JOURNAL OF FORENSIC SCIENCES

J Forensic Sci, November 2012, Vol. 57, No. 6
doi: 10.1111/j.1556-4029.2012.02234.x
Available online at: onlinelibrary.wiley.com

PAPER

PSYCHIATRY & BEHAVIORAL SCIENCES

Michael Soyka,[1,2] *M.D.; Anna Träder,*[3] *Ph.D.; Jens Klotsche,*[3] *Ph.D.; Annina Haberthür,*[2] *Ph.D.; Gerhard Bühringer,*[2,4] *Ph.D.; Jürgen Rehm,*[5] *Ph.D.; and Hans-Ulrich Wittchen,*[2] *Ph.D.*

Criminal Behavior in Opioid-Dependent Patients Before and During Maintenance Therapy: 6-year Follow-Up of a Nationally Representative Cohort Sample*

ABSTRACT: Lifetime prevalence of opioid dependence is about 0.4% in western countries. Opioid-dependent patients have high morbidity and mortality and a high risk of criminal behavior. Few studies have addressed the long-term impact of opioid maintenance therapy on convictions and criminal behavior. The PREMOS study is a prospective, longitudinal, naturalistic clinical study of a nationally representative sample of 2694 opioid-dependent patients to investigate convictions and criminal behavior at baseline and after 6 years of maintenance treatment. At follow-up, 2284 patients still were eligible (84.7%). A comprehensive assessment including a patient and doctor questionnaire, and the EuropASI was completed at baseline and follow-up. Data on criminality at follow-up had been received for 1147 (70.6%) patients. A large number (84.5%) of them had been charged or convicted at any time before baseline assessment, most frequently with drug-related offenses (66.8%), acquisitive crime (49.1%), or acts of violence (22.0%). Reported charges and convictions had declined to 17.9% for the last 12 months before follow-up, which was also reflected by a significant decrease in the EuropASI subscore "legal problems" from 1.52 at baseline to 0.98 after 6 years. These data indicate a significant and clinically relevant reduction in criminal behavior in opioid-dependent patients in long-term maintenance treatment. Maintenance therapy is effective in the reduction in both narcotics-related and acquisition crime.

KEYWORDS: forensic science, opioids, dependence, methadone, buprenorphine, criminal behavior, maintenance

The average lifetime prevalence of opioid dependence is 0.4% in most western countries (1,2). Long-term studies among opioid-dependent individuals indicate a low abstinence rate and a high mortality rate (3–7) as well as a high risk of psychiatric and somatic comorbidity, including hepatitis and HIV (4–14). Numerous studies have found evidence for criminal and antisocial behavior in many opioid-dependent patients (13,15–17). Many opioid users finance their drug use through crime, including theft, burglary, and drug dealing (18), and high rates of criminal behavior have been reported in drug users (19,20). In Germany, 13% of prison inmates have a history of injecting drugs, especially heroin (21). In France, 30% of prison inmates are heroin dependent (22). High rates of heroin use and dependence have also been reported in prisoners in the United States (23) and Australia (24). Earlier long-term studies suggested that opioid users have a very high risk of being incarcerated. In addition, substance use in general is a severe risk factor for criminality and in particular for violent crime in individuals with major mental disorders such as schizophrenia and bipolar disorder (25,26).

Maintenance treatment with methadone or buprenorphine is one of the major treatment strategies for opioid dependence, and its efficacy has been demonstrated in many studies, meta-analyses, and Cochrane reviews (11,18,27–34). One of the major arguments for maintenance therapy is the reduction in criminal behavior, which increases the chance of social reintegration (35). Some earlier studies suggested a reduction in criminality in methadone-treated patients (20,36,37). Ball and Ross (35) reported that during methadone treatment, the number of offenses decreased by 20% from pretreatment levels. However, an ecological study by Niveau et al. (38) failed to find a clear reduction in the number of incarcerations of people with drug addiction after an extensive increase in the number of maintenance treatments being administered, and the authors recommended more observational studies in this area. In addition, a recent Cochrane analysis (30) failed to show clear evidence for a reduction in criminal activity as a result of methadone treatment.

Longer periods of methadone treatment have been linked to greater reductions in both drug use and criminal activity (39, 40). Gossop et al. (41–43) reported 1- and 5-year outcomes in 1075 clients admitted to 54 drug misuse treatment services in England. Conviction rates in this prospective cohort study were lower during follow-up than at intake. Eighteen percent of the sample had been convicted for at least one offense and, as in other studies, risk of convictions was associated with heroin consumption (41,42,44).

[1]Psychiatric Hospital, University of Munich, Nussbaumstr. 7, 80336, Munich, Germany.
[2]Private Hospital Meiringen, P.O. Box 612, 3860, Meiringen, Switzerland.
[3]Institute of Clinical Psychology and Psychotherapy, Technische Universität Dresden, Chemnitzer Str. 46, 01187, Dresden, Germany.
[4]Institut für Therapieforschung (IFT), Parzivalstr. 25, 80804, Munich, Germany.
[5]Centre for Addiction and Mental Health, 33 Russell Street, Toronto, ON, Canada.
*Supported by the German Ministry of Health (BMG).

Received 13 April 2011; and in revised form 18 July 2011; accepted 18 Sept. 2011.

The influence of drug misuse treatment interventions on criminal behavior remains unclear. We therefore evaluated convictions and criminal behavior at a 6-year follow-up as well as clinical correlates or predictors in a large sample of opioid-dependent patients on maintenance therapy with either methadone or buprenorphine.

Methods

Setting and Participants

The PREMOS study (previously called the COBRA study [45,46]) is a prospective, longitudinal, naturalistic clinical study consisting of a comprehensive baseline evaluation and a 1- and 6-year follow-up assessment. The study was conducted in a nationally representative sample of physicians (originally $N = 223$) in Germany in enrollment settings ranging from small primary care practices to large specialized substitution centers (for details see Wittchen et al. [45]). A total of $N = 2694$ opioid-dependent patients were consecutively enrolled at baseline. The background, aims, and methods of this study as well as the sample characteristics have been described in greater detail elsewhere (32,45–47), and 1-year outcome data have been reported (32,46).

Measures

At baseline and follow-up, patients completed a comprehensive assessment consisting of a patient questionnaire, a doctor's interview and questionnaire, and a standardized urine screening. The assessment tools and variables are described in detail in the previous publications mentioned above (32,45,46,48). Severity of opioid dependence was assessed by the EuropASI (49), the validated German version of the Addiction Severity Index that measures correlates of opioid dependence in various domains, including legal problems (50).

This study reports descriptive information about the rates of criminal behavior and convictions as assessed by the physicians' and patients' questionnaires at baseline (T1) and 6-year follow-up (T3). A number of questions and items in both questionnaires were directly related to lifestyle and criminal behavior. The primary outcome criterion was whether or not the patients were still receiving maintenance treatment at follow-up.

Statistical Analyses

Gender differences in baseline characteristics of the eligible study sample were analyzed by linear regression analysis for interval-scaled variables and logistic regression analysis for categorical variables. The Stata Software package 11.3 (51) was used to compute robust variances, confidence intervals, and *p*-values (by applying the Huber-White sandwich matrix, which is required when analyzing clustered data) (52).

Results

Participant Characteristics at Baseline

The baseline characteristics of the eligible follow-up sample $N = 2284$ consisted of opioid-dependent men (68.4%) and women (31.6%). Mean age was 34.8 years (SD = 8.1; range 17–62 years). All but 8.7% of the sample were German citizens. The majority (56.4%) had never been married; 19.5% were separated, divorced, or widowed; and 12.2% were currently married. The mean years of education were 10.0 (SD = 1.8; range 1–20 years), and 54.5% were unemployed. On average, women were slightly younger than men (34.2 years [SD = 8.0] vs. 35.1 years [SD = 8.1]; $\beta = -0.86$, $p < 0.05$) and had more years of education (10.2 years [SD = 1.7] vs. 10.0 years [SD = 1.8]; $\beta = 0.24$, $p < 0.01$). The mean age at onset of any substance use (except nicotine) was 20.0 years (SD = 5.2) for men and 19.6 years (SD = 5.3) for women ($\beta = -0.42$, n.s.). The mean age of the first substance use treatment was 29.8 years (SD = 7.5) for men and 28.3 years (SD = 7.6) for women ($\beta = -1.48$, $p < 0.001$). With regard to treatment setting, 32.8% of the patients were treated in small settings, 47.2% in medium, and 20.1% in large. In total, 74.0% of the patients were treated with methadone, 25.3% with buprenorphine, and 0.7% ($n = 16$) with other substitution drugs such as codeine. Patients suffered from a wide range of somatic and mental disorders (diagnosed by the treating physician). The majority (73.1%) had at least one somatic disorder, for example HIV (6.4%), hepatitis C (64.2%), and any mental disorder (65.9%). Baseline sample characteristics are given in Table 1.

Follow-Up Status at 6 Years

The analyses presented here are based on the 6-year follow-up of 2284 still eligible patients from the original cohort of $N = 2694$. There was no evidence for systematic selection effects. Of the 2284 eligible patients, 190 (8.3%) were lost to follow-up and for 470 (20.6%) only rudimentary information was available. Thus, whether or not patients were alive could be obtained for 2094 ($n = 131$ were deceased; $n = 1963$ were alive).

A total of 1624 (71.1%) of the 2284 eligible patients were assessed for the primary outcome criterion of continued maintenance treatment (total assessed group): 70.4% ($n = 1144$) were found to still be in maintenance treatment (whereby the course of treatment was stable, unstable, or unclear). Patients no longer receiving maintenance treatment for the following reasons: 7.1% ($n = 115$) were abstinent, 1.5% ($n = 25$) in an abstinence-oriented therapy, 1.7% ($n = 28$) in another inpatient treatment, and 0.9% ($n = 15$) incarcerated; the exact status of 7.6% ($n = 125$) was unclear. In total, $n = 348$ patients (21.4%) had discontinued maintenance treatment but were definitely alive at the time of re-examination. The entire questionnaire package was completed by $n = 1147$ (full outcome group) of the 1624 patients and their treating physicians (flow chart see Fig. 1).

Criminality

After 1 year, physicians had reported that 589 (51.8%) of the full outcome group ($n = 1147$) had legal problems because of involvement in criminal activities. The EuropASI subscore "legal problems" was 1.52 (SD = 2.02), 1.63 (SD = 2.09) for men and 1.30 (SD = 1.84) for women ($\beta = -0.33$, $p < 0.01$) (see Fig. 2). Sixty-seven patients (5.9%) stated that they had been involved in criminal activities/prostitution to make money within the past 30 days. The majority of patients ($n = 969$, 84.5%) had been charged with or convicted of the following kinds of criminal behavior at least once in their life: narcotics-related offenses (66.8%), acquisition crimes (49.1%), acts of violence (22.0%), prostitution (2.7%), intoxicated or drunk driving (17.0%), and other traffic offenses (9.2%). Except for prostitution, all rates were higher in men than in women. A total of 796 (71.5%)

TABLE 1—*Sociodemographic and selected clinical characteristics of the study (*N = *2284) sample at baseline.*

	Total (*N* = 2284)		Male (*N* = 1561)		Female (*N* = 723)		Gender Differences[†]	
	N	%	*N*	%	*N*	%	OR/Beta	95% CI
Baseline characteristics[‡]								
Male gender, %	1561	68.4						
Age, mean (SD) range	34.8 (8.1), 17–62		35.1 (8.1), 17–58		34.2 (8.0), 17–62		−0.86*	−1.57–−0.15
<30 years	733	32.1	491	31.5	242	33.5	1.00 (ref)	
31–40 years	985	43.1	662	42.4	323	44.7	1.01	0.82–1.24
41+ years	566	24.8	408	26.1	158	21.9	0.79*	0.63–1.00
German citizenship, %	1943	91.3	1305	89.4	638	95.2	0.43***	0.29–0.63
Family status, %								
Single	1284	56.4	962	61.8	322	44.7	1.00 (ref)	
Married	277	12.2	183	11.8	94	13.1	1.53**	1.16–2.03
Sep./div./wid.	443	19.5	243	15.6	200	27.8	2.46***	1.96–3.08
Other	273	12.0	169	10.9	104	14.4	1.84***	1.40–2.42
Education; mean (SD) range	10.0 (1.8), 1–20		10.0 (1.8), 1–20		10.2 (1.7), 2–18		0.24**	0.08–0.40
Professional status, %								
Employed	518	22.9	370	23.9	148	20.6	1.00 (ref)	
Unemployed	1235	54.5	930	60.1	305	42.5	1.22	0.97–1.54
Homemaker	349	15.4	140	9.0	209	29.1	4.55***	3.54–5.85
Other	164	7.2	108	7.0	56	7.8	1.58**	1.12–2.24
Age of onset for any substance use; mean (SD) range	19.8 (5.2), 1–46		20.0 (5.2), 1–46		19.6 (5.3), 4–45		−0.42	−0.89–0.06
Years of opiate use; mean (SD) range	14.9 (8.2), 0–47		15.1 (8.4), 0–47		14.6 (7.8), 0–37		−0.47	−1.19–0.25
Age of onset of first substance use treatment; mean (SD) range	29.3 (7.6), 14–58		29.8 (7.5), 14–58		28.3 (7.6), 16–56		−1.48***	−2.15–−0.81
Years since first substance use treatment; mean (SD) range	5.5 (5.1), 0–31		5.3 (4.9), 0–31		5.9 (5.4), 0–29		0.62**	0.16–1.08
Treatment setting, %								
Small	749	32.8	518	33.2	231	32.0	1.00 (ref)	
Medium	1077	47.2	729	46.7	348	48.1	0.93	0.76–1.14
Large	458	20.1	314	20.1	144	19.9	0.96	0.76–1.22
Substitute, %								
Methadone	1690	74.0	1157	74.1	533	73.7	1.00 (ref)	
Buprenorphine	578	25.3	395	25.3	183	25.3	1.01	0.82–1.23
Codeine	16	0.7	9	0.6	7	1.0	1.69	0.63–4.56
HIV/AIDS, %	123	6.4	75	5.8	48	7.8	1.37	0.94–2.00
Hepatitis B, %	627	31.9	416	31.0	211	33.8	1.14	0.93–1.39
Hepatitis C, %	1357	64.2	902	62.8	455	67.1	0.83	0.68–1.00
Any somatic disorder, %	1669	73.1	1130	72.4	539	74.6	0.90	0.73–1.09
Any mental disorder, %	1467	64.2	985	63.1	482	66.7	0.86	0.71–1.03

Beta, mean difference for interval-scaled variables; OR, odds ratio for categorical variables; CI, confidence interval; mean, mean value; SD, standard deviation; ref, reference group.

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

[†]Gender differences were calculated by logistic regression analyses for categorical variables and by linear regression for dimensional variables.

[‡]Baseline characteristics if not indicated otherwise.

patients stated that they had no charges or convictions for criminal activities, 219 (19.7%) some and 98 (8.8%) severe. Thirty-three patients (3.1%) had been incarcerated in the 6 months before the assessment.

At the 6-year follow-up, the overall rates for criminality were lower. The number of patients reported by the physicians to be involved in criminal activities had decreased to 267 (25.6%), the EuropASI subscore measuring "legal problems" for the last 30 days had decreased to 0.98. Charges or convictions for criminal activities in the past 12 months were reported by a lot fewer patients (n = 189, 17.9%) than at the baseline evaluation. Most offenses were drug related (5.8%) or acquisitive crimes (3.7%, see Table 2).

Discussion

Substantial evidence exists for a strong association between crime and opioid use (3,53–55). Many opioid-dependent patients lead a lifestyle that is in some way criminal, or they finance drug use via illegal activities (53,56,57). Swedish data suggest that a third of patients admitted to methadone treatment have been in prison before, and only 9% have not been convicted in the 4 years preceding treatment (58). The impact of opioid maintenance therapy on the crime rate in opioid users is controversial. While most clinical studies indicate that the crime rate is lower in methadone- or buprenorphine-maintained patients (37), especially for drug-related offenses (36)—a finding that is also supported by a meta-analysis (59)—a recent Cochrane review did not confirm the decrease in crime rate (30). In addition, Niveau et al. (38) reported that while the number of methadone-maintained patients in the Swiss Canton of Geneva increased between 1983 and 1999, the number of drug addict incarcerations or overdose-related deaths decreased only slightly.

Data from this 6-year follow-up study of a nationally representative cohort study of opioid-dependent patients in maintenance therapy indicate a persistently high rate of criminal convictions before and throughout substitution treatment, with a moderate reduction over time. The EuropASI mean subscore

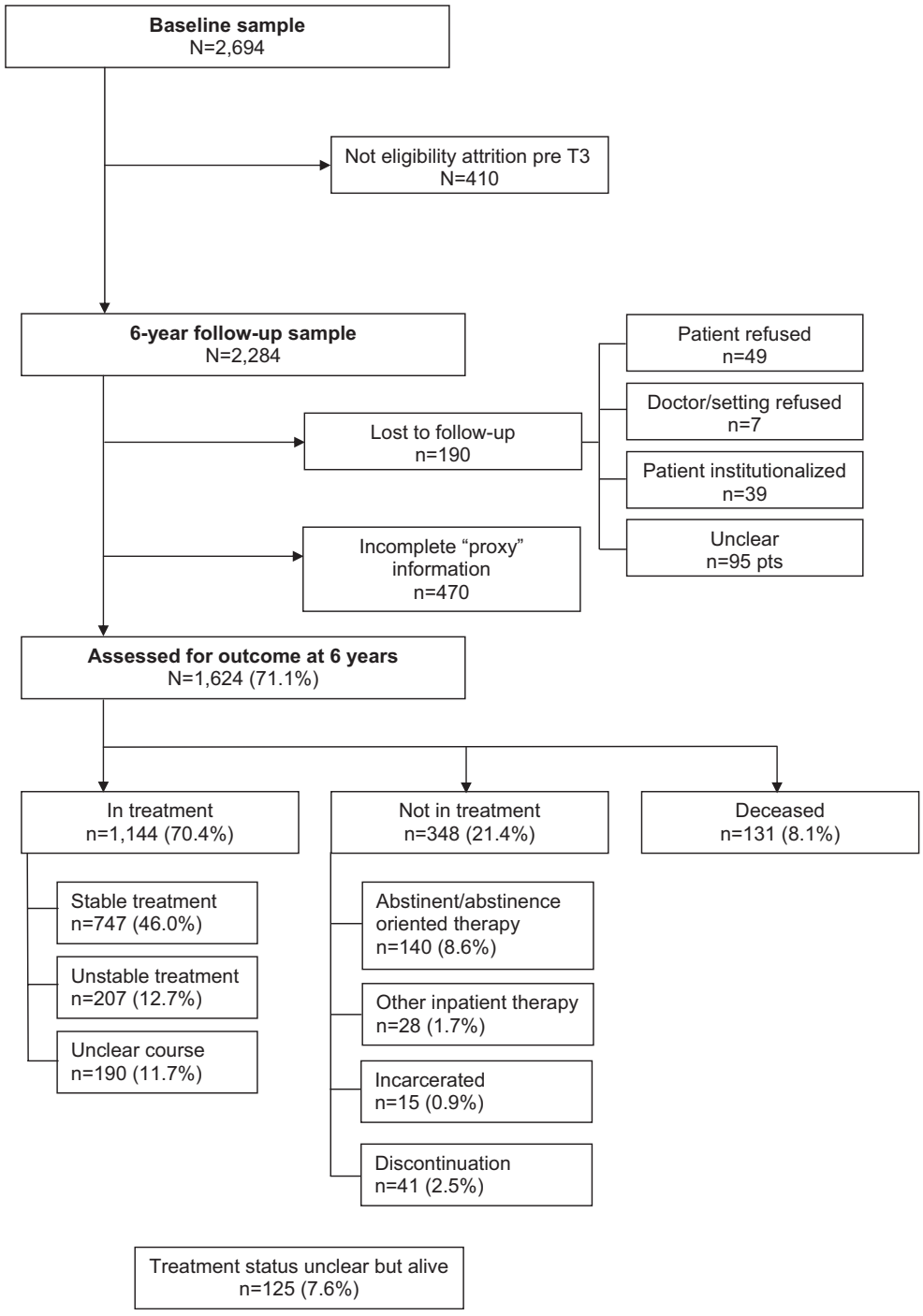

FIG. 1—*Study flow chart. Number of patients included and followed-up, and clinical outcome after 6 years.*

"legal problems" showed a clear decrease from 1.52 at baseline to 0.98 at the 6-year follow-up, and questions concerning prostitution or criminal activity or both indicated correspondingly that 5.9% of patients were involved in such activities before baseline compared with 2.0% in the year before the 6-year follow-up.

Robust evidence for the effectiveness of therapeutic interventions in drug use to reduce crime rates comes from the British NTORS study (41–43). For Sweden, Stenbacka et al. (20) reported a positive effect of methadone treatment on arrests and convictions even in patients who were expelled from treatment involuntarily, and Teesson et al. (60) reported Australian data indicating a reduced criminality rate corresponding with decreased drug use after 3 years' treatment.

Risk factors related to criminality in a Swedish long-term follow-up study were as follows: age between 17 and 20 years at first conviction, frequency of convictions, prison sentence, 1–5 inpatient admissions for abuse of drugs other than opiates during the 4 years before admission (58).

Recently Oliver et al. (61) reported interesting 5-year follow-up results of a smaller study of 108 patients in methadone maintenance. Different to our larger sample, the authors could access data from the national police computer and criminal

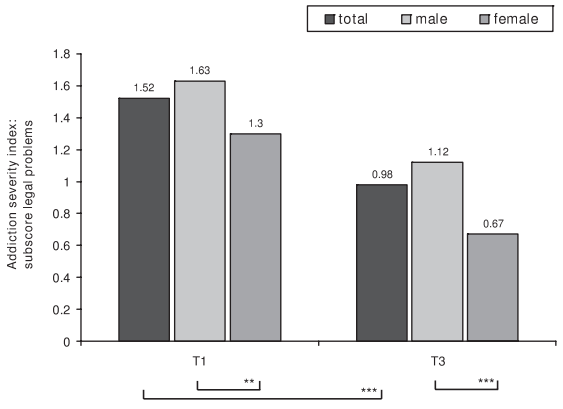

FIG. 2—*Addiction severity subscore "legal problems" at baseline and follow-up (T1: baseline. T3: follow-up after 5–6 years).*

records. Data indicated a robust overall reduction in the number of convictions and cautions over time. The reduction was estimated at 10% for each 6 months retained in treatment. Retention in treatment is crucial for the reduction in criminality (62).

Little is known about the effects of different maintenance drugs on antisocial behavior and criminality. The evidence for psychological and pharmacological interventions in antisocial personality in general is very poor (63,64).

Few studies have compared the effects of buprenorphine and methadone on crime rates. Magura et al. (65) found that heroin-dependent patients sentenced to 10–90 days in jail ($N = 116$) were less likely to withdraw from buprenorphine in jail than from methadone, but the number of self-reported postrelease re-arrests or re-incarcerations did not differ between the two treatment groups.

Our study has certain limitations. First, only for 1147 of the initial 2694 patients we have information about criminal issues for the 6-year follow-up examination. A higher follow-up rate would have provided more precise data. Nevertheless, the total number of patients studied after 6 years was still remarkably high for a group of opioid-dependent patients. It should be noted that only 190 patients were completely lost to follow-up. For 470 at least it was possible to find out whether or not they were still alive.

Second, data on outcome and criminality/convictions are based on physicians' and patients' questionnaires. No "objective" records such as criminal or police records were available. Still, considering the high number of reports of criminal activity and the long observation period, it seems likely that the most relevant convictions were captured in our study. Methodologically, it seems noteworthy that the year in which convictions were recorded did not necessarily reflect the time of the crime, because it may take years before clients have to appear in court.

Summary and Conclusions

In conclusion, our data correspond to some previous publications in that they suggest a very significant rate of criminal activity and convictions in patients entering opioid-substitution treatment and a certain decrease in criminal activities over time. Future studies may aim to identify special subgroups of patients at higher risk of criminal behavior and possible intervention strategies.

Acknowledgment

The authors thank Jacquie Klesing, ELS, for editing assistance with the manuscript.

TABLE 2—*Criminality of the full outcome group (*N = *1147) at baseline and at follow-up.*

	T1						T3					
	Total		Male		Female		Total		Male		Female	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
No. of patients	1147		782		365		1147		782		365	
Doctor's rating												
Legal problems	Present						Past 12 months					
Yes	589	51.8	383	49.4	206	56.9	267	25.6	181	25.0	86	26.9
No	549	48.2	393	50.6	156	43.1	776	74.4	542	75.0	234	73.1
Patient's rating												
Prostitution/illegal activities to make money	Past 30 days						Past 12 months					
Yes	67	5.9	45	5.8	22	6.1	21	2.0	14	1.9	7	2.2
No	1071	94.1	731	94.2	340	93.9	1034	98.0	719	98.1	315	97.8
Charged with/convicted of a crime (multiple entries)	Lifetime						Past 12 months					
Yes	969	84.5	691	88.4	278	76.2	189	17.9	144	19.7	45	14.0
No	178	15.5	91	11.6	87	23.8	866	82.1	589	80.4	277	86.0
Narcotics-related	766	66.8	548	70.1	218	59.7	61	5.8	491	6.7	12	3.7
Acquisition crime	563	49.1	402	51.4	161	44.1	39	3.7	929	4.0	10	3.1
Violence	252	22.0	208	26.6	44	12.1	18	1.7	615	2.1	3	0.9
Prostitution	31	2.7	7	0.9	24	6.6	1	0.1	1	0.1	0	0.0
Intoxicated/drunk driving	195	17.0	167	21.4	28	7.7	10	1.0	9	1.2	1	0.3
Other traffic offenses	106	9.2	92	11.8	14	3.8	9	0.9	6	0.8	3	0.9

Missing value: legal problems/T1 $n = 9$ (0.8%); prostitution/illegal activities to make money/T1 $n = 9$ (0.8%); legal problems/T3 $n = 104$ (9.1%); prostitution/illegal activities to make money/T3 $n = 92$ (8.0%); charged with/convicted of a crime/T3 $n = 92$ (8.0).

Percentages are proportions of patients with available data.

References

1. European Monitoring Centre for Drugs and Drug Addiction. The state of the drug problem in Europe. Annual Report, 2010. Lisbon, Portugal: European Monitoring Centre for Drugs and Drug Addiction, 2010.
2. United Nations Office on Drugs and Crime. World drug report. Vienna, Austria: UNODC, 2006.
3. Hser YI, Anglin D, Powers K. A 24-year follow-up of California narcotics addicts. Arch Gen Psychiatry 1993;50:577–84.
4. Bargagli AM, Hickman M, Davoli M, Perucci CA, Schifano P, Buster M, et al. Drug-related mortality and its impact on adult mortality in eight European countries. Eur J Public Health 2006;16:198–202.
5. Bjornaas MA, Bekken AS, Ojlert A, Haldorsen T, Jacobsen D, Rostrup M, et al. A 20-year prospective study of mortality and causes of death among hospitalized opioid addicts in Oslo. BMC Psychiatry 2008;8:8.
6. Degenhardt L, Bucello C, Mathers B, Briegleb C, Ali H, Hickman M, et al. Mortality among regular or dependent users of heroin and other opioids: a systematic review and meta-analysis of cohort studies. Addiction 2011;106:32–51.
7. Termorshuizen F, Krol A, Prins M, van Ameijden EJ. Long-term outcome of chronic drug use: the Amsterdam cohort study among drug users. Am J Epidemiol 2005;161:271–9.
8. Degenhardt L, Randall D, Hall W, Law M, Butler T, Burns L. Mortality among clients of a state-wide opioid pharmacotherapy program over 20 years: risk factors and lives saved. Drug Alcohol Depend 2009;105:9–15.
9. Hulse GK, English DR, Milne E, Holman CD. The quantification of mortality resulting from the regular use of illicit opiates. Addiction 1999;94:221–9.
10. Kimber J, Copeland L, Hickman M, Macleod J, McKenzie J, De Angelis D, et al. Survival and cessation in injecting drug users: prospective observational study of outcomes and effect of opiate substitution treatment. BMJ 2010;341:c3172.
11. Kleber HD, Weiss RD, Anton RF Jr, George TP, Greenfield SF, Kosten TR, et al. Treatment of patients with substance use disorders, second edition. American Psychiatric Association. Am J Psychiatry 2007;164:5–123.
12. McCowan C, Kidd B, Fahey T. Factors associated with mortality in Scottish patients receiving methadone in primary care: retrospective cohort study. BMJ 2009;338:b222–5.
13. Prendergast ML, Urada D, Podus D. Meta-analysis of HIV risk-reduction interventions within drug abuse treatment programs. J Consult Clin Psychol 2001;69:389–405.
14. Mathei C, Buntinx F, van Damme P. Seroprevalence of hepatitis C markers among intravenous drug users in western European countries: a systematic review. J Viral Hepat 2002;9:157–73.
15. Amato L, Davoli M, Perucci CA, Ferri M, Faggiano F, Mattick RP. An overview of systematic reviews of the effectiveness of opiate maintenance therapies: available evidence to inform clinical practice and research. J Subst Abuse Treat 2005;28:321–9.
16. Lind B, Chen SL, Wheatherburn D, Mattick R. The effectiveness of methadone maintenance treatment in controlling crime—an Australian aggregate analysis. Br J Criminology 2005;45:201–11.
17. Marsh LA. The efficacy of methadone maintenance interventions in reducing illicit opiate use, HIV risk behaviour and criminality: a meta-analysis. Addiction 1988;93:515–32.
18. Bell J, Trinh L, Butler B, Randall D, Rubin G. Comparing retention in treatment and mortality in people after initial entry to methadone and buprenorphine treatment. Addiction 2009;104:1193–200.
19. Anglin MD, Perrochet B. Drug use and crime: a historical review of research conducted by the UCLA Drug Abuse Research Center. Subst Use Misuse 1998;33:1871–914.
20. Stenbacka M, Leifman A, Romelsjo A. The impact of methadone treatment on registered convictions and arrests in HIV-positive and HIV-negative men and women with one or more treatment periods. Drug Alcohol Rev 2003;22:27–34.
21. Michels II, Stover H, Gerlach R. Substitution treatment for opioid addicts in Germany. Harm Reduct J 2007;4:5.
22. Michel L, Maguet O. Guidelines for substitution treatments in prison populations. Encephale 2005;31:92–7.
23. National Institute of Justice. Drug and alcohol use and related matters among arrestees, 2003. Washington, DC: National Institute of Justice, 2004.
24. Butler T, Boonwaat L, Hailstone S, Falconer T, Lems P, Ginley T, et al. The 2004 Australian prison entrants' blood-borne virus and risk behaviour survey. Aust N Z J Public Health 2007;31:44–50.
25. Fazel S, Langstrom N, Hjern A, Grann M, Lichtenstein P. Schizophrenia, substance abuse, and violent crime. JAMA 2009;301:2016–23.
26. Fazel S, Lichtenstein P, Grann M, Goodwin GM, Langstrom N. Bipolar disorder and violent crime: new evidence from population-based longitudinal studies and systematic review. Arch Gen Psychiatry 2010;67:931–8.
27. Connock M, Juarez-Garcia A, Jowett S, Frew E, Liu Z, Taylor RJ, et al. Methadone and buprenorphine for the management of opioid dependence: a systematic review and economic evaluation. Health Technol Assess 2007;11:1–171, iii–iv.
28. Farre M, Mas A, Torrens M, Moreno V, Cami J. Retention rate and illicit opioid use during methadone maintenance interventions: a meta-analysis. Drug Alcohol Depend 2002;65:283–90.
29. Mattick RP, Ali R, White JM, O'Brien S, Wolk S, Danz C. Buprenorphine versus methadone maintenance therapy: a randomized double-blind trial with 405 opioid-dependent patients. Addiction 2003;98:441–52.
30. Mattick RP, Breen C, Kimber J, Davoli M. Methadone maintenance therapy versus no opioid replacement therapy for opioid dependence. Cochrane Database Syst Rev 2009;(3):CD002209.
31. Mattick RP, Kimber J, Breen C, Davoli M. Buprenorphine maintenance versus placebo or methadone maintenance for opioid dependence. Cochrane Database Syst Rev 2008;(2):CD002207.
32. Soyka M, Apelt SM, Lieb M, Wittchen HU. One-year mortality rates of patients receiving methadone and buprenorphine maintenance therapy: a nationally representative cohort study in 2694 patients. J Clin Psychopharmacol 2006;26:657–60.
33. Soyka M, Zingg C, Koller G, Kuefner H. Retention rate and substance use in methadone and buprenorphine maintenance therapy and predictors of outcome: results from a randomized study. Int J Neuropsychopharmacol 2008;11:641–53.
34. West SL, O'Neal KK, Graham CW. A meta-analysis comparing the effectiveness of buprenorphine and methadone. J Subst Abuse 2000;12:405–14.
35. Ball JC, Ross A. The effectiveness of methadone maintenance treatment: patients, programs, services, and outcome. New York, NY: Springer-Verlag, 1991.
36. Jacobs PE, Doft EB, Koger J. Methadone and criminality: a suburban perspective. Am J Drug Alcohol Abuse 1978;5:51–8.
37. Sechrest DK. Methadone programs and crime reduction: a comparison of New York and California addicts. Int J Addict 1979;14:377–400.
38. Niveau G, Rougemont AL, La Harpe R. Methadone maintenance treatment, criminality and overdose-related deaths. An ecological study, 1983–1999. Eur J Public Health 2002;12:224–7.
39. Flynn PM, Joe GW, Broome KM, Simpson DD, Brown BS. Looking back on cocaine dependence: reasons for recovery. Am J Addict 2003;12:398–411.
40. Flynn PM, Porto JV, Rounds-Bryant JL, Kristiansen PL. Costs and benefits of methadone treatment in DATOS. Part 1: discharged versus continuing patients. J Maint Addict 2003;2:129–49.
41. Gossop M, Mardsen J, Stewart D. Drug selling among drug misusers before intake to treatment and at 1-year follow-up: results from the National Treatment Outcome Research Study (NTORS). Drug Alcohol Rev 2000;19:143–51.
42. Gossop M, Marsden J, Stewart D, Rolfe A. Reductions in acquisitive crime and drug use after treatment of addiction problems: 1-year follow-up outcomes. Drug Alcohol Depend 2000;58:165–72.
43. Gossop M, Trakada K, Stewart D, Witton J. Reductions in criminal convictions after addiction treatment: 5-year follow-up. Drug Alcohol Depend 2005;79:295–302.
44. Nurco DN, Hanlon TE, Kinlock TW, Duszynski KR. The consistency of types of criminal behavior over preaddiction, addiction, and nonaddiction status periods. Compr Psychiatry 1989;30:391–402.
45. Wittchen HU, Apelt SM, Buhringer G, Gastpar M, Backmund M, Golz J, et al. Buprenorphine and methadone in the treatment of opioid dependence: methods and design of the COBRA study. Int J Methods Psychiatr Res 2005;14:14–28.
46. Wittchen HU, Apelt SM, Soyka M, Gastpar M, Backmund M, Golz J, et al. Feasibility and outcome of substitution treatment of heroin-dependent patients in specialized substitution centers and primary care facilities in Germany: a naturalistic study in 2694 patients. Drug Alcohol Depend 2008;95:245–57.
47. Soyka M, Träder A, Klotsche J, Backmund M, Bühringer G, Rehm J, et al. Six year mortality rates in methadone and buprenorphine maintenance therapy: results from a nationally representative cohort study. J Clin Psychopharmacol 2011;31(5):678–80.

48. Buehringer G, Kroeger C, Kuefner H, Lieb R, Schuetz C, Soyka M, et al. Substance abuse research ASAT: allocating substance abuse treatments to patient heterogeneity. Suchtmed 2004;6:7–13.
49. Gsellhofer B, Kuefner H, Vogt M, Weller D. European addiction severity. Index-EuropASI. Manual for training and execution. Stuttgart, Germany: Scheider Verlag, 1999.
50. McLellan AT, Luborsky L, Woody GE, O'Brien CP. An improved diagnostic evaluation instrument for substance abuse patients. The addiction severity index. J Nerv Ment Dis 1980;168:26–33.
51. Stata Corporation. StatsCorp [Stata Statistical Software]. Release 10.1. College Station, TX: Stata Corporation, 2008.
52. Royall RM. Model robust confidence intervals using maximum likelihood estimators. Int Stat Rev 1986;54:221–6.
53. Ball JC, Shaffer JW, Nurco DN. The day-to-day criminality of heroin addicts in Baltimore—a study in the continuity of offence rates. Drug Alcohol Depend 1983;12:119–42.
54. Speckart G, Anglin MD. Narcotics and crime: an analysis of existing evidence for a causal relationship. Behav Sci Law 1985;3:259–82.
55. Mays DM, Gordon AJ, Kelly ME, Forman SD. Violent criminal behavior and perspectives on treatment of criminality in opiate treatment. Subst Abus 2005;26:33–42.
56. Bell J, Mattick R, Hay A, Chan J, Hall W. Methadone maintenance and drug-related crime. J Subst Abuse 1997;9:15–25.
57. Rothbard A, Alterman A, Rutherford M, Liu F, Zelinski S, McKay J. Revisiting the effectiveness of methadone treatment on crime reductions in the 1990s. J Subst Abuse Treat 1999;16:329–35.
58. Davstad I, Stenbacka M, Leifman A, Romelsjo A. An 18-year follow-up of patients admitted to methadone treatment for the first time. J Addict Dis 2009;28:39–52.
59. Johansson BA, Berglund M, Lindgren A. Efficacy of maintenance treatment with methadone for opioid dependence: a meta-analytical study. Nord J Psychiatry 2007;61:288–95.
60. Teesson M, Mills K, Ross J, Darke S, Williamson A, Havard A. The impact of treatment on 3 years' outcome for heroin dependence: findings from the Australian Treatment Outcome Study (ATOS). Addiction 2008;103:80–8.
61. Oliver P, Keen J, Rowse G, Ewins E, Griffiths L, Mathers N. The effect of time spent in treatment and dropout status on rates of convictions, cautions, and imprisonment over 5 years in a primary care-led methadone maintenance service. Addiction 2010;105:732–9.
62. Bell J, Hall W, Byth K. Changes in criminal activity after entering methadone maintenance. Br J Addict 1992;82:251–8.
63. Gibbon S, Duggan C, Stoffers J, Huband N, Vollm BA, Ferriter M, et al. Psychological interventions for antisocial personality disorder. Cochrane Database Syst Rev 2010;(6):CD007668.
64. Khalifa N, Duggan C, Stoffers J, Huband N, Vollm BA, Ferriter M, et al. Pharmacological interventions for antisocial personality disorder. Cochrane Database Syst Rev 2010;(8):CD007667.
65. Magura S, Lee JD, Hershberger J, Joseph H, Marsch L, Shropshire C, et al. Buprenorphine and methadone maintenance in jail and post-release: a randomized clinical trial. Drug Alcohol Depend 2009; 99:222–30.

Additional information and reprint requests:
Michael Soyka, M.D.
Psychiatric Hospital
University of Munich
Nussbaumstr. 7
80336 Munich
Germany
E-mails: michael.soyka@med.uni-muenchen.de; Michael.Soyka@privatklinik-meiringen.ch