An Observational Study of Dyspnea in Emergency Departments: The Asia, Australia, and New Zealand Dyspnea in Emergency Departments Study (AANZDEM)

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ABSTRACT

Objectives: The objective was to describe the epidemiology of dyspnea presenting to emergency departments (EDs) in the Asia-Pacific region, to understand how it is investigated and treated and its outcome.

Methods: Prospective interrupted time series cohort study conducted at three time points in EDs in Australia, New Zealand, Singapore, Hong Kong, and Malaysia of adult patients presenting to the ED with dyspnea as a main symptom. Data were collected over three 72-hour periods and included demographics, comorbidities, mode of arrival, usual medications, prehospital treatment, initial assessment, ED investigations, treatment in the ED, ED diagnosis, disposition from ED, in-hospital outcome, and final hospital diagnosis. The primary outcomes of interest are the epidemiology, investigation, treatment, and outcome of patients presenting to ED with dyspnea.

Results: A total of 3,044 patients were studied. Patients with dyspnea made up 5.2% (3,105/60,059, 95% confidence interval [CI] = 5.0% to 5.4%) of ED presentations, 11.4% of ward admissions (1,956/17,184, 95% CI = 10.9% to 11.9%), and 19.9% of intensive care unit (ICU) admissions (104/523, 95% CI = 16.7% to 23.5%). The most common diagnoses were lower respiratory tract infection (20.2%), heart failure (14.9%), chronic

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obstructive pulmonary disease (13.6%), and asthma (12.7%). Hospital ward admission was required for 64% of patients (95% CI = 62% to 66%) with 3.3% (95% CI = 2.8% to 4.1%) requiring ICU admission. In-hospital mortality was 6% (95% CI = 5.0% to 7.2%).

Conclusion: Dyspnea is a common symptom in ED patients contributing substantially to ED, hospital, and ICU workload. It is also associated with significant mortality. There are a wide variety of causes however chronic disease accounts for a large proportion.

Shortness of breath is the one of the most disturbing symptoms that patients can experience. It is also a common reason for presentation to emergency departments (EDs) and has a wide range of possible causes. It could be an exacerbation of a chronic condition such as asthma, heart failure, chronic lung disease, or liver or kidney failure. It can also be due to an acute condition such as a pneumothorax, chest infection, trauma, or an allergic reaction.[1–4]

Chief complaints often drive patient management algorithms in emergency medicine. Pathways for assessment, investigation, and treatment are often based on a knowledge of the likely disease processes in ED populations. It has previously been recognized there is a shortage of evidence regarding the strength of the association between chief complaints and putative diagnoses and a lack of high-quality, large-scale epidemiologic data specific to ED patient populations.[5] High-quality data could help us better understand how common shortness of breath is as a symptom in the ED patient population, the distribution of causes, what proportion of patients require admission, and whether treatment complies with evidence-based guidelines. Chief complaints may also play a role in patient selection into clinical trials, particularly those of interventions that are performed before diagnoses are confirmed.

In recent years, there has been a preponderance of disease-specific studies. These by their nature exclude patients with significant mixed disease thus excluding a significant proportion of patients. This group may require different therapeutic approaches for optimal outcomes. This information is also important for service planning, training of emergency clinicians, and development of evidence-based care pathways.

Dyspnea has been regarded as a specific symptom —specific to a small group of diseases.[6] In fact it has been asserted that over 90% of all emergency presentations with severe dyspnea will be accounted for by pulmonary and cardiac diseases such as obstructive and infiltrative lung disease, pulmonary embolism, myocardial infarction, or heart failure.[6] Data to support this assertion are scarce.

An unpublished pilot study in Europe found that 53% of patients had a respiratory cause for their symptoms, that 22% had a cardiac cause, and that 15% had both cardiac and respiratory components. Sixty percent were admitted to hospital with 36% discharged from ED (EURODEM pilot study, S. Laribi, personal communication, presented at Mediterranean Emergency Medicine Congress, Marseilles, France, September 2013). The results of that pilot study suggest that patients with dyspnea are a high-risk and complex patient group, that inpatient studies do not assess characteristics or quality of care parameters for about 30% of patients (those discharged from ED), and that there is potential for variation in practice between hospitals/regions. In many ways, the pilot study raised more questions than it answered. Also data were derived solely from Europe where disease distribution and clinical practice may be different from other regions and EDs may be used differently by local populations.

The objective of the Asia, Australia and New Zealand Dyspnea in ED (AANZDEM) study was to describe the epidemiology of dyspnea presenting to EDs in the Asia-Pacific region, to understand how it is investigated and treated and its outcome.

METHODS

The methodology of this study has been published previously.[7] In summary, it was a prospective interrupted time series cohort study conducted at three time points in 46 EDs in Australia, New Zealand, Singapore, Hong Kong, and Malaysia of consecutive adult patients presenting to the ED with dyspnea as a main symptom. Operationally, the decision as to whether dyspnea (shortness of breath) was a main symptom was at the discretion of the assessing clinician. This approach allowed overlap with other clinical features such as chest pain, fever, palpitations, etc.

Data were collected over three 72-hour periods in May, August, and October 2014 (autumn, winter, and spring) and included demographics, comorbidities, mode of arrival, usual medications, prehospital treatment, initial assessment, ED investigations, treatment

in the ED, ED diagnosis, disposition from ED, in-hospital outcome, and final hospital diagnosis. Participating hospitals also provided data on total ED presentations and admissions (ward or intensive care [ICU]) for each data collection window. Depending on local processes, systems, and resources data could be collected prospectively or by chart review or administrative coding. This flexibility was important as sites differed significantly in data collection systems and resources.

The primary outcomes of interest are the epidemiology and outcome of patients presenting to ED with dyspnea. Secondary outcomes were the contribution of dyspneic patients to ED, hospital, and ICU workloads.

Analysis was by descriptive statistics and comparisons of proportions (chi-square). Analyses by age group bracketed patients into four groups: 18–40, 41–60, 61–75, and >75 years. A formal sample size calculation was not performed as this is a descriptive study; however, it was anticipated that data on > 2000 patients will be collected. This was considered adequate data for most of the analysis methods being considered. Reporting complies with the STROBE guidelines.[8]

Human research ethics approvals were obtained for all sites according to local requirements. In most jurisdictions patient consent for data collection was not required. Patient consent was required for some Queensland sites so that part of the data is not consecutive.

Table 1
Patient Characteristics

Variable	Result (Total *N* = 3,044)	Missing data
Age (y)	67 (49–80)	0
Age > 60 y	1,858, 61% (59.3%–62.8%)	0
Sex (male)	1,495, 49.1% (47.4%–51%)	5
Region		
Australia	1,724, 56.6%	0
Singapore	648, 21.3%	0
Hong Kong	339, 11.1%	0
New Zealand	234, 7.7%	0
Malaysia	99, 3.3%	0
Comorbidities		
Hypertension	1,405, 46.4% (44.6%–48.1%)	13
Dyslipidemia	893, 29.5% (27.9%–31.2%)	19
COPD	721, 23.9% (22.3%–25.4%)	21
Ischemic heart disease	708, 23.4% (21.9%–24.9%)	16
Diabetes	697, 23% (21.6%–24.6%)	19
Asthma	685, 22.6% (21.2%–24.2%)	18
Heart failure	522, 17.2% (15.9%–18.6%)	17
Atrial fibrillation	468, 15.5% (14.2%–16.8%)	19
Chronic renal disease	396, 13.1% (11.9%–14.4%)	20
Active smoker	389, 12.9% (11.7%–14.1%)	22
Active malignancy	242, 8% (7.1%–9.1%)	22
Previous pulmonary embolism	86, 2.8% (2.3%–3.5%)	23
None	378, 12.4% (11.3%–13.6%)	0
Arrival mode (ambulance)		
Overall	1,444, 48.5% (46.8%–50.3%)	69
Australia and New Zealand	1,007, 52.6% (50.4%–54.9%)	44
South East Asia	437, 41.2% (38.2%–44.1%)	25
Duration of symptoms (days)	2 (1–7)	107

Data are reported as median (interquartile range); *n*, %; or *n*, % (95% CI).
COPD = chronic obstructive pulmonary disease.

RESULTS

Forty-six EDs contributed data on 3,044 patients. Summary data (admission/discharge and destination) was provided on a further 61 patients from Queensland sites for whom consent for full data collection was not obtained. Thirty-three sites were located in Australia, four in New Zealand, four in Hong Kong, three in Singapore, and two in Malaysia. The study sites have a combined annual ED census of 2,886,178 patients (see Appendix A for full list).

Patient Characteristics

Patient characteristics are summarized in Table 1. Median age was 67 years (interquartile range = 49 to 80 years) with 61% aged > 60 years. Forty-nine percent were male and 48.5% arrived by ambulance. Caucasian ethnicity made up 48.2% with 28.6% of patients of South East Asian ethnicities.

Clinical variables are shown in Table 2. Noteworthy, regarding investigations the vast majority of patients had a chest x-ray (86.1%), serum electrolytes (78.9%), and white cell count (77.8%); however, the analyses of natriuretic peptides (8.3%) and D-dimer (3.5%) were uncommon and CT pulmonary angiography (3.3%) was used uncommonly while lung ultrasonography was rare (0.6%).

Main Diagnosis, Interventions, and Outcome

Main diagnosis, major interventions, and outcome are summarized in Table 3. In 53.9% of cases (1640) clinicians considered the cause of dyspnea to be respiratory, in 20.2% (616) it was considered cardiac in origin, and in 5.8% (177) it was considered to have mixed cardiac and respiratory causation. Causation was considered to be other in 13.8% of cases (420) and in 191 cases (6.3%) it was unknown. The "other" group was very diverse. All had prevalence less than 5% and included chest pain (no specific diagnosis) 4.4%, malignancy (1.8%), anemia (1.5%), allergic reaction (0.9%), nonrespiratory sepsis (1.3%), noncardiorespiratory

Table 2
Clinical Features at Initial Assessment and Main Investigations

Variable	Result (Total *N* = 3,044)	Missing Data
Clinical assessment		
Pulse rate	92 (78–106)	53
Pulse rate > 120 beats/min	323, 10.8% (9.7%–12%)	53
Respiratory rate	22 (18–26)	95
Respiratory rate ≥ 30/min	429, 14.6% (13.3%–15.9%)	95
Systolic BP	136 (120–154)	74
Systolic BP < 100 mm Hg	141. 4.8% (4%–5.6%)	74
Oxygen saturation (air or oxygen) < 90%	350, 11.7% (10.6%–12.9%)	51
Temperature < 35°C or > 38°C	282, 9.7% (8.7%–10.8%)	137
Altered conscious state	75, 2.5% (2%–3.1%)	*
Cyanosis	52, 1.7% (1.3%–2.2%)	*
Peripheral edema	634, 20.8% (19.4%–22.3%)	*
Chest auscultation		152
Normal	1004, 34.7% (33%–36.5%)	
Bilateral crepitations (base or widespread)	912, 31.5% (29.9%–33.3%)	
Wheeze	590, 20.4% (19%–21.9%)	
Localized rhonchi/bronchial breathing	106, 3.7% (3%–4.4%)	
Widespread rhonchi	174, 6.0% (5.2%–7%)	
Other abnormal (e.g., signs of pneumothorax, pleural effusion)	106, 3.7% (3%–4.4%)	
Investigations		
Chest x-ray	2612, 86.1% (84.8%–87.3%)	9
Serum electrolytes	2400, 78.9% (77.4%–80.3%)	*
White cell count	2368, 77.8% (76.3%–79.2%)	*
Troponin assay	1159, 38.1% (36.4%–39.8%)	*
Blood gas (venous or arterial)	963, 31.6% (30%–33.3%)	*
C-reactive protein	934, 30.7% (29.1%–32.3%)	*
Lactate	734, 24.1% (22.6%–25.7%)	*
Natriuretic peptides (BNP or Pro-NT BNP)	253, 8.3% (7.4%–9.3%)	*
D-dimer	106, 3.5% (2.9%–4.2%)	*
CT pulmonary angiography	100, 3.3% (2.7%–4%)	9
Procalcitonin	28, 0.9% (0.6%–1.3%)	*
Ventilation-perfusion scan	20, 0.7% (0.4%–1%)	9
Lung ultrasound	17, 0.6% (0.4%–0.9%)	9

Data are reported as median (interquartile range) or *n,* % (95% CI).
*For these items the data dictionary specified that not recorded would be treated as absent.
BP = blood pressure.

fluid congestion for example liver or kidney failure (2.3%), upper respiratory tract infection (2.4%), and non–CAD-related cardiac disease, e.g., pericardial effusion, pericarditis (0.9%). There was heterogeneity in diagnoses by age and sex ($p < 0.001$ for both analyses; Table 4), with asthma being much more common in the young and heart failure and chronic obstructive pulmonary disease (COPD) in older patients.

Hospital ward admission was required for 64% (95% CI = 62% to 66%) with 3.3% (95% CI = 2.8% to 4.1%) requiring ICU admission. In-hospital mortality was 6% (95% CI = 5.0% to 7.2%). The characteristics of patients who died are shown in Table 5. The most common diagnoses of those who died were lower respiratory tract infection (50%), cardiac failure (15%), and COPD (14%).

Contribution to ED and Hospital Workload

During the data collection periods, there were a total of 60,059 ED attendances of which patients with dyspnea made up 5.2% (3,105/60,059, 95% CI = 5.0% to 5.4%). Patients with dyspnea accounted for 11.4% of all ward admissions from ED (ED observation unit admissions excluded; 1,956/17,184, 95% CI = 10.9% to 11.9%) and 19.9% of all ICU admissions from ED (104/523, 95% CI = 16.7% to 23.5%).

There was seasonal variation in ED presentations and ward admissions. Patients with dyspnea accounted for a higher proportion of ED presentations and ward admissions in winter (5% vs. 5.9% vs. 4.6% and 10.8% vs. 12.9% vs. 10.4% in autumn, winter, and spring, respectively, $p < 0.001$ for both; omnibus chi-square); however, the proportion of ICU admissions did not change with the seasons ($p = 0.46$).

DISCUSSION

Our study found that dyspnea is a common reason for presentation to ED and that these patients make up approximately 10% of ward admissions and 20% of ICU admissions making them a high consumer of acute healthcare resources. We also demonstrated

Table 3
Diagnoses, Major Interventions, and Outcome

Variable	Result (Total *N* = 3,044)	Missing Data
ED main diagnosis		
Lower respiratory tract infection	616, 20.2% (18.9%–21.7%)	0
Heart failure	459, 15% (13.9%–16.4%)	0
COPD	415, 13.6% (12.5%–14.9%)	0
Asthma	387, 12.7% (11.6%–13.9%)	0
Acute coronary syndrome	94, 3.1% (2.5%–3.8%)	0
Arrhythmia (including AF with rapid ventricular response)	78, 2.6% (2.1%–3.2%)	0
Pleural effusion	67, 2.2% (1.7%–2.8%)	0
Pulmonary embolism	35, 1.2% (0.8%–1.6%)	0
Pneumothorax	27, 0.9% (0.6%–1.3%)	0
Hyperventilation	89, 2.9% (2.4%–3.6%)	0
Other	695, 22.8% (21.4%–24.4%)	0
No clear diagnosis in ED	86, 2.8% (2.3%–3.5%)	0
Main interventions		
Oxygen (any delivery mode)	1485, 48.8% (47%–50.6%)	0
Noninvasive ventilation	145, 4.8% (4.8%–5.6%)	0
Mechanical ventilation	18, 0.6% (0.4%–1%)	24
Inhaled beta-agonists	1019, 33.7% (32%–33.4%)	16
Antibiotics	938, 31% (29.4%–32.7%)	18
Corticosteroids (oral or IV)	762, 25.2% (23.7%–26.8%)	16
IV diuretics	468, 15.5% (14.2%–16.8%)	17
Rate/rhythm control agents	121, 4% (3.4%–4.8%)	20
Inotropes/vasopressors	24, 0.8% (0.5%–1.2%)	21
Outcome		
Deaths in ED	13, 0.4% (0.3%–0.7%)	4
Admitted to hospital (including ICU admissions and transfers for admission but not including ED short-stay wards/units)	1946, 64% (62%–66%)	4
Admission to ICU	103, 3.3% (2.8%–4.1%)	4
Mortality (admitted patients only)	112, 6% (5.0%–7.2%)	0
Length of stay for admitted patients (d)	5, 3–8	2

Data are reported as *n,* % (95% CI) or n (interquartile range).
AF = atrial fibrillation; COPD = chronic obstructive pulmonary disease; ICU = intensive care unit.

season variation in the contribution to ED and ward workload without a seasonal impact on ICU admissions. The most common diagnoses were lower respiratory tract infection, heart failure, COPD, and asthma with approximately 6% considered to have mixed cardiac and respiratory disease. Importantly, in about 20% of cases an unknown cause or cause other than cardiac or respiratory disease was found.

This study took an unusual perspective, that of the patient's symptom (shortness of breath) rather than a single disease. This is important because patients do not come to ED with diagnostic labels and it is the role of ED clinicians to determine the likely cause, its severity, and appropriate treatment. Chief complaints drive assessment and treatment algorithms and robust knowledge of the distribution of diagnoses is important to inform these. A limited study investigating diagnoses and outcome of ED patients with dyspnea was reported by Mockel et al.;[5] however, to our knowledge, this is the first study of this type reporting causes for dyspnea in a Southeast Asia and Australasian cohort and the contribution of patients with this symptom to ED and hospital caseload. The wealth of data paves the way for similar studies of important other symptoms/symptom complexes to inform ED care and planning.

Dyspnea has been defined by the American Thoracic Society[9] as "mismatch between central respiratory motor activity and incoming afferent information from receptors in the airways, lungs and chest wall structures." From the patient's point of view it is a subjective experience—a sensation of difficult or uncomfortable breathing and as such involves a degree of cognitive interpretation. Thus the degree of perceived dyspnea may not match physical findings. Its classification is complex but can be thought of as obstructive (e.g., asthma and COPD), parenchymal (e.g., heart failure or pneumonia), circulatory (e.g., pulmonary embolism), compensatory (e.g., anemia or metabolic acidosis), or other (including anxiety).[10] The relative contributions of these classifications in ED practice has been unclear. Our study found that lower respiratory tract infection, heart failure, COPD, and asthma were the most common diagnoses. The proportion diagnosed with COPD and heart failure are similar to that reported by Mockel et al.[5] but the rates of lower respiratory tract infection (20% vs. 9%) and

Table 4
Diagnosis by Age Group

	Age group (years)														
	18–40			41–60			61–75			>75			Overall		
ED Diagnosis	Male (*n* = 218)	Female (*n* = 275)	Total (*n* = 493)	Male (*n* = 350)	Female (*n* = 339)	Total (*n* = 690)*	Male (*n* = 480)	Female (*n* = 377)	Total (*n* = 817)	Male (*n* = 487)	Female (*n* = 552)	Total (*n* = 1,041)†	Male (*n* = 1,495)	Female (*n* = 1,544)‡	Total (*n* = 3,044)
Lower respiratory tract infection	24 (11)	44 (16)	68 (14)	66 (19)	50 (15)	116 (17)	101 (21)	70 (19)	171 (21)	135 (28)	126 (23)	261 (25)	326 (22)	290 (19)	616 (20)
Heart failure	6 (3)	3 (1)	9 (2)	29 (8)	18 (5)	48 (7)	76 (16)	57 (15)	133 (16)	116 (24)	149 (27)	265 (25)	227 (15)	225 (15)	459 (15)
COPD	1 (0.5)	0	1 (0.2)	31 (9)	31 (9)	62 (9)	111 (23)	63 (17)	174 (21)	106 (22)	72 (13)	178 (17)	249 (17)	166 (11)	415 (14)
Asthma	67 (31)	92 (33)	159 (32)	57 (16)	79 (23)	136 (20)	20 (4)	35 (9)	55 (7)	10 (2)	26 (5)	36 (3)	154 (10)	232 (15)	387 (13)
ACS	0	1 (0.4)	1 (0.2)	17 (5)	11 (3)	28 (4)	15 (3)	12 (3)	27 (3)	16 (3)	21 (4)	38 (4)	48 (3)	45 (3)	94 (3)
Arrhythmia	5 (2)	4 (2)	9 (2)	10 (3)	5 (1)	15 (2)	16 (3)	12 (3)	28 (3)	8 (2)	18 (3)	26 (3)	39 (3)	39 (3)	78 (3)
Pulmonary embolism	2 (0.9)	2 (0.7)	4 (0.8)	3 (0.9)	9 (3)	12 (2)	5 (1)	9 (2)	14 (2)	1 (0.2)	4 (0.7)	5 (0.5)	11 (0.7)	24 (2)	35 (1)
Pleural effusion	0	2 (0.7)	2 (0.4)	7 (0.2)	7 (2)	14 (2)	11 (2)	13 (3)	24 (3)	10 (2)	17 (3)	27 (3)	28 (2)	39 (3)	67 (2)
Pneumothorax	13 (6)	5 (2)	18 (4)	5 (0.1)	0	5 (0.7)	2 (0.4)	0	2 (0.2)	1 (0.2)	1 (0.2)	2 (0.2)	21 (1)	6 (0.4)	27 (0.9)
Hyperventilation	13 (6)	29 (11)	42 (9)	13 (4)	12 (4)	25 (4)	2 (0.4)	11 (3)	13 (2)	1 (0.2)	7 (1)	8 (0.8)	29 (2)	60 (4)	89 (3)
Malignancy	0	0	0	3 (0.9)	5 (1)	8 (1)	11 (2)	5 (1)	16 (2)	6 (1)	7 (1)	14 (1)	20 (1)	17 (1)	38 (1)
Anemia	2 (0.9)	4 (2)	6 (1)	2 (0.6)	2 (0.6)	7 (1)	6 (1)	9 (2)	15 (2)	4 (0.8)	12 (2)	16 (2)	14 (0.9)	30 (2)	44 (1)
Chest pain (no cause found)	20 (9)	20 (7)	40 (8)	35 (10)	22 (6)	57 (8)	16 (3)	21 (6)	37 (5)	8 (2)	16 (3)	24 (2)	79 (5)	79 (5)	158 (5)
Allergy	7 (3)	7 (3)	14 (3)	4 (1)	7 (2)	11 (2)	1 (0.2)	0	1 (0.1)	1 (0.2)	1 (0.2)	2 (0.2)	13 (0.9)	15 (1)	28 (0.9)
Other	58 (27)	62 (23)	120 (24)	68 (19)	81 (24)	149 (22)	87 (18)	60 (16)	147 (18)	64 (13)	75 (14)	139 (13)	237 (16)	277 (18)	514 (17)

Data are reported as *n* (%).
*One patient no recorded sex.
†Two patients no recorded sex.
‡Five patients no sex; three no age.
ACS = acute chest syndrome; COPD = chronic obstructive pulmonary disease.

Table 5
Characteristics of Patients Who Died During Hospital Stay

Variable	Result	Missing Data
Age (y), median (±SD)	67 (±20)	0
Sex		1
Male	68, 54% (46%–63%)	
Female	56, 45% (37%–54%)	
ED disposition		0
General ward	100, 80% (72%–86%)	
ICU/HDU	12, 10% (6%–16%)	
Died in ED	13, 10% (6%–17%)	
Final hospital diagnosis		0
Lower respiratory tract infection	50, 40% (32%–49%)	
Cardiac failure	19, 15% (10%–23%)	
COPD and chronic lung disease	17, 14% (9%–21%)	
Malignancy	9, 7% (4%–13%)	
Fluid congestion	6, 5% (2%–10%)	
Acute coronary syndrome	5, 4% (2%–9%)	
Nonrespiratory sepsis	4, 3% (1%–8%)	
Pleural effusion	4, 4% (1%–8%)	
Pulmonary embolism	2, 2% (0.4%–6%)	
Other	9, 7% (4%–13%)	

Data are reported as *n*, % (95% CI) unless otherwise specified.
COPD = chronic obstructive pulmonary disease; HDU = high dependency unit.

asthma (12% vs. <2%) are much higher. With respect to lower respiratory tract infection, the difference may be accounted for by varying study definitions. This is unlikely to be the case for asthma where a difference in disease prevalence is the more likely explanation.

Surprisingly, "other" (including unknown) was also very common accounting for approximately 29% of diagnoses. This is an important finding—a reminder that the causes of shortness of breath are legion and that careful clinical assessment is required to discern the cause.

The finding that most patients are older (more than 60% aged > 60 years) is not surprising as the chronic conditions associated with dyspnea including COPD, heart failure, and acute coronary syndrome become more common with age. Mockel et al.[5] found a very similar age range. The high rate of comorbidity is noteworthy. Only 12% of patients did not have a significant comorbidity. The fact that the comorbidities prominently include cardiac and respiratory chronic illnesses and risk factors for coronary heart disease partly explains why clinicians considered mixed pathology likely in a significant proportion of patients.

The finding that patients with dyspnea made up just over 5% of ED caseload is at variance with other reports. A study of the US National Hospital Ambulatory Medical Care Survey (NHAMCS) reported that 0.9%–3.8% of ED attendances had a major complaint of shortness of breath and that the rate was highest in those aged 65 or older.[11] In a German study 7.4% (95% CI = 7.1% to 7.7) of presenters to two EDs had a main complaint of dyspnea.[5] The differences may be due to how populations in United States, Europe, and our study cohort use ED and alternative health services. In Australia and New Zealand, for example, there is universal health cover and access to ED and many family practitioners is free. That said, when considered together, these data suggest that in developed countries, dyspnea accounts for of the order of one in 20 ED patients. Admission rate was high (64%), which is similar to the proportion reported in a European study.[5]

The three chronic conditions (heart failure, COPD and asthma) accounted for more than 40% of cases. These data point to the importance of chronic disease management in reducing exacerbations of these conditions and associated hospital-based treatment. Lower respiratory tract infection, cardiac failure, and COPD accounted for almost 70% of in-hospital deaths with no deaths reported for asthma. This reinforces the high mortality for lower respiratory tract disease, especially in elderly patients with comorbidity. Mortality was lower than that reported by Mockel at al.[5] (6% vs. 9.4%) as was the rate of ICU admission (3% vs. 18%). Reasons for these differences are unclear. Heterogeneity of diagnoses by age and sex has also been reported from U.S. data.[11] While the proportion of lower respiratory tract diagnosis was not statistically significant across the age groups, asthma was prominent in the young and decreased with age while COPD and heart failure diagnoses were uncommon in the young and increased with age. These finding are consistent with the pathology of the conditions.

The "other" group, all individually with low prevalence, contained some interesting findings. They were very diverse including allergic reactions, nonrespiratory sepsis, noncardiorespiratory fluid congestion for example liver or kidney failure, upper respiratory tract infection, and anemia. Mockel et al.[5] also reported septicemia and renal failure to be uncommon but important causes of dyspnea. This is further reminder of the diversity of causes of dyspnea and the need for a broad diagnostic net.

A significant subset of patients had clinical markers of serious illness such as significant tachycardia (10.8%) or tachypnea (14.5%), low oxygen saturation (11.7%), or fever (9.7%), although hypotension was uncommon (4.7%). This is as was expected as ED is a major point of access for patients with acute severe illness.

The high use of chest x-ray is unsurprising given the high proportion of cardiac or respiratory causes for dyspnea. It has been the standard test for many years although accuracy of chest x-ray for diagnosis of heart failure and pneumonia is suboptimal.[12,13] Use of advanced imaging to investigate for pulmonary embolism was uncommon (4%) with a diagnostic yield of just over 25%. This is in stark contrast to U.S. studies that report a diagnostic yield of approximately 10%.[14,15] Whether this reflects differences in adherence to diagnostic algorithms guiding advanced imaging or under investigation is unclear. Despite growing evidence of its accuracy and utility,[13,16] lung ultrasound was uncommonly used in our cohort. Reasons may include that this is an emerging technology and not yet widely accepted and small numbers of clinicians trained in its use. We would expect use of this bedside imaging modality to increase in the future. Use of other tests was roughly concordant with the distribution of final diagnoses. A notable exception is the use of natriuretic peptide analysis which is significantly lower than the proportion of patients with an ED diagnosis of heart failure. Our study was not designed to assess reasons for this; however, they may include difficulties accessing the test in a timely manner, local hospital protocols, and persisting belief among emergency clinicians that they are useful with respect to ED management only in selected cases of ongoing diagnostic uncertainty.

These data have important implications for physician education. Currently, emergency clinicians develop their understanding of the breadth of causes of dyspnea (other than cardiac or respiratory) and the complexity of management in patients with comorbidity through clinical education and experience. These data prove that important information to inform less experienced emergency clinicians, clinicians outside ED, and those responsible for education of trainee specialists of the complexity of the diagnosis and management of these patients. While sometimes considered a lower level of evidence, descriptive data forms an important element of the body of evidence and an important basis for future research questions. Given the paucity of data regarding dyspnea in ED, these descriptive data provide an important platform for further research especially into diagnosis and management of mixed cardiorespiratory disease.

Our study has some limitations that should be considered when interpreting its results. The study sites were located in the South East Asia/Australasia geographical area and may not be generalizable to other regions. There may also be differences in health care access (in particular cost of attending an ED) between our cohort and those from other regions that influence how local populations use EDs and what types of illness present to them. The diagnostic categories were based on the treating ED clinician's judgment based on information available in the ED. It is possible that, with the availability of additional information obtained during hospital admission, the final hospital diagnosis may have been different. This, however, represents the "real world" of emergency medicine practice. We were unable to assess patient severity (e.g., by triage scores) as quite different triage systems are used in the participating countries. There is a modest amount of missing data for some data items that may have influenced the results.

CONCLUSION

Dyspnea is a common symptom in ED patients contributing substantially to ED, hospital, and ICU workload. It is also associated with significant mortality. There are a wide variety of causes; however, chronic disease accounts for a large proportion with implications for care planning, including ED pathways of care.

APPENDIX A

AANZDEM STEERING COMMITTEE

Anne Maree Kelly (Chair), Gerben Keijzers (Vice-chair and Queensland), Simon Craig (Victoria), Colin Graham (Hong Kong), Anna Holdgate (NSW), Peter Jones (New Zealand), Win Sen Kuan (Singapore), and Said Laribi (France).

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