

ORIGINAL ARTICLE

Need for intensive care in patients admitted for asthma: Red flags from the social history

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ABSTRACT

Background and objective: Asthma deaths in Australia are associated with illicit substance abuse, mental health problems and social issues. However, a large proportion of these deaths occurs out of hospital and is difficult to avert by the time the individuals seek medical attention. We hypothesized that these characteristics may also increase the risk for a patient to require intensive care admission when they present to emergency departments.

Methods: We studied consecutive patients admitted to a tertiary metropolitan hospital with a primary diagnosis of asthma between January 2010 and January 2014. Clinical and demographical data were obtained from chart review. The patient's postcode was used as a surrogate for socioeconomic status.

Results: There were 482 asthma patients admitted during the study period, of which 39 required intensive care. Ten patients admitted to intensive care (26%) used illicit drugs compared with 29 (7%) of those admitted to the ward (adjusted odds ratio: 3.6, $P=0.012$). For illicit users, nonadherence to preventer therapy was associated with an even higher risk of intensive care unit admission. Socioeconomic index was lower in the group requiring intensive care admission. The frequency of psychiatric diagnoses was similar in both groups.

Conclusion: Among patients admitted to hospital for asthma, illicit substance abuse is a strong independent risk factor for intensive care requirement. Preventer therapy nonadherence further increases this risk. Lower socioeconomic status is also associated with increased risk. These historical features should be actively sought on admission and may serve as useful 'red flags' to prompt consideration of intensive monitoring.

Key words: asthma, drug use, exacerbation, intensive care unit, psychiatric illness.

Abbreviations: BMI, body mass index; CI, confidence interval; ICU, intensive care unit; IRSAD, Index of Relative Socioeconomic

SUMMARY AT A GLANCE

We examined social determinants of ICU admissions for asthma exacerbations. Asthma-related ICU admissions were significantly associated with illicit drug use and low socioeconomic status. The association with illicit drug use was further modified by preventer adherence. These historical factors should be systematically elicited at emergency presentations for acute asthma.

Advantage and Disadvantage; OR, odds ratio; SD, standard deviation; SEIFA, Socioeconomic Indexes for Areas.

INTRODUCTION

Asthma exacerbations carry a risk of asthma death. A number of factors may heighten the risk of mortality.¹ In Australia, Goeman *et al.* reported that deaths from asthma were associated with three psychosocial factors: illicit drug use, mental health disorders and socioeconomic disadvantage.¹ Unfortunately, the vast majority of these deaths occurred out of hospital and would have been difficult to avert by the time help was sought.

We hypothesized that patients reaching hospital with acute asthma would have a higher risk of adverse outcomes if they had a history of illicit drug use, psychiatric illness or low socioeconomic status. Such patients might be more likely to require intensive care unit (ICU) admission. Determining the presence of these factors might assist risk stratification and selection of the most appropriate level of monitoring. To test our hypothesis, we conducted a retrospective analysis of asthma admissions at our metropolitan tertiary teaching hospital over a 5-year period.

METHODS

We examined the electronic medical records of all patients admitted to The Alfred Hospital with a primary diagnosis of asthma with International

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Classification of Diseases (ICD) codes PJ45.0 and PJ45.9 from 1 January 2010 to 31 December 2014 (Fig. 1). Ethics approval was obtained from The Alfred Hospital Ethics Committee. The patients were cross-referenced with the hospital ICU database of admissions to ensure that all asthma-related ICU admissions were captured. Patients were excluded if they were discharged directly from the emergency department or if they had a significant comorbid cardiac or respiratory condition (e.g. cystic fibrosis or heart failure). Patients aged less than 16 years were also excluded.

Information was collected from the admission and outpatient notes. Preventer adherence was determined from medical records and pharmacy reconciliation notes. Pulmonary function tests were obtained from the hospital-specific respiratory laboratory database or external results if these were available in the hospital record. The diagnosis of pneumonia was determined by review of the chest radiograph findings and clinical presentation.

Use of illicit drugs was identified from the medical records or correspondence. A psychiatric diagnosis was considered present if a patient had it listed as an active issue in their medical history, were currently prescribed relevant medications based on the medication reconciliation chart or were noted to be under the care of a psychiatrist/psychologist. A patient's socioeconomic status was determined by postcode using the Australian Bureau of Statistics-derived Socioeconomic Indexes for Areas (SEIFA) to provide consistency in assessment. Of the four indexes included in SEIFA, the Index of Relative Socioeconomic Advantage and Disadvantage (IRSAD) takes measures of relative advantage and disadvantage into consideration. The index is centred on a mean of 1000, with a lower value associated with disadvantage in terms of access to resource, income, employment and education.

Statistical analysis

Asthma patients admitted during the study period were divided into two groups: those admitted to the ICU and those admitted to a general ward. Only first admissions were used for patients presenting to

emergency multiple times. Demographical and clinical characteristics of those admitted to the ICU and those admitted to a general ward were compared using *t*-tests for continuous variables and Fisher's exact tests for categorical variables. Univariate logistic regression was used to calculate odds ratios for need for intensive care among patients with a history of illicit substance use, a history of psychiatric disorders and a lower IRSAD (≤ 1000). Multivariate logistic regression was used to examine all risk factors in one model while adjusting for potential confounders: age, gender, current smoking, pneumonia at presentation, previous ICU admission, previous hospital admission in the last 12 months, previous intubation and compliance with preventer therapy. Descriptive data were presented as frequencies and percentages for categorical data and mean (standard deviation (SD)) for continuous variables, and *P*-values < 0.05 were considered statistically significant.

RESULTS

Over the specified 60-month period, there were 482 independent patients accounting for 624 hospital admissions with the primary diagnosis of exacerbation of asthma. Of these, 443 patients were admitted to the ward, and 39 to the ICU on their first admission (Fig. 1).

The baseline characteristics differed between the ICU and ward admission groups (Table 1). Those admitted to ICU were generally younger ($P=0.029$), with a mean age of 37 years ($SD=15.8$) compared with 43 years ($SD=17.9$) in patients requiring ward management alone. There was no difference in gender distribution nor the average body mass index between the ICU and ward groups. Where smoking history was available, there was a higher proportion of patients admitted to ICU being current smokers (51.3% vs 25.3%, $P=0.001$).

Published predictors of ICU admission were analysed, and our cohort was consistent with the previous literature (Table 1). There was no difference in patient-reported adherence to corticosteroid preventer inhalers between groups ($P=1.000$).

Univariate logistic regression results are given in Table 2. The proportion of patients using illicit drugs was significantly higher in ICU admission group (odds ratio (OR) = 4.92, $P<0.001$). Overall, 10/39 (25.6%) of patients requiring ICU admission used illicit substances, compared with 29/443 (6.6%) of those requiring ward management alone. Of the 39 patients admitted to ICU, 7.7% used marijuana compared with 3.4% of ward patients ($P=0.188$), 5.1% used heroin compared with 2.7% of ward patients ($P=0.398$), and 12.8% used other illicit drugs compared with 2.3% ($P=0.001$). The latter category included amphetamines, cocaine and nonprescribed opioids.

Adjusted odds ratios are presented in Table 3. The final model covariates were previous admission in the last 12 months, previous intubation, current smoking and pneumonia at presentation with only pneumonia contributing significantly to the final model (OR = 5.53, $P<0.001$), and the rest retained as confounders. The adjusted OR of admission to ICU among those with substance use was 3.60 (confidence interval (CI): 1.33–9.73, $P=0.012$).

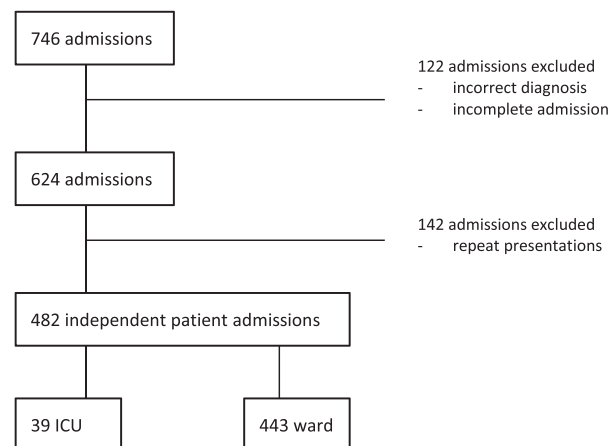


Figure 1 Patient flow.

Table 1 Comparison of baseline characteristics

Characteristic	ICU (<i>n</i> = 39)	Ward (<i>n</i> = 443)	<i>P</i> -value
Age (mean, SD)	37 (15.8)	43 (17.9)	0.029
Gender (% male)	17 (44)	157 (35)	0.385
BMI, mean (SD)	28.37 (7.4) (<i>n</i> = 27)	29.52 (8.0) (<i>n</i> = 200)	0.481
Current smoker (%)	20 (51)	94 (25) (<i>n</i> = 371)	0.001
Previous admission 12 months (%)	9 (23)	49 (11) (<i>n</i> = 430)	0.043
Previous ICU admission (%)	12 (32) (<i>n</i> = 38)	68 (17) (<i>n</i> = 396)	0.046
Previous intubation (%)	7 (18) (<i>n</i> = 38)	23 (6) (<i>n</i> = 396)	0.010
Adherent preventer therapy prior to admission (%)	23 (59)	255 (58) (<i>n</i> = 441)	1.000
X-ray infiltrate on presentation (%)	12 (32) (<i>n</i> = 38)	37 (9) (<i>n</i> = 431)	<0.001
IRSAD mean (SD)	1039 (68)	1059 (56)	0.033

BMI, body mass index; ICU, intensive care unit; IRSAD, Index of Relative Socioeconomic Advantage and Disadvantage; SD, standard deviation.

Table 2 Univariate logistic regression results for the association between substance use, psychiatric diagnosis and Index of Relative Socioeconomic Advantage and Disadvantage, and the outcome admission to intensive care unit

Characteristic	ICU (<i>n</i> = 39)	Ward (<i>n</i> = 443)	Odds ratio	95% CI	<i>P</i> > <i>z</i>
Substance use (%)	10 (26)	29 (7)	4.92	2.19–11.08	<0.001
Psychiatric diagnosis (%)	9 (23)	90 (20)	1.17	0.54–2.56	0.688
IRSAD < 1000 (%)	10 (27)	62 (14)	2.07	0.96–4.46	0.063

CI, confidence interval; ICU, intensive care unit; IRSAD, Index of Relative Socioeconomic Advantage and Disadvantage.

Table 3 Multivariate logistic regression results after adjusting for final model covariates: previous admission in the last 12 months, previous intubation, current smoker and pneumonia at presentation

Characteristic	Odds ratio	95% CI	<i>P</i> > <i>z</i>
Substance use	3.60	1.33–9.73	0.012
Psychiatric diagnosis	0.62	0.24–1.60	0.321
IRSAD < 1000	1.95	0.83–4.56	0.124

CI, confidence interval; IRSAD, Index of Relative Socioeconomic Advantage and Disadvantage.

There was no significant increase in psychiatric diagnoses in the ICU cohort (9/39, 23.1%) compared with the ward (90/443, 20.4%, *OR* = 1.17, *P* = 0.688). There were 9/39 patients admitted to ICU with depression compared with 53/443 in the ward admission group (not significant). A diagnosis of anxiety was recorded in 4/39 ICU patients and 30/443 ward patients (not significant). There was also no significant difference in schizophrenia diagnosis or other psychiatric diagnoses between the two groups. Adjusted for potential confounders, the *OR* was 0.62, *P* = 0.321.

Patients admitted to ICU had a lower mean IRSAD compared with those admitted to the ward (1059 compared with 1039, *P* = 0.03). When comparing IRSAD < 1000 between both groups, the *OR* was trending towards significance at 2.07, *P* = 0.063. This was not significant when adjusted for other covariates (*OR* = 1.95, *P* = 0.124).

In an exploratory analysis, an interaction was found between substance use and adherence to corticosteroid preventers (*P* = 0.022 for interaction). The *OR*

for ICU admission among patients who were not adherent to preventer therapy and used illicit substance(s) was 8.14 (CI: 2.32–28.54, *P* = 0.001) compared with nonadherent patients who did not use illicit substances. The *OR* for ICU admission in substance users reduced to 0.39 (CI: 0.04–4.09, *P* = 0.43) for those adherent to preventer therapy.

DISCUSSION

Our results showed that key aspects of the social history predict an increased need for intensive care among patients admitted for asthma. Firstly, patients with illicit drug use were almost four times as likely to require intensive care. This was significant even after adjustment for known confounders. Secondly, socioeconomic disadvantage also increased the need for intensive care, although this was not a statistically significant risk factor after adjusting for other covariates in our cohort.

Baseline characteristics of patients admitted to ICU versus ward were similar in terms of gender and mean body mass index. Those admitted to ICU were significantly younger, which has previously been documented in near-fatal asthma cases, although this has not been a universal finding across studies.^{2,3} A higher percentage of ICU patients compared with ward patients had radiographical infiltrates. We also confirmed previous findings of a greater need for intensive care among current tobacco smokers who are known to be less responsive to corticosteroids⁴ and those with hospital or intensive care admissions in the prior 12 months.^{5,6}

There was no association with reported adherence to preventer therapy and ICU admission seen in this

study. The literature in this regard is conflicting, with reports of inhaled corticosteroids being associated with both an increased and a decreased risk of ICU admissions.^{7–9} Important biases that may have occurred in this setting include selection, recall, reporting and verification bias.

There was a higher risk of being admitted to ICU in patients who used illicit substances even after adjustment for known confounders. It is likely that substantial illicit substance use may lead to poorer self-management of asthma. Some forms of substance use such as smoking of marijuana or inhalation of amphetamine derivatives might also directly worsen asthma.¹⁰

There was a further doubling of risk (from approximately fourfold to eightfold) among those with illicit drug use who were also nonadherent to inhaled corticosteroids. Because asthma control may be poorer among illicit drug users for a combination of reasons, we postulate that regular preventer use in this population may be more critical and its absence more deleterious.

These findings suggest that elucidating an illicit drug history is of immediate clinical relevance in patients presenting with an exacerbation of asthma and should be systematically elicited. Although there are barriers to this such as time constraints, revelation of substance use provides clinicians with an opportunity to engage with the patients in a discussion about their use and assess their openness to a referral to a drug and alcohol service. Further studies are needed to address the role of individual illicit drugs, route of administration and the role of preventer therapy in the substance use population. Incorporating an illicit drug history into existing asthma management protocols used in many hospitals would prompt clinicians to ask about substance use and provide a structured consistent approach to documentation for future studies.

There was a significantly lower mean IRSAD in the population admitted to ICU. We chose SEIFA as a marker of socioeconomic status due to its consistency and availability across all admissions. Postcodes are insensitive in small cohorts such as ours and poorly discriminatory for an individual's socioeconomic status. Our tertiary hospital has a small geographical catchment area, and subtleties in socioeconomic differences such as standard of living of an individual patient, employment and education level are difficult to capture in a postcode-based system. Despite the potential insensitivity of our methodology, we were still able to detect significant differences between the ICU and ward-admitted patients. Following adjustment for confounders, socioeconomic status was not a significant predictor of intensive care admission, suggesting that it may confer risk through other factors such as the ability to afford medication or delayed emergency presentation.

Goeman *et al.* found an association between psychiatric diagnoses and fatal asthma in Australia.¹ There is evidence that patients with asthma have a higher rate of mental illness than those without asthma,^{11–13} although whether this is causal or not has not been determined. However, in our study, a psychiatric

diagnosis was not significantly associated with admission to the ICU.

Our study is limited by the inherent issues which attend retrospective analyses. Firstly, there were no prespecified criteria for admission to intensive care. Secondly, we were reliant on documented history to verify drug use and psychiatric diagnosis and acknowledge the possibility of reporting bias. Critically unwell patients may be more closely questioned regarding drug use and other medical diagnoses. Thirdly, baseline pulmonary function testing was not included in our analysis as it was available in only 52% of cases.

In summary, our study demonstrates that the social history may yield important red flags to identify high-risk patients requiring intensive care. In particular, illicit drug use and low socioeconomic status should be explicitly sought. The presence of these factors should prompt consideration for more intensive monitoring.

Disclosure statement

This research was presented at the Australasian Society of Clinical Immunology and Allergy (ASCIA) meeting in 2014.

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