for treatment success (3;87), and patients engaged in continuous treatment over a longer period of time are more likely to have improved treatment outcomes compared to those who leave treatment after a shorter period (55;59;78;87;88). However, treatment compliance for drug dependence is generally poor (89), and although retention rates are usually higher in maintenance treatment than in other forms of substance abuse treatment (52) patients differ in the nature and duration of their engagement with treatment. Patients in OMT have been found to have high turnover, and the chronic, relapsing course of drug dependence often leads to multiple treatment episodes (90).

Patients who drop out of treatment tend to be more involved in criminal activity during treatment, and often relapse to drug use and higher rates of criminal activity after intervention (3;13;59;90). Research has shown that patients who had more than one treatment period did no better during treatment than those who dropped out permanently (59). The first weeks after leaving treatment have been identified as a *critical period*. Patients who drop out of treatment often relapse to opioids within a very short time after leaving treatment (91) and there is a higher risk of overdose mortality in the immediate period after leaving treatment (53;92;93).

Treatment outcome has also been associated with the manner in which programme services are delivered (3;94;95). More effective clinics have been characterised by prescribing higher doses of methadone, having a treatment goal of successful ongoing maintenance rather than abstinence, and focusing on quality counselling, more medical services, better staff-patient relationships, low staff turnover rates, and better clinic management (3;96). However, OMT should not be considered a single type of procedure (97). The organisation of the delivery of substitution treatment is generally unique for each country. In a study which compared methadone maintenance in six different countries (Australia, Canada, France, the Netherlands, Thailand and the UK) marked variations between each country were found in terms of dosage level, staffing, entry criteria, frequency of programme attendance, and frequency of health counselling (97).

OMT also often varies considerably *within* countries (94;98;99). The Norwegian programme includes 14 regional centres that are subject to the same national guidelines. However, although regional centres are subject to the same regulations, both research reports and annual assessments indicate that the different Norwegian regional centres have developed considerable variations in treatment strategies (5;98;99). Differences between the regional centres have been found in terms of choice of opioid agonist, control measures such as urine drug screening, degree of psychosocial rehabilitation, provision of long-term living arrangements, education and work (5). Findings from a recent study revealed that centres organised treatment differently. Centres where patients had more illicit drug use also had fewer patients in long-term living arrangements, more unemployment, and more patients reporting social security benefits as main income (99).

1.7 The assessment of criminal behaviour

Different methods have been utilized to measure criminal behaviour. All of the methodologies and measures are associated with both strengths and weaknesses. Most research investigating drug use and criminal activity typically comes from studies using self-report methods (27;79;100). Because of the difficulties in remembering the exact timing of events, the validity of self-reported criminal behaviour may be adversely affected by problems of recall (36). Respondents of self-report studies have been found to both over-report and under-report behaviours that occurred in the time-window of the study period (101). If there are perceived negative consequences associated with reporting certain types of behaviour, respondents may feel motivated to conceal the truth (100). In a study investigating the validity of methadone clients' self-reported drug use, it was found that some respondents systematically denied devaluated behaviours, like drug use and criminal behaviour (102). In another study examining the differences between self-reported and official crime records, the results showed that there was a lower agreement for minor offences, and a higher agreement for more serious forms of criminal offences (103). The study thus concluded that retrospective reports were not suitable to address research questions requiring detailed information (i.e., most criminal career parameters, age of onset, frequency, age of termination) for studying minor forms of offences, and that the use of self-reported retrospective data would be particularly vulnerable in samples where individuals have had severe substance use problems (103).

Other methods of assessing crime have used more objective measures of criminal involvement such as convictions (61;68) or arrests (104;105). One disadvantage of using official data is that crime records are known to systematically underestimate the actual prevalence of criminal activity

(101;106). According to Statistics Norway, only 16 percent of all cases reported to the police within a given year resulted in criminal convictions (107), and crime statistics are hence considered a crude measure of heroin users' involvement in crime. Moreover, there is a low risk of arrest for many of the income-generating crimes committed by heroin users (108), and especially for "victimless" offences (e.g. drug selling and dealing, or driving without a licence), the priorities of the public authority have a great impact on the number and type of cases being prosecuted (109). For this reason, it is likely that much of the crime committed by a drug-using population goes undetected and hence unreported in the official crime statistics. Nevertheless, one important advantage of official data in longitudinal studies is that arrests and criminal case processing are recorded at specific points in time, as opposed to the typical self-report studies which typically ask about behaviour in a specific window of time (101). Although official records underestimate the volume of crime, it is possible to study the patterns of crime across time, and it is likely that changes in the observed numbers of criminal convictions probably indicate changes in actual crime rates.

1.8 Objectives

The overall objective of this thesis was to investigate criminal convictions before, during and after treatment among patients in OMT.

The specific aims were:

1. To investigate patterns of criminal convictions among heroin users before admission to OMT (Papers I & IV)

2. To investigate criminal convictions during OMT compared with pre-treatment levels (Paper II)

3. To investigate criminal convictions during drop out and re-entry of OMT (Papers II & IV)

4. To investigate pre-treatment (gender and pre-crime) and in-treatment (programme features and treatment duration) characteristics associated with criminal convictions (Papers I,II, III &IV)

Both published (Appendix) and unpublished results (UPR) are reported in this thesis.

2.0 Material and methods

2.1 Sources of data

The papers presented in this thesis are based on data from two population registers. The Norwegian OMT patient register, which is a defined research project register, was linked to official data from the Norwegian crime register. Data linkage was conducted using the unique national identification number assigned by the Norwegian state for all residents.

2.1.1 The Norwegian crime register

The Norwegian crime register forms the basis of the official Norwegian crime statistics and includes information on all registered criminal cases including identified offenders. The Norwegian crime register was established during 1979, and in 1992 it contained information from all the Norwegian police districts. In every police district of Norway, offence details are registered in accordance with national instructions (110).

An important feature of the Norwegian crime register is that it is based on individual codes for every offence (110). The crime codes contain information on the offence in question and corresponding paragraphs of the Penal Law. Currently more than 600 different codes are included in the Norwegian crime register (109). Based on the individual crime codes, Statistics Norway (111) describes ten groups of offences; economic offences, other offences for profit, offences of violence, sexual offences, offences of narcotics, damage to property, environment offences, work environment offences, traffic offences, and other offences. In our study, the OMT population was not sufficiently represented in all ten categories. Consequently, we summarized the offences into five main categories with a total of 17 subcategories. The five main crime categories were; offences for acquisitive crimes, drug offences, violent offences, road traffic offences, and other offences (Paper I & UPR).

In Norway, any use, possession and sale of narcotics may lead to prosecution. The term *narcotic* is hence a legal term and includes the substances the legislature at any time has defined as narcotics. There are two main types of drug offences in Norway. “Sale and distribution of narcotics” are defined according to the Penal Law section 162, and include unlawful storage, import and export of drugs, liable to fines or up to two years of imprisonments (112). An aggravated drug felony may be punished by imprisonment for up to 10 years, and if an extensive quantity is involved in the offence,

a prison sentence up to 21 years may be imposed. “Use and possession of narcotics” might be regarded as less severe offences, defined according to the Medical Act section 31, and liable to fines or prison up to 6 months (113). The distinction between possession (the Medical Act) and storage of drugs (the Penal Law) is set at one or two doses of narcotics, regardless of type. As all the individuals in this study were dependent on opiates, use and possession may be understood to reflect the nature and severity of their drug dependence. Moreover, use and possession of drugs link drug use and crime by a definition of the law, rather than by any effect of one behaviour (114). For this reason, all convictions for use and possession of drugs were excluded from all analysis in the study. Consequently, the category *drug offences* in our dataset consisted of sale and distribution of drugs, and these offences were further subdivided into a category of more serious cases providing imprisonment up to 10 years, and a category of less serious cases providing imprisonment up to 2 years.

The Norwegian crime register provided data on four prosecuting decisions: formal charge leading to conviction, formal charge leading to acquittal, fines and other. All convictions are decisions finding a person guilty of a crime in the court of law (109). In our material, only formal charges leading to final convictions were included in the analysis.

According to the national directives, every single offence committed at one particular occasion must be registered separately (109). Hence a person may be registered as having several convictions during a single day, e.g. being convicted for both stealing a car and for driving under the influence. In Papers I, II and III, rates of convictions refer to the number of convictions that occurred within a given period of time. In Paper IV, the unit of observation was a “crime-day”, defined as a day an individual had one or more criminal offences leading to convictions.

2.1.2 The Norwegian OMT register

The national OMT register was a research-based register established based on lists of patients from each of the 14 OMT centres in Norway, and included data on all patients who applied for, started and left OMT during the period of 1997-2003. The OMT patient register included information on age and gender, treatment region, and the exact dates of treatment admission and cessation.

The OMT patient register comprised four treatment regions according to the administrative regional health enterprises. The Eastern region included patients from Oslo, Akershus, Hedmark, Oppland and Østfold. The Southern region included Buskerud, Vestfold, Telemark, Aust-Agder and Vest-Agder. The Western region included Rogaland, Hordaland and Sogn and Fjordane, and the Central-Northern

region included patients from Nord-Trøndelag, Sør-Trøndelag, Møre and Romsdal, Nordland, Troms and Finnmark.

During the first years of our observation period, all patients were on methadone. Buprenorphine was defined as an OMT drug during 2001 and was used by 16% in 2002 and 23% in 2003 (5). The internationally recommended dose of methadone is approximately 80-130 mg per day, and Norway is located in the upper strata of the recommended dosage. The average dosage of methadone and buprenorphine in Norway was 112 mg and 17 mg respectively during 2003 (5).

2.2 Study population and observation period

A total number of 4204 individuals applied for OMT during 1997-2003 (Figure 1). Those not eligible for treatment (n=415), either because they did not fulfil the criteria for OMT or because they withdrew their application for treatment, were excluded from the dataset, leaving 3789 individuals eligible for treatment. Of patients eligible for OMT, 3221 started treatment during the observation period of 1997-2003, whereas 568 were on the waiting-list and had not yet started OMT by 31 December 2003. During the period of observation 63.5% (n=2046) patients were retained in continuous treatment and 36.5% (n=1175) patients left treatment (Figure 1). No patients were lost during follow-up.

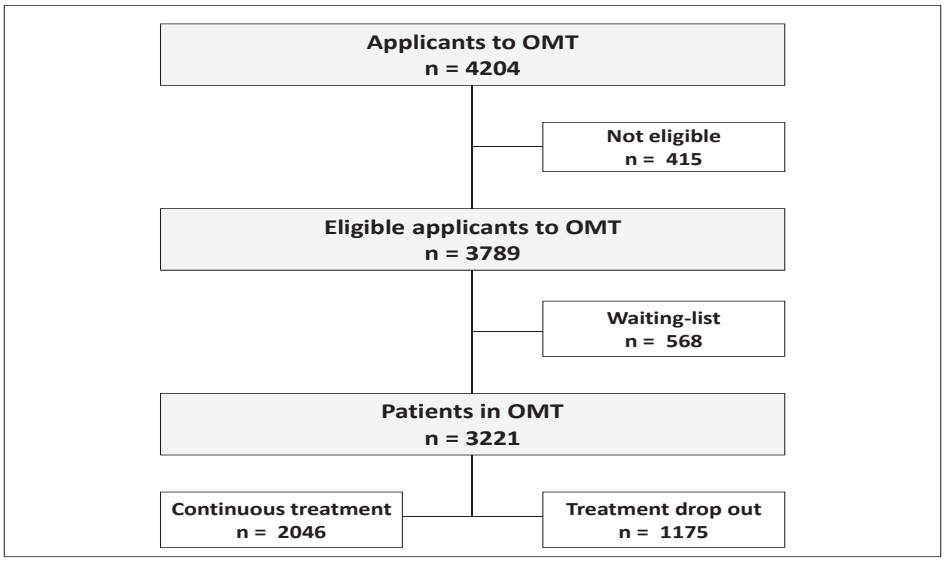

Figure 1. Flow-chart of the Norwegian OMT cohort (1997-2003).

The study refers to individual and varying observation times for each person; from formal application and entry to OMT, until the last day of observation, set at 31 December 2003. Some patients (n=135) died between treatment start and the last day of observation (31.12.2003), and the date of death was set as the end of observation for those who died.

Table 1. The study populations in Papers I-IV (1997-2003).

	Paper I	Paper II	Paper III	Paper IV
Study population	n=3789	n=3221	n=3221	n=3221
Mean age , (SD)	36.1 (6.7)[a]	37.0 (6.7)[b]	37.0 (6.7)[b]	37.0 (6.7)[b]
Female, n (%)	1207 (31.9)	1045 (32.4)	1045 (32.4)	1045 (32.4)
Period of observation	3 years prior to application	Pre-, during, between and after treatment	Pre-, during and after treatment	Pre-, during, between and after treatment

[a] Age at application, [b] Age at treatment start

In Paper I (Table 1), the 3-year period prior to application for treatment was defined based on the date of the first OMT application (1997-2003), creating a dynamic cohort with individual 3-year observations. First year of observation was 3 years prior to the OMT application date.

In Paper II, the period of observation was separated into different phases; *pre-treatment* included days between application and the first day of treatment (waiting-list), *in-treatment* included the actual number of days in OMT, *between treatment* included the total days between each treatment period for those who re-entered, and *post-treatment* included the sum of all days after ending treatment until end of 2003 (Table 1).

In Paper III (Table 1), the period of observation was separated into different phases; *pre-treatment* included three years prior to the first day of treatment, *in-treatment* included the actual number of days in OMT, and *post-treatment* included both the period between treatment episodes (for those who re-entered treatment) and the period after treatment cessation.

In Paper IV, the period of observation was separated into different phases. The *pre-treatment* period included three years prior to the first day of treatment. The *in-treatment* period was divided into the actual number of days during the first episode of OMT, and further into the number of days in the

subsequent treatment episodes. *Between treatments* included the total days between each treatment period for those who re-entered, and *post-treatment* included the period after treatment cessation (Table 1).

2.3 Subgroups of patients

In Paper I, heroin users (n=3789) were defined into three groups according to levels of convictions three years prior to treatment application. Heroin users who did not have any convictions were defined as the "no-conviction group" (n= 1480). Of those having convictions (n=2309); heroin users in the "high-conviction group" (n=251) comprised the 90-percentile of patients having the most convictions (≥ 26 convictions) whereas the rest of the cohort (n=2058) were termed the "medium-conviction group" (1-25 convictions).

In Paper II, patients (n=3221) were defined into groups according to levels of convictions during waiting list and retention status. Patients who did not have any convictions during waiting list were defined as the "no-conviction group" (n= 2504). Of those having convictions (n=717), patients in the "high-conviction group" comprised the 90-percentile of patients having the most convictions (≥ 11.5 convictions per person year) during waiting list (n= 72). The rest of the patients with criminal convictions during waiting list (n=645) were included in the "medium-conviction group" (0.2-11.4 convictions per person year).

In Paper II, patients were further classified into one of four categories, depending on their retention status at the end of follow-up (December 31 2003). Group I were made up of "stayers", who were in continuous treatment throughout observation (n= 2046). Group II were "re-entering stayers", patients who had several treatment episodes (n=422) but who were in treatment at the end of the observation period. Group III, "re-entering leavers" were those who had left treatment after several treatment episodes (n=93), and group IV, "leavers", were patients who ended treatment after one single treatment episode (n=660) (Paper II).

In Paper III, patients (n=3221) were classified into one of the four different health regions in Norway; the Eastern region (n=1717), the Southern region (n=751), the Western region (n=586) and the Central-Northern region (n=167).

In Papers III & IV, patients (n=3221) were divided into three groups according to levels of convictions three years prior to treatment start. Patients who did not have any convictions were defined as the "no-conviction group" (n= 1375). Of those having convictions (n=1846); patients in the "high-

conviction group" comprised the 90-percentile of patients (n=187) having the most convictions (≥ 28 convictions), and the rest of the patients (n=1659) were included in the "medium-conviction group" (1-27 convictions).

To investigate the OMT programme's overall effect, all patients in the cohort (n=3221) were included in an "intention-to-treat group", where all convictions for both periods in treatment, between treatment episodes and after treatment were included (UPR).

2.4 Data analysis

Analyses were performed using SPSS version 18 (115), STATA version 11.0 (116) and R (117).

Table 2. Statistical packages and statistical analyses used in Papers I, II, III, IV & UPR

		Paper number				
		I	II	III	IV	UPR
Statistical package	**SPSS version 18**	X	X			
	Stata version 11	X	X	X	X	X
	R				X	
Statistical analysis	**Chi-square test**	X	X	X	X	
	Student's t-test	X	X	X	X	
	Pearson's product correlation	X				
	Incident rate		X	X		X
	Rate ratio		X	X		X
	Multivariate logistic regression	X				
	Multivariate negative binomial regression		X	X		
	Time-continuous probability model				X	

The estimation of incidence rates, with person-time instead of individuals as the unit of measure, allows for some flexibility in the analysis of cohort studies (118). When calculating the incidence rate (Papers II, III & UPR), the numbers of cases were divided by a measure of time. This time measure is the summation, across all individuals, of the time experienced by the total population being followed, and can be referred to as the time at risk of criminal convictions.

$$\textbf{Incidence rate} = \frac{\text{Number of criminal convictions}}{\sum \text{person time}}$$

$$\textbf{95 \% confidence interval for Incidence rate} = \frac{\text{Exp (In (IR)} \pm 1.96}{\text{VA}}$$

Incidence rates treat one unit of time as equivalent to another, regardless of whether these time units come from the same person, or from different people, and is often referred to as *person-time* (119). The rate ratio (Papers II,III & UPR) measures the strength of an association between an exposure and the outcome (120). If treatment has no effect, the rate would be the same in the unexposed and the exposed group, and the rate ratio would be equal to 1. If the incidence rate is lower in the exposed group, the rate ratio would be less than 1 (120).

$$\textbf{Rate ratio} = \frac{\text{Rate in the exposed group}}{\text{Rate in the unexposed group}}$$

$$\textbf{95\% confidence interval for rate ratio} = \frac{\text{Rate ratio}}{\text{EF to rate ratio x EF}}$$

$$\textbf{EF} = \exp\,[1.96 \text{ x s. e of} \log(\text{rate ratio})]$$

Multivariate logistic regression models (95% CI) were calculated to determine the associations of age and gender on odds for being convicted (Paper I). The association of variables with criminal convictions during treatment (Papers II & III) was assessed using multivariate negative binomial regression models designed for count outcomes (121). The negative binomial regression model can be considered a generalization of Poisson regression and is often used for over-dispersed count data which is when the conditional variance exceeds the conditional mean (121). The effect sizes are reported as the incidence rate ratio (IRR). The incident rate ratios are obtained by exponentiation of the regression coefficient. For interpretation of the IRR, the expression 100*(exp[β]-1) tells us the percentage change in the incidence risk for a one-unit increase of change in the explanatory variable given the other variables held constant in the model (122). Exposure time (sum of person-years in treatment) was included in the models. In order to test for differences between each value in the factor variables, post-estimations following each of the negative binomial regression analyses were conducted.

In Paper IV, a model for the time-continuous estimate for the probability of criminal convictions was calculated. The number of crime-days at a specific given time, measured relative to entering, re-entering or leaving treatment, divided by the number of patients observed at that time, is an estimate of the probability of a criminal activity at that time (123). Calculating this probability for all times, i.e. all days where patients were observed as being in the study, resulted in a time continuous estimate of the probability of a criminal event in the cohort on any day. In order to reduce the effect of natural day-to-day variation, the estimate was smoothed using a Gaussian Kernel (124;125). A time continuous 95% confidence interval (CI) was calculated using bootstrapping (126), a general statistical re-sampling methodology.

2.4.1 Sensitivity analysis

The stability of the groups categorized according to retention in Paper II, could be vulnerable to patients coming late into the study. Hence, sensitivity analyses were performed in order to exclude those who entered treatment after 01 January 2003. A total of 682 (21.17%) patients entered treatment after 01 January 2003; of those 563 were categorized as "continuous", 48 as "re-entering stayers", 4 as "re-entering leavers" and 67 as leavers. Calculating new crime rates, and negative binomial regression analysis excluding all patients coming late into the study (n=682), did not alter any results, with the exception of years in treatment which were not significantly associated with convictions during treatment. It was therefore decided to keep the model including all patients and available data in our presentation (Paper II).

The crime register also included information on fines, and it was considered reasonable to investigate whether crime-patterns for fines were similar to those for criminal convictions. A negative binomial regression analysis with fines as the outcome variable was hence preformed (Paper II). The results of the sensitivity analysis showed virtually the same patterns as for convictions, except that no gender differences were found. In Paper II however, it was decided to concentrate on convictions as the outcome variable. Being convicted of a criminal offence requires legal processing, making convictions a more homogeneous unit of criminal activity. When our study is not focusing on the actual prevalence of criminal activity, but rather changes in levels of crime in relation to treatment initiation or termination, the actual prevalence is considered to be less important (Paper II).

2.5 Ethics

The use of national registers as a source of information did not require any further data collections or interventions, and it is considered important to utilize existing data sources to evaluate and improve treatment. The study was approved by the Norwegian Social Science Data Services (NSD), the Norwegian Directorate of Health, The Police Directorate and the Regional Committees for Medical and Health Research Ethics. The information included in the Norwegian OMT register and the Norwegian crime register was given exemption from the requirement of informed consent. Files were merged and made anonymous by Statistics Norway.

3.0 Results

3.1 Patterns of criminal convictions among heroin users before admission to OMT

A total of 24 478 convictions were recorded among heroin users (n=3789) in the 3-year period prior to OMT application (Figure 2). Most convictions were for acquisitive crime (55.9%) and drug offences (21.5%). Road traffic offences constituted the third largest category in the dataset, and were mainly related to driving without a valid driving licence (7.2%) and to driving under the influence (3.6%). There were 557 convictions of violence (2.3% of all convictions), where most of these were considered to be less aggravated. The subcategory of aggravated violence contained only 8 of the most severe convictions; murder (n=4), attempted murder (n=2) and rape (n=2). Distributions of convictions remained similar during each individual year of observation (Paper I).

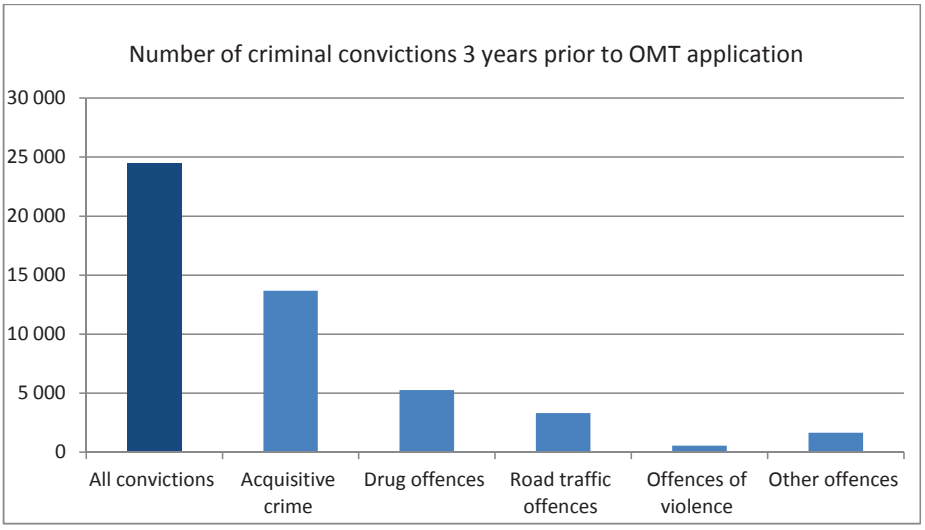

Figure 2. Sum of convictions during the 3 years prior to treatment application (n=3789) (Paper I).

During the 3 years prior to application, 60.9% of the cohort had at least one conviction. The overall rates of heroin users exhibiting the various types of criminal convictions were quite stable for each year of observation (Paper I). Variations in individual crime sequences were found. About 40% of the sample was convicted during 1 or 2 years of the three-year observation period, but only 18.3% had convictions every single year of the study period. Of those who had convictions for acquisitive crime,

11.0% of the cohort had convictions for acquisitive crime each year of observation. However, only 5.3% of the cohort had convictions for drug offences during every year of observation. Of the 140 individuals who were convicted with offences of violence during the first year, 105 did not have further convictions for violence, and only 6 of them continued having convictions for violence during all 3 years (Paper I).

When examining the day-to-day probability of criminal convictions during the years prior to treatment entry, the probability of criminal convictions among the cohort was approximately 0.4% per day. However, about three months before treatment initiation, the probability of criminal convictions within the cohort gradually fell to a new and lower level, stabilizing at about 0.2% per day at the day of treatment initiation (Paper IV).

3.2 Criminal convictions during OMT compared with pre-treatment levels

During treatment, rates of criminal convictions for the cohort were reduced to less than half (RR 0.40) of waiting-list levels (IR 1.57 vs. IR 0.63) (Paper II, Figure 3). There were however differences in criminal convictions according to the patient's engagement in treatment. Patients in continuous treatment (n=2046) had a two-thirds reduction in criminal convictions during treatment. This group had low rates of convictions both prior to (IR 1.39) and during treatment (IR 0.47). Patients retained in treatment after several treatment episodes (n=422) had higher rates of convictions during treatment (IR 0.74) than patients in continuous treatment, and had less than a 50% reduction in criminal convictions during treatment. The group out of treatment after several treatment episodes (n=93) had more than four convictions per person-year (IR 4.46) prior to treatment. During treatment, convictions per person-year fell to less than two (IR 1.52), which constitutes a reduction in convictions of about two thirds compared to waiting-list levels. Patients who left treatment after one treatment episode (n=660) had nearly two convictions per person-year prior to treatment, and during treatment, convictions were reduced to almost 40% compared to pre-treatment levels (RR 0.63) (Paper II).

An overall reduction in criminal convictions of almost 50% (RR 0.53) was found when comparing the waiting-list level (IR 1.57[1.54-1.60]) and the "intention-to-treat" level (IR 0.83 [0.81-0.85]) where convictions for periods in treatment, between treatment episodes and after treatment were included (UPR).

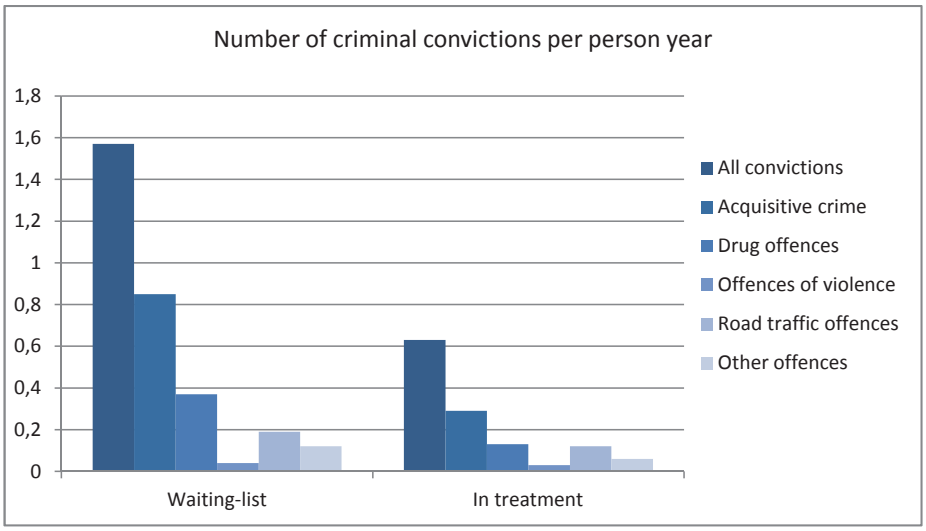

Figure 3. Criminal convictions prior to (waiting-list) and during OMT (n=3221). Y-axis: IR: Incidence rate (number of criminal convictions/ total person-years of observation) (UPR).

There was a reduction in all five categories of offences when compared to pre-treatment levels (Figure 3). Both offences of acquisitive crime (RR 0.34) and drug offences (RR 0.35) showed approximately a two-thirds reduction from waiting-list levels. Offences of violence (RR 0.66) and road traffic offences (RR 0.64) showed less reduction during treatment, with rates reduced by one-third of waiting-list levels (UPR).

3.3 Criminal convictions during treatment drop out and re-entry of OMT

A number of patients engaged in several treatment episodes (n=515). Of these patients, some were retained in treatment (n=422), and some were out of treatment (n=93) at the end of observation (Paper II). During periods between treatment episodes patients relapsed to more criminal convictions. Patients who were retained in treatment after several treatment episodes, had nearly three times as many convictions during between treatment episodes (IR 2.1) compared to during treatment (IR 0.74). Patients who were out of treatment after several treatment episodes had nearly three convictions per person-year (IR 2.93) between treatment episodes, which is nearly twice as many convictions (IR 1.52) as during treatment (Paper II).

For all patients leaving the first episode of OMT (n=1175), there was an increase in criminal convictions prior to the change in treatment status. During the two months prior to treatment termination the probability of crime gradually rose, reaching a new, higher level around the day of treatment dropout. This new and relatively stable level appeared to be somewhat higher than the pre-treatment level (Paper IV). For all patients with several treatment episodes (n=515), the higher crime level between treatments was steady until approximately three months before re-entering treatment, when it again fell to a lower level of about 0.2%. Compared to the period prior to the first episode of treatment, the probability of criminal activity was higher during the period before re-entering OMT (Paper IV).

3.4 Pre-treatment and in-treatment characteristics associated with criminal convictions

When analysing criminal convictions among patients in four treatment regions, differences were found with regard to criminal convictions during treatment (Paper III). Compared to patients in the Eastern region, patients in the Southern and Central-Northern region had correspondingly 32% and 58% less convictions during treatment, whereas patients in the Western region had 19% more convictions. When stratifying patients according to retention in treatment, differences in criminal convictions across regions were sustained for patients in continuous treatment; compared to patients in the Eastern region, those in the Southern and the Central-Northern region had respectively 44% and 81% less criminal convictions during treatment. In contrast, patients in the Western region had 60% more convictions. For patients not in continuous treatment, no differences were found in criminal convictions between the four treatment regions (Paper III).

Time spent in treatment was associated with significantly reduced rates of convictions during treatment. Those patients who were in treatment for more than two years were associated with 28% ($P<0.05$) less convictions during treatment compared to patients who were in treatment for a year or less (Paper II).

In the 3-year period prior to OMT application, a high-risk group, comprising the 10% (n=251) with the highest frequencies of convictions, accounted for 37.8% (n=9249) of all convictions. This group of high-risk offenders had at least 26 convictions each during the 3 years prior to application. The high-rate offenders accounted for 45.4% of all acquisitive crime, 37.9% of all traffic offences, and 22.8% of violent offences. Men had higher odds (OR 3.86[CI 2.65-5.53]$p< 0.001$) for being in the group with 10% highest convictions compared to women. Older individuals had lower odds for being in the high-risk group; the odds decreased ($P<0.001$) by a factor of 0.93[0.91-0.95] for each year of increasing

age, holding all other variables constant (Paper I). Having a high level of pre-treatment convictions was also found to have an impact on levels of convictions during treatment. Compared to patients who had no pre-treatment convictions, patients with high levels of convictions prior to treatment were associated with more than five times as many convictions during treatment (Paper II). Patients with a high level of pre-treatment convictions also had an elevated probability of criminal convictions during the months before treatment drop out (Paper IV).

During the three years prior to OMT application, men had more convictions (median 7.0) than women (median 4.0). When adjusting for age, the odds ratio for having convictions among men was 2.2 [CI 1.89- 2.51] compared with women (Paper I). Compared to women, men had higher rates of convictions both during waiting list and during treatment (Paper II). Also when stratifying into groups according to retention status, both women in continuous treatment, and women with several treatment episodes, had consistently fewer criminal convictions per person year compared to men (Paper II). When adjusting for age, levels of pre-treatment criminal convictions, and years spent in treatment it was found that women had 42% ($P<0.001$) fewer convictions during treatment compared to men (Paper II).

3.5 Brief summary of main findings

During the three years prior to application for OMT, the heroin users in this national cohort were engaged in extensive levels of criminal activity resulting in convictions. Of those who were convicted, most had convictions for acquisitive crime and for drug offences. During the months prior to treatment initiation, a gradual reduction in criminal convictions was observed.

During treatment, the levels of criminal convictions were reduced to less than half of pre-treatment levels. The greatest reductions were found for acquisitive crime and drug offences. Variations in treatment outcomes correlated with treatment retention. Patients in continuous treatment had less criminal convictions compared to patients dropping out of treatment.

During the months prior to treatment drop-out, patients had a gradual increase in the risk of criminal convictions. In periods between and after treatment episodes, patients relapsed into higher levels of criminal convictions. In the phase before re-entry of treatment, a reduction in criminal convictions was also found.

Both pre-treatment and in-treatment characteristics were found to be associated with criminal convictions. Patients in the Central-Northern and Southern region had less criminal convictions during treatment compared to patents in the Western and Eastern region. Staying in treatment for more than two years was associated with fewer convictions during treatment. High levels of pre-treatment convictions and being male were associated with more criminal convictions during treatment.

4.0 Methodological considerations

4.1 Study design

The study presented in this thesis had a longitudinal cohort study design. A cohort is defined most broadly as any group of individuals who are followed or traced over a period of time, and a study is considered longitudinal if the information is obtained at more than one point in time (119). The cohort designates a group of people who share a common experience or condition and comparisons of outcomes are made within the cohort across subgroups by one or more exposures (118). The cohort included in the OMT register, shared that they all had applied to OMT. The Nordic countries probably have the highest numbers of population-based registers that are available for research (127). However, there are several potential biases associated with this method of data collection, and awareness of the sources of bias and how they can affect the study results are important for drawing the right conclusions.

Errors in estimations are usually classified as random error or systematic error (118). The effect of random errors will be reduced towards zero in a study that is infinitely large. In contrast, systematic errors are not affected by the size of the study (119). Systematic errors are often referred to as biases. A study can be biased in the way in which the subjects have been selected, in the way the study variables have been measured or by some confounding factor that has not been controlled for. The opposite of systematic errors or biases is validity, and a study that has little systematic error may be described as valid (118). The validity of a study is often separated into two components; internal and external validity (generalizability).

4.2 Sample and selection bias

Selection biases represent common violations of internal validity and stem from the procedures used to select subjects and from factors that influence study participation. Selection bias is present when the exposure and/or outcome differs between those who participate and those from the source population who do not participate in the study (118).

Our study cohort comprised all individuals who applied for OMT (n=3789) and subsequently started treatment (n=3221) in Norway, and is thus regarded as a complete national cohort of patients. Even so, it might be that the characteristics of those individuals seeking treatment were different from

those who did not. Research has investigated differences between heroin dependent individuals who seek treatment compared to those who do not seek treatment (128;129). In a recent study it was found that in-treatment participants were more likely to have lower rates of criminal activity and higher employment functioning. They were also more likely to have a more extensive history of methadone treatment, greater desire to seek help in coping with the drug problem they were experiencing, and a more positive view of methadone (129). Our sample consisted of a group of heroin users who had actively and voluntarily applied for OMT. Since the Norwegian OMT programme during the period of observation could be described as high-threshold and restrictive, it is likely that our cohort included a group of particularly motivated patients. Those theoretically eligible for treatment, but with less severe or shorter lengths of dependence may thus be less prevalent in the study cohort than in the source population. On the other hand one could argue that even though the entry criteria were aimed at selecting patients with serious dependence, the introduction process itself might have selected those less severely dependent because the heroin dependent persons had to deal with an especially complicated and comprehensive application process (6). However, since the literature has documented the effect of OMT for several groups of patients, we would expect similar outcomes also for other heroin dependent individuals not recruited to the Norwegian OMT programme.

Selection bias can also occur in cases where patients drop out of the study population during follow-up. Although OMT is offered as a long-term or lifelong treatment, interruptions of treatment are common (57;59;90), and premature dropout is arguably the most common and significant problem facing patients, practitioners, and clinical researchers (130). Of all patients recruited to OMT in Norway (n=3221), 1175 dropped out of the first episode of treatment and 515 returned to treatment for several treatment episodes. It is likely that the group of patients who left treatment included individuals with the largest burden of psychiatric co-morbidity and poly-drug use. Studies have found that high levels of criminal activity prior to treatment (131), illicit drug use and alcohol problems (132;133) and indicators of maladaptive functioning were strongly associated with reasons for dropping out of treatment (130). Unlike an RCT, observational studies cannot control for the selection of patients entering or leaving the study. To weigh up against the problem of selection bias, all patients were stratified according to whether they were in continuous treatment or not. By stratifying patients according to retention, and by comparing crime rates before, during and after treatment, we were able to gain valuable information on crime patterns both for patients in continuous and in non-continuous treatment, during the different phases of OMT.

4.3 Information bias

Information bias refers to the systematic error that arises when the information collected is incorrect or variables are misclassified (119). Obtaining data on criminal convictions from the Norwegian crime register eliminates recall bias. The Norwegian crime register included information from all the Norwegian police districts, and offence details are registered in accordance with national instructions (110). Nevertheless, even with best practices, errors may occur. Statistics Norway has reported some cases of misclassifications by the police departments in Norway (134). The fact that all crime cases were registered using specific crime codes makes it challenging to determine whether the correct codes were given at the time when the crime was recorded. However, in cases of criminal convictions, offence codes are registered by a lawyer after the crime case has been closed (134). For this reason, the electronic registration of criminal convictions in Norway is considered to be of high quality (110). Nevertheless, several aspects can influence the specific information that goes into the registers.

Changes in legislations, governmental control and police priorities may produce changes in the criminal statistics across time (109;135). A more explicit focus on drug use may hence lead to more drug offences and drug-related offences being recorded (109). In the period of 1990-2002 there was an increase in the number of less serious drug offences (use and possession of drugs) in Norway, due to the explicit focus on this type of crime (136). Moreover, as most drug-related criminal offences are detected by the police themselves, the police in such cases have both a suspect and evidence, which is quite the opposite of the majority of other criminal offences. Hence, almost 90% of less serious drug-related criminal offences go to fines, acquittals or convictions instead of being dropped (109). Further, the fact that many drug users are particularly visible and also often known to the police can also contribute to a higher risk of being detected by the police, compared with the general population. Finally, criminal offences registered in the crime register may not be evenly distributed across the country. Oslo, the capital city, is the county with the highest amount of registered criminal offences, both when it comes to the actual figure, and when the figure is adjusted according to the number of citizens (109). One in five offences was registered in Oslo, even though only one in ten of the general population were resident there.

Because all cases concerning use and possession of drugs were excluded from the analysis and because the periods of observation included individual observation periods for each patient, there is no reason to believe that our results were influenced by shifts in governmental focus on drug use. Also, given that the focus in this study was to compare criminal convictions in phases before, during,

and after treatment, our study is considered to be less influenced by geographical differences in criminal convictions.

4.4 Confounding

The OMT register only included patient information on age and gender, and the few background variables that were included in this study made our results especially vulnerable to confounding variables. Confounding may be thought of as mixing of effects, implying that the effect of the exposure is confused with the effect of another unknown variable, leading to bias. The confounder must be associated to both the factor and the outcome variable, but must not be an effect of the exposure (119). The distortion caused by a confounding factor can be large, and it can lead to overestimation or underestimation of an effect depending on the direction of the association with the confounding factor (118). The effect of confounding may however be reduced through stratification or multivariate statistical analysis, thus stratifications and/or multivariate analysis were applied in all the papers presented in this thesis. However, in the absence of an equivalent, randomly assigned untreated control group, we cannot conclude exactly how much of the reductions in criminal convictions may have resulted from unmeasured factors that were not related to the OMT programme.

Our data did not include information on poly-drug use and continued heroin use among the members of the cohort. Prior studies have pointed out that heroin users are rarely exclusive users of one drug (24), and that a characterization of drug users as solely heroin users misses the context in which drugs are used (137). Criminal involvement has been found to be associated with patterns of drug use (79), and the effectiveness of pharmacological treatment is less pronounced for users of both heroin and other drugs, than for users of heroin alone (138). In 2004, a study investigating drug use during OMT in Norway, found that 11% were found to have used heroin, 25% to have used cannabis, 27% to have used benzodiazepines and 12% to have used amphetamines during the previous 4 weeks (6). Studies have also shown that treatment outcomes have been mediated by continued use of heroin during OMT (98). Stratifying patients according to poly-drug use and continued heroin would probably have displayed stronger reductions in criminal convictions for patients who were predominantly users of heroin and for those who did not continue using heroin during treatment.

Moreover, our register did not include available data on general health status. Medical- and social status are considered important indicators of the addiction career. Researchers have reported high

degrees of psychiatric co-morbidity and personality disorders among entrants to treatment for heroin dependence (27), and that a range of psychological and social problems are associated with increased frequency of crime (18). Studies investigating the effect of psychiatric severity on treatment outcome have reached various conclusions. In the ATOS study, it was found that major depression was the most consistent participant characteristic associated with poor outcome (29). Other studies have found that patients with high psychiatric severity do not display worse treatment outcomes, in terms of retention and drug use, compared to patients with low psychiatric severity (139). Since patients with severe somatic or psychiatric diseases were prioritized at intake to OMT (6), a number of patients in our cohort may have had psychiatric co-morbidities. It is thus likely that controlling for factors like general health status and psychiatric co-morbidity, if available, would have provided a more nuanced picture of the OMT outcomes.

4.5 Low risk periods during follow-up

Our period of follow-up included all the time that the population was enrolled in the study, and no patients were lost during follow-up. Nevertheless, the dataset did not allow adjustments for time spent in prison, hospital or other institutions during the study period. For heroin users, periods of intensive drug use are often interrupted by cycles of drug treatment and incarceration for drug related offences (12). Given that one of the criteria for acceptance to OMT was to have had some previous contact with abstinence-oriented treatment (6), it is likely that most patients in the cohort have been admitted to institutions at some point prior to OMT, where their ability to commit criminal acts may have been removed or substantially reduced. However, during the initial years of OMT in Norway, only very few patients received OMT drugs in prison or other institutions. According to the national guidelines at that time, patients in OMT could receive OMT drugs in prison, but only during periods on remand or short sentences. In cases of longer sentences, treatment could be commenced one month prior to release (71). Because admissions to prison and other institutions most likely would have occurred *prior to* and *after treatment* instead of during treatment, it is likely that the levels of reductions in criminal convictions during OMT documented in this study compared to outside OMT are somewhat underestimated.

4.6 Strengths

It is generally recognised that longitudinal studies are required to investigate the various stages of addiction and crime careers (80). Because drug users typically move through various stages of both

dependence and treatment, a more sensitive longitudinal approach is needed to identify and understand key factors influencing drug use and treatment over time (89). However, critics have pointed out that studies evaluating maintenance treatment have often failed to include analysis of patients dropping out of treatment but rather have focused on treatment effects for the selection of those who were compliant with treatment regimes (140). A loss of subjects during the study period is a common problem for observational studies, and often prevents reliable outcome measurements because the outcomes of lost subjects are unknown (118). The major strength of our study was having a complete national cohort of OMT patients, including all who had applied for and subsequently entered OMT in the period of 1997-2003, including more than 20 000 years at risk. The availability of nationwide registers ensured that no patients were lost to follow-up, making it possible to address the possible effect of patients cycling in and out of treatment.

Studies investigating criminal activity in OMT have usually compared levels of criminal activity in relation to pre-defined categories, such as the period before and after the date of treatment entry. However, the analysis of pre-post data may involve comparisons of relative dysfunctional pre-treatment periods with more stable in-treatment periods (74), and categorizing data into pre-defined categories often does not include a perceptive of the dynamic aspect of treatment. A major advantage of the use of criminal registers was that all criminal offences were recorded at specific points in time, making it possible to calculate a time-continuous day-to-day probability for criminal activity for the entire observation period, beyond regular pre-post comparisons.

In most countries, the linkage of data are made by an exact match on first name, last name and birth date to link records. However, data entry errors, e.g. misspelled names, transposed digits, may complicate the task of linking (141;142). In Norway, records are linked by using the unique national identification number assigned to all residents. An important strength of our study was hence to have a good match between each patient and every criminal conviction registered.

Another advantage of the use of criminal records in longitudinal studies include the length of the time period covered, and the lack of gaps in the recording of criminal events (101). Self-reported survey data collections are often designed to have gaps in the reporting period, often associated with the costs of carrying out the research or to problems of recall. The use of convictions as the measure for crime avoided the problems associated with the use of self-report data, namely that the validity of self-reported criminal behaviour may be adversely affected by problems of recall, or by motivated deception involving either exaggeration or concealment of illegal activities. Moreover, having the complete number of convictions made it possible to study patterns of crime prior to, during, and

after OMT without having information about the actual prevalence of criminal behaviour in the cohort.

4.7 External validity

The process of generalization in science involves making assumptions about the domain in which the study results apply, and is often a question of whether the factors studied distinguish the studied groups from other groups, and somehow modify the results from the study (118). Before generalising the findings reported in this present study, it is important to recognize that there may be differences between the cohort studied and the cohort of patients that are currently in OMT in Norway. Our cohort included the first group of heroin dependents entering OMT in Norway when the criteria for entry were high threshold (6), and it is likely that patients were particularly motivated for treatment and hence made a great effort when treatment was offered. In the current treatment setting where new guidelines (2) have been introduced and the criteria for entry and re-entry are less strict, patients may consider that they can stay in methadone treatment for a while, without putting the most effort into rehabilitation, and it has been suggested that increased access to treatment could make patients more prone to drop out (143).

It is also important to recognize that there are marked variations between countries, both in the cultural context of drug use, and with regard to the legal, administrative, governmental and medical framework. Firstly, the European countries differ with regard to heroin use and route of administration. Norway, and particularly Oslo, have had worrying drug problems mainly related to injected use of heroin and the number of overdose deaths (144). Available comparisons of injecting heroin users between EU member states show a variance with respect to patterns of injecting drug use. Estimates range from 2.6 (injectors per 1000 inhabitants) in Germany to 4.8 in Luxembourg. Rates for Austria, Finland, Portugal, and the United Kingdom fall within this range, with both Denmark and Norway estimated at the rate of 4.3 (145).

Moreover, the delivery of OMT is often a result of complex interactions dependent on which drugs are allowed according to national health systems, as well as the political and financial frameworks at a national level (146). OMT has been introduced at different stages in the European countries, and each country has had different reasons for introducing methadone treatment (146). As heroin spread so did methadone treatment, although the timing and the extent of both the heroin “epidemic” and the treatment provision has varied. In the 1960s Sweden, the Netherlands and the UK were some of

the fist countries in the world to introduce methadone treatment (146;147). For Belgium, France and Norway OMT was introduced more than 25 years later (146).

Differences in government treatment policies and health-care delivery systems as well as drug-user characteristics can make it debatable whether the outcomes observed in this study can be directly translated into other settings. It is likely that differences in outcome may reflect differences in setting across different OMT programmes. Maintenance treatment services differ in the extent to which they are characterized as rehabilitation- or harm reduction-oriented (6). When the Norwegian maintenance programme was introduced it could be described as rehabilitation-oriented, high threshold and restrictive (71) and it adhered to the original American programme (6). In contrast, harm reduction programmes are often aimed at groups that do not actively seek therapeutic support, and in these programmes little is demanded from the users while much is offered. In contrast to the Norwegian system, the Netherlands, Portugal, Germany and Switzerland have a more low-threshold OMT system founded on a harm reduction perspective (144).

Furthermore, the organisation of maintenance treatment is more or less unique for each country. Some countries, like Norway, Sweden, Finland and Greece provide methadone maintenance through specialist centres, while other countries such as Austria, Germany, Ireland and Luxemburg offer maintenance treatment through General Practitioners. Some countries, like Belgium, France and the UK offer maintenance treatment in a mixed organization mode with both General Practitioners and specialized centres (146).

However, despite the variations in treatment settings across time and between different countries and treatment settings, the reductions in criminal convictions that were found in our study were similar to findings from previous international studies conducted in a range of different countries and treatment settings through years of comprehensive research (3;25;61;148). This suggests that it might be possible to make some generalizations that criminal convictions are reduced during OMT, also in another treatment setting outside the Norwegian OMT programme. It is therefore believed that the results presented probably are a fair guidance to the usefulness of OMT in reducing crime while patients are retained in treatment, although the exact effect sizes of OMT are likely to vary across treatment settings.

5.0 Discussion of results

5.1 Patterns of criminal convictions among heroin users before admission to OMT

Consistent with previous findings (17;18;79) the heroin users in this national cohort had a considerable criminal involvement during the years prior to OMT application, both in the numbers of crimes committed and the percentage of heroin users involved in crime. More than 60 percent had been convicted of at least one offence during this period, and more than 24 thousand convictions were brought against them. Heroin users were mostly convicted of acquisitive crimes and drug offences (Paper I), a finding that is well-established (18;19;21;61;149). In a recent study conducted in the UK, it was found that 57% of a cohort of patients recruited to methadone maintenance treatment had received one or more convictions or cautions of any type during the 12-month period prior to treatment start, and of those 51% one or more had convictions for an acquisitive offence, or for a drug-related offence (59).

Road traffic offences constituted the third largest category, and almost a quarter of the study sample had convictions for road traffic offences during the three years prior to application (Paper I). Even though most road traffic offences were related to driving without a licence, almost 4 percent of all convictions during the observation period were associated with intoxication. Despite the relatively few cases, driving under the influence may have serious consequences and studies have found high levels of psychoactive substances among accident-involved drivers (150). Driving under the influence has been found to be particularly common among injecting drug users (151;152). In a study investigating drug driving among a sample of injection drug users in Australia, it was reported that 88% of current drivers had drug driven in the previous 12 months and that 9% reported having an accident in the previous year (151).

Convictions for violent offences were relatively few when compared to other types of criminal offences (Paper I). Violent crime is not common among heroin users (21;28;153), and the pharmacological effects of opioids alone are not known to be particularly associated with violent behaviour (154). In an Australian study investigating the levels of offending among methamphetamine and heroin users, it was found that methamphetamine use was associated with an increased risk of violent offending compared to heroin use (155). However, in contrast to general population data in Norway (men 22-66 years) (156;157), men in our OMT cohort were approximately 8 times more likely to be convicted of violence. Different factors may explain the link between heroin

use and violence. Illicit drug use is a risk factor for men committing intimate partner violence against women. A high prevalence of partner violence has been found among patients in methadone maintenance treatment programmes, and heroin use was significantly associated with perpetration of partner violence (158). It is also highly likely that a proportion of the OMT population may have been poly-drug users (6) who have been found to be more involved with violence than heroin-only users (153). Furthermore, it is possible that the heroin-using lifestyle may lead to situations were violence is more likely, such as in the situations of selling and distributing illegal drugs.

Although most heroin users were frequently involved in crime prior to OMT application, a central finding was that almost 40 percent of the cohort was not convicted of any criminal offence during the entire study period (Paper I). Our findings are similar to those of the NTORS study (79;81). It is likely that some in our cohort might have been criminally active at some point, but not registered by the police. However, it is important to emphasize that there are large variations within the group of heroin users, and that criminal activity is not inevitably linked to problems of drug misuse.

When investigating the year-by-year involvement in the criminal justice system among the cohort, we found high and relatively unchanging levels of convictions during the 3 years prior to OMT application (Papers I & IV). The overall percentages of the cohort who were convicted with different types of criminal offences were also found to be relatively stable across the three years prior to application. About a quarter of the cohort was convicted of an acquisitive crime, and about a quarter was convicted of a drug offence in each of the 3 years prior to application for OMT (Paper I). This finding is in accordance with those of the NTORS study, reporting that almost a third of their sample had been convicted of acquisitive crime during the year prior to treatment entry (61).

However, reductions in criminal convictions were evident in the months prior to initiation to treatment (Paper IV). The period of reductions in levels of criminal activity corresponds approximately to the waiting list period, i.e. the period between application and treatment start (Paper II). In the research literature, there have been few studies focusing on the pattern of drug and alcohol abuse during the waiting-list period, and the studies carried out show somewhat dissimilar results. Some have found that there are little changes in the quality or frequency of substance abuse during the waiting-list period (159). Our result are in accordance with research findings that sizable numbers of treatment-seeking people began making changes in substance use *prior* to treatment entry (160;161). In a study investigating pre-treatment abstinence rates among treatment seekers, it was found that 45% of patients reported stopping substance use prior to entering treatment, and the numbers of patients remaining abstinent were similar for both injectors and non-injectors (160).

Several factors may have contributed to the reduction in criminal activity during the months prior to OMT. During the process of applying for OMT, it is likely that patients would have established contact with the health and social services and, for example, been set up with long-term living arrangements (6). More stable living and social conditions may have contributed to the reduction in criminal convictions prior to treatment initiation. Additionally, individual factors such as treatment readiness, e.g. perceived need for treatment and commitment to participate, is commonly viewed as a critical factor affecting treatment participation and cessation of drug use (162;163). A reduction in criminal activity prior to treatment may be a sign of early action stages, during which the individuals begin taking active steps toward change (160). By actively applying for OMT treatment, a process of change was likely to be initiated and supported, which might have lead to less drug use and consequently less criminal activity. Earlier studies have found that the rate of pre-treatment abstinence correlates with the degree to with participants saw themselves as already taking steps to modify behaviour (160).

5.2 Criminal convictions during OMT compared with pre-treatment levels

Opioid maintenance treatment was found to be associated with significant reductions in criminal convictions in this national cohort. Following treatment entry the overall rates of criminal convictions were less than half of pre-treatment levels (Paper II). Our findings are in accordance with a number of studies documenting the reduction in crime for patients in OMT (59;64;68;148;164). There were also significant reductions in criminal convictions when including convictions for all patients, during all periods of treatment, i.e. the "intention-to-treat" perspective, although this estimate of the Norwegian OMT programme's total effect on crime reduction was lower than when studying in-treatment effects alone. This calculated overall crime reduction gives an estimate of the total reduction in number of convictions as a consequence of the national OMT programme.

The strongest reduction in criminal convictions was found for drug-related offences, there was a two-thirds reduction not only for offences of acquisitive crime but also for drug offences during OMT (UPR). This finding is in accordance with those of the NTORS study, which found that the numbers of acquisitive crime fell to less than a third of pre-intake levels during the first year of follow-up (81;82). Even though the reduction for road traffic offences was less strong compared to the reductions in acquisitive crime and drug offences, there was a one-third reduction when compared with pre-treatment levels (UPR). Driving under the influence is regarded as one of the most important risk factors with respect to traffic safety (150;165), and the results from our study show that OMT may

have contributed to reducing some of the potential harm caused by intoxicated driving. Similar to previous studies (61) our results showed that OMT was also associated with reductions in violent crime. The reductions in offences of violence were however less evident compared to the drug related offences (UPR). This may be due to that fact that factors other than drug use tend to be associated to violent crime, e.g. individual psychological characteristics (41). A previous study found that those whose crime preceded heroin use, were more likely to qualify for a diagnosis of antisocial personality disorder, and also more likely to have committed violent crime (30).

We observed differences according to patients' engagement with treatment. Consistent with a number of earlier findings (25;55;59;68;166) patients who were retained in continuous treatment had fewer criminal convictions during treatment, compared to those who left (Paper II). As in other studies (59), we found that there were differences in criminal convictions among patients in discontinuous treatment; patients who were out of treatment after one or more treatment episodes had more convictions during treatment compared to patients who were retained in treatment after several treatment episodes (Paper II). It might be that patients leaving treatment after several treatment episodes consisted of a selected group of patients. In a recent study carried out in Sweden, it was reported that patients discharged from treatment after the second treatment episode had the most severe addiction career, both in relation to hospitalizations, drug abuse and criminal activity (166).

When comparing the rates of convictions during treatment to the rates of convictions prior to treatment within each group (rate ratio) it was found that patients in continuous treatment (with the lowest rates of criminal convictions during treatment) and patients who left treatment after several treatment episodes (with the highest rates of criminal convictions during treatment), both had a two-thirds reduction in criminal convictions during treatment compared to pre-treatment levels, and hence the most substantial treatment reductions within the cohort (Paper II). Our results are in agreement with those of earlier studies, finding that maintenance treatment was associated with dramatic reductions in illicit opiate use during treatment among patients in non-continuous treatment (25;68).

5.3 Criminal convictions during treatment drop out and re-entry of OMT

During the months before discontinuing treatment the risk of criminal convictions gradually escalated, before stabilizing into a new and higher level outside of treatment (Paper IV). The first few weeks after leaving treatment have frequently been describes as a *critical period* (91), both in terms

of relapse to drug use (91), risk of overdose mortality (53;92;93) and the implications for longer-term outcomes. However, the findings from our study demonstrated that the critical period might start *prior to* discontinuing treatment. The elevated risk of convictions prior to treatment termination may be an indication of an increasingly difficult and chaotic personal situation, resulting in increased drug use and as a consequence increased criminal activity. It is likely that those who left OMT might have continued taking drugs during treatment, and that the extent of the drug use was escalating prior to treatment drop out. Research has indicated that discharged patients had a higher rate of positive urine samples on illicit drugs during treatment compared to patients who remained in treatment (133), and that alcohol related problems were associated to both illicit drug use and discharge from treatment (132).

More than 35% of patients dropped out of treatment, and those who dropped out had higher levels of criminal convictions in periods between treatment episodes and after treatment cessation, compared to during treatment (Paper II). The finding that patients dropping out of treatment relapsed into higher levels of criminal activity during periods out of treatment is consistent with findings from other studies (3;13;25;59;167-169).

This higher crime level between treatment episodes was steady until approximately three months before re-entering treatment, when the risk again fell to a new lower level of about 0.2% per day (Paper IV). The finding that patients with several treatment episodes had a similar reduction in criminal convictions prior to re-entering treatment as when entering treatment for the first time, may point towards revitalization of readiness for additional treatment, even if previous treatment episodes have failed. The chronic, relapsing course of drug addiction and multiple treatment episodes may hence be understood as parts of a cyclic long-term process of recovery, rather than as categorical treatment failures (77). Drug users may well experience a number of failed attempts before being maintained in long term treatment, and treatment effects has been found to accumulate across multiple treatment episodes (170). Some patients may need more time to mature from illicit drug use, and it is known that patients experiencing multiple episodes in maintenance treatment tended to stay in treatment for progressively longer periods in later episodes (171) and that increasing numbers of treatment episodes may be protective of overdose mortality (93). This is an important finding, illustrating that high-severity groups are also potentially high-improvement patients.

5.4 Pre-treatment and in-treatment characteristics associated with criminal convictions

Several *pre-treatment factors* were found to be associated with criminal convictions (Paper I, II & IV). Consistent with previous findings (79) we found that a small fraction of the study population accounted for a high number of the offences during the 3 years prior to treatment start (Paper I). In the National Treatment Outcome Study (NTORS) it was reported that a small group of 10% committed more than three quarters of all crimes in total, and that the group of high-crime individuals were more than 11 times more likely to be regular users of heroin (79). Further, the levels of criminal convictions following programme entry and during the transition out of treatment, were found to be strongly linked to a history of crime in the past; patients with high levels of pre-treatment convictions had an increased risk of criminal convictions during treatment (Paper II) and the highest probability of criminal convictions during the months prior to treatment drop out (Paper IV). The fact that previous criminal activity was a predictor for more criminal activity is a well established finding (166;172). It is likely that those who had high levels of criminal convictions prior to and during treatment represent a selected group of OMT patients. Earlier studies have shown that heroin use is not completely prevented for all patients by methadone maintenance treatment , and that one-in-four tends to not respond well to treatment (82). In the NTORS study, it was found that clients who were the most involved in crime, were the most frequent users of heroin and cocaine, reported more severe drug dependence, poorer psychological health and lower rates of employment at intake (79;81). Hence it has been suggested to strengthen OMT treatment, particularly the psychosocial interventions, for patients with psychiatric and psychological problems (82).

There were gender differences in the proportions of heroin users having criminal convictions. During all stages of treatment, a higher proportion of men were convicted compared to women (Papers I, II & IV). Several studies have reported significantly higher crime rates among men than among women (28;152;173;174). There may be several reasons for the gender differences in levels of crime. Studies have found that female intravenous drug users are more likely to prostitute themselves (149;175) and to be supported by others (174) as a way of financing their drug habits. Also, the characteristics of male and female drug users have been found to differ, and it has been suggested that there are different pathways to heroin dependence for men and women (176). Female heroin users have more often reported being sexually assaulted (177), to have had a more dysfunctional family background (176) and to have more chronic health problems, particularly related to mental health, compared to men (23;178;179).

However, despite men having higher levels of convictions compared to women, an important finding was that both genders followed the same crime *patterns* during the different periods of treatment. Both men and women had a reduction in criminal convictions *prior* to treatment entry, and both genders experienced a significant reduction in convictions during treatment (Papers IV & II). Our findings are consistent with previous studies reporting that treatment outcomes were similar across gender (180) and that both men and women have made significant reductions in criminal activity following treatment (68;179). Further, there were no gender differences in the proportions of patients dropping out of treatment, or the proportions of patients having several treatment episodes. Before treatment drop out, both genders had an increase in criminal convictions, followed by high levels of convictions in periods out of treatment (Papers II & IV). This finding indicate that even though women are less criminally involved than men, there are important gender similarities among those men and women who are criminally active, and that those heroin using women who are criminally active, show the same crime pattern as men. Previous studies have found parallel drug use patterns among men and women (178), and that relapse to drug use is independent of gender (25). Consistent with our findings, earlier studies have reported that men and women tended to remain in treatment for comparable periods, and that there was no gender differences in patients having further treatment episodes (179;181).

In-treatment factors were also found to be associated with criminal convictions. In accordance to earlier findings (171;182) we found that that time spent in treatment was linked to better treatment outcome (Papers II & III). In our study, being in treatment for more than two years was associated with fewer criminal convictions during treatment (Paper II), and is hence similar to other studies suggesting that clients must stay in treatment beyond a temporal threshold before favourable outcomes are observed (88).

Differences were found for criminal convictions during OMT when compared by treatment regions; patients in the Southern and Central-Northern region had significantly less criminal convictions during treatment, compared to patients in the Eastern and Western region. After stratifying patients in the four treatment regions into whether patients were in continuous treatment or not, the differences were sustained for patients in continuous treatment, but not for patients in non-continuous treatment (Paper III). The regional variation in criminal convictions cannot be attributed to pre-treatment characteristics in terms of convictions, as pre-treatment levels of criminal convictions were similar across the four regions, suggesting that a similar population was entering OMT on a national scale.

Treatment regions may serve as a proxy for programme characteristics, and our results are hence in accordance with prior studies finding that treatment outcomes are associated with the manner in which programme services are delivered (3;94). In Norway, the regional centres have been found to perform differently (99), and variations between regional centres have been found in terms of degree of psychosocial rehabilitation, provision of long-term living arrangements, education and work (5). In 2003, 81% of patients in the Central-Northern region have had contact with their OMT-consultant within the last 30 days, compared to 40% in the Eastern region, 37% in the Southern region and 32% in the Western region. Further differences have been found in the proportions of patients engaged in work or education. During 2003, the Southern and the Central-Northern region had employment rates of 25% and 32% respectively, compared to 17% in the Eastern region and 18% in the Western region (5). Moreover, caseload has been found to differ considerably between regions. During 2009, the Eastern and the Western region had 67 and 68 clients per staff, compared to 41 and 36 in the Southern and Central-Northern region (7). A high number of patients per staff may limit the possibilities for comprehensive follow-up (7), and may hence contribute to some of the variations found in terms of criminal convictions between centres.

5.5 Concluding remarks

The main finding of this study is that OMT offers major crime reductions among a national cohort of OMT patients. The reduction in criminal convictions was substantial, also when calculating an overall crime rate, in which all patients who started OMT and all dropouts were included. The effect of OMT on crime is important and is experienced by society, the victims of crime and by those individuals dependent on heroin, who are not able to support their habits without facing criminal activity and personal risks.

Awareness and understanding of the process by which the programmes are delivered is essential for improving treatment effectiveness. Treatment centres known to provide OMT with a particular focus on patient-staff engagement and psychosocial rehabilitation were found to have most improvement in terms of reductions in crime during treatment. Rapid expansion of the national OMT programme without accompanying sufficient resources to maintain high standards of treatment might be a challenge in terms of optimal treatment delivery.

6.0 Implications

Several clinical and public health implications arise from our findings. The overall extent and frequency of criminal involvement among heroin users is worrying. The social harm due to untreated heroin dependence is too great to miss any opportunity to improve systems of intervention, and to encourage drug dependents' contact with treatment services. In order to identify drug problems among offenders, criminal justice services should not only screen for, but also provide appropriate interventions for drug dependence. As the results from our study indicate, OMT can help tackle crime among heroin dependent individuals, and it is suggested that OMT should be made more available for heroin dependents within the criminal justice system.

Although the majority of patients responded well to OMT, some patients continued to be involved in crime while receiving OMT. High-level offending drug users may comprise a particular high-risk section of the drug using population. Younger age and prior history of criminal activity were found to be important risk factors for continued criminal activity during treatment, and it is likely that a higher proportion of the high-risk group were poly-drug users and continued drug use during OMT. It is however important to argue that this does not imply that high-crime patients are not suitable for OMT. Patients with high levels of criminal convictions prior to treatment had a substantial reduction in convictions during treatment compared to pre-treatment levels, implying that OMT had a beneficial effect for high-risk patients - as long as they were retained in treatment. Hence it is vital that high-risk individuals in particular are offered support and access to psychosocial interventions while in OMT.

Retention in treatment often serves as a proxy for treatment outcome and the association between retention in treatment and reductions in criminal convictions, makes treatment retention a prudent clinical concern. The findings from our study indicated that the effect of OMT on criminal convictions was moderated by treatment drop out, and it is likely that higher levels of retention in treatment would have made significant improvements on treatment outcomes. Hence, there is a need in the OMT system to screen for risk of drop out. Our findings also suggest that there is a need for early interventions to address treatment retention. It is however important to point out that the retention rate is itself not necessarily an indicator of a poor programme. The fact that dependence often follows a chronic relapsing course highlights the need for an accessible and comprehensive range of treatment alternatives for this group of patients. It is essential that lapses and relapses to drug use

are not inevitably interpreted as treatment failure. Rather, periods of drop out could indicate that treatment needs to be reinstated or adjusted, or that alternate treatment is needed. Heroin users are a diverse and heterogeneous group, and an important principle of effective treatment is that no single treatment is appropriate for everyone. Matching treatment settings, interventions and services to an individual's particular problems and needs are hence crucial to ultimate treatment success.

7.0 Future research

Although most patients had significant reductions in criminal convictions during treatment, several patients showed less improvement. Some patients dropped out of treatment, and some continued being criminally active while in treatment. It is likely that drug use is not the only factor that contributes to crime among heroin users, and that some patients may have had more co-occurring personality disorders, social problems and more severe poly-drug use patterns, making adaptation to treatment particularly difficult. An essential finding in this study was the presence of a *critical period* in terms of an elevated risk of criminal convictions *prior* to treatment drop out. It is thus important to acquire more information on the ways in which patients respond to OMT, and further studies focusing on predictors associated with treatment drop out are necessary in order to obtain a deeper understanding of the mechanisms related to treatment outcome.

Similar to other studies, we found differences between treatment regions according to treatment outcome. Patients in some regions had less criminal convictions compared to others during OMT. But due to the lack of variables measuring programme factors, we were not able to make direct associations to the different aspects of treatment organisation. Future studies should thus aim to investigate more precisely what type of programme factors that contribute to the differences observed in treatment outcomes between regions.

Although observational longitudinal studies cannot determine causal effects, our study has provided important information on factors affecting both the treatment process and treatment outcome. Since the time of our period of observation, the Norwegian OMT programme has expanded and new guidelines have been introduced. It is thus important that future research will continue investigating the new era of OMT in Norway.

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Papers I - IV

I

II

III

The influence of programme differences on crime reduction in opioid maintenance treatment. An analysis of regional patterns in Norway

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ABSTRACT

Background: Reduced criminal activity is an important outcome for opioid maintenance treatment (OMT).
Aims: Investigate possible differences in criminal convictions in four health regions in Norway among a national cohort of OMT-patients before, during, and after treatment: also investigate treatment retention and other factors that may be associated with treatment outcome.
Design: Official national criminal records were cross linked with all patients who started opioid maintenance treatment in Norway from 1997-2003 (n=3221), including patients from four different health regions in Norway; the Eastern region (n=1717), the Southern region (n=751), the Western region (n=586) and the Central-Northern region (n=167). Patients in each region were divided into separate groups according to whether they were retained or not retained in continuous treatment.
Findings: During opioid maintenance treatment, patients in all four treatment regions had a considerable reduction in criminal convictions compared to pre-treatment levels. Criminal convictions during treatment were associated with retention in treatment. Among patients in continuous treatment, significant differences were found in levels of criminal convictions among the four treatment regions during treatment. Compared to patients in the Eastern region, patients in the Southern and the Central-Northern region had respectively 44 and 81 percent less criminal convictions during treatment, and patients in the Western region had 60 percent more convictions. For patients not in continuous treatment, no statistically significant differences were found between the four regions during treatment.
Conclusions: Differences in criminal convictions during treatment may be related to regional differences in treatment practice within the national OMT system. In all regions, criminal convictions during OMT were higher for patients dropping out of treatment. It is suggested that clinical staff should offer more support to patients at risk of dropping out of treatment.

INTRODUCTION

Opioid maintenance treatment (OMT) has been shown to reduce both drug use (1,2) and criminal activity among heroin users (3-6). Several factors may affect treatment outcome, and research has attempted to identify and study those factors that may account for variability. The majority of studies predicting outcome have focused on patient characteristics (7,8). Individual characteristics such as severity of psychiatric symptoms, presence of an antisocial personality diagnosis, treatment drop out, poly-drug use and prior criminal history have consistently been linked to poor treatment outcome (2,9).

There is also evidence of the association between patient outcome and the manner in which programme services are delivered (10,11). Relapse to opioid use during methadone maintenance treatment has been found to be related to programme variables such as dosage level, the management of urine drug screening, methadone take-home privileges and to treatment plans (12).

Opioid maintenance treatment should not be assumed to be a single type of procedure: for many years it has been known that opioid maintenance treatment varies considerably between countries. In a study which compared methadone maintenance treatment in six different countries (Australia, Canada, France, the Netherlands, Thailand and the UK), marked variations between each country were found in terms of dosage level, staffing, entry criteria, frequency of programme attendance, and health counselling (13). Opioid maintenance treatment also differs within countries (10,11, 14). In Norway, opioid maintenance treatment has been available at a national level since 1998, and the system is based on specialised health care services at regional centres. The Norwegian programme comprises 14 centres that are all subject to the same national guidelines. Although regional centres are subject to the same national standards, research reports and annual assessments suggest that over a period of time the different Norwegian regional OMT-centres have

developed considerable variations in treatment strategies (10,14,15).

Differences between the Norwegian regions have been found in terms of choice of opioid agonist, control measures such as urine drug screening, degree of psychosocial rehabilitation, provision of long-term living arrangements, education and work (15). In a recent study, the effect of treatment organisation and practice on outcome was investigated (16). Findings revealed that centres organised treatment differently, and that patients did not have similar outcomes. Marked variations between centres were found according to caseload, choice of agonist, prescribing doctor, supervised dispersion and urine drug screening, despite all centres being subject to the same national guidelines. However, the effort of Gjersing *et al.* (16) to study the relationship between centre characteristics and treatment outcomes was hampered with the lack of access to individual patient data, as only aggregated/ecological data were available.

Such findings confirm that there may be marked regional differences in OMT treatment delivery. We have in another paper analyzed crime reductions in a national cohort comparing criminal convictions before and during treatment (17). In this present paper we use the health regions as proxy for prevailing regional treatment practices and analyse crime reductions in relation to factors that may be associated with treatment outcome.

This study investigates criminal convictions among a national cohort of OMT-patients before, during, and after treatment in four different health regions in Norway; the study also investigates factors that may be associated with treatment outcome.

MATERIALS AND METHODS

Measures

Complete records on all patients (n=3221) who entered OMT in Norway were included. Additionally, official data from the Norwegian crime statistics (Statistics Norway) contained detailed information of all registered crime cases including date of the crime and offence details. Data from the national OMT-register and the crime statistics were linked using the unique 11-digit identification number, assigned by the Norwegian state for all citizens.

Setting and participants

Opioid maintenance treatment in Norway has been centrally planned and supervised by the government: as such it constitutes a national programme, with monopoly on admissions to OMT, and all regional treatment centres were subject to the same countrywide government standards (18). The programme is integrated into the general health and social security system, and patients apply to a regional centre via their general practitioner or social service centre (19). During initiation of OMT in Norway and at the time of our observation period, the OMT guidelines were characterised as restrictive and high threshold. The criteria for admission to treatment were not rigid, but patients were supposed to be 25 years of age, to have been dependent on heroin for several years, and to have received prior abstinence-oriented treatment (18). Patients with severe somatic or psychiatric diseases were prioritized during the initial phase of the programme. New national guidelines presented in 2010 are however less strict and give no age limit. Currently the only absolute criterion for admission to treatment is opioid dependence, defined according to the ICD-10 or DSM-IV criteria. Throughout the last decade, opioid maintenance treatment in Norway has increased, and during 2010 it exceeded 6000 patients (20), which comprise approximately half of all those 8.600-12.600 estimated to be problematic opioid users in Norway (19).

The study population included all patients (n=3221) in Norway who started OMT from September 1997 until December 2003, creating a dynamic cohort. The study period consisted of individual and varying observation times; from entry to OMT until the last day of observation, set at 31 December 2003. Some patients (n=135) died between treatment start and the last day of observation (31.12.2003). Date of death was set as the end of observation for those who died.

The study sample was divided into four regions according to the administrative "Regional Health Enterprises". The Eastern region (n=1717) included patients from Oslo, Akershus, Hedmark, Oppland and Østfold. The Southern region (n=751) included Buskerud, Vestfold, Telemark, Aust-Agder and Vest-Agder. The Western region (n=586) included Rogaland, Hordaland and Sogn & Fjordane, and the Central-Northern region (n=167) included patients from Nord-Trøndelag, Sør-Trøndelag, Møre & Romsdal, Nordland, Troms and Finnmark.

Data for all patients were analysed according to whether they stayed in continuous (n=2046) or non-continuous (n=1175) treatment during the period of observation.

In addition, the period of observation was separated into different phases; *pre-treatment* included three years prior to treatment start, *in-treatment* included the actual number of days in OMT, and *post-treatment* included both the period between treatment episodes (for those who re-entered treatment) and the period after ending treatment.

The Norwegian crime statistics provided data on date of crime, penal code and 4 prosecuting decisions: 1) formal charge leading to conviction, 2) formal charge leading to acquittal, 3) fines and 4) other. All convictions are decisions finding a person guilty of a crime in the court of law. In our study, only formal charges leading to convictions were included in the analysis. Rates of convictions refer to the number of convictions that occurred per person year.

Table 1. Patient characteristics for each treatment region (n=3221).

	East n=1717	South n=751	West n=586	Central-North n=167	All patients n=3221
Women, % (n)	35.8 (615)	27.7 (208)	28.7 (168)	32.3 (54)	32.4 (1045)
Age, mean (SD)	37.2 (6.9)	36.9 (6.7)	36.4 (6.0)	38.0 (6.3)	37.0 (6.7)
Pre-treatment crime rate (CI)	2.2 (2.08-2.12)	2.3 (2.27-2.33)	2.4 (2.37-2.43)	2.3 (2.24-2.36)	2.2 (2.19-2.21)
Continuous treatment, % (n)	61.7 (1059)	62.6 (470)	65.4 (383)	80.2 (134)	63.5 (2046)
Years in-treatment, continuous, median (max)	2.4 (6.3)	2.0 (5.3)	1.1 (5.3)	1.9 (4.7)	2.0 (6.3)
Years in-treatment, non-continuous, median (max)	1.5 (5.8)	1.2 (4.6)	0.9 (4.9)	1.0 (4.0)	1.3 (5.8)
Months post-treatment, median (max)	6.0 (54.6)	16.3 (58.9)	13.3 (60.3)	10.6 (48.7)	10.3 (60.3)

Patients were divided into three groups according to levels of convictions three years prior to treatment start. Patients who did not have any convictions were defined as the "no-conviction group" (n=1375). Of those having convictions (n=1846); patients in the "high-conviction group" comprised the 90-percentile of patients (n=187) having the most convictions (≥28 convictions), and the rest of the patients (n=1659) were included in the "medium-conviction group" (1-27 convictions).

Ethics

The study was approved by the Regional Committees for Medical and Health Research Ethics, The Norwegian Social Science Data Services (NSD) and the Norwegian Directorate of Health. Files were merged and made anonymous by Statistics Norway.

Statistical analysis

Analyses were performed by STATA version 11.0 (21). Continuous variables were compared using t-tests and discrete variables using the chi-square test (95% CI). Incidence rates (IR: number of events/total person-years of observation) (22) with 95% confidence intervals (23) and rate ratios (RR: rate in exposed/rate in unexposed) (22) with 95% confidence intervals were calculated. All analysis were stratified according to whether patients were in continuous treatment or not.

The association of variables with criminal convictions during treatment was assessed using multivariate negative binominal regression models (NBRM) designed for count outcomes (24). In the present paper, three models were performed; one separate model for all patients and one for continuous and non-continuous respectively. The negative binominal regression model can be considered a generalization of Poisson regression and is often used for over-dispersed count data which is when the conditional variance exceeds the conditional mean (24). The effect sizes are reported as the incidence rate ratio (IRR). The IRRs are obtained by exponentiation of the regression coefficient. For interpretation of the IRR, the expression 100*(exp[β]-1) tells us the percentage change in the incidence risk for a one-unit increase of change in the explanatory variable given the other variables held constant in the model (25). Exposure time (sum of person-years in treatment) is included in the models. In order to test for differences between each region, post-estimations following the NRBM analysis were conducted.

RESULTS

Patient characteristics

The cohort (n=3221) comprised 67.6% (2176) men and 32.4% (1045) women: women were slightly younger (mean age 35.5) than men (mean age 37.7) at entry to OMT. The proportions of women were distributed similarly between each of the four treatment regions and no statistically significant differences between regions were found. Age distributions and pre-treatment crime rates were also similar in the different regions (Table 1). Of all patients (n=3221), 63.5% (n=2046) were in continuous treatment from treatment start until the end of the observation period. The numbers of patients in continuous treatment differed across regions; in the Central-Northern region 80.2% (n=134) were in continuous treatment compared to 61.7% (n=1059) in the Eastern region, 62.6% (n=470) in the Southern region and 65.4% (n=383) in the Western region.

Years spent in treatment were calculated separately for patients in continuous treatment and for those who were not in continuous treatment. Patients who were in continuous treatment had almost twice as many years in treatment (median 2.0 years) compared to those not in continuous treatment (median 1.3 years). Among patients in continuous treatment, there were regional differences in years spent in treatment; in the Eastern region, patients spent a median of 2.4 years in treatment, compared to 1.1 years in the Western region (Table 1).

Regional differences in criminal convictions before and during treatment; patients in continuous treatment

Among patients who remained in continuous treatment, rates of criminal convictions during the three years prior to OMT were similar across regions (Figure 1). Rates of convictions during treatment however, were found to differ. Patients in the Central-Northern region had the fewest convictions during treatment (IR 0.14 [CI 0.18-0.46]), and compared to rates prior to treatment, patients had more than a 90% reduction in cri-

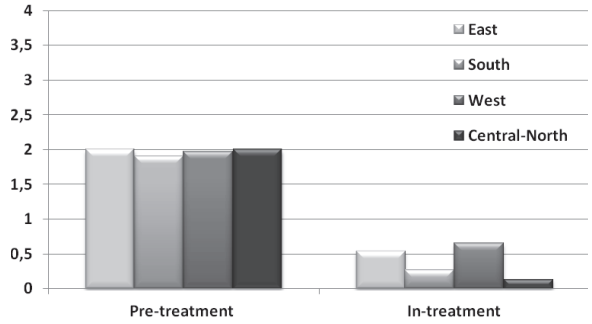

Figure 1. Criminal convictions prior to and during Opioid maintenance treatment (OMT) for patients in continuous treatment, by regions (n=2046). Y-axis: IR: Incidence rate (number of events/total person-years of observation).

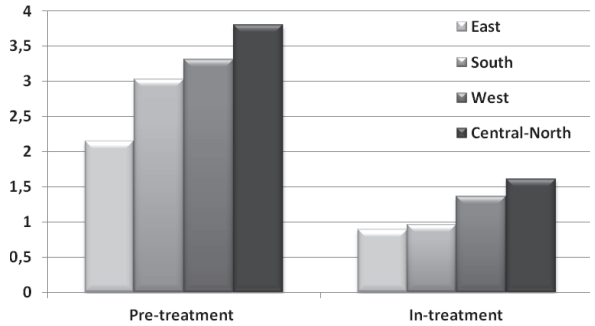

Figure 2. Criminal convictions prior to and during Opioid maintenance treatment (OMT) for patients in non-continuous treatment, by regions (n=1175). Y-axis: IR: Incidence rate (number of events/total person-years of observation).

minal convictions (RR 0.07 [CI 0.05-0.10]). Patients in the Southern region also had few convictions during treatment and compared to pre-treatment levels these patients had more than a 80% reduction in criminal convictions (RR 0.14 [CI 0.12-0.16]).

Similar but slightly less evident reductions in convictions were found for patients in the Eastern and the Western region. Compared to pre-treatment levels (IR 2.0 [CI 1.98-2.02]), rates during treatment were reduced to 0.54 [CI 0.49-0.59] for patients in the Eastern region, giving a two-thirds reduction in convictions during treatment (RR 0.27 [CI 1.25-0.29]). Also patients in the Western region had almost a two-thirds reduction in convictions during treatment (RR 0.33 [CI 0.30-0.37]).

Regional differences in criminal convictions before, during, and after treatment; patients not in continuous treatment

Among those patients who were not in continuous treatment, rates of criminal convictions during the three years prior to OMT differed across regions (Figure 2). Patients in the Eastern region had the lowest rates of criminal convictions prior to treatment, and during treatment rates of convictions fell to more than half of pre-treatment levels (RR 0.42 [CI 0.39-0.45]. In contrast, patients in the Central-Northern region had the highest levels of convictions both prior to (IR 3.8 [CI 2.70-3.90]) and during treatment (1.62 [CI 1.38-1.86]), but still had more than a 50% reduction in convictions (RR 0.43 [CI 0.33-0.56]) (Figure 2).

Rates of convictions increased in the post-treatment period, but differed between regions. Patients in the Southern region had the highest rates (2.25 [CI 2.19-2.31]) outside treatment, compared to 1.76 [CI 1.70-1.82] in the Eastern region, 1.48 [CI 1.37-1.59] in the Western region and 0.95 [CI 0.64-1.26] in the Central-Northern region.

Factors associated with criminal convictions during treatment

Table 2 shows the factors that were found to be associated with criminal convictions during treatment. When analysing criminal convictions among all patients (n=3221), significant differences were found across regions: compared to the Eastern region, patients in the Southern and Central-Northern region had correspondingly 32 and 58 percent less convictions during treatment. There were significant differences in criminal convictions when comparing the Southern region to the Western region ($p<0.001$) but not the Central-Northern region ($P=0.063$). Compared to the western region, the Central-Northern region was associated to significantly fewer ($p<0.001$) convictions during treatment.

Table 2. Criminal convictions during treatment, by gender, age, pre-treatment convictions, years in treatment and treatment region (n=3221)[a].

	All patients (n=3221)		Continuous treatment (n=2046)		Non-continuous treatment (n=1175)	
	IRR (95% CI)	P-value	IRR (95% CI)	P-value	IRR (95% CI)	P-value
Gender						
Men (reference)	1		1		1	
Women	0.68 (0.55-0.85)	0.001	0.83 (0.61-1.15)	0.263	0.56 (0.40-0.76)	<0.001
Age	0.97 (0.95-0.98)	<0.001	0.97 (0.95-0.99)	0.012	0.96 (0.94-0.99)	0.004
Pre-treatment convictions						
No convictions (reference)	1		1		1	
Medium level convictions	4.97 (3.87-6.00)	<0.001	4.79 (3.54-6.49)	<0.001	5.69 (4.03-7.91)	<0.001
High level convictions	18.11 (11.39-26.05)	<0.001	22.98 (12.10-43.63)	<0.001	17.81 (10.41-30.47)	<0.001
Years in treatment						
< 1 yr (reference)	1		1		1	
1-2 yrs	0.82 (0.62-1.09)	0.169	0.94 (0.62-1.43)	0.781	0.89 (0.62-1.28)	0.528
2-3 yrs	0.63 (0.47-0.86)	0.003	0.93 (0.59-1.46)	0.751	0.59 (0.39-0.88)	0.01
> 3 yrs	0.53 (0.40-0.70)	<0.001	0.85 (0.58-1.26)	0.431	0.46 (0.30-0.72)	0.001
Treatment region						
East (reference)	1		1		1	
South	0.68 (0.53-0.88)	0.003	0.56 (0.40-0.80)	<0.001	0.81 (0.56-1.16)	0.241
West	1.19 (0.90-1.57)	0.223	1.60 (1.09-2.34)	0.016	0.87 (0.58-1.32)	0.517
Central-North	0.42 (0.26-0.68)	<0.001	0.19 (0.10-0.38)	<0.001	0.99 (0.43-2.29)	0.982

[a] Multivariate negative binominal regression model.

[b] IRR: Incidence rate ratio (estimated rate ratio for a one unit increase of change in the explanatory variable given the other variables held constant in the model).

When stratifying patients according to retention in treatment, significant differences in criminal convictions across regions were found for patients in continuous treatment (n=2046). Compared to patients in the Eastern region, those in the Southern and the Central-Northern region had respectively 44 and 81 percent less criminal convictions during treatment. In contrast, patients in the Western region had 60 percent more convictions. Further, we found significant differences in criminal convictions when comparing the Southern region to the Western region (p<0.001) and the Central-Northern region (P=0.003), and compared to the western region, the Central-Northern region was associated to significantly fewer (p<0.001) convictions during treatment.

For patients not in continuous treatment, no statistical differences were found in criminal convictions across the four treatment regions (Table 2). Gender differences were found; women had 44 percent fewer convictions during treatment compared to men. Years spent in treatment were also associated with reductions in convictions; patients who had spent three years or more in treatment had 54 percent fewer convictions during treatment compared to patients who only spent a year or less in treatment.

Among all patients, whether retained in continuous treatment or not, younger age and pre-treatment convictions were significantly associated to more convictions during treatment (Table 2).

DISCUSSION

This study looked at changes in criminal behaviour (as measured by conviction rates) among patients receiving opioid maintenance treatment in four health regions. Our results show important reductions in criminal convictions during OMT but with substantial variations in criminal convictions in the four different regions for patients in continuous treatment. This regional variation cannot be attributed to pre-treatment differences in patient characteristics. Prior to treatment entry, levels of criminal activity and individual patient characteristics were comparable across the four geographical regions, suggesting that a similar population of patients was entering OMT on a national scale, likely reflecting relatively similar adherence to the national guidelines on the inclusion criterion issue.

When adjusting for age, gender and years in treatment, we found that patients in the Western and Eastern region had significantly more criminal convictions during treatment, compared to patients in the Southern and the Central-Northern regions. Our finding is in accordance with prior studies finding that patients in the Central-Northern region had lower arrest-rates (2%) compared to patients in the Western region (12%), the Southern region (12%) and the Eastern region (7%) during 2003 (15). As the OMT programme in Norway is centrally planned and subject to the same central regulation, this might be expected to reduce variations

in the delivery of treatment. Prior studies have found that differences in treatment programmes develop despite of national regulations, policies and guidelines (11,16), which may be supported by our findings.

Several factors might explain the differences in criminal convictions across regions. Treatment outcome has been linked to programme size (8,12). The Eastern region has the highest number of patients, dominated by the population in the capital city, Oslo. Larger programme capacity may suggest more resources and more benefits for clients, and studies have found that larger clinics and more counsellors were associated with lower relapse rates (12). However, this effect for programme sizes is not consistent: other studies have reported that programmes with more clients or larger counsellor caseloads have obtained poorer outcomes (8,26). For clients, the chances of getting "lost in the shuffle" increased, and the greater workload among staff may outweigh the potential advantage associated with increased size (8). The Central-Northern region has the smallest number of patients. Provided that staffing levels are adequate, treatment centres with fewer patients may be able to give more attention to each individual patient.

The levels of social rehabilitation in methadone maintenance treatment have been found to be associated with improved treatment outcomes compared to the provision of methadone alone (2,27-29). The Norwegian OMT model is psychosocially oriented (18), however prior reports have documented that the degree of psychosocial assistance varied between treatment regions; in 2003 81% of patients in the Central-Northern region had contact with their OMT-consultant within the last 30 days, compared to 40% in the Eastern region, 37% in the Southern region and 32% in the Western region (15). Proportions of patients in long-term living arrangements have also been found to differ between regions. During 2002, 90% of patients in the Central-Northern region were in long-term living arrangements, compared to 71% in the Eastern region (15). Further differences have been found in the proportion of patients in work or education. The southern and Central-Northern regions had employment rates of 25 and 32 percent respectively, compared to 17 percent in the Eastern region (15). Moreover, during 2002, 43% of patients in the Eastern region had social security benefits as their main income, compared to only 24% in the Western region (15). The differences between the treatment regions have been explained by different staff attitudes towards harm reduction (30), as the Central-Northern region has been found to give higher emphasis on programme structure, requirements for rehabilitation, close monitoring, and discharge in cases of inadequate treatment results, while the Eastern region and especially Oslo have established a more harm reduction perspective.

Using heroin or other types of drugs during treatment may affect treatment outcome. Prior studies have shown that the proportion of patients using heroin while in treatment, was twice as high in Oslo (the Eastern region) compared to the other regions in Norway (14). In another Norwegian study where clinicians were to describe patients' drug use during OMT, it was found that only 39% of patients in the Eastern region were described as having no drug use during the past four weeks, compared to 77% in the Central-Northern region (15). There might be reason to believe that illegal drugs are more available in Oslo compared to the more decentralized locations (14). The city of Oslo has worrying drug problems, particularly related to number of overdose deaths and an open drugs scene in the surrounding area of the central railway station called "Plata" (31). An open drug scene may attract drug users from all over the country, and in a recent report describing fatal overdoses in Oslo, it was found that nearly a third (73 of 232 persons) of those who died from a fatal overdose were persons who had their residential address outside of Oslo (32). The open drug scene in Oslo might also have become a gathering place for OMT patients. In the lack of new social networks, patients in OMT might have continued coming to Plata for the purpose of spending time with old friends and thus become exposed to drug use. In a recent study, spending time with other drug users were found to be associated with higher levels of heroin use during methadone treatment (33).

The Western region has had the highest use of buprenorphine as the maintenance medication rather than methadone. During 2003, 61% of OMT patients in the Western region received buprenorphine, compared to only 9% in the Eastern region, 22% in the Southern region and 13% in the Central-Northern region (15). It is unclear whether type of opioid medication is related to the observed outcomes. A Cochrane report concluded that methadone maintenance treatment at high dose or flexible doses was associated with better suppression of heroin use than buprenorphine maintenance treatment (34). However, research has found few differences between buprenorphine and methadone groups in controlling crime (35).

In the present study, there were considerable regional differences in the proportions of patients engaged in continuous treatment; in the Northern region more than 80% were retained in continuous compared to almost 62% in the Eastern region. Retention in treatment has been consistently found to be associated with treatment outcome (2,3,9,36), and studies have documented that patients who drop out of maintenance treatment have more criminal activity during treatment compared to patients retained in continuous treatment (3,17). The present study is in accordance to prior findings; by stratifying all analysis according to whether patients were retained in continuous treatment or not, we found that the overall crime levels during treatment were significantly higher for patients in non-continuous treatment than for patients in continues. Among patients who were in non-continuous treatment, there were however not differences in criminal convictions between the

regions.

In interpreting these findings certain limitations should be considered. Firstly, official crime records are known to underestimate the actual rates of criminal activity. Also, we did not have information on the reasons why patients failed to remain in treatment. Some patients might have dropped out or have been discharged for some violation of programme rules, others may have left for other reasons (moving home, transfer to other forms of treatment, hospitalisation after accidental injury). It is also possible that the casemix of patients in the different treatment regions might have differed in important psychological, psychiatric, or behavioural characteristics that were not measured during this study. We would also note that this study has certain strengths. It is a longitudinal study that follows a complete national cohort of 3221 patients over a prolonged period of time including time before, during, and after treatment. The study sample includes complete patients records from each OMT-centre, allowing for comparisons between treatment regions. Further, nationwide registers were ensuring that no patients were lost to follow-up, giving us the opportunity to address the consequence of patients' tendencies of interrupting and dropping out of treatment.

Awareness and understanding of the process by which the programmes are delivered when examining the differences in outcomes across treatment regions within a national programme, is essential for improving treatment effectiveness. The substantial variations in criminal convictions during treatment across regions could point toward that national standards may have been implemented differently. Our study suggests that reaching the goals of less criminal activity and more social rehabilitation may be more feasible at the smaller OMT centres. The Central-Northern region stood out by having the highest retention rate and the least criminal convictions among patients in continuous treatment: a small number of patients per staff and being able to give more attention to each individual patient may have contributed to the high levels of patients in work, education and in long-term living arrangements. However, similar and elevated rates of convictions during treatment across regions for non-continuous patients illustrate the need to emphasise retention in treatment on a national level.

Rapid expansion of treatment services, most prominent in the Eastern region, might have been a challenge in terms of optimal treatment delivery. Policy makers need to be aware that a higher burden on the treatment systems may be accompanied with a reduced quality of the treatment services and less favourable treatment outcomes if sufficient resources are not provided.

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