The hospital admission profile of people presenting to specialist addiction services with problematic use of alcohol or opioids: A national retrospective cohort study in England

Emmert Roberts\textsuperscript{a,}\textsuperscript{*}, Matthew Hotopf\textsuperscript{b}, John Strang\textsuperscript{c}, John Marsden\textsuperscript{d}, Martin White\textsuperscript{e}, Brian Eastwood\textsuperscript{e,}\textsuperscript{1}, Colin Drummond\textsuperscript{f,}\textsuperscript{1}

\textsuperscript{a}National Addiction Centre and the Department of Psychological Medicine, Institute of Psychiatry, Psychology and Neuroscience, King’s College London, South London and the Maudsley NHS Foundation Trust and Public Health England, United Kingdom
\textsuperscript{b}Department of Psychological Medicine, Institute of Psychiatry, Psychology and Neuroscience, King’s College London and South London and the Maudsley NHS Foundation Trust, United Kingdom
\textsuperscript{c}National Addiction Centre, Institute of Psychiatry, Psychology and Neuroscience, King’s College London and South London and the Maudsley NHS Foundation Trust, United Kingdom
\textsuperscript{d}National Addiction Centre, Institute of Psychiatry, Psychology and Neuroscience, King’s College London and South London and the Maudsley NHS Foundation Trust, United Kingdom
\textsuperscript{e}Alcohol, Drugs, Tobacco and Justice division, Public Health England, United Kingdom
\textsuperscript{f}National Addiction Centre, Institute of Psychiatry, Psychology and Neuroscience, King’s College London and South London and the Maudsley NHS Foundation Trust, United Kingdom

\textbf{ARTICLE INFO}

\textbf{Article History:}
Received 11 November 2020
Revised 31 December 2020
Accepted 13 January 2021
Available online 17 January 2021

\textit{Background:} Over the past decade in England the rate of alcohol and opioid-related hospitalisation has increased alongside a simultaneous reduction in people accessing specialist addiction treatment. We aimed to determine the hospitalisation patterns of people presenting to addiction treatment with problematic use of alcohol or opioids, and estimate how individual sociodemographic characteristics and hospital admission diagnoses are associated with the rate of hospitalisation, death and successful completion of addiction treatment.

\textit{Methods:} A national record linkage between Hospital Episode Statistics (HES) and the National Drug Treatment Monitoring System (NDTMS) captured lifetime hospital admission profiles of people presenting to addiction services in England in 2018/19. Latent class analysis assigned individuals to clusters based on the ICD-10 diagnosis coded as primary reason for admission. Negative binomial, and multilevel logistic regression models determined if outcomes differed due to sociodemographic characteristics or assigned diagnostic clusters.

\textit{Findings:} Inpatient data were available for 64,840 alcohol patients, and 107,296 opioid patients. The most common reasons for admission were alcohol withdrawal (n = 20,024 (5.3% of alcohol-cohort admissions)), and unspecified illness (n = 11,387 (2.1% of opioid-cohort admissions)). Seven diagnostic clusters were identified for each substance cohort. People with admissions predominantly relating to mental and behavioural disorders, and injuries or poisonings had significantly higher hospitalisation rates (adjusted IRR 7.06 (95%CI 6.72–7.42); \(p < 0.001\), higher odds of death during addiction treatment (adjusted OR 2.71 (95%CI 2.29–3.20); \(p < 0.001\)) and lower odds of successful treatment completion (adjusted OR 0.72 (95%CI 0.68–0.76); \(p < 0.001\)).

\textit{Interpretation:} This is the first study to interrogate national hospitalisation patterns within people presenting to addiction services with problematic use of alcohol or opioids. Having identified high-risk, high-cost individuals with increased hospital usage, and increased odds of death, future work should focus on targeting appropriate interventions, to improve their health outcomes and prevent unnecessary hospital readmission.

\textit{Funding:} The work was funded by the Medical Research Council (MRC).

© 2021 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/)

1. \textbf{Introduction}

Alcohol and non-medical opioid use are modifiable risk factors associated with substantial multimorbidity, and are responsible for millions of preventable deaths and hospital admissions worldwide each year [3,4]. In financial year 2018/19 over 80% of people...
Research in context

Evidence before this study

Alcohol and non-medical opioid use are associated with a substantial global burden of disease, and are responsible for millions of inpatient hospital admissions per year. Previous research reports rates of inpatient hospital admission two to eight times higher in individuals with substance use disorders when compared to groups without substance misuse diagnoses.[1] However, these estimates are largely based subsamples of people identified at the level of individual services, or with specific conditions. To our knowledge only one previous study in Scotland reports national level hospitalisation estimates for the cohort of people with problematic alcohol or opioid use presenting to specialist addiction services. Whilst this study reports significantly elevated admission rates for diagnoses pertaining to mental and behavioural disorders, it does not identify groups of people who may be disproportionately responsible for elevated admission rates.[2]

Added value of this study

With the creation of a novel data-linkage, we believe this is the largest study globally to be able to interrogate national hospitalisation patterns within the cohort of people presenting to specialist addiction services with problematic use of alcohol or opioids. For the first time this paper characterises distinct high-risk high-cost clinical cohorts with hospital admission diagnoses predominantly related to mental and behavioural disorders, and injuries or poisonings that have dramatically increased rates of hospitalisation (adjusted Incidence Rate Ratios (aIRR)s) of 7.06 95%CI 6.72–7.42, p < 0.001 for alcohol, and 7.50 95%CI 7.11–7.9, p < 0.001 for opioids), and an associated increased odds of mortality (adjusted Odds Ratios (aORs) of 2.71 95%CI 2.29–3.20, p < 0.001 for alcohol, and 2.11 95%CI 1.90–2.35, p < 0.001 for opioids).

Implications of all the available evidence

Given the global harm associated with alcohol, and non-medical opioid use, this study is able to suggest which people, at the point at which they present for addiction treatment, are at high risk of hospitalisation, high odds of death during treatment and low odds of successful completion of specialist addiction treatment. As such future work within these cohorts should focus on the development of targeted interventions to reduce unnecessary hospital readmission, and improve health outcomes.
consent [19], and the nature of this consent states that individuals may opt out at any time from having their records used. Approval to conduct the linkage analysis was granted under regulation 3 of the Health Service (Control of Patient Information) Regulations 2002 [20], following review by the PHE Caldicott Advisory Panel (CAP) (Ref: CAP-2019-06). The study benefited throughout from discussions with service users from the South London and the Maudsley (SLaM) Biomedical Research Centre (BRC) Data Linkage Service User and Carer Advisory Group, and the PHE Alcohol Treatment Expert Group, and is reported according to the STROBE statement [21]. There were no deviations from the study protocol, the analysis was not pre-registered, and the results should be considered exploratory.

2.2. Hospital admission definitions

A unique hospital admission was defined as a ‘Continuous InPatient Spell’ (CIPS) according to standard methods [22,23]. A CIPS represents an individual’s continuous journey from admission to discharge from inpatient hospital services regardless of any transfers between hospital consultants responsible for care within the same hospital or any transfers between different hospitals prior to discharge. Unique completed hospital admissions were subsequently characterised as ‘general inpatient admissions’ (i.e. all inpatient hospital admissions excluding day-case visits, regular day or night attenders, and admissions for births or deliveries) [24]. HES records enable one primary and up to nineteen secondary ICD–10 diagnostic codes to be recorded for each unique completed hospital admission.

2.3. Statistical analysis

We described and compared the number of general inpatient admissions, the mean number of admissions per person, mean length of admission, and mean age at first admission between individuals with problematic alcohol or opioid use, and how they differ by sociodemographic (sex, age, ethnicity, residential status and deprivation) and clinical (type of admission) characteristics. Continuous variables were compared using an unpaired t-test, categorical variables compared using a chi-squared test, and ordinal variables using the Wilcoxon rank sum test.

As primary reason for hospital admission is heterogeneous, we aimed to identify distinct clinical groups (i.e. diagnostic clusters) such that, within each cluster, individuals held similar patterns in their primary reason for hospital admission. Binary dummy variables were created representing each of the first 19 diagnostic chapters of ICD-10. The full list of ICD–10 diagnostic chapters, and examples of disorders from each chapter, can be found as table S1 in the online supplementary material. We used latent class analysis (LCA) to assign all individuals to non-overlapping clusters (i.e. each individual is assigned to only one cluster) [25,26]. An initial unconditional 1-class solution was fit to the data and sequentially increased to an 8-class model. Each model used 5000 random sets of starting values to guard against convergence on local maxima, and where higher order latent class models failed to converge, tolerance criteria were relaxed to generate a solution even if that solution was in a non-concave region of the parameter space. Following this, the logit intercepts for each chapter were examined and where they were \(-15\) or \(>15\) these were constrained and the LCA model rerun with normal tolerance criteria. All final models converged using normal tolerance criteria.

The optimal number of clusters was decided using a combination of statistical and clinical assessments (the most parsimonious model in which the expected percentage of the population in each cluster was \(\geq 5\%), the likelihood ratio test had to fail to reject the null hypothesis comparing that latent class model fit to a saturated model, the lowest combination of the Akaike’s Information Criterion (AIC), and Bayesian Information Criteria (BIC), an entropy \(\leq 0.8\), and examination of the derived clusters to ensure they represented clinically distinct populations) [27,28]. The chosen LCA model was thus used to assign the most likely cluster membership for each individual within the cohort, and a multinomial logistic regression was used to characterise the clusters by individual-level sociodemographic characteristics.

Given the hierarchical structure, with individuals clustered in treatment services and services clustered in local treatment systems, confidence intervals (CIs) were calculated using robust standard errors.

To assess the association between an individual’s sociodemographic and clinical characteristics, including their LCA derived diagnostic cluster, and their hospital admission counts we used a zero-truncated negative binomial regression model to generate Incidence Rate Ratios (IRR); an IRR greater than 1 denoting an increased rate of hospital admission when compared to the reference value. A truncated model was used as all individuals in our sample had at least one inpatient hospital admission thereby ensuring predictions were in the range of \([1, \infty]\) rather than \([0, \infty]\), and the negative binomial distribution was used to account for overdispersion in the number of hospital admissions. Confidence intervals were calculated with robust standard errors to account for the clustering of individuals within local authority commissioned specialist addiction treatment services. To assess the association between an individual’s sociodemographic and clinical characteristics and the binary odds of death during treatment or successful treatment completion we used multi-level logistic regression models to generate Odds Ratios (ORs); an OR greater than 1 denoting an increased odds of death during treatment, and an increased odds of successful completion of treatment when compared to the reference value. Successful completion of treatment is a standard NDTMS variable based on clinic reports that the individual has reduced use or abstinence depending on treatment goals, completed interventions and met care plan goals, with mutual agreement to exit treatment [29,30]. The models were adjusted for all sociodemographic and clinical covariates and, additionally, inverse probability weighting was assigned to each individual to examine for the effect of any potential error introduced by the linkage process, as per standard methods to account for non-response bias in cohort studies [31,32]. All studied variables in the substance misuse cohorts had complete data with the exception of ethnicity and IMD, whose missingness was assumed to be completely at random (MCAR).

All analyses were conducted using SQL Server Management Studio version 18.4 and STATA SE version 15.1. The significance level was set at 0.05, no allowance was made for multiplicity.

2.4. Role of the funding source

This study was supported by the corresponding author’s MRC Addiction Research Clinical (MARC) Fellowship. The funder had no role in study design; data collection, data analysis, interpretation of data, the writing of the report, or in the decision to submit the paper for publication. ER and BE had full access to all the data in the study and all authors had final responsibility for the decision to submit for publication.

3. Results

3.1. Characteristics of the study population

Table 1 summarises the sociodemographic and clinical profile of all studied cohorts and their hospital admissions. Linked hospitalisation data were available for 64,840 alcohol and 107,296 opioid patients who presented to addiction services in England in 2018/19, this provided the final sample available for analysis. Since 1st April 1997 these cohorts were responsible for a total of 374,713, and 554,936 general inpatient hospital admissions respectively. When compared to the overall admission profile of all people in HES, both substance misuse cohorts had a higher mean number of admissions per person; 3.8 (all) vs 5.8 (alcohol) vs 5.2 (opioid), a lower mean
The ten most common primary diagnostic reasons for admission in all cohorts can be found in Table 2 with these conditions accounting for one fifth (22.2%) of all admissions for alcohol patients and one sixth (15.6%) of all admissions for opioid patients. Within the top ten primary reasons for admission, the conditions that had a statistically significantly higher proportion in the alcohol cohort compared to all admissions in HES were alcohol withdrawal state, acute alcohol intoxication, alcohol dependence, paracetamol poisoning, antidepresant poisoning and unspecified convulsions (p < 0.001). The conditions with a statistically significantly higher proportion in the opioid cohort were opioid dependence, paracetamol poisoning, benzodiazepine poisoning and dermatological infections (p < 0.001).

The ten most common primary diagnostic reasons for admission in all cohorts at the level of three-digit ICD-10 code can be found in the online supplementary material as Table S2.

Latent class analysis identified seven diagnostic clusters as most representative of the data for each substance cohort. LCA model statistics can be found in the online supplementary tables S3 and S4, the ICD-10 chapter breakdown and a detailed description of each cluster are reported in tables S5 and S6, and the ten most common primary diagnostic reasons for admission within each cluster as tables S7 and S8.

Tables 3 and 4 show the results of the multinomial logistic regression analysis of the diagnostic clusters on sociodemographic characteristics (with each cluster 1 as the referent category).
individuals with digestive problems (41%) and problems related to injuries or poisoning (24%), but with few individuals admitted due to mental and behavioural problems (1%).

AC2 represented just over one in ten (13.0%) of individuals, comprising individuals who were from less deprived areas and more likely to be non-white compared with AC1, and had diagnoses predominantly relating to mental and behavioural disorders (100% of cluster) and injuries or poisoning (66%). Similarly, AC2 represented just over one in five (20.8%) of individuals, comprising individuals who were from less deprived areas, and younger compared with OC1, and had diagnoses predominantly relating to injuries or poisoning (64%), and mental and behavioural disorders (54%).

AC3 represented just under one in ten (9.2%) of individuals, comprising exclusively women of childbearing age, who had diagnoses predominantly relating to pregnancy (100% of cluster), and the digestive system (19%). Similarly, AC3 represented just under one in ten (8.2%) of individuals, and were exclusively women of childbearing age, with diagnoses predominantly related to pregnancy (100%) and digestive problems (17%).

AC4 represented just over one in ten (10.3%) of individuals, comprising predominantly older, less affluent men with problems relating to injuries and poisoning (89% of cluster) and digestive problems (88%) but also a high preponderance of admissions due to mental and behavioural disorders (79%). Similarly, AC4 represented just under one in ten (8.3%) of individuals, comprising older more deprived men, who had diagnoses predominantly relating to injuries and poisoning (83%) and digestive problems (79%) but also a high preponderance of admissions due to mental and behavioural disorders (54%).

AC5 represented just over one in twenty (7%) of individuals, comprising predominantly younger men with injuries and poisonings (100%) and musculoskeletal issues (15%). Similarly, OC5 represented just over one in twenty (7%) of individuals, comprising predominantly younger men with injuries and poisonings (100%) and musculoskeletal issues (14%).

AC6 represented just over one in twenty (5.2%) of individuals, comprising exclusively of women of childbearing age who had diagnoses predominantly relating to pregnancy (100% of cluster), and the genitourinary system (62%). Similarly, OC6 represented just over one in twenty (6%) of individuals, comprising mostly of women of childbearing age who had diagnoses predominantly relating to pregnancy (66%), and the genitourinary system (60%).

AC7 represented just over one in twenty (7.0%) of individuals, comprising predominantly older women who had diagnoses predominantly relating to the digestive system (79%) and musculoskeletal problems (48%). OC7 was dissimilar and represented just over one in twenty (5.7%) of individuals, comprising predominantly more deprived men who had diagnoses predominantly relating to injuries and poisoning (78%) and skin problems (77%).

### 3.3. Sociodemographic and clinical associations with rate of inpatient hospital admission, odds of death during treatment and odds of successful treatment completion

Results for the sociodemographic and clinical associations with hospitalisation rate, odds of death during treatment and successful treatment completion can be found in Tables 5 and 6.

In the adjusted model, for each substance we found a statistically significantly higher rate of general hospital admissions for women, people aged over 30, people who are from more deprived areas, and people in both alcohol and opioid diagnostic clusters 2, 4, 6, and 7.

In the adjusted model, for each substance we found a statistically significant increase in the odds of death during treatment for older...
Table 3
Characteristics of the cohort and diagnostic sub-populations of the n=64,840 individuals who presented to community drug and alcohol treatment services in England in 2018/19 with problems related to alcohol.

| Characteristics                                      | All People n (%) | AC1n (%) | AC2n (%) | AC3n (%) | AC4n (%) | AC5n (%) | AC6n (%) | AC7n (%) |
|------------------------------------------------------|------------------|----------|----------|----------|----------|----------|----------|----------|
| Mean number of admissions per person (n)             | 64,840 (100.0)   | 31,132 (100.0) | 10,316 (100.0) | 7,350 (100.0) | 5,919 (100.0) | 3,594 (100.0) | 3,407 (100.0) | 3,122 (100.0) |
| Mean age at first admission (years)                  | 40.8             | 40.4     | 39.7     | 29.6     | 44.6     | 32.8     | 31.9     | 47.3     |
| Mean length of admission (days)                      | 3.3              | 2.2      | 5.5      | 0.9      | 3.4      | 1.8      | 2.0      | 2.8      |

Most prevalent ICD-10 chapters in cluster

| Chapter number: Condition (% of cluster)              | 1st | 2nd | 3rd | 4th | 5th |
|------------------------------------------------------|-----|-----|-----|-----|-----|
| 1st A 18: Symptoms/Signs (46)                        |     |     |     |     |     |
| 11: Digestive (48)                                   |     |     |     |     |     |
| 5: Mental/Behavioural (100)                          |     |     |     |     |     |
| 15: Pregnancy (100)                                  |     |     |     |     |     |
| 18: Symptoms/Signs (93)                              |     |     |     |     |     |
| 19: Injury/Poisoning (89)                            |     |     |     |     |     |
| 13: Musculoskeletal (15)                              |     |     |     |     |     |
| 14: Genitourinary (17)                               |     |     |     |     |     |
| 11: Digestive (11)                                   |     |     |     |     |     |
| 19: Injury/Poisoning (52)                            |     |     |     |     |     |
| 10: Respiratory (7)                                  |     |     |     |     |     |
| 19: Injury/Poisoning (46)                            |     |     |     |     |     |

Sociodemographic

| Sex                  | Alln (%) | AC1n (%) | AC2n (%) | AC3n (%) | AC4n (%) | AC5n (%) | AC6n (%) | AC7n (%) |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|
| Female               | 27,439 (42.3) | 9,021 (29.0) | 3,452 (33.2) | 7,340 (100.0) | 2,294 (38.8) | 547 (15.2) | 3,047 (100.0) | 1,399 (44.8) |
| Male                 | 37,401 (57.7) | 22,111 (71.0) | 6,891 (66.8) | 0 (0.0) | 3,047 (84.8) | 0 (0.0) | 1,723 (55.2) | 1,723 (55.2) |

Age in years (at presentation to D&A services)

| Age group             | AC1n (%) | AC2n (%) | AC3n (%) | AC4n (%) | AC5n (%) | AC6n (%) | AC7n (%) |
|-----------------------|----------|----------|----------|----------|----------|----------|----------|
| 18-30                 | 4,839 (7.5) | 2,306 (7.4) | 771 (7.5) | 732 (10.0) | 175 (3.0) | 523 (14.6) | 281 (8.3) | 51 (1.6) |
| 31-45                 | 21,856 (33.7) | 8,756 (28.1) | 3,855 (37.3) | 4,125 (56.1) | 1,338 (22.6) | 1,650 (45.9) | 1,751 (51.4) | 381 (12.2) |
| 46-60                 | 29,168 (45.0) | 14,945 (48.0) | 4,561 (44.2) | 2,471 (33.6) | 3,073 (51.9) | 1,201 (33.4) | 1,354 (39.7) | 1,563 (50.1) |
| 60+                   | 8,977 (13.8) | 5,125 (16.5) | 1,129 (10.9) | 22 (0.3) | 1,333 (22.5) | 220 (6.1) | 21 (0.6) | 1,127 (36.1) |

Deprivation (IMD)

| Quintile | AC1n (%) | AC2n (%) | AC3n (%) | AC4n (%) | AC5n (%) | AC6n (%) | AC7n (%) |
|----------|----------|----------|----------|----------|----------|----------|----------|
| First (Most deprived) | 16,953 (26.7) | 7,804 (25.0) | 2,968 (29.5) | 1,734 (23.9) | 1,762 (30.4) | 965 (28.1) | 911 (27.1) | 809 (26.2) |
| Second   | 16,756 (26.4) | 7,926 (25.0) | 2,709 (26.9) | 1,969 (27.1) | 1,577 (27.2) | 903 (26.3) | 922 (27.4) | 750 (24.3) |
| Third     | 13,604 (21.4) | 6,715 (22.0) | 2,049 (20.4) | 1,560 (21.5) | 1,149 (19.8) | 748 (21.8) | 675 (20.1) | 708 (23.0) |
| Fourth    | 10,901 (17.1) | 5,402 (17.7) | 1,609 (16.0) | 1,324 (18.2) | 893 (15.4) | 562 (16.3) | 561 (16.7) | 550 (17.8) |
| Fifth (Least deprived) | 5,351 (8.4) | 2,702 (8.9) | 732 (7.3) | 672 (9.3) | 415 (7.2) | 261 (7.6) | 296 (8.7) | 268 (8.7) |

Residential status

| AC1n (%) | AC2n (%) | AC3n (%) | AC4n (%) | AC5n (%) | AC6n (%) | AC7n (%) |
|----------|----------|----------|----------|----------|----------|----------|
| Non NFA postcode | 63,908 (98.6) | 30,700 (98.6) | 10,117 (98.0) | 7,301 (99.3) | 5,843 (98.7) | 3,456 (96.2) | 3,382 (99.3) | 3,109 (99.6) |
| NFA postcode   | 932 (1.4) | 432 (1.4) | 199 (1.9) | 49 (0.7) | 76 (1.3) | 138 (3.8) | 25 (0.7) | 13 (0.4) |

Ethnicity

| AC1n (%) | AC2n (%) | AC3n (%) | AC4n (%) | AC5n (%) | AC6n (%) | AC7n (%) |
|----------|----------|----------|----------|----------|----------|----------|
| White    | 59,371 (93.8) | 28,685 (94.3) | 9,201 (91.8) | 6,776 (94.3) | 5,350 (93.2) | 3,298 (94.1) | 3,157 (95.0) | 2,904 (94.9) |
| Non-white| 3,900 (6.2) | 1,744 (5.7) | 825 (8.2) | 412 (5.8) | 390 (6.8) | 207 (5.9) | 165 (5.0) | 157 (5.1) |

Emboldened percentages are statistically significant (p < 0.05) from multivariable, multinomial logistic regression with robust standard errors (Cluster 1: referent) Relative Risk Ratios and 95% confidence intervals can be found in the online supplementary material as table S12; AC1-7 Alcohol Cluster 1-7; D&A Drug and Alcohol; IMD Indices of Multiple Deprivation; NFA No fixed abode; ICD-10 International Classification of Disease-Volume 10; 1 General inpatient admissions are row percentages, all other percentages in table are column percentages 2 Office of Population Censuses and Surveys (OPCS) categories A, B and C collapsed as white, all other OPCS categories (D-S) collapsed as non-white;
### Table 4
Characteristics of the cohort and diagnostic sub-populations of the \( n = 107,296 \) individuals who presented to community drug and alcohol treatment services in England in 2018/19 with problems related to opioids.

|                  | OC1 n (%) | OC2 n (%) | OC3 n (%) | OC4 n (%) | OC5 n (%) | OC6 n (%) | OC7 n (%) |
|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| **People n (%)** | 107,296 (100.0) | 50,325 (100.0) | 17,910 (100.0) | 10,866 (100.0) | 8,501 (100.0) | 9,442 (100.0) | 4,897 (100.0) | 5,355 (100.0) |
| **Mean number of admissions per person (n)** | 5.2 | 2.4 | 6.7 | 2.6 | 19.3 | 1.9 | 10.0 | 11.0 |
| **Mean age at first admission (years)** | 34.0 | 34.9 | 32.5 | 27.9 | 36.5 | 30.3 | 29.1 | 35.9 |
| **Mean length of admission (days)** | 4.3 | 2.4 | 9.0 | 1.0 | 4.1 | 1.9 | 2.1 | 3.6 |

#### Most prevalent ICD-10 chapters in cluster

**Chapter number: Condition (% of cluster)**

| Cluster | 1st | 2nd | 3rd | 4th | 5th |
|---------|-----|-----|-----|-----|-----|
|         | 19: Injury/Poisoning (45) | 11: Digestive (41) | 19: Injury/Poisoning (64) | 18: Symptoms/Signs (93) | 19: Injury/Poisoning (100) |
| 1st     | 13: Musculoskeletal (22) | 18: Symptoms/Signs (30) | 18: Symptoms/Signs (17) | 18: Symptoms/Signs (34) | 18: Symptoms/Signs (19) |
| 2nd     | 11: Digestive (39) | 19: Injury/Poisoning (20) | 11: Digestive (17) | 14: Genitourinary (16) | 10: Respiratory (7) |
| 3rd     | 11: Digestive (39) | 19: Injury/Poisoning (20) | 11: Digestive (17) | 14: Genitourinary (16) | 10: Respiratory (7) |
| 4th     | 13: Musculoskeletal (22) | 18: Symptoms/Signs (21) | 11: Digestive (17) | 14: Genitourinary (16) | 10: Respiratory (7) |
| 5th     | 15: Pregnancy (20) | 10: Respiratory (16) | 10: Respiratory (18) | 10: Respiratory (18) | 10: Respiratory (18) |

#### Sociodemographic

| Sex          | OC1 n (%) | OC2 n (%) | OC3 n (%) | OC4 n (%) | OC5 n (%) | OC6 n (%) | OC7 n (%) |
|--------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| **Female**   | 31,760 (29.6) | 7,883 (15.7) | 4,075 (22.7) | 10,866 (100.0) | 2,695 (31.7) | 552 (5.9) | 4,645 (94.9) | 1,053 (19.7) | 4,302 (80.3) |
| **Male**     | 75,536 (70.4) | 42,442 (84.3) | 13,835 (77.3) | 0 (0.0) | 5,806 (68.3) | 8,890 (94.1) | 252 (5.1) | 252 (5.1) |

| Age in years (at presentation to D&A services) | OC1 n (%) | OC2 n (%) | OC3 n (%) | OC4 n (%) | OC5 n (%) | OC6 n (%) | OC7 n (%) |
|-----------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 18-30                                         | 8,036 (7.5) | 3,513 (7.0) | 1,549 (8.7) | 1,095 (10.1) | 358 (4.2) | 970 (10.3) | 431 (8.8) | 120 (2.2) |
| 31-45                                         | 58,631 (54.6) | 25,061 (49.8) | 10,064 (56.2) | 7,807 (71.8) | 3,612 (42.5) | 5,938 (62.9) | 2,391 (25.3) | 1,171 (23.9) | 2,188 (40.9) |
| 46-60                                         | 37,110 (34.6) | 19,565 (38.9) | 5,905 (33.0) | 1,951 (18.0) | 3,939 (46.3) | 143 (1.5) | 47 (1.0) | 146 (2.7) |
| 60+                                           | 3,519 (3.3) | 2,186 (4.3) | 329 (2.2) | 13 (0.1) | 592 (7.0) | 143 (1.5) | 47 (1.0) | 146 (2.7) |

| Deprivation (IMD) | OC1 n (%) | OC2 n (%) | OC3 n (%) | OC4 n (%) | OC5 n (%) | OC6 n (%) | OC7 n (%) |
|-------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| **First (Most deprived)** | 38,059 (37.7) | 17,152 (36.1) | 6,420 (35.6) | 3,793 (36.6) | 3,280 (40.7) | 3,280 (38.0) | 2,828 (44.4) | 1,866 (39.6) | 2,283 (44.4) |
| **Second**        | 28,628 (28.4) | 13,620 (28.7) | 4,699 (28.3) | 2,972 (28.7) | 2,281 (28.3) | 2,399 (27.9) | 1,257 (26.7) | 1,040 (22.7) | 1,400 (27.2) |
| **Third**         | 18,024 (17.8) | 7,000 (18.3) | 2,395 (17.5) | 1,893 (18.3) | 1,374 (17.0) | 1,517 (17.7) | 857 (18.2) | 778 (15.1) | 511 (10.0) |
| **Fourth**        | 11,533 (11.4) | 5,657 (11.9) | 1,847 (11.1) | 1,190 (11.4) | 799 (9.9) | 987 (11.4) | 540 (11.5) | 513 (10.0) | 513 (10.0) |
| **Fifth (Least deprived)** | 4,714 (4.7) | 2,366 (5.0) | 724 (4.4) | 508 (5.0) | 330 (4.1) | 426 (5.0) | 193 (4.1) | 167 (3.3) |

| Residential status | OC1 n (%) | OC2 n (%) | OC3 n (%) | OC4 n (%) | OC5 n (%) | OC6 n (%) | OC7 n (%) |
|--------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| **Non NFA postcode** | 100,235 (93.4) | 47,141 (93.7) | 16,455 (91.9) | 10,284 (94.6) | 8,041 (94.6) | 8,485 (94.6) | 4,694 (95.9) | 5,135 (95.9) |
| **NFA postcode**   | 7,061 (6.6) | 3,184 (6.3) | 1,435 (8.1) | 582 (5.4) | 460 (5.4) | 957 (10.1) | 203 (4.1) | 220 (4.1) |

Emboldened percentages are statistically significant \((p < 0.05)\) from multivariable, multinomial logistic regression with robust standard errors (Class 1: referent); Relative Risk Ratios and 95% confidence intervals can be found in the online supplementary material as table S13; D&A Drug and Alcohol; IMD Indices of Multiple Deprivation; NFA No fixed abode; ICD-10 International Classification of Disease-Volume 10; OC1-7 Opioid Cluster 1-7; 1 General inpatient admissions are row percentages, all other percentages in table are column percentages 2 Office of Population Censuses and Surveys (OPCS) categories A, B and C collapsed as white, all other OPCS categories (D-S) collapsed as non-white.
| Sociodemographic | People (n) | Admissions (n) | Admissions rate (Mean number of admissions per person) | p value | Deaths in treatment n (%) | Death in treatment rate (Mean number of deaths per person) | p value | People successfully completing treatments n (%) | Successful treatment rate (Mean number of successful treatments per person) | p value |
|------------------|------------|---------------|------------------------------------------------------|---------|--------------------------|----------------------------------------------------------|---------|-----------------------------------------------|-------------------------------|---------|
| All Sex          | 64,840 (100.0) | 374,713 (100.0) | 5.8  | 1,115 (100.0) | 0.017 | 35,581 (100.0) | 0.549 |
| Female           | 27,439 (42.3)  | 168,490 (45.0)  | 6.1  | Reference | <0.001 | 398 (35.7) | 0.015 | Reference | 15,553 (41.7) | 0.567 |
| Male             | 37,401 (57.7)  | 206,223 (55.0)  | 5.5  | 0.87 (0.85-0.90) | <0.001 | 717 (64.1) | 0.019 | Reference | 20,028 (56.3) | 0.535 |
| Age in years     |             |               |                                              |         |             |                                           |         |                          |                               |         |
| 18-30            | 4,889 (7.5)   | 22,238 (5.9)   | 4.6  | Reference | <0.001 | 30 (2.7) | 0.017 | Reference | 2,504 (7.0) | 0.517 |
| 31-45            | 21,856 (33.7) | 120,866 (32.3) | 5.5  | 1.15 (1.11-1.20) | <0.001 | 284 (25.5) | 0.013 | 1.99 (1.35-2.92) | <0.001 | 11,399 (32.0) | 0.522 |
| 46-60            | 29,166 (45.0) | 171,898 (45.9) | 5.9  | 1.19 (1.15-1.24) | <0.001 | 581 (52.1) | 0.020 | 2.78 (1.31-4.96) | <0.001 | 15,957 (44.9) | 0.547 |
| Deprivation (IMD) |             |               |                                              |         |             |                                           |         |                          |                               |         |
| Quintile         |             |               |                                              |         |             |                                           |         |                          |                               |         |
| First (Most deprived) | 16,953 (26.7) | 111,242 (30.4) | 6.6  | Reference | <0.001 | 301 (27.6) | 0.018 | Reference | 8,824 (25.2) | 0.520 |
| Second           | 16,736 (26.4) | 97,204 (26.5)  | 5.8  | 0.95 (0.91-0.99) | 0.002 | 279 (25.8) | 0.017 | 0.94 (0.79-1.11) | 0.486 | 9,233 (26.3) | 0.551 |
| Third            | 13,664 (21.4) | 74,816 (20.4)  | 5.5  | 0.94 (0.91-0.97) | 0.001 | 235 (21.5) | 0.017 | 0.97 (0.80-1.16) | 0.703 | 7,575 (21.6) | 0.557 |
| Fourth           | 10,891 (17.1) | 56,612 (15.4)  | 5.2  | 0.91 (0.88-0.95) | <0.001 | 180 (16.5) | 0.017 | 0.95 (0.78-1.15) | 0.588 | 6,290 (17.9) | 0.577 |
| Fifth (Least deprived) | 5,351 (8.4)   | 26,605 (7.3)   | 5.0  | 0.94 (0.88-0.99) | 0.034 | 94 (8.6) | 0.18 | 1.00 (0.78-1.28) | 0.995 | 3,134 (9.0) | 0.586 |
| Residential status |             |               |                                              |         |             |                                           |         |                          |                               |         |
| Non NFA postcode | 63,908 (98.6) | 368,986 (98.5) | 5.8  | Reference | <0.001 | 1,100 (98.7) | 0.017 | Reference | 35,262 (99.1) | 0.594 |
| NFA postcode     | 952 (1.4)    | 5,772 (1.5)    | 6.1  | 0.82 (0.87-1.02) | 0.072 | 15 (1.3) | 0.016 | 1.11 (0.35-3.50) | 0.861 | 319 (9.9) | 0.342 |
| Ethnicity         |             |               |                                              |         |             |                                           |         |                          |                               |         |
| White            | 59,371 (93.8) | 342,185 (93.7) | 5.8  | Reference | <0.001 | 1,049 (93.5) | 0.018 | Reference | 32,476 (93.5) | 0.547 |
| Non-white        | 5,080 (6.2)  | 23,528 (6.3)   | 5.9  | 0.94 (0.90-0.98) | <0.001 | 38 (3.5) | 0.019 | 0.56 (0.40-0.77) | 0.001 | 2,245 (6.5) | 0.576 |
| Clinical          |             |               |                                              |         |             |                                           |         |                          |                               |         |
| AC1              | 31,132 (48.0) | 79,490 (21.2)  | 2.6  | Reference | <0.001 | 45 (40.5) | 0.041 | Reference | 17,584 (49.4) | 0.564 |
| AC2              | 10,316 (15.9) | 81,559 (22.5)  | 7.9  | 2.32 (2.24-2.40) | <0.001 | 211 (18.9) | 0.020 | 1.56 (1.31-1.85) | <0.001 | 5,282 (16.8) | 0.519 |
| AC3              | 7,350 (11.3)  | 19,663 (5.2)   | 2.7  | 1.00 (0.96-1.04) | 0.931 | 64 (7.9) | 0.009 | 0.84 (0.63-1.13) | 0.257 | 4,170 (11.7) | 0.567 |
| AC4              | 5,919 (9.1)  | 125,526 (33.5) | 21.2 | 7.06 (6.73-7.42) | <0.001 | 230 (20.6) | 0.009 | 2.71 (2.39-3.20) | <0.001 | 2,933 (8.2) | 0.496 |

Emboldened percentages are statistically significant (p < 0.05) from zero truncated negative binomial regression with robust standard errors; aIRR Adjusted Incidence Rate Ratio; D&A Drug and Alcohol; IMD Indices of Multiple Deprivation; NFA No fixed abode; AC1-7 Alcohol Cluster 1-7; 1 Adjusted for all other covariates listed in table; 2 Office of Population Censuses and Surveys (OPCS) categories A, B and C collapsed as white, all other OPCS categories (D-S) collapsed as non-white. 
Table 6
Incidence rate of hospital admissions since 1st April 1997 of the n = 107,296 individuals who presented to community drug and alcohol treatment services in England in 2018/19 with problems related to opioids.

| Sociodemographic | Peoplen (%) | Admissionsn (%) | Admission rate (Mean number of admissions per person) | p value | Deaths in treatmentn (%) | Death in treatment rate (Mean number of deaths per person) | p value | People successfully completing treatmentsn (%) | Successful treatment rate (Mean number of successful treatments per person) | p value |
|------------------|-------------|-----------------|-------------------------------------------------------|---------|------------------------|----------------------------------------------------------|---------|---------------------------------------------|----------------------------------------------------------|---------|
| All | 107,296 (100) | 554,936 (100.0) | 5.2 | 3,301 (100.0) | 0.031 | 12,140 (100.0) | 0.113 |
| Sex | 31,760 (29.6) | 205,444 (37.0) | 6.5 | Reference | 72 / (2.2) | 0.009 | Reference | 1,207 (10.4) | 0.158 |
| Female | 75,536 (70.4) | 349,492 (63.0) | 4.6 | 0.71 (0.69-0.74) | -0.001 | 2,427 (73.5) | 0.032 | 3,836 (31.6) | 0.121 | Reference |
| Male | 3,010 (1.0) | 19,162 (1.2) | 0.64 | Reference | 7.58 (1.5) | <0.001 | 1.02 (0.93-1.12) | 0.702 | 8,304 (68.4) | 0.110 | 0.92 (0.87-0.97) | 0.002 |
| Age in years (at presentation to D&A services) | | | | | | | | | | |
| 18-30 | 8,036 (7.5) | 37,048 (6.7) | 4.6 | Reference | 72 / (2.2) | 0.009 | Reference | 1,207 (10.4) | 0.158 |
| 31-45 | 58,631 (54.6) | 299,491 (54.0) | 5.1 | 1.06 (1.05-1.06) | -0.001 | 1,230 (73.7) | 0.021 | 4,581 (15.6) | 0.046 | 64,322 (27.6) | 0.108 | 0.64 (0.60-0.68) | <0.001 |
| 46-60 | 37,110 (34.6) | 198,835 (35.8) | 5.4 | 1.18 (1.12-1.23) | -0.001 | 1,692 (91.2) | 0.046 | 3,320 (28.2) | 0.146 | 146,543 (28.2) | 0.51 | 0.96 (0.94-0.99) | 0.008 |
| 60+ | 3,519 (3.3) | 19,562 (3.5) | 5.6 | 1.52 (1.42-1.63) | -0.001 | 307 (9.3) | 0.087 | 8,304 (68.4) | 0.110 | 3,320 (28.2) | 0.146 | 0.96 (0.94-0.99) | 0.008 |
| Deprivation (IMD) | | | | | | | | | | |
| Quintile First (Most deprived) | 38,059 (37.7) | 210,557 (40.6) | 5.5 | Reference | 1,302 (41.0) | 0.034 | Reference | 3,725 (31.8) | 0.098 |
| Second | 28,628 (26.4) | 146,543 (28.2) | 5.1 | 0.96 (0.94-0.98) | 0.008 | 925 (29.3) | 0.032 | 3,320 (28.2) | 0.146 | 0.96 (0.94-0.99) | 0.008 |
| Third | 18,024 (17.0) | 86,184 (16.6) | 4.8 | 0.94 (0.91-0.97) | -0.001 | 504 (15.9) | 0.028 | 3,320 (28.2) | 0.146 | 0.96 (0.94-0.99) | 0.008 |
| Fourth | 11,333 (10.4) | 54,851 (10.6) | 4.8 | 0.95 (0.91-0.99) | 0.008 | 306 (9.8) | 0.027 | 3,320 (28.2) | 0.146 | 0.96 (0.94-0.99) | 0.008 |
| Fifth (Least deprived) | 4,714 (4.4) | 20,984 (4.0) | 4.5 | 0.92 (0.87-0.97) | 0.008 | 140 (4.4) | 0.030 | 3,320 (28.2) | 0.146 | 0.96 (0.94-0.99) | 0.008 |
| Residential status Non NFA postcode | 100,235 (93.4) | 514,512 (92.7) | 5.1 | Reference | 3,178 (96.3) | 0.032 | Reference | 11,078 (96.4) | 0.117 |
| Ethicity4 White | 97,006 (91.8) | 506,145 (92.8) | 5.1 | Reference | 3,138 (96.9) | 0.032 | Reference | 10,203 (98.9) | 0.110 |
| Non-white | 8,615 (8.2) | 39,267 (7.2) | 4.6 | 0.98 (0.92-1.04) | 0.047 | 101 (3.1) | 0.012 | 1,203 (10.1) | 0.140 | 1,232 (12.3-14.2) | <0.001 |
| Clinical Opioid Cluster | | | | | | | | | | |
| OC1 | 50,325 (46.9) | 118,299 (21.3) | 2.4 | Reference | 1,467 (44.4) | 0.029 | Reference | 5,786 (41.2) | 0.155 |
| OC2 | 9,442 (8.8) | 17,605 (3.2) | 1.9 | 0.42 (0.41-0.44) | -0.001 | 109 (5.1) | 0.018 | 3,725 (28.2) | 0.098 |
| OC3 | 10,866 (10.1) | 28,118 (5.1) | 2.6 | 0.94 (0.90-0.99) | 0.001 | 184 (5.6) | 0.017 | 3,725 (28.2) | 0.098 |
| OC4 | 4,897 (4.6) | 48,782 (8.8) | 10.0 | 2.02 (1.96-2.08) | -0.001 | 535 (16.2) | 0.030 | 3,725 (28.2) | 0.098 |
| OC5 | 4,897 (4.6) | 48,782 (8.8) | 10.0 | 2.02 (1.96-2.08) | -0.001 | 535 (16.2) | 0.030 | 3,725 (28.2) | 0.098 |
| OC6 | 5,355 (5.0) | 56,862 (10.6) | 11.0 | 1.37 (1.35-1.39) | -0.001 | 292 (8.8) | 0.055 | 3,725 (28.2) | 0.098 |
| OC7 | 8,501 (7.9) | 164,250 (29.6) | 19.3 | 2.50 (2.47-2.53) | -0.001 | 544 (16.5) | 0.064 | 3,725 (28.2) | 0.098 |

Emboldened percentages are statistically significant (p < 0.05) from zero truncated negative binomial regression with robust standard errors; aIRR Adjusted Incidence Rate Ratio; D&A Drug and Alcohol; IMD Indices of Multiple Deprivation; NFA No fixed abode; OC1-7 Opioid cluster 1-7; 1 Adjusted for all other covariates listed in table; 2 Office of Population Censuses and Surveys (OPCS) categories A, B and C collapsed as white, all other OPCS categories (D-S) collapsed as non-white.
people and people of a white ethnicity and people in both alcohol and opioid diagnostic clusters 2, and 4 and additionally AC6 and OC7.

In the adjusted model, for each substance we found a statistically significantly reduced odds of successful treatment completion for men, people from more deprived areas, people with no fixed residential address and people of a white ethnicity. In addition, there was a reduced odds of successful treatment completion for people in diagnostic clusters AC2, AC4, OC5 and OC7.

No associations changed substantially following inverse probability weighting, suggesting they were not driven by bias from linkage error.

4. Discussion

This study represents the first national examination of the hospitalisation of people with problematic alcohol and opioid use presenting to specialist addiction services in England. We identified that 64,840 alcohol patients and 107,296 opioid patients accessing treatment in 2018/19 were responsible for 374,713, and 554,936 general inpatient hospital admissions since 1st April 1997 respectively. Within both these cohorts, women, people over 30, and those residing in more deprived areas have statistically significantly higher admission rates compared to their counterparts. The most common primary admission reason was alcohol withdrawal syndrome (5.3%) in alcohol patients or an unspecified illness (2.1%) in opioid patients. The largest diagnostic clusters of individuals with either substance have a primary admission reason relating to diseases of the digestive system or to injuries and poisonings, but minimal recorded reasons due to mental and behavioural disorders. Following adjustment for sociodemographic characteristics, several diagnostic clusters demonstrated statistically significantly higher hospital admission rates, significantly increased odds of death during treatment and a significantly reduced odds of successful treatment completion for both substances, particularly for those diagnostic clusters in which admission diagnoses predominantly related to mental and behavioural disorders, and injuries or poisonings.

Individuals within these clusters have poor health outcomes and place high cost burdens on healthcare systems through repeated hospital admission. Identification of these individuals, within either addiction or hospital services, may enable more intense personalised services with an alcohol or opioid problem they, by demonstrating statistically significant paucity of admissions primarily due to mental and behavioural disorders. Following adjustment for either patients whom, at presentation in 2018/19, reported that alcohol is the only substance they use systematically or patients whom reported any problematic use of opioids, thus the studied alcohol cohort results cannot be generalised to individuals with any comorbid drug and alcohol problems, and the studied opioid cohort may have individuals who use a variety of other substances in addition to opioids. The nature of this study additionally does not examine the hospitalisation patterns of those individuals with problematic alcohol or opioid use who do not present to publicly funded specialist addiction services.

5. Conclusions

Problematic alcohol and opioid users are highly multimorbid cohorts, with identifiable modifiable risk factors. These individuals place a high cost burden on the healthcare system each year [39], a large proportion of which is due to the use of general inpatient hospital beds. These annual costs look set to increase given national increases in substance-related hospital admissions [6], and significant reductions to real term funding of specialist addiction services [34]. As such, innovative methods need to be found to identify individuals with high hospital usage, in order for clinical teams working in general hospitals and addiction services to develop and target appropriate interventions to both improve their health outcomes and prevent unnecessary readmission. We have aimed to characterise the hospitalisation patterns of this cohort and future work should focus on targeting our identified clusters of individuals with high cost (i.e. high hospital admission rates), high risk of death during treatment, and low odds of successful treatment completion. These are largely characterised by hospital admissions due to mental and behavioural disorders and injuries and poisonings, and previous work has highlighted the lack of integration and barriers between mental health and addiction services in England [36]. As these individuals
may be able to be identified using hospital admission patterns prior to engagement with addiction services these results may ultimately help identify individuals in whom problematic alcohol or opioid use was missed, and enable more assertive referral into addiction services [1]. Linkage of further years of NDTMS to HES and analysis of how rates of hospitalisation compare over time would be useful next steps to identify potential mechanisms to reduce unnecessary readmission, and additionally prioritisation of further work with cohorts of people not accessing services could improve the lives of people suffering from substance use disorders.

Contributors

All authors meet the ICMJE criteria for authorship:
Dr Roberts formulated the research question, designed and carried out the study, analysed the data and drafted the article
Professor Hotopf contributed to the formulation of the research question, study design, data analysis and writing the article
Professor Marsden contributed to the data interpretation and writing the article
Professor Strang contributed to the data interpretation and writing the article
Mr White contributed to the study design, data analysis and writing the article
Dr Eastwood contributed to the formulation of the research question, study design, data analysis and writing the article
Professor Drummond contributed to the formulation of the research question, study design, data analysis and writing the article
Dr Roberts has nothing to disclose
Professor Hotopf reports grants from Innovative Medicines Initiative, outside the submitted work.
Professor Strang reports other from Molteni Farma, grants from Mundipharma, grants from Camurus, other from Accord Pharma, outside the submitted work.
Professor Marsden reports grants from National Institute for Health Research (NIHR), grants from NIHR Biomedical Research Centre for Mental Health at South London and Maudsley NHS Mental Health Foundation Trust (SLaM), grants from Indivior, outside the submitted work; and I have part-time employment as Senior Academic Advisor for the Alcohol, Drugs, Tobacco and Justice Division, Health Improvement, Public Health England and I am a clinical academic consultant for the US National Institute on Drug Abuse, Centre for Clinical Trials Network. I have received honoraria and travel support from PCM Scientific and Martindale for the Improving Outcomes in Treatment of Opioid Dependence conference. I hold no stocks in any company.
Mr White has nothing to disclose
Dr Eastwood has nothing to disclose
Professor Drummond has nothing to disclose

Data sharing statement

Whilst access to the linked dataset is only available within Public Health England, subject to approval, extracts of NDTMS are available to researchers through the Office of Data Release (ODR) at PHE, and extracts of HES APC are available through the Data Access Request Service (DARS) at NHS Digital. In addition, the code for the linkage algorithm will also be made available upon request to PHE, subject to approval.

Role of the funding source

This paper represents independent research funded by the Medical Research Council (MRC), as part of the corresponding author’s MRC Addiction Research Clinical (MARC) Fellowship. The research was part funded by the NIHR Biomedical Research Centre at South London and Maudsley NHS Foundation Trust and King’s College London, and by the NIHR Collaboration for Leadership in Applied Health Research and Care South London (NIHR CLAHRC South London) now recommissioned as NIHR Applied Research Collaboration South London, and both CD, MH and JS receive funding from an NIHR Senior Investigator award. The funders had no contribution to the study design; in the collection, analysis, and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. All authors were independent from funders had full access to all of the data (including statistical reports and tables) in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. The views expressed are those of the authors and not necessarily those of the MRC, the National Health Service (NHS), the NIHR, Public Health England (PHE) or the Department of Health and Social Care (DHSC).

Declaration of Competing Interest

All Individual authors have completed the ICMJE Conflict of Interest form:

Acknowledgements

Nil.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.lanepe.2021.100036.

References

[1] Lawlor D, Freer J, King E, Laney S, Degenhardt L, Tweed EJ, et al. Frequency of health-care utilization by adults who use illicit drugs: a systematic review and meta-analysis. Addiction 2020;115(6):1011–23.
[2] Mallord K, Bird S, Hutchinson S. A record linkage study of hospital episodes for drug treatment clients in Scotland, 1996–2006. Addict Res Theory 2013;21(1):52–61.
[3] Degenhardt L, Whiteford HA, Ferrari AJ, Baxter AJ, Charlson FJ, Hall WD, et al. Global burden of disease attributable to illicit drug use and dependence: findings from the Global Burden of Disease Study 2010. Lancet 2013;382(9904):1564–74.
[4] Multimorbidity: a priority for global health research. https://acmedsci.ac.uk/policy/policy-projects/multimorbidity.
[5] Substance misuse treatment for adults: statistics 2018 to 2019. https://www.gov.uk/government/statistics/substance-misuse-treatment-for-adults-statistics-2018-to-2019. Statistics on alcohol and drug misuse treatment for adults from PHE’s National Drug Treatment Monitoring System (NDTMS).
[6] Statistics on Alcohol. England. 2020. https://digital.nhs.uk/data-and-information/publications/statistical/statistics-on-alcohol/2020.
[7] Local Alcohol Profiles, Public Health England. https://fingertips.phe.org.uk/profile/local-alcohol-profiles.
[8] PHE Public Health Profiles. https://fingertips.phe.org.uk/search/drug.
[9] Review of drugs: phase one report. https://www.gov.uk/government/publications/review-of-drugs-phase-one-report.
[10] PHE inquiry into the fall in numbers of people in alcohol treatment: findings. Published. https://www.gov.uk/government/publications/alcohol-treatment-inquiry-summary-of-findings/phe-inquiry-into-the-fall-in-numbers-of-people-in-alcohol-treatment-findings#the-inquiry-process.
[11] Hill McManus D, Stone T, Alty A, Pryce RE, Gillespie D, Buyx K, et al. An evidence-based model for estimating requirements for specialist alcohol treatment capacity in England the specialist treatment for alcohol model (STreAM) version 1.0. 2016.
[12] Peacock A, Chiu V, Leung J, Dobkins T, Laney S, Gisew N, et al. Protocol for the Data-Linkage Alcohol Cohort Study (DACS): investigating mortality, morbidity and offending among people with an alcohol-related problem using linked administrative data. BMJ Open 2019;9(8):e030605.
[13] Roberts E, Doidge JC, Harron KL, Hotopf M, Knight J, White M, et al. National administrative record linkage between specialist community drug and alcohol treatment data (the National Drug Treatment Monitoring System (NDTMS)) and inpatient hospitalisation data (Hospital Episode Statistics (HES)) in England: design, method and evaluation. BMJ Open 2020;10(11):e043540. doi: 10.1136/bmjopen-2020-
[14] National Drug Treatment Monitoring System. https://digital.nhs.uk/data-and-information/information-standards/information-standards-and-data-
[15] Hospital Admitted Patient Care Activity. https://digital.nhs.uk/data-and-information/publications/statistical/hospital-admitted-patient-care-activity.

[16] Herbert A, Wijlaars L, Zylbersztejn A, Cromwell D, Hardelid P. Data resource profile: hospital episode statistics admitted patient care (HES APC). Int J Epidemiol 2017;46(4):1093-4.

[17] Healthcare across the UK: a comparison of the NHS in England, Scotland, Wales and Northern Ireland. https://www.nao.org.uk/wp-content/uploads/2012/06/1213192.pdf.

[18] NDTMS: consent and confidentiality guidelines. https://www.gov.uk/government/publications/confidentiality-guidance-for-drug-and-alcohol-treatment-providers-and-clients.

[19] Marsden J, Eastwood B, Bradbury C, Dale-Perera A, Farrell M, Hammond P, et al. Understanding alcohol-related hospital admissions, Public Health England. https://publichealthmatters.blog.gov.uk/2014/01/15/understanding-alcohol-related-hospital-admissions/.

[20] The Health Service (Control of Patient Information) Regulations. 2002. http://www.legislation.gov.uk/uksi/2002/1438/contents/made.

[21] The Health Service (Control of Patient Information) Regulations. 2002. http://www.legislation.gov.uk/uksi/2002/1438/contents/made.

[22] Methodology to create provider and CIP Spells from HES APC data. http://content.digital.nhs.uk/media/11859/Provider-Spells-Methodology/pdf/Spells_Methodology.pdf.

[23] Aylin P, Bottle A, Jen MH, Middleton S, Intelligence F. HSMR mortality indicators. Imperial College Technical Document. 2010.

[24] Understanding alcohol-related hospital admissions, Public Health England. https://publichealthmatters.blog.gov.uk/2014/01/15/understanding-alcohol-related-hospital-admissions/.

[25] Larsen FB, Pedersen MH, Friis K, Glümer C, Lasgaard M. A latent class analysis of multimorbidity and the relationship to socio-demographic factors and health-related quality of life. A National Population-Based Study of 162,283 Danish adults. PLoS One 2017;12(1):e0169426.

[26] Hall M, Dondo TB, Yan AT, Mamas MA, Timmis AD, Deanfield JE, et al. Multimorbidity and survival for patients with acute myocardial infarction in England and Wales: Latent class analysis of a nationwide population-based cohort. PLoS Med 2018;15(3):e1002501.

[27] Nylund KL, Asparouhov T, Muthén BO. Deciding on the number of classes in latent class analysis and growth mixture modeling: a Monte Carlo simulation study. Struct Equ Model 2007;14(4):535-69.

[28] Van De Schoot R, Sijbrands J, Winter SD, Depaoli S, Vermunt JK. The GROTSChecklist: guidelines for reporting on latent trajectory studies. Struct Equ Model 2017;24(3):451-67.

[29] Eastwood B, Strang J, Marsden J. Effectiveness of treatment for opioid use disorder: a national, five-year, prospective, observational study in England. Drug Alcohol Depend 2017;176:139-47.

[30] Peacock A, Eastwood B, Jones A, Millar T, Horgan P, Knight J, et al. Effectiveness of community psychosocial and pharmacological treatments for alcohol use disorder: a national observational cohort study in England. Drug Alcohol Depend 2018;186:60-7.

[31] Høfle M, Pfister H, Lieb R, Wittchen H-U. The use of weights to account for non-response and drop-out. Soc Psychiatry Psychiatr Epidemiol 2005;40(4):291-9.

[32] Little RJ, Vartivarian S. On weighting the rates in non-response weights. Stat Med 2003;22(9):1589-99.

[33] Bird SM, McAuley A, Perry S, Hunter C. Effectiveness of Scotland’s National Naloxone Programme for reducing opioid-related deaths: a before (2006–10) versus after (2011–13) comparison. Addiction 2016;111(5):883–91.

[34] Roberts E, Hotopf M, Drummond C. The relationship between alcohol-related hospital admission and specialist alcohol treatment provision across local authorities in England since passage of the Health and Social Care Act 2012. Br J Psychiatry 2020;1-3.

[35] Health and Social Care Act 2012. http://www.legislation.gov.uk/ukpga/2012/7/enacted.

[36] Roberts E, Hillyard M, Hotopf M, Parkin S, Drummond C. Access to specialist community alcohol treatment in England, and the relationship with alcohol-related hospital admissions: qualitative study of service users, service providers and service commissioners. BJPsych Open 2020;6(5):e094.

[37] Department of Health. A simple guide to payment by results. 2011. https://www.gov.uk/government/uploads/system/uploads/.

[38] Davis KAS, Bashford O, Jewell A, Shetty H, Stewart RJ, Sudlow CL, et al. Using data linkage to electronic patient records to assess the validity of selected mental health diagnoses in English Hospital Episode Statistics (HES). PLoS One 2018;13(3):e0195002.

[39] Scarborough P, Bhatnagar P, Wickramasinghe KK, Allender S, Foster C, Rayner M. The economic burden of ill health due to diet, physical inactivity, smoking, alcohol and obesity in the UK: an update to 2006–07 NHS costs. J Public Health 2011;33(4):527–35.