

1 **Utilisation of alcohol-related treatment after a first alcohol use disorder diagnosis in Hamburg,**
2 **Germany**

3 **Brief title:** Alcohol treatment after first diagnosis

4 Jakob Manthey^{1,2,3}, Kilian Huß¹, Sven Buth¹, Ludwig Kraus^{1,4,5}, Anna Schranz¹, Carolin Kilian^{1,2}, Jürgen
5 Gallinat², Ingo Schäfer^{1,2}, Bernd Schulte^{1,2}

6

7 ¹ Centre for Interdisciplinary Addiction Research (ZIS), University of Hamburg, Hamburg, Germany

8 ² Department of Psychiatry and Psychotherapy, University Medical Center Hamburg-Eppendorf,
9 Hamburg, Germany

10 ³ Department of Psychiatry, Medical Faculty, University of Leipzig, Leipzig, Germany

11 ⁴ Department of Public Health Sciences, Centre for Social Research on Alcohol and Drugs, Stockholm
12 University, Stockholm, Sweden

13 ⁵ Institute of Psychology, ELTE Eötvös Loránd University, Budapest, Hungary

14

15 **Corresponding author:** Dr. Jakob Manthey; j.manthey@uke.de; Centre for Interdisciplinary Addiction
16 Research (ZIS), Department of Psychiatry and Psychotherapy, University Medical Center Hamburg-
17 Eppendorf, Hamburg, Germany

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18 **Abstract:**

19 **Background:** A variety of treatment options for people with alcohol use disorder (AUD) exist. Surveys
20 estimate that 1 in 10 people with AUD utilise treatment, but real-world treatment pathways remain
21 covert. This data-linkage study seeks to characterise treatment utilisation patterns to identify gaps in
22 treatment access and delivery in Germany.

23 **Methods:** Linking individual-level data from three sources (statutory health insurance, pension funds,
24 outpatient addiction care services) identified seven alcohol-related treatment types delivered in
25 outpatient (brief psychiatric consultation; formal psychotherapy; pharmacotherapy; low-threshold
26 counselling), inpatient (standard, somatic inpatient treatment; intensive inpatient treatment with
27 somatic and psychosocial care), or either of the two settings (long-term rehabilitation treatment)
28 during 2016 to 2021. For patients with a new AUD diagnosis (ICD-10: F10.1-9), treatment utilisation
29 over 24 months was recorded and patterns were identified using latent class analyses.

30 **Results:** Of n=9,491 patients with a new AUD diagnosis, 30% utilised at least one alcohol-related
31 treatment type. Treatment utilisation was associated with younger age, female sex, unemployment,
32 German nationality and lower physical comorbidity. Among treatment entrants, nearly half received
33 only brief psychiatric consultation. A similar share of patients utilised standard or intensive inpatient
34 treatment, the latter occasionally followed by rehabilitation treatment. Formal psychotherapy, low-
35 threshold counselling and pharmacotherapy were rarely utilised and were mostly used in conjunction
36 with other treatments.

37 **Conclusions:** The real-world utilisation of alcohol-related treatments contrasts with existing
38 guidelines, as most patients with diagnosed AUD do not receive adequate care. Structural and social
39 barriers should be minimised to ensure healthcare provision for those affected.

40 **Keywords:** *Alcohol use disorders, health care utilisation, health care pathways, data linkage*

41 Introduction

42 In most high-income countries, alcohol is the most prevalent psychoactive substance used. In many
43 European countries, the use of alcohol and attributable disease burden remains high despite slight
44 decreases in the past decades [1]. To alleviate the considerable alcohol-attributable disease burden in
45 high-income countries, the World Health Organization recommends strict control policies (e.g., raising
46 taxes or restricting availability) and access to screening, brief interventions, and treatment [2]. A
47 range of evidence-based and cost-effective psychosocial and pharmacological interventions are
48 available, from brief interventions in primary healthcare (PHC) for hazardous drinking to specific
49 psychological and pharmacological treatments for long-term and severe AUD in specialised care [3,
50 4]. PHC is the entry point into the health care system for most people with AUD, where many clinical
51 interventions are delivered [5, 6]. In PHC settings, brief interventions may be offered for those
52 drinking hazardously [3] and pharmacological treatments, including detoxification, are targeting those
53 with more severe forms of AUD [7]. In most jurisdictions, people with AUD are typically referred from
54 PHC to the specialist treatment system [3]. In the specialist treatment system, patients with AUD are
55 treated to maintain low alcohol consumption or abstinence after detoxification, initiate lifestyle
56 changes and prevent relapse [8]. To facilitate and standardise AUD treatment, guidelines with or
57 without pharmacological support are available (e.g., Germany: [9]; UK: [10]; global: [11]).

58 On average, less than one in five people with AUD have utilised alcohol-related treatment [12].
59 Treatment demand estimates are typically based on surveys like the World Mental Health Surveys
60 Initiative [13] where people with AUD report any help-seeking behaviour. This approach identifies
61 individual risk factors linked to treatment demand, for example, higher alcohol intake and high
62 comorbidity [14]. However, it lacks accurate information on the type and sequence of interventions,
63 e.g., actual treatment dates for specific interventions or prescribed medications. Such detailed
64 information is crucial for maximising treatment access and effectiveness as highlighted in a recent
65 study: in people discharged from hospital after an alcohol-related inpatient stay, the administration of
66 medications for AUD was associated with reduced mortality and hospitalisations [15].

67 Acknowledging the constraints of survey data to improve treatment access and effectiveness, it is
68 essential to exploit information from electronic health records. To date, this source of information has
69 been insufficiently analysed to uncover treatment pathways in the context of AUD. Demonstrating the
70 potential of this approach, a recent study from Germany showed that the majority of patients who
71 had undergone inpatient treatment, with or without detoxification, were found to have not utilised
72 post-acute treatment – despite being recommended by official guidelines [16].

73 In the present study, we seek to comprehensively describe treatment pathways for people with a first
74 AUD diagnosis based on electronic health records from Hamburg, Germany. Specifically, we aim to
75 characterise the population utilising alcohol-related interventions and compare them to people with
76 AUD not utilising alcohol-related interventions to identify barriers to and gaps in treatment access
77 and delivery.

78 **Methods**

79 ***Data sources and linkage***

80 We obtained regional health care data from three different data sources for the years 2016-2021 for
81 people residing in the German city of Hamburg: (a) two statutory health insurance providers (SHI)
82 (AOK Rheinland/Hamburg - Die Gesundheitskasse; DAK – Gesundheit), (b) two German pension funds
83 (PF) (Deutsche Rentenversicherung Nord; Deutsche Rentenversicherung Bund) and (c) municipality-
84 funded outpatient addiction care services (OACS; from Basisdatendokumentation im Suchtbereich
85 [BADO e.V.]). The data from both SHIs cover about 25% of the adult population in Hamburg and
86 include addiction-specific, as well as other medical outpatient (especially primary health care) and
87 inpatient services (hospital stays with overnight stays), outpatient surgeries (hospital stays without
88 overnight stays), and outpatient prescriptions. Data from the pension funds (PF) cover outpatient or
89 inpatient addiction medicine rehabilitation, whereas the OACS data provide information on the
90 utilisation of addiction support services, which mainly cover addiction counselling.

91 As there is no common identifier in the different datasets, the data holders used a project-specific
92 tool to create cryptographically encrypted identifiers based on personally identifiable variables (first
93 name, last name, birth year, sex). The encrypts were used to identify persons in the different datasets
94 and to link the respective data in one dataset that did contained pseudonymized identifiers only (for a
95 more detailed data linkage description, see [17]). The data linkage using personal identifying
96 information was approved by the Federal Office for Social Security. This approval exempted us from
97 seeking formal ethics approval as we had no access to personal identifying information at any time
98 but only handled and analysed pseudonymized electronic health records.

99 ***Study population***

100 We included SHI-insured patients meeting the following criteria in the analytical sample:

- 101 1) At least three years of complete insurance data
- 102 2) At least one AUD diagnosis (ICD-10: F10.1-F10.9)

103 3) 12 months before AUD diagnosis (look-behind window): No other AUD diagnosis and no
104 diagnosis indicative of chronic harm from alcohol use (ICD-10: E24.4; G31.2; G62.1; G72.1;
105 I42.6; K29.2; K70; K70.x; K85.2; K86.0; O35.4)

106 4) 24 months of available follow-up period after the AUD diagnosis

107 For each person, we identified the index date, i.e., the first AUD diagnosis that was preceded by no
108 other diagnosis indicative of chronic alcohol use (for more information on the study population
109 definition, see **Supplementary Material**), followed by a period of 24 months. The choice of 24
110 months was considered a trade-off between maximising the follow-up and minimising the exclusion
111 of patients due to lack of data. It is important to note that SHI data for more than 6 years is not
112 retrospectively available due to data protection laws requiring any data to be deleted after 6 years.

113 ***Alcohol-related treatment***

114 For the present study, we consider seven alcohol-related treatment types, which are described in
115 detail in **Table 1**. In short, the available data allows us to identify four types of interventions delivered
116 in outpatient settings (PSYCH-BRIEF; PSYCH-LONG; PHARMA; COUNSEL), two intervention types
117 delivered in inpatient settings (INPAT-STANDARD; INPAT-INTENSIVE), as well as one intervention type
118 delivered in either inpatient or outpatient settings (REHAB).

119 For four intervention types (PSYCH-LONG; INPAT-STANDARD; INPAT-INTENSIVE; REHAB), the exact
120 start and end days were available from the data, while only single days of consultations or
121 dispensations were registered for two intervention types (PSYCH-BRIEF; PHARMA). For one
122 intervention type – COUNSEL – the start and end dates of counselling episodes were available, yet
123 some episodes lasted several years during which hardly any contacts may have been made. To avoid
124 assuming that alcohol-related interventions were delivered at any time between the start and end
125 date, only the first contact after the index date was considered and, unlike for other interventions,
126 subsequent contacts were not included due to lack of date information. Also, counselling episodes

127 initiated before the index diagnosis were not considered, as we were interested in the pathway after
128 the index diagnosis.

129 - *INSERT TABLE 1 HERE*

130 ***Sociodemographic information***

131 For each patient, some sociodemographic information is available from the SHI, including time-
132 invariant information on nationality (German, not German/unknown), sex (male/female) as well as
133 the year of birth to calculate age at the time of index diagnosis (similar sized groupings: 18-34; 35-54;
134 55-64; 65-96 years). Time-varying information on employment/retirement status was grouped into
135 four different categories: employed (including self-employed), unemployed, retired, other (school,
136 university, refugee, other). Patients were assigned the employment/retirement status that dominated
137 the 12-month look-behind window (i.e., relative maximum in the 12 months preceding the index
138 date).

139 ***Comorbidity***

140 To characterise the patient's health status before their first AUD diagnosis, we relied on diagnostic
141 information from various settings contained in the SHI data set: outpatient medical treatments
142 (general practitioner or specialists, e.g., psychiatrist, cardiologist), inpatient, outpatient surgery (brief
143 surgeries in hospitals), rehabilitation (inpatient or outpatient), or temporary incapacity for work. We
144 used ICD-10 diagnoses registered in these settings during the look-behind period (12 months before
145 the index date) to calculate the Elixhauser comorbidity index [18]. Ranging between 0 and 31, a
146 higher Elixhauser score indicates presence of diagnoses in different disease groups (e.g.,
147 hypertension, liver disease, drug abuse), i.e., a higher comorbidity. Psychiatric diagnoses may only be
148 documented when psychiatric care is accessed, which could introduce a bias in the score. Thus, as
149 done previously [19], we only considered physical comorbidities and removed diagnoses pertaining to
150 alcohol (100% in our sample), drug abuse, psychosis, and depression from the score. The resulting

151 Elixhauser physical comorbidity score has a narrower range (0-27). The distribution of the full score
152 including psychiatric diagnoses is shown in **Supplementary Figure 1**.

153 **Statistical analysis**

154 We first identified patients utilising any alcohol-related treatment after a new AUD diagnosis. Among
155 those with treatment utilisation, we conducted latent class analyses (LCA) to identify treatment
156 utilisation patterns. Seven binary variables indicative of the use of the seven treatment types within
157 24 months after AUD diagnosis were used as indicator variables in the LCA. Model selection was
158 based on minimising the Bayesian Information Criterion while ensuring that the smallest class had a
159 sufficient number of members (≥ 100 ; for model selection details see **Supplementary Table 1**).

160 As class membership probabilities were close 0 and 1 for most patients and classes, patients were
161 distinctly assigned to one of the identified classes based on their maximum posterior class
162 membership probability. To describe each class, we determined a) the dominant intervention type,
163 and b) overlaps between treatment types (e.g., INPAT-INTENSIVE and REHAB).

164 Lastly, class assignment was used to describe how patients with different treatment patterns differ in
165 terms of a) sociodemographic information and b) comorbidity. For a) we conducted multinomial
166 regression analyses predicting class membership (categorical variable) with sex, age group,
167 nationality and employment/retirement status as covariates. For b) we ran zero-inflated negative
168 binomial regressions predicting the Elixhauser physical comorbidity score with sex, age, nationality
169 and employment/retirement status as covariates in the count model component and sex and age as
170 covariates in the zero-inflation model component. Zero-inflated negative binomial regressions were
171 chosen as optimal models due to the skewed distribution of the comorbidity score (see
172 **Supplementary Figure 6**).

173 All analyses were performed in R version 4.2.3 [20] and the LCA conducted using the R package poLCA
174 [21] version 1.6.0.1. The underlying data cannot be shared due to data protection agreements but all

175 R codes used to prepare and analyse the data are in the public domain

176 (https://github.com/jakobmanthey/PRAGMA_treatment-patterns/).

177 **Results**178 ***Sample description***

179 We identified n=9,491 patients with an index AUD diagnosis and available information from a
180 subsequent period of 24 months. During the first quarter, 75% of patients received either a F10.1 or
181 F10.2 diagnosis in outpatient settings, while AUD diagnoses in inpatient settings or combinations of
182 AUD diagnoses and settings were rare (see ***Supplementary Figure 3***).

183 A sample description is given in **Table 2**. Of all patients, 28.6% were female (71.4%: male), had a
184 mean age of 54.2 years, 36.8% were employed (unemployed: 30.3%; retired: 20.2%; other: 12.7%)
185 and 82.7% had a German nationality. The mean Elixhauser physical comorbidity score was 2.1, i.e.,
186 the study population had on average 2 conditions in addition to AUD diagnosed in the 12 months
187 before the index diagnosis. Only 22.6% had an Elixhauser physical comorbidity score of 0, while
188 43.5% had 1 or 2 other conditions diagnosed (sum score 3+: 33.9%). Among those receiving any
189 treatment, a higher share of women, younger, unemployed, and German nationals can be observed.
190 Moreover, the physical comorbidity was on average lower among those utilising any treatment.

191 - ***INSERT TABLE 2 HERE***

192 ***Treatment utilisation***

193 Overall, 30% (n=2,860) utilised at least one of the seven treatment options within 24 months of index
194 AUD diagnosis. Brief contacts with psychiatrists or psychologists (PSYCH-BRIEF: 17%) were the most
195 common treatment type, followed by inpatient qualified withdrawal treatment (INPAT-INTENSIVE:
196 9%) or regular inpatient treatment (INPAT-STANDARD: 7%). A similar proportion of patients were
197 documented to enter rehabilitation services (REHAB: 4%) or to receive low-threshold counselling
198 (COUNSEL: 4%) after index diagnosis. Only very few patients had alcohol-related medications
199 prescribed (PHARMA: 1%) or received formal psychotherapy (PSYCH-LONG: 1%). Among those
200 utilising at least one intervention, 70% utilised only one intervention type (2 types: 20%, 3 types: 8%,
201 4 or more types: 2%).

202 **Treatment utilisation patterns**

203 Among those utilising at least one intervention (n=2,860), we identified six classes describing distinct
204 treatment utilisation patterns (% refer to entire sample, see **Figure 1**):

205 (1) Brief psychiatric care (N = 1,267; 13.3%)

206 (2) Inpatient standard treatment only (N= 255; 2.7%)

207 (3) Inpatient intensive treatment (N = 597; 6.3%)

208 (4) Rehabilitation (N = 366; 3.9%)

209 (5) Counselling (N = 267; 2.8%)

210 (6) Mixed with a high share of pharmacological treatment (N = 108; 1.1%)

211 In classes 1 to 5, all patients utilised one intervention type that was also used to label the class (e.g.,
212 inpatient intensive treatment in classes 3 and 4). In class 6, the respective patients were typically
213 using multiple interventions of different types. Class 1 is characterised by very low utilisation rates of
214 interventions other than psychiatric brief contacts. Class 2 is distinct from other classes as the only
215 intervention in this class was inpatient standard treatment. Class 3 and 4 are characterised by all
216 patients utilising inpatient intensive treatment and rehabilitation, respectively. While 54% of patients
217 in class 4 (rehabilitation), also utilise inpatient intensive treatment, rehabilitation is not used by any
218 patient in class 3 (inpatient intensive treatment). In both classes 3 and 4, inpatient standard
219 treatment is utilised by about 1 in 4 patients. Class 5 is characterised by all patients seeking low-
220 threshold counselling support, while 23% also utilised brief psychiatric consultations and 15% entered
221 inpatient standard treatment. Lastly, class 6 is characterised by very high rates of pharmacological
222 treatment (92%) and brief psychiatric care (62%), but all other interventions are also utilised in this
223 group (utilisation rates: 6 to 39%).

224 - INSERT **FIGURE 1** HERE

225 The intensity of each treatment was operationalised by the number of interventions utilised among
226 those utilising at least one intervention of each type (see **Figure 2**). Across all latent classes, brief

227 psychological consultations were utilised more than once by most patients, while most other
228 intervention types were typically used only once. Class 6 was not only characterised by utilisation of
229 various treatment types, but also by on average more frequent utilisation of each treatment type. To
230 which degree various treatment types were utilised by the same person within each class is shown in
231 **Supplementary Figure 2**. Most people utilised only one treatment type, but high overlaps are
232 observed in classes 4 ('rehabilitation') and 6 ('mixed') – those classes characterized by presence of
233 multiple intervention types.

234 - INSERT **FIGURE 2** HERE

235 ***Treatment utilisation patterns, baseline diagnoses and sociodemographics***

236 We explored whether treatment utilisation patterns are related to AUD diagnosis and setting
237 recorded during the index quarter. Single F10.1 or F10.2 diagnoses in outpatient settings were more
238 common among those seeking no treatment (class 0: 82.3%) as well as in classes 1 (brief psychiatric
239 care: 77.3%) and 5 (counselling: 72.7%). In classes 2, 3, 4, and 6, a considerably higher share of
240 inpatient AUD diagnoses at index quarter was observed (see **Supplementary Figure 3**).

241 With multinomial regression analyses, we investigated how age, sex, nationality, and
242 employment/retirement status were linked to treatment utilisation patterns (model results:
243 **Supplementary Table 2**; illustrations: **Supplementary Figures 4 and 5**). Compared to no treatment,
244 every treatment utilisation pattern was linked to younger age. The classes 1 (brief psychiatric care), 4
245 (rehabilitation), and 6 (mixed) had statistically significantly higher shares of women than the no-
246 treatment group. A higher share of German nationals was recorded in classes 1 (brief psychiatric care)
247 and 3 to 5 (inpatient intensive, rehabilitation, counselling). Compared to employed patients, those
248 unemployed had higher odds of utilising brief psychiatric care (class 1), inpatient standard treatment
249 only (class 2) and inpatient intensive treatment (class 3). Those in retirement were more likely to
250 receive brief psychiatric care (class 1) but less likely to receive rehabilitation treatment (class 4).

251 ***Treatment utilisation patterns and physical comorbidity score***

252 The skewed distribution of the Elixhauser physical comorbidity scores is shown in **Supplementary**
253 **Figure 6**. Most patients have 0 or 1 condition diagnosed in addition to AUD, while only a few patients
254 have more than 5 conditions diagnosed. Compared to no treatment utilisation and controlling for
255 differences in sex, age, employment/retirement status, and nationality, patients in classes 1 to 4 (brief
256 psychiatric care, inpatient standard, inpatient intensive, rehabilitation) had statistically significantly
257 lower comorbidity scores before their index AUD diagnosis. Specifically, the mean Elixhauser physical
258 comorbidity scores were 8%, 17%, 16%, and 17% lower in classes 1 to 4, respectively (results see
259 **Supplementary Table 3**).

260 **Discussion**

261 ***Summary***

262 This study investigated the utilisation of various alcohol-related treatment options in Hamburg,
263 Germany 24 months after an index AUD diagnosis. Relying on electronic health records of about
264 9,500 patients residing in the between 2016 and 2021, we find that only 3 in 10 patients utilised at
265 least one treatment option. Brief consultations with psychiatrists or psychotherapists constitute the
266 most frequently utilised treatment type, followed by intensive and standard inpatient (withdrawal)
267 treatment, as well as post-acute rehabilitation treatment and low-threshold outpatient counselling.
268 Alcohol-related pharmacotherapy and formal psychotherapy were very rarely utilised. The findings
269 further suggest that treatment types are often not combined, except for rehabilitation treatment,
270 which is often preceded by intensive inpatient treatment (qualified withdrawal, see also [22]).
271 Overall, people utilising alcohol-related treatment after their AUD diagnosis are more likely to be
272 younger and some treatment patterns are more prevalent among women and unemployed patients,
273 and among patients with less physical comorbidity.

274 ***Limitations***

275 We need to acknowledge three areas limiting the interpretation of our findings. First, by analysing
276 electronic health records, we rely on the information documented for administrative and
277 reimbursement purposes. For example, the diagnostic information may not be complete as some
278 conditions may only be recognised by certain professionals and require in-depth (medical)
279 assessments. By applying strict inclusion criteria and adhering to treatment definitions applied in
280 previous studies (e.g., [16]), we sought to minimise any biases inherent in the data. This specifically
281 concerned psychiatric comorbidities, which were excluded from the data altogether and thus limits
282 the assessment of comorbidity to physical conditions.
283 Second, we only had access to 6 years of data, which limited the look-behind window to 12 months
284 for determining the index AUD diagnosis date. We cannot rule out that some patients had been

285 diagnosed with AUD more than 12 months before the index date and may have even utilised alcohol-
286 related treatments. As previous treatment experiences may influence current treatment utilisation
287 behaviour, this unmeasured confounder constitutes a possible bias that we cannot control for.

288 Third, we were unable to consider all types of treatment available for people with AUD in Germany.
289 While we have taken into account major treatment types recommended by the national guidelines
290 [9], several services considered to be integral parts of the German addiction care system were not
291 included in our analyses, such as integration assistance (“Eingliederungshilfe”), self-help groups,
292 occupational support, and services offered in the judiciary system [23]. Further, due to not being
293 explicitly reimbursed, brief interventions in PHC settings could not be identified in the data, but
294 surveys suggest that delivery rates of brief interventions in Germany are low [24, 25]. Generally, we
295 cannot gauge how many people with diagnosed AUD utilised treatment types other than those
296 analysed in this study. It appears unlikely that we have missed important treatment types, thus, we
297 believe that our findings overall are an accurate representation of reality in Hamburg. In rural areas,
298 however, treatment utilisation may differ due to variations in treatment availability.

299 ***Implications***

300 The findings suggest that 7 out of 10 patients with a diagnosed AUD do not utilise any alcohol-related
301 treatment as defined in our study. Given that some of the treatments, for instance psychiatric
302 consultations, might not have focussed solely on AUD but on other psychiatric conditions, this might
303 even be an underestimation. Previous studies have already demonstrated the low treatment
304 utilisation among people with AUD in the general population [12]. Our study completes that picture
305 by demonstrating that very low treatment rates are also observed among those already recognised in
306 the healthcare system. In other words, most people receiving an AUD diagnosis in PHC or other
307 healthcare settings, are not effectively referred to specialists and do not receive adequate care. To
308 explain suboptimal care, patient-level and provider-level perspectives need to be considered.

309 For the patient, the AUD diagnosis may not be the primary reason for a healthcare visit. The higher
310 comorbidity score among those not utilising alcohol-related treatments could be interpreted as many
311 patients prioritising the management of other, perhaps more impairing conditions like liver disease or
312 chronic pulmonary diseases. Importantly, heavy alcohol use is a risk factor for most of the identified
313 physical comorbidities [26], thus, ignoring that untreated AUD may result in suboptimal care for those
314 conditions. Those willing to enter specialist AUD treatment will encounter further barriers, e.g.,
315 stigmatisation [27], limited knowledge of treatment options [28], long waiting times for withdrawal
316 and post-acute rehabilitation treatment [29]. The higher unemployment rates among people entering
317 specialist treatment in our study may indicate that current employment constitutes a barrier to
318 entering treatment as it is incompatible with certain treatment types.

319 Optimal treatment provision may be further complicated by the very fragmented treatment system in
320 Germany. While we linked three major data sources to give a comprehensive account of alcohol
321 treatment services, however, we could not consider all possible treatments. From both a patient and
322 a health care provider perspective, the complex treatment system can be perceived as a barrier. To
323 navigate through the health care system is a core aspect of alcohol health literacy and requires
324 training or comprehensive experiences. Surveys of PHC providers suggest that they are ill-prepared,
325 indicated by low knowledge of existing guidelines and insufficient time to deal with AUD [29] as well
326 as lack of postgraduate training on alcohol-related topics [30]. Lastly, AUD remains a stigmatised
327 condition that impedes optimal care on various levels, including but not limited to the patient-
328 clinician relationship and allocation of resources [31].

329 Importantly, we find that a substantial share of people with AUD are in regular contact with
330 psychiatrists – a pattern we have not seen in previous studies on this subject. The available data does
331 not allow for an extensive characterisation of the treatment provided, except that medications
332 specific to AUD were rarely prescribed. Further research investigating patient perspectives on
333 consulting psychiatrists versus general practitioners can help to tailor treatment options according to
334 personal preferences. It should be explored to which degree brief interventions are contained in

335 psychiatric consultations. As the efficacy of brief interventions for severe AUD may be limited [32],
336 more extensive interventions may be required for many people with AUD in regular contact with
337 psychiatrists.

338 Lastly, it should be noted that among those utilising alcohol treatments, usually one type of
339 treatment is utilised and only a few people combine various treatment types. One notable exception
340 is inpatient intensive treatment followed by post-acute rehabilitation treatment. This cascade of care
341 is a core recommendation in the national guidelines [9] but only very few patients were documented
342 to follow this pathway. Surprisingly, brief consultations with psychiatrists or psychotherapists appear
343 to be an important treatment option that has hardly gained any scientific attention to date.

344 Addiction-specific training of psychiatrists, e.g., in giving alcohol brief advice, could improve care
345 provision. Unlike brief consultations, SHI-reimbursed formal psychotherapy requires patients to be
346 abstinent within 10 sessions [33]. Thus, brief consultations appear to be the more accessible
347 treatment option. However, further research is required to understand the actual care delivered in
348 this format. Possibly, the brief consultations identified in our study focus on psychiatric conditions
349 other than AUD, which may be one reason why the prescription of pharmacological interventions to
350 reduce craving and maintain abstinence was so rarely recorded in our study. Given the compelling
351 evidence of pharmacotherapy for AUD [34], the observed very low prescription rates constitute
352 perhaps the most pronounced healthcare provision gap. According to estimates for 2004, increasing
353 the coverage of AUD patients in pharmacological treatment can delay up to 10,000 deaths within one
354 year [35].

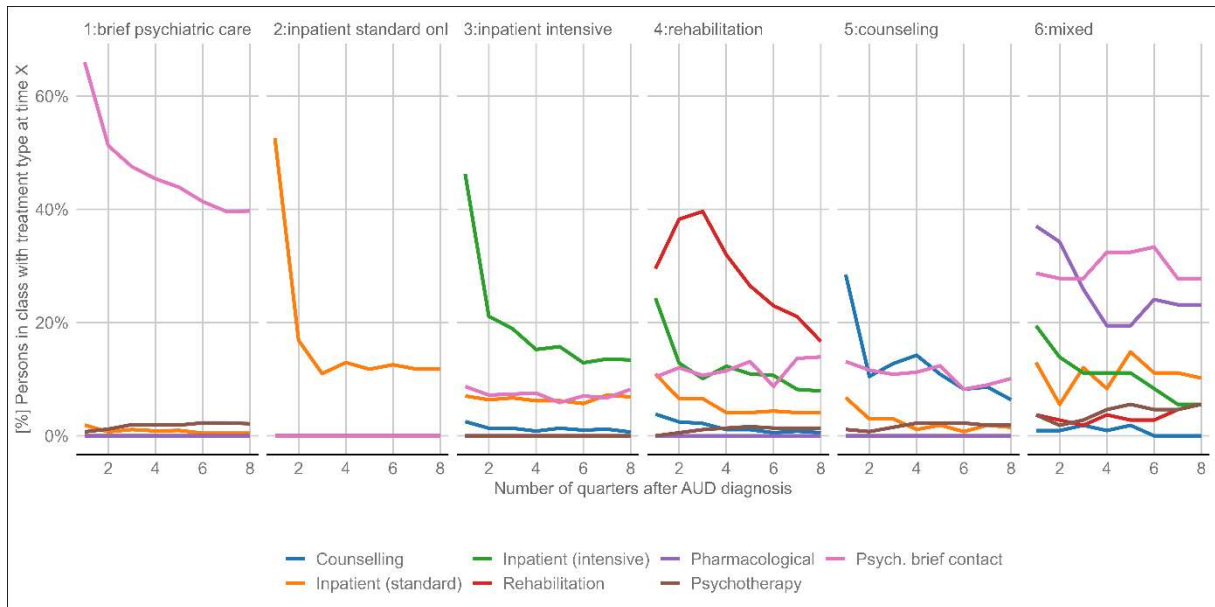
355 **Conclusion**

356 This data-linkage study offers a novel approach to understanding the real-world utilisation of alcohol-
357 related treatment options after a first AUD diagnosis in the fragmented German healthcare system.
358 Our findings demonstrate that treatment pathways mostly contrast with national guidelines. The
359 majority of patients diagnosed with AUD do not receive adequate care, with possibly detrimental
360 effects on other psychiatric or physical conditions. Minimising structural and social barriers is not only

361 required to ensure optimal healthcare provision for those affected but also to reduce the overall
362 societal burden attributable to alcohol use.

363 **Figure legends**

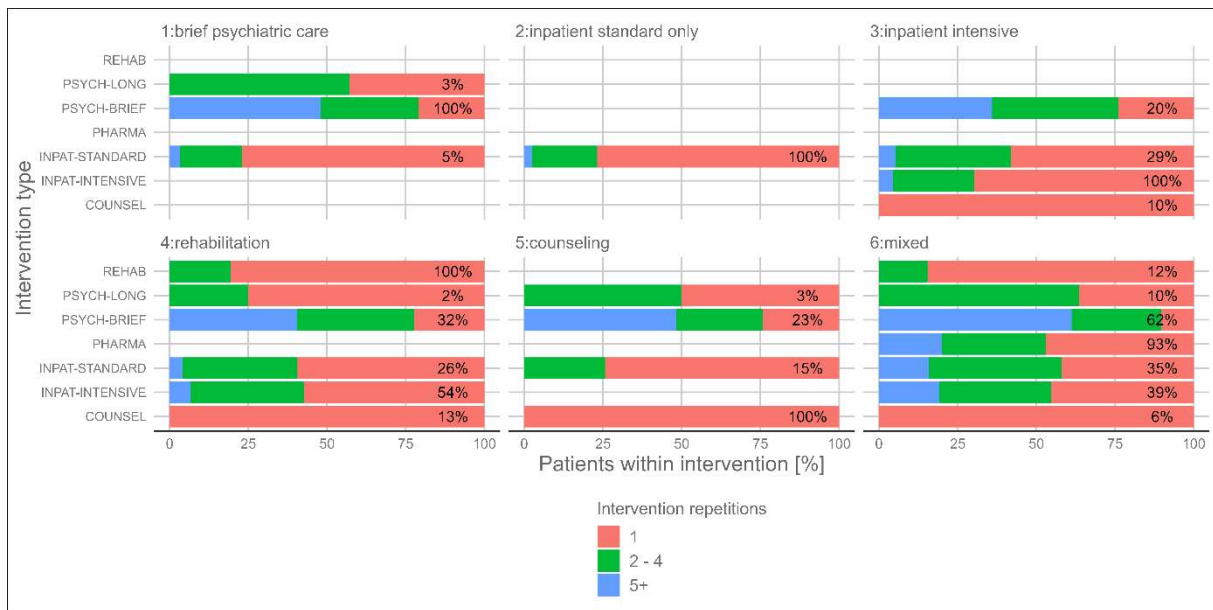
364 Figure 1. Utilisation of seven alcohol-specific treatment options 24 months after new AUD diagnoses
 365 for six latent classes. Displayed is the % in each class that utilises a specific treatment option in 3-
 366 month intervals. The % in the class label refers to the number of all n=9,541 patients with a new AUD
 367 diagnosis that fall into that class.



368

369

370 Figure 2. Intensity in utilization of seven different treatment options within 24 months after first AUD
 371 diagnosis for six latent classes. On each bar, the percentage displays how many individuals in each
 372 class have utilized the respective intervention type, while the bar itself displays how often each
 373 intervention type was utilised within each class. For example, 54% of the rehabilitation class (#4) have
 374 used intensive inpatient treatment, and among these persons, the percentage of 1, 2-4, and 5 or
 375 more inpatient stays was 57.3%, 36.2%, and 6.5%, respectively.



376

377 Author contributions (CRediT)

378 Conceptualization: JM; Methodology: JM, KH; Software: JM, KH; Validation: JM, SB, BS, LK; Formal
 379 analysis: JM, KH; Investigation: all authors; Resources: JM, BS; Data Curation: JM, KH; Writing –
 380 Original Draft: JM, BS, LK; Writing – Review & Editing: all authors; Visualisation: JM, KH; Supervision:
 381 JM; Project administration: BS; Funding acquisition: JM, BS

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391 publication.

392 **Conflicts of interests**

393 Unrelated to the present work, JM has worked as consultant for and received honoraria from various
394 public health agencies. All other authors declare no conflicts of interest.

395 **Data availability**

396 The underlying data and R codes are publicly available
397 (https://github.com/jakobmanthey/PRAGMA_treatment-patterns/).

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