Burden of alcohol disorders on emergency department attendances and hospital admissions in England.

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ABSTRACT

Aims:

This study aims to estimate the prevalence and burden of alcohol disorders on Emergency Department (ED) and hospital inpatients in England through the exploratory analysis of NHS data.

Short Summary:

We provide analysis from a national routine dataset that quantifies the disproportionate burden of alcohol disorders on ED workload. Our analysis identifies 13 specific presentations predictive of alcohol disorders in ED with excess burden on hospital admission, total bed days and overall costs related to chronic alcohol disorders.

Methods:

ED attendances and admission data were linked using hospital episode statistics. Diagnoses were preserved at a patient level to identify individuals who had an alcohol attributable diagnosis. Four groups were identified; a) individuals with no alcohol disorder (NAD), b) acute alcohol disorder (AAD), c) chronic alcohol disorder (CAD) and d) those with any alcohol disorder (AD) (b) and c) combined). Associations between ED diagnosis and alcohol disorders were examined using logistic regression adjusted for hospital provider, age and sex. Non-parametric tests were employed examining ED and hospital service use. Cost differences by group was explored using a propensity scored match sample.

Results:

Of the 1.2million subjects 6.7% were identified as having one or more AD accounting for 11.7% of ED attendances, 9.2% of hospital admissions and 7.2% total bed days. Bootstrapped derived means identified that hospital service use varied significantly between AAD and CAD. Whilst AAD accounted for greater attendances than NAD (2.78; 95% CI 2.680-2.879) those with CAD accounted for even greater attendances (4.33; 95% CI. 4.136-4.515), admissions (2.56; 95% CI. 2.502-2.625) and total bed days (15.14; 95% CI. 14.716-15.559).

Conclusions:

AD place a disproportionate impact on hospital services with CAD exerting the greatest burden on hospital utilisation. The complexity and burden of CAD suggests this group should be a priority for intervention.

INTRODUCTION

The burden of alcohol-related emergency department (ED) attendances and hospital admissions is a priority for health services worldwide. Globally 5.9% of deaths and 5.1% of the burden of disease is attributable to alcohol placing increasing demands on healthcare (World Health Organisation, 2014). Analysis of nationally representative US data has identified between 2001 and 2011 alcohol-related ED attendances have increased at a greater rate than overall ED attendances placing a greater burden on hospital resources (Mullins et al., 2017). Despite concerns over the increasing demands on ED as a consequence of alcohol use in England (Mann, 2016), there has been a lack of systematic recording or coding of alcohol-related ED attendances. Consequently, the characteristics of alcohol-related ED attenders that may form the basis of effective identification and intervention are poorly understood.

Estimates of alcohol-related ED attendances have been drawn from a limited number of studies often involving a small number of EDs (Parkinson et al., 2016; Pirmohamed et al., 2000) or limited time points (Drummond et al., 2005), and therefore may not be representative. Prevalence rates drawn from validated alcohol screening tools (Drummond et al., 2014) consider those amenable to a brief intervention in ED and often exclude those experiencing significant health conditions. Whilst the advent of a new ED coding system in the NHS, the Emergency Care Data Set (ECDS) (NHS Digital, 2017a), may improve the identification of alcohol-related ED attendances previous attempts to link reasons for ED attendance to the presence of alcohol misuse (Huntley et al., 2001), has lacked robust analysis into the associations between reasons for attendance and alcohol disorders.

Increasingly the linkage and secondary analysis of data to address health inequalities is gaining traction in research (Research Councils of United Kingdom, 2017). Recent studies in the United States used International Classification of Disease, Ninth Version (ICD-9) (World Health Organisation, 1977) diagnostic codes within the Nationwide Emergency Department Sample, to assess the impact of acute alcohol consumption and chronic alcohol consumption on ED (White et al., 2018). This study found that although acute alcohol consumption accounted for greater ED attendances, chronic

alcohol consumption accounted for greater emergency hospital admissions and financial burden. Until now no similar study has previously been undertaken in the UK using national routine data sources.

This study used existing data collected by the NHS in England to examine the impact and costs of wholly alcohol attributable disorders (AD) on ED attendances and hospital admissions. Hospital Episode Statistics (HES) data is collected across different settings including ED and for those admitted for inpatient care. Although, HES data is collected for clinical and commissioning purposes, previous studies have found these data sufficiently robust for use in research (Burns et al., 2012). HES admitted patient care data includes International Classification of Diseases tenth edition (ICD-10) (World Health Organisation, 1992) diagnostic codes including those diagnoses wholly attributable to alcohol. As each individual has a unique pseudo-anonymised identification code (HES-ID) individuals from the ED data can be linked with admitted patient care data allowing for the identification of individuals with an AD. Characterising those with acute AD (e.g. intoxication, toxic effects) and chronic AD (e.g. alcohol dependence, alcohol liver disease) who attend ED provides an opportunity to assess their relative burden on healthcare resources.

METHODS

Study Design and Setting

An exploratory analysis of routine NHS was conducted to examine the characteristics and burden of AD in adult attenders (18 years or more) to ED in England; identifying differences in reasons and frequency for ED attendances, hospital admissions and establishing estimated overall costs between those individuals with an in-year history of acute alcohol disorder (AAD), and chronic alcohol disorder (CAD).

Data extracts from the 2009/10 data sets for emergency department attendances (HES-ED) and admitted patient care (HES-APC) data for the same year for 225 hospital providers in England were obtained from the Health and Social Care Information Centre for the purpose of this study. The HES-ED data contained 13,284,470 separate attendances representing 92.9% of consultant-led 24-hour EDs in England. The HES-APC data request was restricted to emergency admissions to all NHS hospitals in England and contained 6,563,447 finished consultant episodes (FCE), the time a patient spends under the continuous care of one consultant in a specific hospital. The majority of hospital admissions involve one FCE however if the patient's care is transferred to a different consultant during their stay a new FCE commences.

Each data set contained a unique HES-ID per individual, age, sex, ethnicity, and region of residence. The HES-ED data contained fields related to date and times of arrival and following assessment an ED 'diagnosis' using one of 39 ED Commissioning Data Set (CDS) clinical codes from the relevant data dictionary in use at the time of reporting (Health and Social Care Information Centre, 2010). The time of ED departure and the 'disposal code' identifying the patients' destination following attendance was specified. The HES-APC data extract contained only cases where the source of admission was via ED. The data set retained demographic descriptors, dates and times for each FCE, permitting the calculation of hospital spells, which was used to determine the number of admissions, and their length of stay (Health and Social Care Information Centre, 2014). Each FCE provides up to twenty ICD-10 diagnostic codes allowing for disorders wholly attributable to alcohol, and all other diagnoses, to be identified for each individual. All diagnostic codes within all FCEs for each individual were searched using the *regexm* command using STATA 11SE (STATA Corp.) to identify the presence of any alcohol disorder during any admission.

NHS Reference Costs for 2009/10 (Department of Health , 2011) were used to calculate the financial burden on ED and hospital admissions with an ED attendance resulting in admission being set at £134, reduced to £103 for an ED attendance not leading to admission. The costs of inpatient care

vary significantly based on the type and nature of interventions provided and the length of stay. Average costs for non-elective admissions were utilised with admissions <2 days incurring a cost of £535. A non-elective admission of 2 days or more incurred a bundle-price of £1,205 for the first 2 days, with each excess day costing £242/day. The frequency of ED attendances, admissions, total bed days and all related costs were identified for each individual using HES-ID codes. All previously recorded ED diagnosis for each individual were retained as separate dichotomous variables.

Selection of Cases

Data retained for analysis were categorised into one of four diagnostic groups; no alcohol disorder (NAD), acute alcohol disorder (AAD) or chronic alcohol disorder (CAD), and any alcohol disorder (AD) (AAD+CAD). NAD was assigned to patients where there was absence of any wholly alcohol attributable diagnosis identified in the HES-APC (table 1). AAD was endorsed using five diagnostic categories relating to acute alcohol intoxication, toxic effects of alcohols and accidental poisoning. Similarly, CAD was endorsed using twenty-two wholly alcohol attributable diagnosis drawn from mental and behavioural disorders due to use of alcohol, alcoholic liver disease and other wholly attributable conditions. Those found to possess both AAD and CAD were categorised as CAD; assigning the patient into the potentially more burdensome group.

[Consider table 1 here]

Statistical Analyses

The coding principles allowed for the clinical information related to all ED attendances and admissions to be preserved for each unique individual. Prior to the analysis each data set was interrogated for errors and accuracy with invalid data being removed. All duplicate entries for each individual were removed allowing for one-to-one merge of the HES-ED with HES-APC, using the unique HES-ID as the matching variable.

Given the large number of hospital sites reporting to the HES-APC data set (n=225) considerable variance across hospital sites was expected. Using the svyset and svy commands in STATA adjusted the analysis for hospital sites to provide robust standard errors. Two-way tables and chi-square tests were used to examine differences in sex and ethnicity, re-categorised into Caucasian and non-Caucasian. Non-parametric tests were employed in the examination of mean age differences between groups. Two-way tables and chi-squared tests were employed to examine the relationship between ED diagnosis and AD allowing for the identification of prevalence and measures of association between AD and each ED diagnosis. Logistic regression, utilising robust standard errors, was employed adjusting for age and sex to identify those ED diagnosis associated with AD. Subgroup analysis of AAD and CAD with ED diagnosis was undertaken using 97.5% confidence intervals to offset the reduction in the overall sample size. Multinomial regression was employed to examine the strength of association between groups where an ED diagnosis was found to be significantly associated to both AAD and CAD.

The distribution of continuous variables for ED attendances, admissions and total bed days for each of the four groups were examined and considered for transformation. Normality of distribution could not be achieved through transformation of these data, due to high skewness, therefore a non-parametric approach using the K-sample test of equality of medians was employed with options for dropping, splitting or dividing the median valves dependent on distribution of the data. Bootstrapped derived mean ED attendances, admission, total bed days and total costs for ED and admissions, using 1,000 replications stratified by hospital providers were conducted using the cluster command in STATA to provide more precise estimates of burden.

The financial burden of AD on ED and admission costs were assessed between groups using Propensity Score Matching (PSM). PSM used matching procedures based on balancing scores calculated from observed covariates for age, sex and ethnicity where those with NAD are identified as controls and those with AD are cases. The PSM model regressions considered the relationship

between covariates and alcohol disorder status for costs of those *treated* (i.e. with alcohol disorder) to provide the *average treatment effect* (i.e. cost difference) *on those treated* (ATT). Applying bootstrapped derived ATT results, using 50 replications, improved the precision of estimated cost differences between groups.

RESULTS

Following the cleaning of the HES-APC data 2,154,158 separate patients were matched within the HES-ED data set (See supplementary figure 1). Scrutiny of HES-ED data prior to the data merge identified that ED diagnosis was not recorded in 43.8% of attendances. Regression analysis was employed to explore the missing data and concluded that missing data was missing at random. The final data set of 1,209,760 patients were drawn from all regions of England of which 81,258 (6.7%) were identified as experiencing AD during one or more emergency hospital admission in 2009/10. With a mean age difference of 13.7 years those with AD were significantly younger than those with NAD, more likely to be male and Caucasian (table 2). Similarly, patients with CAD made up 65.8% of those with an alcohol disorder and were found to be significantly older than those with AAD and were more likely to be male and Caucasian.

[Consider table 2 here]

ED diagnosis associated with AD

For each of the 39 ED diagnostic categories the prevalence of AD revealed that seventeen clinical presentations and two unascertained categories (i.e. Nothing abnormal detected and Diagnosis not classifiable) were positively associated with AD (see online supplementary table). Whilst the prevalence of AD was greatest in those receiving an ED diagnosis of poisoning, social problems and psychiatric conditions the greatest number of attendees with AD was identified in patients receiving a category of diagnosis not classifiable, poisoning and gastrointestinal conditions. Sub group analysis

of ED diagnosis revealed twelve diagnoses positively associated with AAD and nineteen clinical presentations and the two unascertained categories being associated with CAD.

Regression analysis adjusting for age, sex and provider reduced those ED diagnostic codes predictive of AD to thirteen (table 3) with six diagnostic codes; poisoning, social problems, psychiatric conditions, head injury, contusion and laceration being common to AAD and CAD. Multinomial regression revealed that when compared with CAD, AAD was significantly associated with poisoning (OR 2.22; 95% CI 2.05-2.41; z=19.33; p=<0.001), head injury (OR 1.91; 95% CI 1.71-2.13; z=11.56; p=<0.001) and laceration (OR 1.33; 95% CI 1.18-1.50; z=4.73; p=<0.001), whereas CAD was significantly associated with social (OR 1.90; 95% CI 1.61-2.24; z=7.70; p=<0.001) and psychiatric problems (OR 1.19; 95% CI 1.04-1.35; z=2.59; p=<0.010). Contusion (OR 1.05; 95% CI 0.97-1.13; z=1.14; p=<0.256) was not significantly associated to either alcohol disorder group. Throughout regression analysis being older (OR 0.97; 95% CI 0.97-0.97; z=-38.57; p=<0.001) and male (OR 2.42; 95% CI 2.34-2.50; z=53.21; p=<0.001) was consistently predictive of alcohol disorder.

[Consider table 3 here]

ED attendances and hospital utilisation

Patients with AD had a significantly disproportionate impact on services with greater ED attendances and hospital admissions (table 4). However, analysis of hospital bed days using K-sample test on equality of medians for those with NAD compared to those with AD, indicated the random splitting of median values between groups revealing those with AD spent significantly less time in hospital. Subgroup analysis identified those with AAD experienced greater ED attendances, however significantly less admissions and total hospital bed days. Those with CAD had greater ED attendances, admissions and total hospital beds days compared to NAD.

[Consider table 4 here]

Estimated financial burden

PSM found that once age, sex and ethnicity were matched the presence of AD accounts for an overall average annual mean cost difference in ED attendances and hospital admissions of £1,456.53 (SE 468.30; 95% CI £538.68 - £2,374.38; z=3.11; p=0.002). This figure however takes account of those with AAD who do not exert a significant financial burden on hospital admissions (β = -£884.27; SE 953.02; 95% CI -£2,752.15 - £953.02; z=-0.93; p=0.353) (table 5). Therefore, the excessive financial burden is driven by those with CAD with a cost difference of £2,324.02 (SE 490.85; 95% CI £1,361.97 - £3,286.08; z=4.73; p=<0.001) which equates to a 47% cost increase on matched cases with NAD.

[Consider table 5 here]

DISCUSSION

This study employs a narrow definition of alcohol burden on ED where diagnostic codes are used to define 6.7% of patients with wholly alcohol attributable diagnoses (AD) who exert a disproportionate impact on ED attendances, hospital admissions and costs. These impacts should be of relevance to emergency departments, public health practitioners and commissioners given the increasing demands on ED and hospital services.

The findings reveal that alcohol disorders in ED and hospital admissions are associated with being male, older and Caucasian, reflecting overall community population prevalence (McManus et al., 2016). The use of routine ED diagnostic codes identified eleven clinical codes and two non-specific codes associated with complex presentations associated with acute or chronic alcohol disorders. Those presenting with poisoning (including overdose), head injury and laceration are more likely to be associated with acute alcohol disorders such as intoxication resulting in greater ED attendances. Whereas, social, psychiatric problems, medical conditions (central nervous system, diabetes, gastrointestinal, haematological) and near drowning presentations are associated with chronic alcohol disorders (i.e. alcohol dependence, alcohol liver disease) that were found to be linked to

increased ED attendances, hospital admissions, longer stays in hospital and increased costs. The disparity in ages between those with NAD and AD highlights a disproportionate burden being driven by those in their mid-40s with CAD. Overall the disproportionate financial burden of alcohol disorder is driven by those with CAD being admitted more often and for longer.

Previous studies have estimated that 2-40% ED attendances are alcohol-related (Charalambous, 2002) with variations being influenced by community prevalence within the hospital catchment areas and the investigation methods and measures used. Our study focussed on identifying individuals with a definitive AD in a year and across England that could be replicated. Although we believe this is the first study of its kind to link HES-APC and HES-ED on an individual case basis our findings are supported by similar studies that found comparable relationships between severe and chronic alcohol disorders and greater ED attendances, admissions and costs amongst ED attenders within the United States (White et al., 2018) and Australia (Butler et al., 2016). Future studies examining ED diagnosis in the NHS will be required to use a broader range of ED diagnosis found in the new Emergency Care Data Set (ECDS), however these codes can be mapped to the CDS codes used in this study to allow comparison between time points (Health and Social Care Information Centre, 2017).

Strengths in this study relate to the use of wholly alcohol attributable diagnosis to identify individuals with an acute or chronic alcohol disorder. The use of routine hospital data includes complex and severe cases often excluded from prospective studies in ED. We acknowledge a broader estimate of the alcohol-related burden would have be achieved through the use of partially alcohol attributable diagnosis (e.g. hypertension) however, there is no accurate method of apportioning an alcohol disorder to an individual patient. The data used in our analysis is drawn from individual patients who experienced one or more emergency hospital admission and ED attendances

during 2009/10. Our results provide an important comparison between on the relative impact and burden of alcohol disorders on ED attendances and emergency hospital admissions. Although our study excludes those individuals who attended ED but did not experience an admission we have been able quantify the burden of those admitted where the impact is arguably greatest. With a recorded increase of 21% in the same chronic alcohol disorders receiving hospital admissions between 2009/10 to 2016/17 it is likely this burden has widened further (Public Health England, 2018b).

We recognise that HES data is an untapped research resource that is primarily an administrative database to support the commissioning and performance monitoring of healthcare providers. Therefore, concerns exist over the accuracy and completeness of the records (Audit Commission, 2002). Previous studies have found variability in the coding of data across hospital providers with direct contact between clinicians and administrative coders improving data accuracy whereas inadequate administrative systems and procedures based on coders extracting data from clinical records and discharge summaries are least accurate (Royal College of Physicians, 2006). Additionally, it is recognised that some diagnoses are more accurately coded than others, yet little is known about the coding accuracy of alcohol disorders. We used four-digit ICD-10 codes to specify alcohol disorders, and whilst more specific than the three-digit codes, it is suggested that this level of coding is more inaccurate due to the requirement for greater precision of diagnosis coding (Cleary et al., 1994). However, a recent systematic review of diagnostic and procedural coding accuracy identified three studies which used four-digit ICD-10 diagnostic codes and identified diagnostic data accuracy of 71.0% (Gibson & Bridgman, 1998), 95.9% (Kirkman et al., 2009) and 87% (Audit Commission, 2010) compared to an overall accuracy of 80% across the 23 studies (Burns et al., 2011). The use of HES data for research has increased despite the lack of consensus on the acceptable level of data accuracy (Chaudhry et al., 2017). Albeit that overall data accuracy in the NHS has improved since the introduction of financial reimbursements in 2004 the likely variation in data accuracy, under-identification of alcohol disorders by non-specialist clinicians (Mitchell et al., 2012) and the

limitations in the identification of ED clinical diagnosis will have resulted in conservative estimates of alcohol disorders in this study. Despite these limitations a key strength of HES data is its comprehensive coverage and large sample frame which allows for national estimates to be developed (Herbert et al., 2017).

These findings identify those with chronic alcohol disorder placing a disproportionate burden on the NHS, and clinical research aimed at reducing this burden is a priority. Chronic alcohol presentations such as alcohol dependence and alcohol liver disease are likely to present with mental health and physical morbidities requiring multi-agency service models and care pathways to address complex needs (Curran et al., 2008; Hasin et al., 2007; PHE, 2018a; Williams et al., 2018). Whilst, there is limited understanding of the most effective service models to reduce the overall burden of alcohol disorders on the NHS, the development of alcohol care teams (Moriarty, 2011) and assertive models of care (Drummond et al., 2017) show promise. Future research addressing the clinical and cost-effectiveness of such service models in improving service user reported outcomes and reducing impact on the NHS is needed given the continued increases in wholly alcohol attributable admissions (NHS Digital, 2017b). Prospective studies into the relationship between ED diagnosis and attenders with alcohol disorders will enhance our findings and understanding of potential clinical targets for interventions.

Our findings represent a significant challenge for clinicians in meeting individual patient needs and reducing hospitalisation. Services targeted at addressing the immediate needs of these patient groups should consider these results and recognise the increased clinical risks related to alcohol disorders, mental health and physical morbidities in ED. Presentations with AAD are likely to require alcohol screening followed by simple clinical feedback and alcohol information that has been found to be effective in ED (Drummond et al., 2014). Whereas those experiencing CAD should be identified

early, receive appropriate assessment of their needs and risks prior to accessing appropriate clinical care pathways (National Institute for Health and Care Excellence, 2011, Public Health England, 2018a).

This paper characterises the burden of AD on ED and hospital admissions in England that although conservative identifies potential targets for enhanced screening and identification in ED and valuable information for the designing effective services based on the needs of patient group.

Governance and Ethics. Health Research Authority assessment identified NHS REC approval was not required for this study. Approval for use of HES data was received from Health and Social Care Information Centre Reference NIC-361919-B1M3R

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Contributions. TP devised the study as part of their doctoral programme hosted at King's College London, and was responsible for data handling, analysis and writing the manuscript. SC advised on the methods and contributed to writing the manuscript. CD advised on overall design and contributed to writing the manuscript.

Conflicts of Interest

None declared

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Table 1 Definitions employed to identify Alcohol Disorder Diagnostic Groups

Alcohol Disorder Diagnostic Groups	Definition/ICD-10 Diagnosis (code)
No Alcohol Disorder (NAD)	No wholly alcohol attributable diagnosis identified in any FCE
Acute Alcohol Disorder (AAD)	Acute alcohol intoxication (F10.0) Toxic effects of ethanol (T51.0); Toxic effects of Methanol (T51.1), Toxic effects alcohol, unspecified (T51.9) Accidental poisoning by and exposure to alcohol (X45)
Chronic Alcohol Disorder (CAD)	Harmful use (F10.1), Alcohol dependence (F10.2), Alcohol withdrawal state (F10.3), Alcohol withdrawal with delirium (F10.4), Alcohol psychotic disorder (F10.5), Alcohol amnesic syndrome (F10.6), Alcohol residual psychotic disorder (F10.7), Alcohol other disorder (F10.8), Alcohol unspecified disorder (F10.9) Alcoholic fatty liver (K70.0), Alcoholic hepatitis (K70.1), Alcoholic fibrosis (K70.2), Alcoholic cirrhosis (K70.3), Alcoholic hepatitis: failure (K70.4), Alcohol liver disease: unspecified (K70.9) Alcohol-induced pseudo-Cushing's syndrome (E24.4), Degeneration of nervous system due to alcohol (G31.2), Alcoholic polyneuropathy (G62.1), Alcoholic myopathy (G72.1), Alcoholic cardiomyopathy (I42.6), Alcoholic gastritis (K29.2), Chronic pancreatitis: alcohol (K86.0).
Any Alcohol Disorder (AD)	AAD plus CAD

Table 2 Distribution of demographic characteristics for the whole sample and by each diagnostic group for alcohol disorders

	All	No Alcohol Disorder (NAD)	Any Alcohol Disorder (AD)	AD versus NAD: p-value	Alcohol Disorder - Sub Groups		
					Acute Alcohol Disorder (AAD)	Chronic Alcohol Disorder (CAD)	CAD versus AAD: p-value
Totals: N (%)	1,209,760 (100)	1,128,502 (93.3)	81,258 (6.7)		27,798 (2.3)	53,460 (4.4)	
Age							
Mean Age in Years (SE; 95%CI)	58.3 (0.020; 58.3-58.3)	59.2 (0.021; 59.2-59.3)	45.5 (0.056; 45.4-45.6)	<0.001	38.0 (0.093; 37.8-38.1)	49.5 (0.064; 49.3-49.6)	<0.001
Age Band: N (%)							
18-30yrs:	188,820 (15.6)	172,330 (15.3)	16,490 (20.3)		11,014 (39.6)	5,476 (10.2)	
31-40yrs:	129,965 (10.7)	114,493 (10.1)	15,472 (19.0)		5,702 (20.5)	9,770 (18.3)	
41-50yrs:	146,955 (12.2)	127,074 (11.3)	19,881 (24.5)		5,540 (19.9)	14,341 (26.8)	
51-60yrs:	136,869 (11.3)	122,706 (10.9)	14,163 (17.4)		2,835 (10.2)	11,328 (21.2)	
61-70yrs:	158,958 (13.1)	149,749 (13.3)	9,209 (11.3)		1,568 (5.6)	7,641 (14.3)	
71-80yrs:	200,392 (16.6)	196,007 (17.4)	4,385 (5.4)		798 (2.9)	3,587 (6.7)	
81-90yrs:	200,014 (16.5)	198,480 (17.6)	1,534 (1.9)		310 (1.1)	1,224 (2.3)	
91+yrs:	47,787 (3.9)	47,663 (4.2)	124 (0.2)		31 (0.1)	93 (0.2)	
Sex							
Male (%)	574,816 (47.5)	520,039 (46.1)	54,777 (67.4)	<0.001	16,621 (59.8)	38,156 (71.4)	<0.001
Female (%)	634,944 (52.5)	608,463 (53.9)	26,481 (32.6)		11,177 (40.2)	15,304 (28.6)	
Ethnic Groups: N (%)							
White (Caucasian):	1,013,019 (83.7)	942,502 (83.5)	70,517 (86.8)		23,428 (84.3)	47,089 (88.1)	
Non-White:	102,039 (8.5)	98,190 (8.7)	3,849 (4.7)		1,234 (4.4)	2,615 (4.9)	
Mixed:	8,162 (0.7)	7,715 (0.7)	447 (0.6)		187 (0.7)	260 (0.5)	
Asian or Asian British:	46,941 (3.9)	45,440 (4.0)	1,501 (1.9)		374 (1.4)	1,127 (2.1)	
Black or Black British:	25,391 (2.1)	24,544 (2.2)	847 (1.0)		262 (0.9)	585 (1.1)	
Other ethnic group:	21,545 (1.8)	20,491 (1.8)	1,054 (1.3)		411 (1.5)	643 (1.2)	
Not known:	23,155 (1.9)	21,464 (1.8)	1,691 (2.1)		793 (2.9)	898 (1.7)	
Not stated:	71,547 (5.9)	66,346 (5.9)	5,201 (6.4)		2,343 (8.4)	2,858 (5.4)	
Caucasian/Non-Caucasian %	83.7/16.3	83.5/16.5	86.8/13.2	<0.001	84.3/15.7	88.1/11.9	<0.001

Table 3 Summary of odds ratios for ED diagnoses which following adjustment for age, gender and ED Hospital Provider (i.e. Cluster) were significantly associated with either Any, Acute or Chronic Alcohol Disorder

	Any Alcohol Disorder (AD)					Alcohol Disorder - Sub Groups									
						Acute Alcohol Disorder (AAD)					Chronic Alcohol Disorder (CAD)				
	AOR	RSE	z	(95% CI)	p=value	AOR	RSE	z	(97.5% CI)	p=value	AOR	RSE	z	(97.5% CI)	p =value
Poisoning (inc. Overdose)	14.58	0.529	73.86	(13.582; 15.657)	<0.001	22.50	1.062	65.98	(20.242; 25.010)	<0.001	10.08	0.421	55.36	(9.179; 11.067)	<0.001
Social problems (inc. chronic alcohol. & home.)	12.23	1.097	27.89	(10.253; 14.577)	<0.001	8.51	0.885	20.57	(6.737; 10.743)	<0.001	14.23	1.333	28.35	(11.534; 17.552)	<0.001
Psychiatric conditions	5.62	0.281	34.50	(5.095; 6.199)	<0.001	4.88	0.359	22.55	(4.141; 5.759)	<0.001	5.92	0.294	35.78	(5.295; 6.617)	<0.001
Head injury	3.28	0.176	22.13	(2.950; 3.640)	<0.001	4.75	0.349	21.20	(4.030; 5.602)	<0.001	2.53	0.116	20.30	(2.282; 2.801)	<0.001
Central nervous system conditions (ex. stroke)	1.73	0.059	16.17	(1.619; 1.849)	<0.001	-					2.27	0.081	23.06	(2.095; 2.456)	<0.001
Contusion / abrasion	1.67	0.067	12.60	(1.538; 1.803)	<0.001	1.69	0.085	10.48	(1.513; 1.897)	<0.001	1.64	0.067	11.94	(1.491; 1.794)	<0.001
Nothing Abnormal Detected	1.60	0.080	9.46	(1.454; 1.767)	<0.001	-					1.88	0.096	12.40	(1.678; 2.109)	<0.001
Laceration	1.47	0.083	6.92	(1.320; 1.646)	<0.001	1.76	0.133	7.42	(1.481; 2.081)	<0.001	1.32	0.067	5.47	(1.179; 1.481)	<0.001
Diagnosis not classifiable	1.29	0.039	8.51	(1.219; 1.373)	<0.001	-					1.55	0.048	14.21	(1.446; 1.660)	<0.001
Diabetes and other endocrine conditions	1.22	0.063	3.85	(1.103; 1.352)	<0.001	-					1.59	0.079	9.44	(1.426; 1.779)	<0.001
Gastrointestinal conditions	1.21	0.034	6.87	(1.146; 1.278)	<0.001	-					1.89	0.052	22.97	(1.777; 2.012)	<0.001
Near drowning	-					-					1.70	0.317	2.82	(1.114; 2.579)	0.005
Haematological conditions	-					-					1.23	0.098	2.61	(1.030; 1.469)	0.009

Table 4 Frequency, Proportions, Median scores and bootstrapped derived means for ED Attendances, Hospital Admissions and Total Bed Days for individuals admitted to Hospital via ED in 2009/10

	All	No Alcohol Disorder (NAD)	Any Alcohol Disorder (AD)	AD versus NAD p-value	Alcohol Disorder - Sub Groups			
					Acute Alcohol Disorder (AAD)	AAD versus NAD p-value	Chronic Alcohol Disorder (CAD)	CAD versus NAD p-value
ED Attendances								
ED Attend: N	2,631,755	2,323,246	308,509		77,272		231,237	
% Attend.	100.0	88.3	11.7		3.2		9.1	
ED Attend: Median (IQR)	2 (1-2)	1 (1-2)	2 (1-4)	<0.001	2 (1-3)	<0.001	2 (1-5)	<0.001
ED Attend: Mean	2.18	2.06	3.80		2.78		4.33	
SE:	0.031	0.027	0.079		0.051		0.097	
95% CI:	2.12; 2.24	2.00; 2.11	3.64; 3.95		2.68; 2.88		4.14; 4.52	
Hospital Admissions								
Admiss: N	1,957,452	1,776,589	180,865		43,819		137,046	
% Admiss.	100.0	90.8	9.2		2.4		7.2	
Admiss: Median (IQR)	1 (1-2)	1 (1-2)	1 (1-3)	<0.001	1 (1-2)	<0.001	2 (1-3)	<0.001
Admiss: Mean	1.62	1.57	2.23		1.58		2.56	
SE:	0.008	0.001	0.008		0.019		0.031	
95% CI:	1.60; 1.64	1.57; 1.58	2.21; 2.24		1.54; 1.61		2.50; 2.63	
Total Hospital Bed Days								
Bed days: N	12,694,034	11,782,034	912,005		102,733		809,272	
% Bed days	100.0	92.8	7.2		0.9		6.4	
Bed days: Median (IQR)	3 (1-11)	3 (1-11)	3 (1-12)	0.004	3 (0-2)	<0.001	6 (2-18)	<0.001
Bed days: Mean	10.49	10.44	11.22		3.70		15.14	
SE:	0.133	0.203	0.141		0.116		0.215	
95% CI:	10.23; 10.75	10.16; 10.72	10.16; 10.72		3.47; 3.92		14.72; 15.56	

Table 5 Propensity Score Matching for Overall total costs for Any, Acute and Chronic Alcohol Disorder versus No Alcohol Disorder

Sample	Average Mean Cost of Treated Group (With Alcohol Disorder)	Average Mean Cost of Control Group (No Alcohol Disorder)	Difference in Average Mean Costs	S.E.	t-stat
(Sample: N=1,209,760) Comparison of Any Alcohol Disorder (Treated N= 81,258) v. No Alcohol Disorder (Control N=1,128,502)					
Unmatched Sample	£5,634.24	£4,742.13	£892.11	30.381	29.36
Matched Sample (ATT)*	£5,634.24	£4,177,70	£1,456.53	506.550	2.88
(Sample: N= 1,156,300) Comparison of Acute Alcohol Disorder (Treated N= 27,798) v. No Alcohol Disorder (Control N= 1,128,502)					
Unmatched Sample	£2,487.97	£4,742.13	-£2,254.15	50.451	-44.68
Matched Sample (ATT)*	£2,487.97	£3,372.24	-£884.27	486.928	-1.82
(Sample: N= 1,181,962) Comparison of Chronic Alcohol Disorder (Treated N= 53,460) v. No Alcohol Disorder (Control 1,128,502)					
Unmatched Sample	£7,270.22	£4,742.13	£2,528.09	37.191	67.98
Matched Sample (ATT)*	£7,270.22	£4,946.20	£2,324.02	1218.905	1.91

* ATT = average treatment effect on the treated

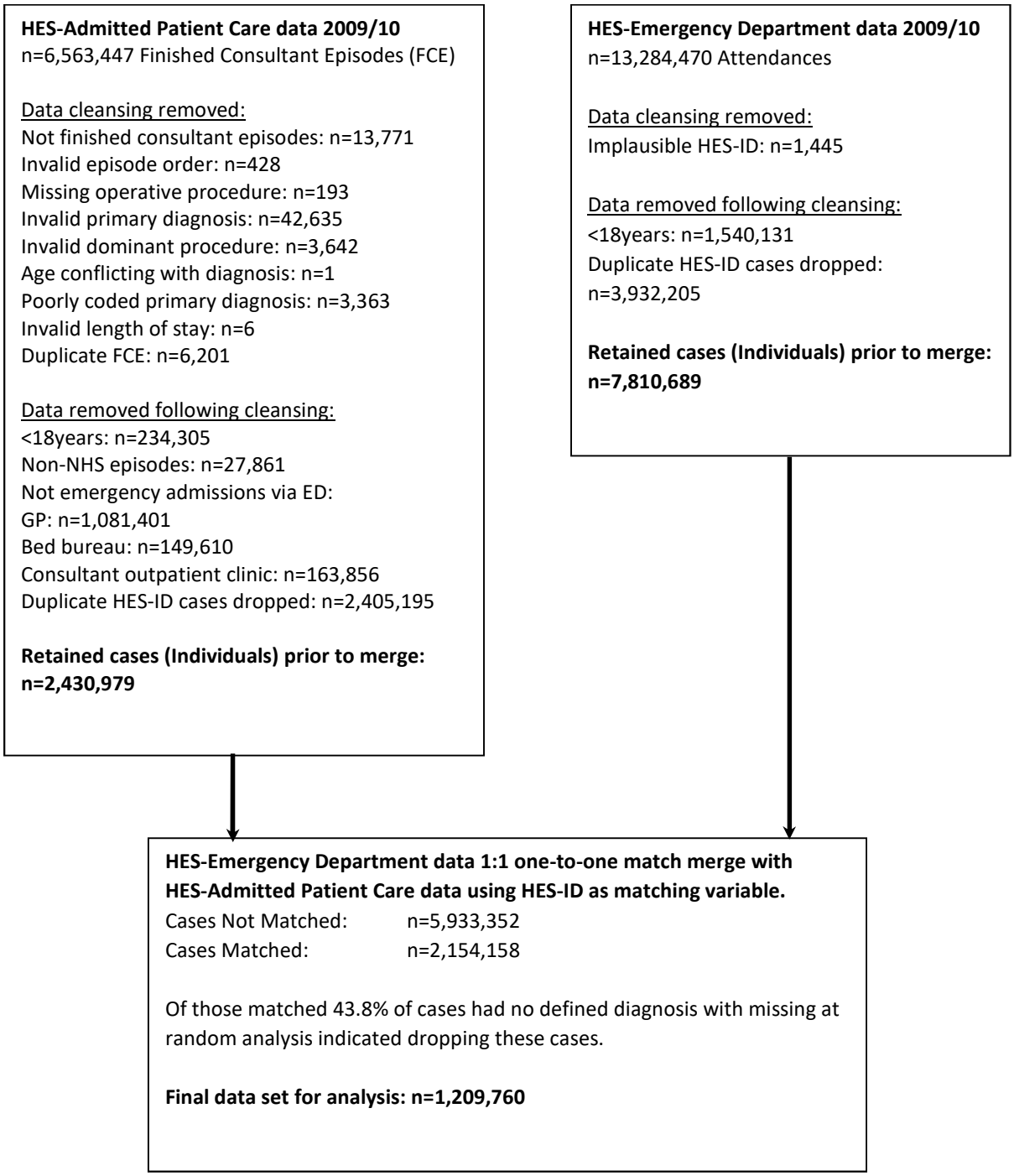

Figure 1 Flowchart depicting identification of individual cases found in both HES-APC and HES-ED data set 2009/10

Supplementary Table. Proportions for ED Diagnoses with prevalence for alcohol disorder, obtained using HES-APC and HES-ED 2009/10 data († = diagnosis positively associated to AAD; ‡ = diagnosis positively association to CAD)

Presenting ED diagnosis	With ED diagnosis 1,209,760 (100.0)	No Alcohol Disorder (NAD) 1,128,502 (93.3)	Any Alcohol Disorder (AD) 81,258 (6.7)	Prevalence of Alcohol Disorder %	P=value
Significant: Alcohol Disorder - positive association					
Poisoning (including overdose) † ‡	45,493 (3.8)	22,982 (2.0)	22,511 (27.7)	49.5	<0.001
Social problems (inc. alcoholism and homelessness) † ‡	12,723 (1.1)	7,750 (0.7)	4,973 (6.1)	39.1	<0.001
Psychiatric conditions † ‡	29,715 (2.5)	20,147 (1.8)	9,568 (11.8)	32.2	<0.001
Head injury † ‡	43,112 (3.6)	34,750 (3.1)	8,362 (10.3)	19.4	<0.001
Contusion / abrasion † ‡	37,207 (3.1)	32,918 (2.9)	4,289 (5.3)	11.5	<0.001
Laceration † ‡	61,352 (5.1)	54,721 (4.9)	6,631 (8.2)	10.8	<0.001
Central nervous system conditions (excl. stroke) ‡	75,965 (6.3)	67,972 (6.0)	7,993 (9.8)	10.5	<0.001
Facio-maxillary conditions † ‡	5,141 (0.4)	4,615 (0.4)	526 (0.7)	10.2	<0.001
Nothing abnormal detected ‡	70,488 (5.8)	63,583 (5.6)	6,905 (8.5)	9.8	<0.001
Near drowning ‡	317 (0.0)	286 (0.0)	31 (0.0)	9.8	0.029
Burns and scalds † ‡	5,117 (0.4)	4,627 (0.4)	490 (0.6)	9.6	<0.001
Bites / stings † ‡	4,021 (0.3)	3,674 (0.3)	347 (0.4)	8.6	<0.001
Sprain/ligament injury † ‡	29,878 (2.5)	27,413 (2.4)	2,465 (3.0)	8.3	<0.001
Gastrointestinal conditions ‡	175,442 (14.5)	161,127 (14.3)	14,315 (17.6)	8.2	<0.001
Diabetes and other endo. Conditions ‡	17,359 (1.4)	15,960 (1.4)	1,399 (1.7)	8.1	<0.001
Foreign body † ‡	7,707 (0.6)	7,087 (0.6)	620 (0.8)	8.0	<0.001
Diagnosis not classifiable ‡	307,540 (25.4)	283,613 (25.1)	23,927 (29.5)	7.8	<0.001
Soft tissue inflammation ‡	43,323 (3.6)	40,127 (3.6)	3,196 (3.9)	7.4	<0.001
Muscle/tendon injury ‡	18,899 (1.6)	17,546 (1.6)	1,353 (1.7)	7.2	0.014
Significant: Alcohol Disorder - negative association					
Dislocation / fracture / joint injury / amputation †	123,202 (10.2)	115,203 (10.2)	7,999 (9.8)	6.5	0.001
Ophthalmological conditions	17,344 (1.4)	16,352 (1.5)	992 (1.2)	5.7	<0.001
Haematological conditions ‡	9,359 (0.8)	8,844 (0.8)	515 (0.6)	5.5	<0.001
Vascular injury	2,881 (0.2)	2,726 (0.2)	155 (0.2)	5.4	0.004
Infectious disease	15,101 (1.3)	14,364 (1.3)	737 (0.9)	4.9	<0.001
Local infection	41,970 (3.5)	40.009 (3.6)	1,961 (2.4)	4.7	<0.001
Other vascular conditions	18,048 (1.5)	17,216 (1.5)	832 (1.0)	4.6	<0.001
Respiratory conditions	120,313 (10.0)	115,166 (10.2)	5,147 (6.3)	4.3	<0.001
Septicaemia	5,653 (0.5)	5,415 (0.5)	238 (0.3)	4.2	<0.001
Cerebro-vascular conditions	50,439 (4.2)	48,395 (4.3)	2,044 (2.5)	4.1	<0.001
ENT conditions	20,726 (1.7)	19,970 (1.8)	756 (0.9)	3.7	<0.001
Allergy (inc anaphylaxis)	7,937 (0.7)	7,656 (0.7)	281 (0.4)	3.5	<0.001
Cardiac conditions	177,344 (14.7)	171,326 (15.2)	6,018 (7.4)	3.4	<0.001
Urological conditions (including cystitis)	69,619 (5.8)	67,720 (6.0)	1,899 (2.3)	2.7	<0.001
Gynaecological conditions	30,503 (2.5)	29,982 (2.7)	521 (0.6)	1.7	<0.001
Obstetric conditions	12,653 (1.1)	12,440 (1.1)	213 (0.3)	1.7	<0.001
Alcohol Disorder – no association					
Visceral injury	915 (0.1)	847 (0.1)	68 (0.1)	7.4	0.388
Dermatological conditions ‡	6,704 (0.6)	6,258 (0.6)	446 (0.6)	6.7	0.833
Electric shock	311 (0.0)	288 (0.0)	23 (0.0)	6.7	0.633
Nerve injury	2,524 (0.2)	2,362 (0.2)	162 (0.2)	6.4	0.549