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Predictors of Readmission following Outpatient Treatment for Alcohol Use Disorder

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Abstract:

**Aims:** To identify predictors of readmission to outpatient treatment for alcohol use disorder (AUD) with a view to identifying underlying mechanisms for preventing relapse.

**Methods:** A consecutive clinical cohort of 2130 AUD outpatients treated between January 1, 2006 and June 1, 2016 was studied. Data were collected by means of the Addiction Severity Index upon treatment entry and at discharge. Outcome measures were readmission to out-patient treatment and time to readmission. Potential predictors were tested for significance using Cox Proportional Hazards multivariate analysis.

**Results:** A total of 22% were readmitted during the follow-up time. Patients readmitted within one year of treatment conclusion differed significantly from those not-readmitted on age, cohabitation status, and completion status of index treatment. Significant predictors of readmission during follow-up time were younger age (Hazard ratio (HR)=0.99, 95%CI 0.98-1.00), history of psychiatric illness (HR=1.24, 95%CI 1.02-1.50), drop-out from index treatment (HR=1.41, 95%CI 1.15-1.72) and length of index treatment (HR=1.02, 95%CI 1.00-1.04).

**Conclusion:** Premature drop-out from treatment, a history of psychiatric illness, younger age and longer treatment episodes appear to be the most important predictors of readmission.
Short summary:

The aim of this study was to identify predictors of readmission to outpatient alcohol use disorder (AUD) treatment. Drop-out from treatment, a history of psychiatric illness, younger age and longer treatment episodes are the most important predictors of readmission to outpatient treatment for AUD.
1. **Introduction:**

Most patients with alcohol use disorder (AUD) are treated in outpatient clinics (National Institute of Health and Care Excellence (NICE) 2011) but high relapse rates are a significant challenge. This has led to the suggestion that remission from AUD should not be regarded as a binary state of being either drinking or abstaining (Witkiewitz and Marlatt, 2007). It has been reported that only 24% of patients remain abstinent a year after completing formal treatment (Miller et al., 2001). Predictors of relapse have been found to be female gender, having a history of prior treatment for AUD, having a history of prior psychiatric treatment (Soyka and Schmidt, 2009), shorter education, as well as a higher frequency of mood disorders and medical conditions (Durazzo and Meyerhoff, 2017), when relapse is defined as not having achieved total abstinence following outpatient treatment for AUD. The majority of patients with AUD thus experience a chronic relapsing-remitting course (Witkiewitz and Marlatt, 2007), if successful treatment outcome is defined as complete abstinence. If relapse is defined as problem drinking following outpatient treatment for AUD, the predictors for relapse have been found to be higher educational level, problem drinking at treatment initiation, a treatment goal of controlled drinking (when compared to a goal of abstinence), and having a history of prior AUD treatment (Haug and Schaub, 2016).

Individual definitions of treatment goal can complicate an unambiguous definition of relapse, since the treatment goal of
patients seeking AUD treatment in outpatient clinics can vary from total abstinence to controlled drinking (Haug and Schaub, 2016). Therefore, when evaluating the efficiency of outpatient AUD treatment programs, the use of total abstinence as an outcome measure is problematic since varying treatment goals are present. Instead outcome measures such as days with heavy drinking, defined as consumption of certain levels of alcohol in a 30-day period, have been used to define relapse (Soyka and Schmidt, 2009; Manning et al., 2013; Mellentin et al., 2018), yet the definition of controlled drinking as a successful treatment goal may vary between patients and misestimations of alcohol quantities among study participants have been shown to result in overestimations of treatment efficiency and underestimation of relapse (Kirouac et al., 2019).

An alternative way of defining relapse is to define it as readmission to treatment. Independently of treatment goal and definition of relapse as exceeding some specific amount of alcohol, readmission to treatment may be seen as an indicator that the patient has (again) reached a point, where he or she can no longer control alcohol intake or fears losing control. As an outcome measure, it has the advantage of not being reliant on self-reported data. Furthermore, readmission as an outcome measure of treatment efficiency is highly relevant from an institutional and financial perspective, as recurrent patients add to the workload of the outpatient institutions offering treatment for AUD.
Readmission is often used as an outcome measure of detoxification treatment efficiency (Siegel et al., 1984; Ponzer et al., 2002; Running Bear et al., 2014; Yedlapati and Stewart, 2018), of inpatient care (Ahacic et al., 2011; Müller et al., 2016), and a very few studies have examined readmission rates following outpatient substance abuse treatment (Luchansky et al., 2000). To our knowledge, however, none have studied a population consisting exclusively of patients seeking outpatient treatment for AUD.

In studies of readmission to inpatient alcohol detoxification, predictors for readmission were having a history of prior treatment (Siegel et al., 1984; Ponzer et al., 2002), being female, having psychiatric comorbidity, treatment discharge against medical advice (Yedlapati and Stewart, 2018), having more severe alcohol problems (Ponzer et al., 2002), lower overall levels of social, psychological and occupational functioning (Running Bear et al., 2014), and shorter treatment duration (Siegel et al., 1984).

Detoxification is, however, not sufficient treatment for AUD, and typically only serves as the first step in long-term treatment (NICE 2011). Patients entering post-detoxification aftercare services have been shown to have lower rates of readmission to detoxification (Siegel et al., 1984). This suggests that different factors may be associated with readmission to long-term outpatient AUD treatment compared to detoxification treatment.

Identifying predictors of readmission to AUD outpatient treatment is an important step in identifying underlying mechanisms and
preventing relapse leading to these readmissions. Knowing at treatment start which patients are at increased risk of being readmitted may also aid clinicians in ensuring that patients receive treatment that matches their needs.

Therefore, this study aimed to identify predictors of readmission to outpatient AUD treatment in an outpatient alcohol treatment clinic.

2. Material and methods:

2.1. Study setting:

The study utilized data from a clinical database collected as part of the treatment for AUD in the outpatient Alcohol Treatment clinic in Odense, Denmark. Treatment is open for self-referral, free of charge, and patients can remain anonymous.

2.2. Participants:

Patients included in the study entered treatment in the period between the January 1, 2006 and the June 1, 2016.

All patients in the clinical database were considered viable for inclusion in the study. Exclusion criteria were: 1) still being in treatment by the data collection end, 2) having died during the treatment course, 3) having missing data on any of the predictor variables included in the analysis.

2.3. Treatment:

Treatment consisted of outpatient psychosocial therapy comprising either cognitive behavioural therapy, supportive consultations, family therapy or contract treatment preceded by motivational
interviewing, as well as pharmacological treatment targeting the AUD.

Before commencing outpatient treatment, some patients underwent detoxification at the clinic. If patients experienced severe withdrawal symptoms, or in case of repeated problems with compliance in outpatient treatment, treatment could take place in an inpatient psychiatric setting, though this was rare. If the patients primarily suffered from illegal drug abuse, or they presented with major psychiatric comorbidities, treatment would take place elsewhere.

2.4. Assessment:

All patients completed a baseline assessment interview as well as an assessment after treatment. Baseline assessment took place after medical consultation and detoxification, but before being matched to psychosocial treatment type.

All assessments were conducted by the clinical staff of the outpatient clinic and consisted of an Addiction Severity Index (ASI) interview (McLellan et al., 1980).

The ASI covers nine areas of patients’ lives related to medical health status, psychiatric status, employment status, economic situation, alcohol use, drug use, legal status, family status and social conditions.

Prior to baseline assessment patients would undergo a medical consultation by a psychiatrist, who would make any relevant
psychiatric diagnoses per the ICD-10 Diagnostic Criteria for Research (World Health Organization 1993).

2.5. Measures:

2.5.1. Outcome variables:

The primary outcome variable was readmission to treatment within the data collection period.

Furthermore, the time to readmission was measured in days passed since the conclusion of the index treatment to the initiation of the next treatment.

For patients with multiple readmissions, only the first readmission was measured.

The secondary outcome was readmission to treatment within one year of the conclusion of the index treatment.

2.5.2. Predictor variables:

Predictor variables examined in the study, were chosen on the basis of the variables applied in previous studies, including studies on readmission to detoxification (Siegel et al., 1984; Ponzer et al., 2002; Running Bear et al., 2014; Yedlapati and Stewart, 2018) as well as studies on relapse following outpatient AUD treatment (Soyka and Schmidt, 2009; Haug and Schaub, 2016; Durazzo and Meyerhoff, 2017; Mellentin et al., 2018).

The variables were age in years (measured at baseline assessment), gender, cohabitation status (married / living with partner or single / living alone), housing status (stable or unstable), referral form (self-referral or other), childcare responsibilities, vocational education
(none, short-cycle / medium-cycle higher education or long-cycle higher education (> 4 years)), employment status, drinking days (consumption of alcohol in the past 30 days at baseline assessment), days with excessive drinking (consumption of > 5 units of alcohol (1 unit = 12 g pure ethanol) in the past 30 days), current chronic physical health problems, prior periods of receiving prescription psychopharmacological treatment (that was not a direct result of drug/alcohol use), previous treatment for AUD, completion category (positive i.e. treatment concluded in accordance with clinical advice, or negative i.e. treatment concluded against clinical advice), and treatment length in months.

All predictor variables were derived from the index treatment episode.

2.6. Statistical analysis:

Bivariate descriptive analyses were conducted using student’s t-test (two-tailed) for continuous data and chi-square tests for categorical data stratified 1-year readmission status (table 2).

Survival analysis was carried out by multivariate analysis using a Cox Proportional Hazards model including the predictor variables described above. This model was chosen to conduct multivariate regression with time-to-event data (Cox, 1972). The advantage of this approach is that it can be used to estimate the effect of more than one exposure variable at a time, while taking into account differing durations of survival.
The proportional hazards assumption was tested visually on Kaplan-Meier survival graphs and using STATA’s proportional hazards assumption test.

Analyses were carried out on complete data. Patients presenting with incomplete data on the variables being analyzed were excluded from the study.

Level of statistical significance was set at $P \leq 0.05$.

All analyses were completed with STATA version 15.0 (StataCorp, 2017).

3. Results:

A total of 2668 unique patients entered treatment in the period of study. Of these 538 (20%) were excluded from the study for the following reasons:

At the time of data collection 53 (1.99%) patients were still in treatment, 16 (0.60%) patients had died, and 469 (17.58%) patients had missing data on one or more of the predictor variables included in the analysis.

When comparing the excluded and included groups, we found that the excluded patients were significantly younger (mean=43.05, $SD=12.60$ vs mean=46.55, $SD=11.01$, $P<0.001$), unemployed ($n=322(64.10\%)$ vs $n=1189(55.80\%)$, $P<0.001$), with no education ($n=183(34.40\%)$ vs $n=580(27.20\%)$, $P=0.004$), unstable housing status ($n=60(11.20\%)$ vs $n=134(6.30\%)$ $P<0.001$), more previous treatments ($n=274(51.10\%)$ vs $n=1020(47.9\%)$, $P<0.001$), fewer self-referrals ($n=166(30.9\%)$ vs $n=810(38\%)$, $P=0.002$) and
shorter index treatment length (mean=6.23, SD=5.82 vs mean=7.33, SD=5.46, P<0.001).

We thus included 2130 unique patients in the study and the study population is described in table 1.

Within the period of study 458 patients (22%) were readmitted to outpatient treatment for AUD.

**3.1. Sample characteristics:**

The mean age of the group was 47 (SD=11.01). The majority of the group (94%) had a stable housing status, and 55% (n=1182) of the group had received psychopharmacological treatment at a point in their life.

The mean treatment length was 7 months (SD=5.46) and 56% of the group had a positive completion status.
Table 1 Sample characteristics

<table>
<thead>
<tr>
<th>Total</th>
<th>n = 2130</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline characteristics:</td>
<td></td>
</tr>
<tr>
<td>Age, mean (SD)</td>
<td>46.55 (11.01)</td>
</tr>
<tr>
<td>Gender, n (%)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1466 (68.83)</td>
</tr>
<tr>
<td>Female</td>
<td>664 (31.17)</td>
</tr>
<tr>
<td>Previous treatment for AUD, n (%)</td>
<td>1020 (47.89)</td>
</tr>
<tr>
<td>Form of referral, n (%)</td>
<td></td>
</tr>
<tr>
<td>Self-referral</td>
<td>810 (38.03)</td>
</tr>
<tr>
<td>Other</td>
<td>1320 (61.97)</td>
</tr>
<tr>
<td>Housing status, n (%)</td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td>1996 (93.71)</td>
</tr>
<tr>
<td>Unstable</td>
<td>134 (6.29)</td>
</tr>
<tr>
<td>Cohabitation status, n (%)</td>
<td></td>
</tr>
<tr>
<td>Married or living with partner</td>
<td>1083 (50.85)</td>
</tr>
<tr>
<td>Single or living apart</td>
<td>1047 (49.15)</td>
</tr>
<tr>
<td>Having childcare responsibilities, n (%)</td>
<td>675 (31.69)</td>
</tr>
<tr>
<td>Education, n (%)</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>580 (27.23)</td>
</tr>
<tr>
<td>Short-cycle or medium-cycle higher education</td>
<td>1406 (66.01)</td>
</tr>
<tr>
<td>Long-cycle higher education</td>
<td>144 (6.76)</td>
</tr>
<tr>
<td>Employment status, n (%)</td>
<td></td>
</tr>
<tr>
<td>Having a paid employment</td>
<td>941 (44.18)</td>
</tr>
<tr>
<td>Not having a paid employment</td>
<td>1189 (55.82)</td>
</tr>
<tr>
<td>Chronic physical health problems, n (%)</td>
<td>1127 (52.91)</td>
</tr>
<tr>
<td>Have received psychopharmacological treatment, n (%)</td>
<td>1182 (55.49)</td>
</tr>
<tr>
<td>Drinking days in the month prior to treatment start, mean (SD)</td>
<td>17.84 (11.06)</td>
</tr>
<tr>
<td>Days with excessive drinking during the month prior to treatment start, mean (SD)</td>
<td>16.11 (11.29)</td>
</tr>
</tbody>
</table>

Information on the treatment received:

| Completion category, n (%) |          |
| Positive* | 1201 (56.38) |
| Negative** | 929 (43.63) |
| Treatment length in months, mean (SD) | 7.33 (5.46) |

Sample characteristics of consecutive patients seeking outpatient treatment for Alcohol Use Disorder (AUD) in the period 2006-2016 in an outpatient AUD clinic in Odense, Denmark

* Positive completion category: treatment concluded in accordance with clinical advice
** Negative completion category: treatment concluded against clinical advice

3.2. 1-year readmission:

As illustrated in table 2, patients with readmission within one year of conclusion of the index treatment (n=171(8%)) were significantly younger (P=0.03), significantly more likely to be single or living apart (P=0.007) and significantly more likely to have a negative completion status (P=0.000) than those who did not experience readmission within a year of treatment conclusion.
Table 2 Descriptive analysis

<table>
<thead>
<tr>
<th></th>
<th>Not readmitted</th>
<th>Readmitted</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline characteristics:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, mean (SD)*</td>
<td>46.71 (11.08)</td>
<td>44.77 (10.11)</td>
</tr>
<tr>
<td>Gender, n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1342 (68.50)</td>
<td>124 (72.51)</td>
</tr>
<tr>
<td>Female</td>
<td>617 (31.50)</td>
<td>47 (27.49)</td>
</tr>
<tr>
<td>Previous treatment for AUD, n (%)</td>
<td>935 (47.73)</td>
<td>85 (49.71)</td>
</tr>
<tr>
<td>Form of referral, n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-referral</td>
<td>742 (37.88)</td>
<td>68 (39.77)</td>
</tr>
<tr>
<td>Other</td>
<td>1217 (62.12)</td>
<td>103 (60.23)</td>
</tr>
<tr>
<td>Housing status, n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td>1836 (93.72)</td>
<td>160 (93.57)</td>
</tr>
<tr>
<td>Unstable</td>
<td>123 (6.28)</td>
<td>11 (6.43)</td>
</tr>
<tr>
<td>Cohabitation status, n (%)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married or living with partner</td>
<td>1013 (51.71)</td>
<td>70 (40.94)</td>
</tr>
<tr>
<td>Single or living apart</td>
<td>946 (48.29)</td>
<td>101 (59.06)</td>
</tr>
<tr>
<td>Having childcare responsibilities, n (%)</td>
<td>627 (32.01)</td>
<td>48 (28.07)</td>
</tr>
<tr>
<td>Education, n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>530 (27.05)</td>
<td>50 (29.24)</td>
</tr>
<tr>
<td>Short-cycle or medium-cycle higher education</td>
<td>1298 (66.26)</td>
<td>108 (63.16)</td>
</tr>
<tr>
<td>Long-cycle higher education</td>
<td>131 (6.69)</td>
<td>13 (7.60)</td>
</tr>
<tr>
<td>Employment status, n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Having a paid employment</td>
<td>873 (44.56)</td>
<td>68 (39.77)</td>
</tr>
<tr>
<td>Not having a paid employment</td>
<td>1086 (55.44)</td>
<td>103 (60.23)</td>
</tr>
<tr>
<td>Chronic physical health problems, n (%)</td>
<td>1028 (52.48)</td>
<td>99 (57.89)</td>
</tr>
<tr>
<td>Have received psychopharmacological treatment, n (%)</td>
<td>1077 (54.98)</td>
<td>105 (61.40)</td>
</tr>
<tr>
<td>Drinking days in the month prior to treatment start, mean (SD)</td>
<td>17.73 (11.10)</td>
<td>19.08 (10.58)</td>
</tr>
<tr>
<td>Days with excessive drinking during the month prior treatment start, mean (SD)</td>
<td>15.97 (11.33)</td>
<td>17.73 (10.74)</td>
</tr>
</tbody>
</table>

Information on the treatment received:

| Completion category, n (%)*** |                |            |
| Positive†                    | 1133 (57.84)   | 68 (39.77)  |
| Negative‡                    | 826 (42.16)    | 103 (60.23) |

Descriptive analysis of consecutive patients seeking outpatient treatment for Alcohol Use Disorder (AUD) in the period 2006-2016 in an outpatient AUD clinic in Odense, Denmark, divided by 1-year readmission status

† Positive completion category: treatment concluded in accordance with clinical advice
‡ Negative completion category: treatment concluded against clinical advice
*P<0.05
**P<0.01
***P<0.001

3.3. Survival analysis:
The Cox Proportional Hazards model identified four significant predictors of readmission (see table 3).

Age was negatively correlated with readmission (HR=0.99, 95%CI 0.98-1.00, P=0.039), while index treatment duration was positively correlated with readmission (HR=1.02, 95%CI 1.00-1.04, P=0.015), meaning that each additional month of treatment increased the probability of readmission by 2%.

A prior period of receiving psychopharmacological treatment significantly increased the probability of readmission, at any given time, by 24% (HR=1.24, 95%CI 1.02-1.50, P=0.034).

The strongest predictor of readmission identified in the Cox Proportional Hazards model was the completion status of the index treatment. A negative completion status increased the probability of readmission by 41% (HR=1.41, 95%CI 1.15-1.72, P=0.001).
### Table 3 Predictors of Readmission

<table>
<thead>
<tr>
<th>Factors</th>
<th>Hazard Ratio</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age*</td>
<td>0.99</td>
<td>0.98 - 1.00</td>
</tr>
<tr>
<td>Male gender</td>
<td>1.18</td>
<td>0.96 - 1.46</td>
</tr>
<tr>
<td>Cohabitation status (single or living apart)</td>
<td>1.21</td>
<td>0.99 - 1.47</td>
</tr>
<tr>
<td>Having childcare responsibilities</td>
<td>1.11</td>
<td>0.91 - 1.37</td>
</tr>
<tr>
<td>No education</td>
<td>1 (Reference)</td>
<td>-</td>
</tr>
<tr>
<td>Short-cycle or medium-cycle higher education</td>
<td>1.02</td>
<td>0.82 - 1.27</td>
</tr>
<tr>
<td>Long-cycle higher education</td>
<td>0.97</td>
<td>0.63 - 1.48</td>
</tr>
<tr>
<td>Not having a paid employment</td>
<td>1.09</td>
<td>0.89 - 1.34</td>
</tr>
<tr>
<td>Unstable housing status</td>
<td>0.76</td>
<td>0.51 - 1.15</td>
</tr>
<tr>
<td>Chronic physical health problems</td>
<td>1.00</td>
<td>0.83 - 1.21</td>
</tr>
<tr>
<td>Have received psychopharmacological treatment*</td>
<td>1.24</td>
<td>1.02 - 1.50</td>
</tr>
<tr>
<td>Previous treatment for AUD</td>
<td>1.01</td>
<td>0.84 - 1.23</td>
</tr>
<tr>
<td>Form of referral (other than self-referral)</td>
<td>0.98</td>
<td>0.80 - 1.19</td>
</tr>
<tr>
<td>Drinking days in the month prior to treatment start</td>
<td>1.00</td>
<td>0.98 - 1.01</td>
</tr>
<tr>
<td>Days with excessive drinking during the month prior to treatment start</td>
<td>1.02</td>
<td>1.00 - 1.03</td>
</tr>
<tr>
<td>Completion category (negative)††***</td>
<td>1.41</td>
<td>1.15 - 1.72</td>
</tr>
<tr>
<td>Treatment length in months††*</td>
<td>1.02</td>
<td>1.00 - 1.04</td>
</tr>
</tbody>
</table>

Factors predicting time to readmission for consecutive patients seeking outpatient treatment for Alcohol Use Disorder (AUD) in the period 2006-2016 in an outpatient AUD clinic in Odense, Denmark, identified by Cox Proportional Hazards analysis

† Negative completion category: treatment concluded against clinical advice

†† At conclusion of index treatment

* P ≤ 0.05

** P ≤ 0.01

*** P ≤ 0.001

Figure 1 depicts time to readmission for patients with a positive completion status and patients with a negative completion status.

When testing the proportional hazards assumption, three variables were shown to not fulfill the assumption: completion status (P=0.02), treatment length (P=0.01) and current chronic physical health problems (P=0.01). For completion status, the discrepancy between the graphical and statistical tests is likely a result of the large drop in survival function occurring at approximately 3500 days due to 4 readmission events.
Figure 1 Time to readmission by completion status. Time to readmission to treatment for patients with a positive completion status (n = 1201) and patients with a negative completion status (n = 929) after concluding treatment in the period 2006-2016 in an outpatient Alcohol Use Disorder clinic in Odense, Denmark, measured in days since conclusion of the index treatment (P = 0.001)

4. Discussion:

We believe this may be first published study investigating predictors of readmission to outpatient AUD treatment in an outpatient alcohol treatment clinic.

We included data on 2130 patients collected over a period of 10 years. Our major finding was that premature treatment drop-out was the most important predictor of readmission to outpatient AUD treatment increasing the risk of readmission by 41%. Furthermore, we found that prior psychiatric health problems, younger age and longer treatment, respectively, predicted readmission.

Our findings on treatment drop-out correspond to the findings in studies of detoxification. Yedlapati and Stewart (2018) described
that dropping out of detoxification against clinical advice increased the risk of later readmission. Similar associations have been described in substance use disorder (SUD) literature (Luchansky et al., 2000; Callaghan, 2003; Li et al., 2008).

An implication of this association could be that patients leaving the treatment program before conclusion have not been sufficiently equipped to maintain their treatment goal and, thus, have a greater risk of relapsing, in turn leading to the need for readmission. The predictive value of treatment completion status underlines the importance of keeping a clinical focus on preventing premature treatment drop-out. The question remains, however, of what causes the attrition from treatment, and what can be done to lower attrition rates to increase the chance for a better post-treatment outcome.

In a recent study, Nielsen and Nielsen (2018) found that client retention to treatment could be improved by matching patients to treatment using an actuarial matching system, rather than by clinical judgment, as is common practice in many clinics. This would indicate that treatment attrition may, in part, be a result of a mismatch between patients and treatment modality.

Treatment attrition may, however, also be related to level of social support for treatment seeking. The United Kingdom Alcohol Treatment Trial (UKATT) found, that a larger social support network significantly predicted treatment attendance for AUD patients (Dale et al., 2011). Factors such as “social support by friends” as well as
“living in a supportive relationship” have likewise been reported to be associated with reduced relapse rates in a recent systematic review (Sliedrecht et al., 2019). This plays an important role in modern AUD treatment, is recognized in specific treatment strategies like Social Behaviour and Network Therapy (Copello et al., 2002; National Institute of Health and Care Excellence, 2011), but also through an increased focus on inviting family and network to participate in some of the treatment sessions in order to discuss how family and network can best support the patient (Andersen et al., 2015; Danish Health Authority, 2015).

An increased focus on improving patients’ social support networks might thus be a strategy for reducing treatment drop-out.

Whether reducing treatment drop-out alone would lead to reduced readmission rates is uncertain, as the present study found that longer treatment episodes significantly predicted higher readmission rates. The discrepancy between the predictors may be found in their underlying mechanisms.

Longer treatment episodes have been associated with lower readmission rates following both outpatient SUD treatment (Moos et al., 1995) and inpatient AUD treatment (Siegel et al., 1984). The treatment examined in the present study was designed as a three months course, followed by an assessment interview to determine the need for further treatment. Thus, it seems likely that patients in the present study who remained in treatment for longer periods may have been more troubled by their AUD.

Whether improving on the factors that lead to treatment drop-out
may be enough to mitigate the negative predictive effect of treatment episode length on readmission rates remains an important question warranting more studies.

Furthermore, the clinical significance of the predictor is in question, as the confidence interval borders on the null-hypothesis.

Our study also found that a prior period of receiving psychopharmacological treatment significantly predicts readmission. This referred to psychiatric medications often prescribed for anxiety and depression, rather than medication licensed for preventing relapse in alcohol dependence, the former having elsewhere been associated with greater, not lesser, risk of relapse (Chick, 2019). This is consistent with Yedlapati and Stewart’s (2018) findings on psychiatric comorbidity.

Similar results have been found, when investigating relapse rather than readmissions (Soyka and Schmidt, 2009; Durazzo and Meyerhoff, 2017), and in particular mood disorders such as unipolar depression at baseline of treatment initiation have been shown to predict relapse (Durazzo and Meyerhoff, 2017). As patients presenting with major psychiatric comorbidity at the time of admission would be treated elsewhere and would, thus, not be included in the present study’s population, the findings of the present study suggest, that even patients with less severe comorbid psychiatric disorders or patients in psychiatric remission could be at increased risk of readmission for AUD.
The present study found that younger age significantly reduced time to readmission to treatment.

In a study following patients during and after conclusion of outpatient AUD treatment, higher age significantly increased the odds of both treatment retention and being a non-problem drinker at 12-month follow-up (Haug and Schaub, 2016).

It is of note, that while age did reach statistical significance as a predictor of readmission, the confidence interval borders on the null-hypothesis and should be interpreted with care.

The present study found that patients readmitted within one year of conclusion of the index treatment were significantly less likely to be cohabiting with a partner. This is in line with the finds of Siegel et al. (1984). However, when entered into the Cox Proportional Hazards model cohabitation status did not predict time to readmission, which could indicate confounding by another variable in the model. Haug and Schaub (2016) found that cohabitation in a stable partnership was significantly associated with higher treatment retention rates. As treatment drop-out significantly predicted time to readmission in the present study, it could support the confounding status of this variable on the association between cohabitation status and readmission.

Mellentin et al. (2018) found that patients with childcare responsibilities entering outpatient AUD treatment are less likely to drop out of treatment, and have better treatment outcomes whether defined as abstinence, decline in days with drinking or
decline in days with heavy drinking. In the present study, having childcare responsibilities did not significantly predict readmission, which may be the result of confounding by completion status.

In a study on readmission to detoxification Running Bear et al. (2014) found that patients’ overall level of functioning, as measured by GAF score, significantly predicted readmission. It was described that this score mediated bivariate association between readmission and housing status and employment status, respectively. Housing status did not significantly predict readmission to outpatient treatment in our study. A possible explanation for this could be that only a very small proportion of the study population reported unstable living conditions (6%) compared to 44% in Running Bear et al.’s study. It is possible that this small proportion is an expression of individuals with unstable housing conditions being more likely to enter inpatient treatment or not enter treatment for AUD at all.

Studies on readmission to detoxification have found that treatment prior to the index treatment significantly predicts future readmissions (Siegel et al., 1984; Ponzer et al., 2002), and the variable has been found significantly associated with relapse in other studies (Soyka and Schmidt, 2009; Haug and Schaub, 2016). Prior treatment did not reach statistical significance, which could be related to the definition of the variable in the present study. The question posed in the ASI does not specify what type of addiction
treatment the patient has undergone, and the interpretation may as such vary between patients.

Heavy drinking at initiation of detoxification has been identified as the most important predictor of readmission (Ponzer et al., 2002). This was not the case in our study. The reason for this difference may lie in the distinction between the treatment types examined in the two studies.

Some of the patients included in our study had undergone detoxification prior to initiation of the outpatient treatment episode. They would, thus, be able to report fewer heavy drinking days at baseline assessment than they would, had the assessment taken place on initiation of detoxification. Future studies could attempt to alleviate this issue by collecting measures for baseline drinking severity prior to detoxification or use other measures such as overall ASI alcohol score, when assessing association between drinking severity and readmission.

The present study set out to identify predictors of readmission to outpatient AUD treatment. Due to the scarcity of literature on this subject, we had to rely heavily on the results of similar studies in the fields of readmission to detoxification and relapse following outpatient AUD treatment. However, comparing the results of these studies with the results of the present study, is problematic.

Admission to detoxification treatment requires the patient to have been actively drinking prior to the admission. This is not always the

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case for readmission to outpatient psychosocial treatment. Therefore, the assumption, that a patient has relapsed when being readmitted, may be met when examining readmission as an outcome measure of the efficiency of detoxification treatment, but this assumption cannot be made when examining readmission to outpatient treatment.

However, readmission as an outcome measure may be able to capture another patient group that is omitted when examining relapse exclusively; those patients who are fearing an imminent relapse to drinking and, thus, seek treatment to prevent that from happening.

It is unknown, whether the same mechanisms underlie the processes leading to relapse and readmission. The present study has sought to illuminate this, but in examining the effect of risk factors found to significantly predict relapse on readmission the study is also limited in its range of comparison.

Our study has certain limitations. Due to the nature of the data collection process, the study cannot assess what happens to patients after they leave treatment. We were unable to register patients who moved away after concluding treatment and, thus, would be lost to follow-up. Further, we were unable to register if patients died after concluding treatment and, thus, could not take into account the competing risk of death. However, from an institutional perspective of the clinics facilitating outpatient AUD treatment, these limitations are less severe. Following treatment, a
patient either makes no repeated contact or is readmitted. It is impossible for the clinic to determine, whether the lack of repeated contact is caused by successful recovery, the patient having moved away or having died.

A small number of patients (17.58%) were excluded due to presenting with missing values. Analysis showed, that this group differed significantly on some predictor variables including age and length of index treatment. It is possible that this caused a selection bias in the study and influenced results.

In using Cox Proportional Hazards analysis to determine predictors of readmission, the assumption is made, that the predictor variables tested are constant over time. In a study on readmission to detoxification for SUD Li et al. (2008) found, that different patient factors significantly predicted short-term readmission within one month of completion of the index detoxification, and long-term readmission within one year of completion by using multi-nominal logistic regression rather than the Cox Proportional Hazards analysis, suggesting that the impacts of these factors vary over time. This study is unable to capture such differences due to the assumption of the Cox Proportional Hazards model.

Our study also has a number of strengths. A particular strength of this study is its large study population. Further, the study is strengthened by using objective outcome measures rather than self-reported outcome measures.
In conclusion, the present study found that predictors of readmission following outpatient treatment for AUD were younger age, longer treatment episodes, having prematurely dropped out of the index treatment and having a history of psychiatric health problems. Interventions targeting the attrition from outpatient AUD treatment, such as better matching of patients and treatment modality via actuarial matching systems, or increased focus on establishing social support networks, are of great clinical importance as they might be beneficial for lowering readmission rates going forward. It remains in question whether an increased clinical focus on these predictors would reduce readmission rates, as the underlying mechanisms are still to be determined and should be explored further in future studies.
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Authors Emmanuel Mangkornkaew Hansen, Anna Mejldal and Anette Søgaard Nielsen designed the study. Authors Emmanuel Mangkornkaew Hansen and Anna Mejldal conducted the statistical analyses. Author Emmanuel Hansen wrote the manuscript. Author Anna Mejldal assisted in selecting the statistical models. All authors assisted in editing the manuscript. All authors contributed to and have approved the final manuscript.

Conflict of interest:

No conflict of interest to declare.
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