

Development of an Alcohol Withdrawal risk stratification tool based on patients referred to an addiction liaison nursing service in Glasgow

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3 **DEVELOPMENT OF AN ALCOHOL WITHDRAWAL RISK STRATIFICATION**
4 **TOOL BASED ON PATIENTS REFERRED TO AN ADDICTION LIAISON**
5 **NURSING SERVICE IN GLASGOW**
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8 **ABSTRACT**
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10 **Purpose:** To develop an Alcohol Withdrawal Syndrome (AWS) risk stratification tool that
11 could support the safe discharge of low risk patients from the emergency department.
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14 **Design/Methods:** A retrospective cohort study that included all patients referred to the acute
15 addiction liaison nursing service (AALNS) over one calendar month (n=400, 1st April 2016-
16 30th April 2016) was undertaken. Bivariate and multivariate modelling identified the
17 significant variables that supported the prediction of severe alcohol withdrawal syndrome
18 (SAWS) in the cohort population.
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23 **Findings:** The Glasgow Modified Alcohol Withdrawal Scale (GMAWS), hours since last
24 drink, Fast Alcohol Screening Test (FAST), and systolic blood pressure (SBP) correctly
25 identified 89% of patients who developed SAWS and 84% of patients that did not. Increasing
26 each component by a score of one is associated with an increase in the odds of SAWS by a
27 factor of 2.76 (95% CI 2.21, 3.45), 1.31 (95% CI 1.24, 1.37), 1.30 (CI 1.08, 1.57) and 1.22
28 (95% CI 1.10, 1.34) respectively.
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39 **Research Limitations:** The research was conducted in a single healthcare system that had a
40 high prevalence of alcohol dependence syndrome (ADS). Second, the developed risk
41 stratification tool was unable to guarantee no risk and lastly, the FAST score previously
42 aligned to severe ADS may have influenced the patients highest GMAWS score.
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46 **Originality/ Value:** The tool could help redesign the care pathway for emergency department
47 patients at low risk of SAWS and link them with community alcohol services better equipped
48 to deal with their physical and psychological needs, short and long term, supporting
49 engagement, abstinence and prolongation of life.
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54 **KEYWORDS:** alcohol, general hospital, delirium tremens, alcohol-related seizures, alcohol
55 withdrawal syndrome, risk prediction, hospital admission, risk stratification
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INTRODUCTION

Alcohol use is one of the major causes of disease, death and injury globally (World Health Organisation, 2014). Excessive alcohol consumption is linked to over 200 physical and psychological diseases and has a longstanding association with cardiovascular disease, liver cirrhosis and various cancers (World Health Organisation, 2014; Holman et al., 1996). From an acute health perspective the greatest impact of problematic alcohol use is witnessed by emergency departments, where at peak times 70% of attendances are alcohol related (Vardy et al., 2017; Waye et al., 2015; Stehman & Mycyk, 2013; Manasco. et al., 2012; Forsythe & Lee, 2012; The Department of Health, 2008). The primary alcohol reason for hospital attendance is alcohol withdrawal syndrome (AWS) which is a risk in people who have alcohol dependence syndrome (ADS) when they stop drinking (Vardy et al., 2017). ADS is recognised by the International Classification of Disease- Tenth Revision (ICD-10) when a person experiences three from a suite of six symptoms in the previous 12 months (World Health Organisation, 2016).

AWS and ADS span a spectrum that range from mild to severe, where mild withdrawal requires minimum intervention, and severe alcohol withdrawal syndrome (SAWS) that includes alcohol related seizures (ARS) and delirium tremens (DT's) hospital admission (Sutton & Jutel, 2016; Feeney et al., 2015; Paseti et al., 2008). Although SAWS is experienced by approximately 10% of people, emergency department physicians are under pressure to see patients and make decisions quickly (Vardy et al., 2017). **Consequently, a high proportion of patients are admitted to hospital acutely for alcohol detoxification incase they develop SAWS. The result of this just incase practice is that patients are discharged after 24 hours and has contributed to the increase in short to zero stay hospital admissions (ISD**

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3 Scotland, 2017; NHS England, 2016; Maldonado et al., 2015; Pecoraro et al., 2013; Dolman
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5 & Hawkes, 2005).

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11 The decision to admit to hospital for alcohol detoxification is not supported by the lack of a
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13 tool to inform physicians in this decision (Benson et al., 2019; NICE, 2016; Stephens et al.,
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15 2014; Repper-DeLisi et al., 2008). Despite a number of retrospective studies investigating
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17 risk factors and SAWS, the only protocol located for the identification of low SAWS risk was
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19 developed by Stephens et al. (2014). The Clinical Institute Withdrawal Assessment- Alcohol
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21 Revised (CIWA-AR) (Sullivan et al., 1989) was central to the Stephens et al. (2014) protocol
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23 where SAWS is suspected at a CIWA-AR > 15. While CIWA-AR > 15 necessitated inpatient
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25 detoxification, patients who had a CIWA-AR < 15 were screened for discharge (Stephens et
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27 al., 2014).

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36 Detoxification carried out in hospital is up to eight times more costly than outpatient
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38 treatment, and reduces the likelihood that patients will attend alcohol treatment programmes
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40 on hospital discharge (Alwyn et al., 2004; Cooper, 1995; Bartu & Saunders, 1994).
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42 Importantly, outpatient detoxification presents comparable results with inpatient
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44 detoxification for patient abstinence, engagement, satisfaction and adverse events (Pasetti et
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46 al., 2008). However, the high incidence of alcohol presentations and subsequent admissions
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48 to hospital are having a detrimental impact on the NHS ability to achieve the Government's
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50 waiting time target (ISD Scotland, 2017; NHS England, 2016). In NHS Greater Glasgow &
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52 Clyde (NHSGGC), the guarantee that 95% of patients will be admitted or discharged within
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54 four hours of their presentation to the emergency department is achieved in less than 90% of
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56 cases (ISD Scotland, 2017).

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3 NHSGGC provides health care to a population of 1.2 million people and covers six of the
4 most deprived post code areas in Scotland. **Deprivation in Scotland is captured by the**
5 **Statistical Index of Multiple Deprivation where 1 is the most deprived and 5 the least** (ISD
6 Scotland, 2017). People living in **the most** deprived post code areas are eight times more
7 likely to attend the emergency department for an alcohol related condition than people from
8 more affluent areas (ISD Scotland, 2017; Walsh et al., 2010; The Scottish Government,
9 2009). In 2015/16 there were approximately 12,000 alcohol related acute hospital admissions
10 in Glasgow (ISD Scotland, 2017). Patients in NHSGGC admitted with an alcohol problem
11 are referred to the acute addiction liaison nursing service (AALNS). The AALNS are a team
12 of specialist nurses who provide assessment, treatment planning and onward referral for
13 problematic alcohol use patients admitted to hospital (McPherson & Benson, 2011). In
14 NHSGGC, the level of a person's alcohol consumption and AWS symptoms are captured by
15 the Glasgow Assessment Management of Alcohol (GAMA) guideline (McPherson et al.,
16 2012).

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39 The GAMA is a comprehensive guideline that includes screening for alcohol use and
40 dependency using the Fast Alcohol Screening Test (FAST) and a simple numeric score, the
41 Glasgow Modified Alcohol Withdrawal Scale (GMAWS) to assess the symptoms of AWS
42 (McPherson et al., 2012). The original GAMA study (McPherson et al., 2012) like studies by
43 Maldonado et al. (2015), Pecoraro et al. (2013) and Dolman & Hawkes (2005) developed the
44 GMAWS to identify escalating withdrawal symptoms for the purpose of hospital treatment
45 and not early discharge. The GAMA suggests ADS at FAST greater or equal (\geq) 9 and severe
46 ADS at FAST \geq 12 (McPherson et al., 2012). In addition, mild- moderate AWS is reflective
47 of GMAWS $<$ 4 and SAWS, GMAWS \geq 4 (McPherson et al., 2012). **The GMAWS and**
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3 FAST have been validated and tested previously in the NHSGGC hospitals (McPherson et
4 al., 2012).
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11 The aim of this study and described in this paper is to investigate whether the GMAWS and
12 the quantitative variables identified through a systematic literature review (Benson et al.,
13 2019) can be used in the emergency department to help stratifying a person's risk of
14 developing SAWS and support clinicians in their decision to admit or not. The variables
15 were; previous SAWS, ARS, DT's, hours since last drink, age, post code, gender, reason for
16 admission, physical observations, blood results, co-morbidities, and level of ADS. Currently
17 only one study has explored the use of an alcohol risk stratification tool for the purpose of
18 emergency department discharge (Stephens et al., 2014). Because SAWS development is a
19 consequence of years of drinking we employed a retrospective method, where risk
20 measurement is time from data collection to analysis.
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39 **METHODS**

40 **Patients**

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42 Patients admitted acutely to the two large Glasgow acute adult hospitals within NHSGGC;
43 Queen Elizabeth University Hospital (QEUH) and Glasgow Royal Infirmary (GRI) through
44 the emergency department and referred to the AALNS during one calendar month (1st April -
45 30th April 2016) were retrospectively included in the study. This month was chosen because
46 the study was part of a time limited project that coincided with the end of this period. All
47 patients were treated using the GAMA guideline and benzodiazepines administered for AWS
48 symptoms, and thiamine for treatment and prophylaxis of alcohol related brain damage. ADS
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3 was suspected at FAST ≥ 9 and confirmed using ICD-10 classification, while SAWS was
4 recognised as GMAWS ≥ 4 . Patients were only counted once and subsequent admissions
5 excluded. We also excluded patients who had no documented ICD-10 classification and past
6 or present alcohol history. Ethical approval was granted by the NHS West of Scotland
7 Research Ethics Committee (16/WS/0194).
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19 **Data collection**

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21 The medical records of the potential cohort for the study period were reviewed for exclusion
22 criteria by a single investigator (AM) using a standard extraction form. The inclusion process
23 is shown in Figure 1. Four hundred and eighty nine records related to 432 patients, with only
24 the first referral for patients retained. **The first admission was used as this patient group are**
25 **frequently admitted to hospital and in a number of occasions this may be recent, and therefore**
26 **prior treatment could adversely impact on the patients presenting GMAWS. Of the 432**
27 **records only 400 had complete data, which also included ICD-10 classification of ADS.** Next,
28 a second investigator (GB) reviewed the records and recorded the variables of interest
29 identified by the systematic literature review. The GMAWS measured the patients SAWS
30 status (GMAWS 0-10) on attendance at the emergency department and during admission.
31 SAWS was reflective of GMAWS ≥ 4 and no SAWS, GMAWS < 4 and was supported by the
32 total benzodiazepine requirement throughout admission. Any discrepancies were resolved by
33 the wider research team.
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Data Analysis

Data was analysed using the Statistical Package for Social Scientists (SPSS) programme version 22. Spearman's rank correlation coefficient was used to understand the unique contribution of the independent variables such as systolic blood pressure (SBP) on the dependent variable SAWS status (highest GMAWS). Additionally, as Spearman's rank correlation coefficient does not make assumptions about the distribution of the data it was a test recommended when using an ordinal dependent variable such as GMAWS. Standard multiple linear regression and stepwise regression was employed to determine how the addition of each statistically significant variable ($p < 0.05$) contributed to the patients SAWS status during admission, while controlling for all others. Finally, as the aim of the study was to develop a tool to identify low risk of SAWS, there was a need to differentiate between SAWS ($GMAWS \geq 4$) and no SAWS ($GMAWS < 4$). Therefore, binary logistic regression was performed on the variables to determine how effective they were in predicting the final SAWS status based on a dichotomised outcome of SAWS versus no SAWS. Binary logistic regression identified the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of the variables that made the greatest contribution to the patients SAWS status during admission.

RESULTS

Cohort (n=400)

We collated the records from 400 patients, where 210 (53%) did not develop SAWS during their admission. Table 1 shows that the majority of patients were White Scottish (355/400) and the mean age of the cohort was 50 (± 12) years. The cohort was predominantly male (283 males, 117 females) and co-morbidity was recorded in 212 patient records and more

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3 prevalently recorded for patients who did not develop SAWS. Alcohol liver disease (ALD)
4 was the most prominent (n=78) co-morbidity in the cohort and almost three quarters of
5 patients lived in the two most deprived areas (n=337). The alcohol related conditions of AWS
6 (n=190) and ARS (n=45) were the most common reason for admission and self-harm (n=29)
7 the most non-alcohol related reason.
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18 The mean FAST for the cohort was (14± 1.8) while over one third of the cohort records had a
19 previous history of ARS recorded (n=138). **The mean time since the cohorts last alcoholic**
20 **drink was 30 (± 20) hours and mean alcohol units consumed approximately 196 (± 81) per**
21 **week.** The percentage of males who developed SAWS was greater than those that did not
22 develop SAWS (142/190, 75% versus (vs) 141/210, 67%) which was reversed for females
23 (48/190, 25% vs 69/210, 33%). The group that developed SAWS tended to be slightly
24 younger (49 vs 51 years).
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39 **Table 1 shows that of the blood results alanine aminotransferase (ALT) ($r = 0.244$, N=398,**
40 **$p < 0.01$), aspartate aminotransferase (AST) ($r = 0.209$, N=398, $p < 0.01$) and albumin ($r =$**
41 **0.239 , N=398, $p < 0.01$) were significant and positively correlated with SAWS status during**
42 **admission although accounted for only 6%, 4%, and 6% of the outcome. In addition,**
43 **potassium ($r = -0.110$, N=398, $p < 0.05$) was negatively correlated and responsible for 1% of**
44 **the SAWS status. The physiological markers of systolic blood pressure (SBP) ($r=0.427$,**
45 **n=398, $p < 0.01$), and pulse ($r=0.136$, n=398, $p < 0.01$) explained 18% and 2% of the SAWS**
46 **status.**
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3 FAST ($r = 0.243$, $N=398$, $p<0.01$), GMAWS ($r = 0.822$, $N=398$, $p<0.01$) score at the
4 emergency department, and hours since last drink ($r = 0.548$, $N=398$, $p<0.01$) were positively
5 correlated with the SAWS status experienced during admission, while previous SAWS ($r = -$
6 0.117 , $N=398$, $p<0.05$) and ARS ($r = - 0.198$, $N=398$, $p<0.05$) negatively correlated.
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8 Spearman's rank correlation identified that in isolation these variables were responsible for
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10 1% (SAWS) to 68% (GMAWS) of the variance in a patients SAWS status during hospital
11 admission.
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23 The variables, hours since last drink, FAST, GMAWS at the emergency department, previous
24 ARS, SAWS, ALT, AST, potassium, albumin, SBP, and pulse were analysed further using
25 standard multiple linear regression. The standard multiple linear regression R value for the 11
26 variables above was strong (0.843) and accounted for an adjusted R^2 (squared) that explained
27 71% of the SAWS status experienced by patients during their hospital admission: $F(11,396)$
28 $= 72.83$, $p<0.001$. However, using stepwise regression, seven of the variables were removed
29 as they were not identified as predictor variables: ARS, SAWS, ALT, AST, potassium,
30 albumin, and pulse. A significant model emerged that included: hours since last drink, FAST,
31 GMAWS, and SBP, $F(4,396) = 234.12$, $p<0.001$. Table 2 shows that although the total R^2
32 adds up to 70%, its components are not unique, where fitting the selected predictors in a
33 different order will result in different individual contribution to the same total R^2 outcome.
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52 A logistic regression analysis was performed with SAWS status (SAWS = 0, no SAWS = 1)
53 as the dependent variable and GMAWS at the emergency department, hours since last drink,
54 FAST and SBP as predictor variables. A total of 400 cases were analysed and the total model
55 significantly predicted SAWS status (omnibus chi-square= 316.68, $df= 4$, $p< 0.0005$). The
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3 model accounted for between 54.7% and 73.0% of the variance in SAWS status, with 89% of
4 patients who developed SAWS and 84% of patients not developing SAWS correctly
5 predicted. Overall, 87% of predictions were accurate. Table 3 shows that each increase in the
6 GMAWS by a score of one is associated with a decrease in the odds of no SAWS by a factor
7 of 2.76 (95% CI 2.21, 3.45). In addition, increasing the time since last drink by 1 hour,
8 FAST by a score of 1 and SBP by 1 mmHg increase the odds of SAWS by 1.31 (95% CI
9 1.24, 1.37), 1.30 (CI 1.08, 1.57) and 1.22 (95% CI 1.10, 1.34) respectively.
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23 The study identified that the risk of a patient developing SAWS could be recognised at the
24 emergency department with GMAWS ≥ 4 , FAST ≥ 15 , SBP > 138 mmHg and hours since
25 last drink < 44 hours (Table 1) and therefore the risk of not developing SAWS with GMAWS
26 < 4 , FAST < 15 , SBP ≤ 138 mmHg and hours since last drink ≥ 44 hours.
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36 DISCUSSION

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39 This retrospective cohort study was conducted to capture a population of patients who had a
40 prevalent diagnosis of ADS and admitted to two large acute adult hospitals in Glasgow. A
41 consequence of ADS is the development of AWS on cessation of alcohol use. AWS spans a
42 spectrum that ranges from mild requiring minimal intervention to severe, where hospital
43 admission and pharmacological treatment is required (Sutton & Juttel, 2016). Although there
44 are tools for the treatment of AWS, their purpose is for the identification and treatment of
45 those at high risk of SAWS (Maldonado et al., 2015; Pecoraro et al., 2013; McPherson et al.,
46 2012; Dolman & Hawkes, 2005). The studies investigating AWS identified that the
47 emergency department was a good location to assess SAWS risk and commence treatment
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3 (Maldonado et al., 2015; Pecoraro et al., 2013; Eyer et al., 2011; Monte et al., 2010;
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5 Menecier et al., 2008; Wright et al., 2006; Lee et al., 2005; Dolman & Hawkes, 2005; Lukan
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7 et al., 2002; Ferguson et al., 1996; Booth & Blow, 1993). While we agree that the emergency
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9 department is an ideal location to identify risk, we looked at assessment as an opportunity to
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11 identify and discharge patients who had ADS and at low risk of SAWS.
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18 Attendance at the emergency department with AWS is an ideal opportunity to develop a non-
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20 invasive measurement to stratify SAWS risk and discharge low risk patients home. From this
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22 study, a combination of GMAWS at the emergency department, FAST, hours since last drink
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24 and SBP appear to be a potential indicator of SAWS risk with sensitivity classification
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26 showing 84% accuracy in ruling out those without the disease, and 89% specificity ruling in
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28 those with the disease.
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37 The results of our study are comparable with the studies by Maldonado et al. (2015),
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39 Pecoraro et al. (2013) and Dolman and Hawkes (2005), although these studies looked at risk
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41 stratification for hospital treatment. While the Maldonado et al. (2015) tool comprised of the
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43 10 most common factors identified from their systematic literature review (Maldonado et al.,
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45 2014), Goodson et al. (2014) in their meta-analysis of 15 studies found that only ARS and
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47 DT's were statistically significant in SAWS risk in more than one study. The lack of
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49 consistent variables from studies investigating the same phenomenon suggests that the link
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51 with SAWS was either a chance association or a consequence of poor study design, execution
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53 or low prevalence. Moreover, although Pecoraro et al. (2013) and Dolman and Hawkes
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55 (2005) propose that the Alcohol Use Disorder Identification Test (AUDIT) was effective in
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57 identifying a person's risk of SAWS, this claim was not supported in other studies (Von-der-
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3 Pahlen et al., 2008; Shevlin & Smith, 2007; Lima et al., 2005). In contrast to our study these
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5 published risk stratification tools were based on positive results from small prevalence
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7 samples (7%; 1.4%; 2%) (Maldonado et al., 2015; Pecoraro et al., 2013; Dolman & Hawkes
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9 2005).

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16 The one study by Stephens et al. (2014) that looked at low SAWS risk, unlike our study
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18 presented a limited systematic literature review that included only three studies. The key to
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20 the Stephens et al. (2014) process was the CIWA-AR and like the GMAWS presented
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22 scores for mild- moderate AWS and SAWS, where the mild to moderate patients were
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24 discharged home. Previous research has identified that discharge and successful engagement
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26 with alcohol care and treatment services through a home supported detoxification has been
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28 associated with a 59% reduction in emergency department attendances and 66% reduction in
29
30 frequent hospital admissions (Tadros et al., 2013; Hughes et al., 2013). However, the
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32 Stephens et al. (2014) process provided an outpatient detoxification that was unsupported. In
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34 addition, this process was guided by the CIWA-AR were the predictability for stratifying low
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36 SAWS risk was not investigated, and therefore risk of adverse events on discharge, unknown.
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38 Consequently, the number of readmissions within the study population increased. **For this**
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40 **reason and recognition that the variables in our tool were unable to guarantee no risk**, an
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42 alternative to hospital admission in the form of a home supported detoxification for the
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44 population discharged from hospital would be explored.
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55 In the AWS literature the importance of ADS appears to be overlooked, and presented as a
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57 homogenous concept captured as a single measure by the International Classification of
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59 Disease (ICD) and the Diagnostic and Statistical Manual of Mental Disorders (DSM)
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3 (Maldonado et al., 2015; Pecoraro et al., 2013; Eyer et al., 2011; Monte et al., 2010;
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5 Menecier et al., 2008; Wright et al., 2006; Lee et al., 2005; Dolman & Hawkes, 2005; Lukan
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7 et al., 2002; Ferguson et al., 1996; Booth & Blow, 1993). However, like AWS, ADS spans a
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9 spectrum where SAWS risk is proportionate to a person's level of alcohol dependence
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11 (Stewart & Swain, 2012). Therefore, as a determinant of SAWS the measure of ADS severity
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13 is paramount as a starting point to understanding risk (Stockwell et al., 1983). Subsequently,
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15 none of the studies reviewed used a tool to record the severity of the persons ADS in an
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17 environment where poor alcohol assessment is known (Sutton & Juttel, 2016; Stehman &
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19 Mycyk, 2013; Forsythe & Lee, 2012). Consequently, it is difficult to exclude the prospect
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21 that the results and low prevalence of ADS may be as reflective of the quality of assessment
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23 data as their association with SAWS risk.
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33 Our study, unlike the AWS literature (Maldonado et al., 2015; Pecoraro et al., 2013; Eyer et
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35 al., 2011; Monte et al., 2010; Menecier et al., 2008; Wright et al., 2006; Lee et al., 2005;
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37 Dolman & Hawkes, 2005; Lukan et al., 2002; Ferguson et al., 1996; Booth & Blow, 1993),
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39 provided a population where the prevalence of ADS was high. The prevalence of ADS and
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41 use of FAST as a measure of ADS severity provided a population deemed high risk of
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43 SAWS. Consequently, the novel concept attributed to this study and not found in the
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45 literature is the development of a research based tool that can stratify a person's risk of
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47 developing SAWS and **support clinicians in their decision to admit or discharge** low risk
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49 patients from the emergency department.
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58 The strengths of this study are the accuracy of the data collected by a specialist team of
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60 alcohol nurses. The retrospective nature of the study supported that GMAWS, FAST, hours

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3 since last drink and SBP were not influenced by the aim of the study. The use of a high
4 alcohol screening score (FAST ≥ 15) and high withdrawal symptom score (GMAWS ≥ 4)
5 seem like reasonable indicators of SAWS risk (McPherson et al., 2012) and therefore FAST $<$
6 15 and GMAWS < 4 indicators of low SAWS risk. While time since last drink as an indicator
7 of SAWS risk divides the literature (Maldonado et al. 2015; Eyer et al., 2011; Lee et al.,
8 2005; Lukan et al., 2002; Ferguson et al., 1996) it is safe to assume that SAWS risk decreases
9 with the increase of time (Munchie et al., 2013). However, the impact of SBP is less clear in
10 this population where high levels of co-morbidity and subsequent pharmacological treatment
11 may have normalised an otherwise abnormal SBP (Chen et al., 2015).
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28 Despite the strengths of this study there are a number of limitations. First, the study was
29 conducted in a single healthcare system that has a high prevalence of ADS, although the
30 indicators within the tool are generalisable to other populations. Second, the original GAMA
31 study (McPherson et al., 2012) presented high risk of SAWS at FAST ≥ 12 , which may have
32 resulted in some low risk patients receiving pharmacological intervention influencing their
33 SAWS status. Finally, while the risk stratification tool had excellent predictability, the
34 included variables were not fully responsible for the variance in whether the patient
35 developed SAWS or not, and therefore an alternative treatment pathway is suggested in the
36 form of a home supported detoxification.
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52 The developed risk stratification tool shows considerable promise as a predictor of low risk of
53 SAWS and safe discharge from the emergency department. In addition, the risk stratification
54 tool includes variables that are collected routinely as part of a patient's emergency
55 department journey. However, further research into the use of this risk stratification tool and
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3 the predictor variables are required and should include a prospective cohort study utilising a
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5 home supported detoxification as an alternative to hospital admission for low risk patients.
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11 'This paper contains original material and has not been, nor will be, published in whole or
12 in part by any other journal'. Each author has contributed significantly to the work and
13 gives consent for publication of the article Development of an Alcohol Withdrawal Risk
14 Stratification Tool based on Patients Referred to an Addiction Liaison Nursing Service in
15 Glasgow
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23 acquired in producing this paper.
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28 This research adds to the knowledge surrounding severe alcohol withdrawal syndrome
29 (SAWS) risk. The research proposes that there are variables that can be captured routinely
30 in the emergency department and developed a risk stratification tool based on these
31 variables to support the safe discharge of low risk patients.
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36 The authors
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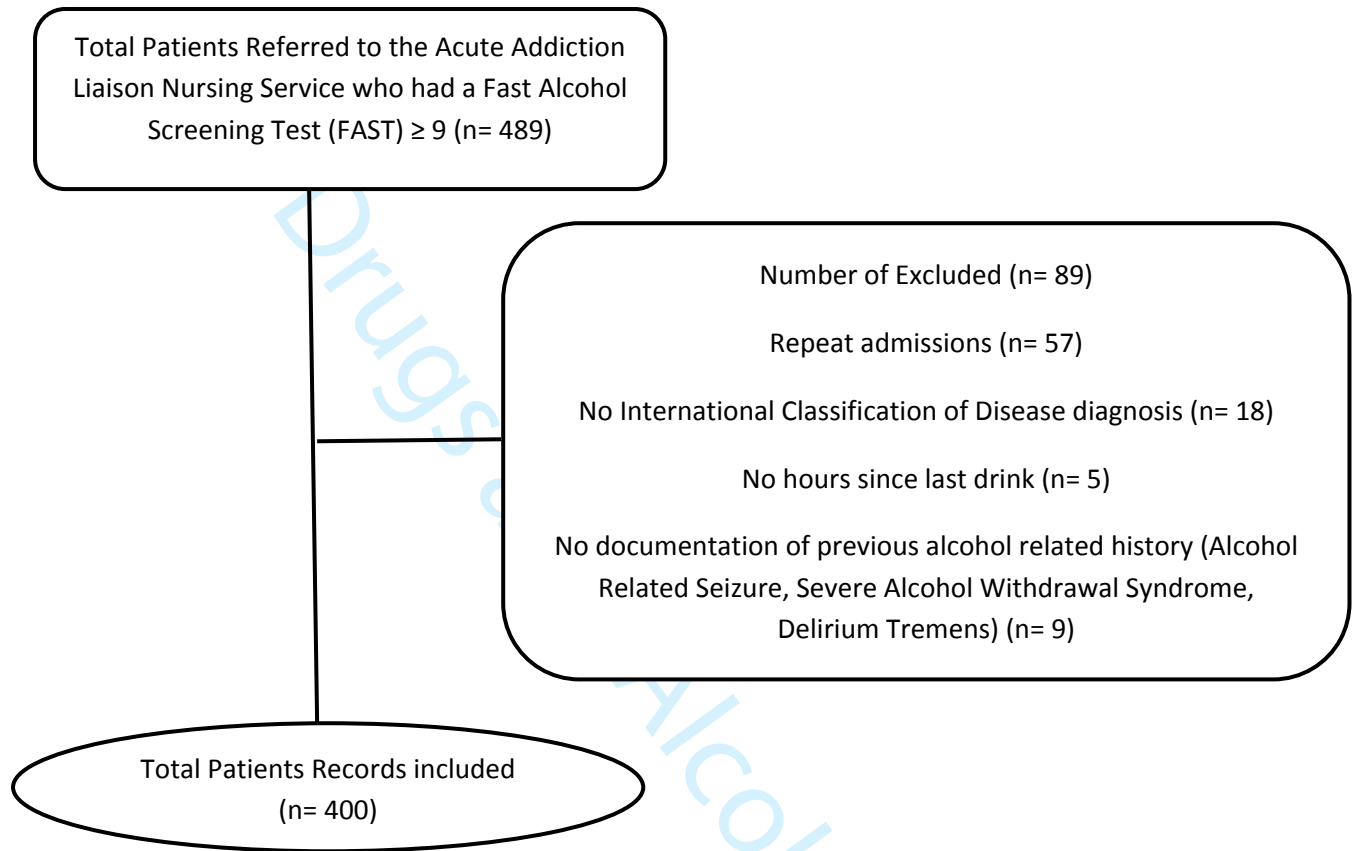
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ABBREVIATIONS

1		
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6	AALNS	Acute Addiction Liaison Nursing Service
7	ADS	Alcohol Dependence Syndrome
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9	ALD	Alcohol Liver Disease
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11	ALT	Alanine aminotransferase
12		
13	ARS	Alcohol Related Seizures
14		
15	AST	Aspartate aminotransferase
16	AUDIT	Alcohol Use Disorder Identification Test
17		
18	AWS	Alcohol Withdrawal Syndrome
19		
20	CI	Confidence Interval
21	CIWA-Ar	Clinical Institute Withdrawal Assessment- Alcohol Revised
22		
23	DSM	Diagnostic and Statistical Manual of Mental Disorders
24		
25	DTs	Delirium Tremens
26		
27	FAST	Fast Alcohol Screening Test
28		
29	GRI	Glasgow Royal Infirmary
30	GMAWS	Glasgow Modified Alcohol Withdrawal Scale
31		
32	GAMA	Glasgow Assessment Management of Alcohol
33		
34	ICD-10	International Classification of Disease- Tenth Revision
35		
36	NHSGGC	National Health Service Greater Glasgow & Clyde
37		
38	NPV	Negative Predictive Value
39		
40	OR	Odds Ratio
41		
42	PAC	Percentage Accuracy IN Classification
43		
44	PPV	Positive Predictive Value
45		
46	QEUH	Queen Elizabeth University Hospital
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48	SAWS	Severe Alcohol Withdrawal Syndrome
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	SBP	Systolic Blood Pressure
	SPSS	Statistical Package for Social Scientists

Figure 1 Algorithm for enrolment of patients for the cohort sample



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Table 1 Comparison of patients with and without development of SAWS

	SAWS (n=190)	NO SAWS (n=210)	P value
Male/ female	142/ 48	141/ 69	NS
Mean age at admission (SD)	48.6 (10.54)	50.8 (12.8)	NS
White Scottish N (%)	166 (88)	189 (90)	NS
White other British N (%)	15 (8)	17 (8)	NS
White Irish N (%)	1 (0.5)	0	NS
White Polish N (%)	6 (3)	2 (1)	NS
Asian N (%)	2 (1)	2 (1)	NS
1 st quintile (most deprived) N (%)	121 (64)	137 (65)	NS
2 nd quintile N (%)	42 (22)	37 (18)	NS
3 rd quintile N (%)	14 (7)	17 (8)	NS
4 th quintile N (%)	9 (5)	9 (4)	NS
5 th quintile (least deprived) N (%)	4 (2)	10 (5)	NS
Employed N (%)	14 (7)	15 (7)	NS
Alcohol Liver Disease (ALD) N (%)	33 (16)	45 (24)	NS
Cardiac N (%)	23 (11)	17 (9)	NS
Diabetes N (%)	14 (7)	24 (13)	NS
Cerebral Vascular Disease (CVD) N (%)	6 (3)	5 (3)	NS
Cancer N (%)	1 (0.5)	2 (1)	NS
Pancreatitis N (%)	18 (9)	13 (7)	NS
Head injury N (%)	5 (2)	6 (3)	NS
Reason for admission N (%)			NS
Alanine aminotransferase (ALT) (U/L) N (SD)	71.4 (132.67)	53.3 (82.30)	0.0005
Aspartate aminotransferase (AST) (U/L) N (SD)	108.9 (163.41)	82.9 (106.02)	0.0005
Potassium (mmol/l) N (SD)	3.99 (0.52)	4.1 (0.59)	0.028
Platelets (X 10 ⁹ /L) N (SD)	206.6 (110.68)	216.2 (106.44)	NS
Albumin (g/l) N (SD)	36.8 (5.89)	34.6 (6.40)	0.0005
Fast Alcohol Screening Test (FAST) N (SD)	15 (1.6)	14 (1.8)	0.0005
Previous history of Severe alcohol withdrawal syndrome (SAWS) ever N (%)	50 (26)	41 (20)	0.019
Previous history of alcohol related seizure (ARS) ever N (%)	80 (42)	58 (28)	0.0005
Previous history of delirium tremens (DT's) ever N (%)	18 (9)	15 (7)	NS
Hours since last drink N (SD)	44.1 (21.66)	17.6 (15.75)	0.0005
Systolic Blood Pressure (SBP) (mmHg) N (SD)	138.4 (18.39)	125.1 (19.86)	0.0005
Pulse (bpm) N (SD)	99.4 (10.54)	94.4 (20.04)	0.006

Data are expressed as mean and standard deviation (SD) for continuous variables and as frequency (n. %) for categorical variables. Only Significant P values ($p < 0.05$) are presented.

Severe alcohol withdrawal syndrome (SAWS) was determined as Glasgow Modified Alcohol Withdrawal Scale (GMAWS) ≥ 4 and no SAWS, GMAWS < 4

Table 2 Multivariate analysis of independent predictors of SAWS status (linear and stepwise regression)

Model	Unstandardised Coefficients		Standardised Coefficients	sig	95% Confidence Intervals for B		R square
	B	Std. Error	Beta		Lower	Upper	
Glasgow Modified Alcohol Withdrawal Scale (GMAWS) (1)	0.665	0.035	0.660	0.0005	0.596	0.733	66%
Hours since last drink (2)	0.015	0.003	0.166	0.0005	0.009	0.021	+1 (68)%
Systolic blood pressure (SBP) (3)	0.13	0.004	0.131	0.001	0.006	0.021	+1 + 2 (69%)
Fast Alcohol Screening Test (FAST) (4)	0.083	0.035	0.071	0.018	0.014	0.152	+1 + 2 + 3 (70%)

Dependent variable was highest Glasgow Modified Alcohol Withdrawal Scale (GMAWS) score (0-10). The R square represents variables identified using stepwise multiple regression. The order and percentage contribution to the models predictive ability is presented

Table 3 *Multivariate logistic regression model. Independent clinical predictors in patients SAWS status (highest GMAWS)*

<i>Model</i>	<i>B</i>	<i>sig</i>	<i>OR</i>	<i>95% CI for OR</i>	
				<i>Lower</i>	<i>Upper</i>
Glasgow Modified Alcohol Withdrawal Scale (GMAWS)	1.016	0.0005	2.762	2.210	3.450
Hours since last drink	0.054	0.0005	1.31	1.24	1.37
Systolic blood pressure (SBP)	0.022	0.014	1.22	1.10	1.34
Fast Alcohol Screening Test (FAST)	0.265	0.006	1.30	1.08	1.57

B, Beta, sig, significance, OR, Odds Ratio, CI, Confidence Intervals