Epidemiology of patients presenting with dyspnea to emergency departments in Europe and the Asia-Pacific region

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Objective The primary objective of this study was to describe the epidemiology and management of dyspneic patients presenting to emergency departments (EDs) in an international patient population. Our secondary objective was to compare the EURODEM and AANZDEM patient populations.

Patients and methods An observational prospective cohort study was carried out in Europe and the Asia-Pacific region. The study included consecutive patients presenting to EDs with dyspnea as the main complaint. Data were collected on demographics, comorbidities, chronic treatment, clinical signs and investigations, treatment in the ED, diagnosis, and disposition from ED.

Results A total of 5569 patients were included in the study. The most common ED diagnoses were lower respiratory tract infection (LRTI) (24.9%), heart failure (HF) (17.3%), chronic obstructive pulmonary disease (COPD) exacerbation (15.8%), and asthma (10.5%) in the overall population. There were more LRTI, HF, and COPD exacerbations in the EURODEM population, whereas asthma was more frequent in the AANZDEM population. ICU admission rates were 5.5%. ED mortality was 0.6%. The overall in-hospital mortality was 5.0%. In-hospital mortality rates were 8.7% for LRTI, 7.6% for HF, and 5.6% for COPD patients.

Conclusion Dyspnea as a symptom in the ED has high ward and ICU admission rates. A variety of causes of dyspnea were observed in this study, with chronic diseases accounting for a major proportion. *European Journal of Emergency Medicine* 26: 345–349 Copyright © 2018 Wolters Kluwer Health, Inc. All rights reserved.

Introduction

Dyspnea is one of the main complaints of patients presenting to the emergency department (ED) [1]. In the United States, dyspnea accounts for three to four million ED visits annually [2,3], representing up to 50% of patients admitted to acute tertiary care hospitals [4,5]. In the Asia-Pacific region, it accounts for 5% of all ED presentations [6]. Diagnosis and treatment of the underlying cause of dyspnea is the most efficient approach

to improve symptoms. However, establishing accurate diagnoses for ED dyspneic patients remains challenging. The sensitivity of the clinical signs associated with this symptom is low, especially in an aging population and the variety of underlying diseases [7–10].

Little is known about the etiology, epidemiology, and outcome of dyspneic patients presenting to the EDs worldwide. Understanding patient characteristics, the range of diagnoses, outcome, and regional differences could help improve emergency care of affected patients.

Therefore, the primary objective of this study was to describe the epidemiology and management of dyspnea patients presenting to EDs in an international patient population. Our secondary objective was to compare the EURODEM and AANZDEM patient populations.

Patients and methods
Study design
This is a combination of two international, multicenter, prospective, observational, cohort studies. They were designed to evaluate the epidemiology and outcomes of patients presenting to the ED with dyspnea as the main complaint. The EURODEM study (NCT02060799) was carried out in 66 European EDs in Belgium ($n = 3$), Finland ($n = 5$), France ($n = 5$), Germany ($n = 5$), Italy (n 1), the Netherlands ($n = 16$), Romania ($n = 7$), Spain ($n = 1$), Turkey ($n = 7$), and UK ($n = 16$). The AANZDEM study was carried out in 46 Asia-Pacific centers in Australia ($n = 33$), New Zealand ($n = 4$), Singapore ($n = 3$), Hong Kong ($n = 4$), and Malaysia ($n = 2$). The study sample was generated with consecutive patients attending EDs during three study periods of 72 h throughout 1 year [6,11]. European centers recruited patients during 3 consecutive days in February, May, and October 2014, whereas inclusion dates for Australasian centers were in May, August, and November. These dates were chosen to represent different seasons (autumn, winter, and spring) in each region.

Patient population
Consecutive adult patients (≥18 years) presenting to the ED with acute dyspnea as the main symptom were included. The study was carried out in accordance with the Declaration of Helsinki. Ethics committee approvals were obtained for all sites according to local requirements. If requested by the local ethics committee, patient consent for data collection was obtained.

Study variables
A specifically designed data collection form was developed by each steering committee (see Annex). Data collected included patient characteristics, comorbidities, mode of arrival, usual medications, prehospital treatment as documented in ED clinical records, initial assessment (clinical assessment and vital signs), investigations performed (laboratory tests, ECG, imaging, etc.) and results, treatment in the ED, ED diagnosis (diagnosis after ED management), outcome after the ED including disposition, in-hospital outcome, and final hospital diagnosis.

Outcomes of interest
The primary outcome of interest was the proportion of patients in each etiologic category of dyspnea, their management at the ED, and in-hospital mortality. Our secondary objective was to compare the characteristics of European patients' (EURODEM study) with those of the Asia-Pacific region (AANZDEM study).

Statistical analysis
Results are presented as frequencies for qualitative variables and as mean (SD) or medians with interquartile range for quantitative variables depending on the distribution. The χ^2-test was used to compare categories. The means of continuous variables were compared using the t-test (parametric) and the Wilcoxon test (nonparametric). Statistical significance was defined as P less than 0.05. Statistical analysis was carried out using SAS version 9.1 software (SAS Institute, Cary, North Carolina, USA).

Results
Patient characteristics
A total of 5569 patients were included in the study. Patient characteristics are summarized in Table 1. The median age of the patients was 68 (51–80) years and nearly half of the cohort were male. In approximately half of all cases, emergency physicians considered the cause of dyspnea to be of pulmonary origin and in a quarter of cases, the cause of dyspnea was considered to be of cardiac origin. The most common ED diagnoses were lower respiratory tract infection (LRTI) (24.9%), heart failure (HF) (17.3%), chronic obstructive pulmonary disease (COPD) exacerbation (15.8%), and asthma (10.5%). A substantial proportion of patients had diagnoses other than the ones listed.

The most frequent comorbidities were hypertension (46.9%), COPD (27.3%), and diabetes mellitus (23.0%). About half of the patients presented to the ED by ambulance (49.3%).

Vital and clinical signs at admission are summarized in Table 2. Of all patients, 4.3% presented with confusion, 28.1% had signs of peripheral edema, and 77.9% had abnormalities at lung auscultation (rales, wheezing, or ronchi). A proportion of patients presented with vital signs, indicating a severe clinical condition: 10% had tachycardia (heart rate >120 bpm/min), 13.6% had oxygen saturation below 90%, and 4.7% were hypotensive (systolic blood pressure <100 mmHg).

Table 1 Patient characteristics

	Total [n (%)]	AANZDEM [n (%)]	EURODEM [n (%)]	P value	OR (95% CI)
N (%)	5569	3044 (54.7)	2525 (45.3)		
Age (median [Q1–Q3]) (years)	68 (51–80) missing data *n*=25	67 (49–80)	69 (53–80)	0.01	
Male	2719 (49.0) missing data *n*=21	1495 (49.2)	1224 (48.8)	NS	1.02 (0.91–1.13)
ED diagnoses					
Lower respiratory tract infection	1389 (24.9)	616 (20.2)	773 (30.6)	<0.001	0.58 (0.51–0.65)
Heart failure	962 (17.3)	455 (14.9)	507 (20.1)	<0.001	0.63 (0.55–0.73)
COPD exacerbation	882 (15.8)	415 (13.6)	467 (18.5)	<0.001	0.70 (0.60–0.81)
Asthma	584 (10.5)	387 (12.7)	197 (7.8)	<0.001	1.52 (1.27–1.82)
Other	2022 (36.3)	1171 (38.5)	851 (33.7)	<0.001	1.24 (1.10–1.38)
Comorbidities					
Chronic heart failure	1102 (20.5) missing data *n*=196	522 (17.2)	580 (24.7)	<0.001	0.63 (0.55–0.73)
Diabetes mellitus	1246 (23.0) missing data *n*=149	697 (23.0)	549 (22.9)	NS	1.01 (0.89–1.14)
Hypertension	2541 (46.9) missing data *n*=152	1405 (46.4)	1136 (47.6)	NS	0.95 (0.85–1.06)
Atrial fibrillation/flutter	873 (16.1) missing data *n*=157	468 (15.5)	405 (17.0)	NS	0.90 (0.77–1.04)
COPD	1477 (27.3) missing data *n*=164	721 (23.9)	756 (31.7)	<0.001	0.67 (0.60–0.76)
Smoker	935 (17.9) missing data *n*=336	389 (12.9)	546 (24.7)	0.001	0.45 (0.39–0.52)
Asthma	1117 (20.6) missing data *n*=143	685 (22.6)	432 (18.0)	0.03	1.33 (1.16–1.53)

CI, confidence interval; COPD, chronic obstructive pulmonary disease; ED, emergency department; OR, odds ratio.

Table 2 Clinical signs at admission

	Total [n (%)]	AANZDEM [n (%)]	EURODEM [n (%)]	P value	OR (95% CI)
Vital signs at admission					
SBP [median (Q1–Q3)] (mmHg)	135 (120–154) missing data *n*=138	136 (120–154)	135 (120–153)	0.21	
SBP <100 mmHg	257 (4.7)	141 (4.7)	116 (4.7)	0.01	1.01 (0.78–1.31)
Heart rate [median (Q1–Q3)] (bpm)	90 (77–106) missing data *n*=115	92 (78–106)	89 (77–105)	<0.001	
Heart rate >120 bpm	547 (10.0)	323 (10.8)	224 (9.1)	0.04	1.21 (1.01–1.45)
Respiratory rate [median (Q1–Q3)] (cycles/min)	21 (18–26) missing data *n*=566	22 (18–26)	20 (18–26)	<0.001	
Respiratory rate >30 cycles/min	550 (11.0)	334 (11.3)	216 (10.5)	NS	1.09 (0.90–1.31)
SpO$_2$ <90%	685 (13.9) missing data *n*=652	308 (12.3)	377 (15.7)	NS	0.75 (0.64–0.89)
Temperature <35 or >38°C	477 (9.2) missing data *n*=392	282 (9.7)	195 (8.6)	NS	1.14 (0.94–1.39)
Clinical signs at admission					
Confusion	237 (4.3) missing data *n*=96	75 (2.5)	162 (6.6)	<0.001	0.36 (0.27–0.48)
Rales	1953 (37.4) missing data *n*=346	912 (31.5)	1041 (44.7)	<0.001	0.57 (0.51–0.64)
Wheezing	1220 (24.0) missing data *n*=496	590 (20.4)	630 (28.9)	<0.001	0.63 (0.55–0.72)
Rhonchi	826 (16.5) missing data *n*=571	280 (9.7)	546 (25.9)	<0.001	0.31 (0.26–0.36)

CI, confidence interval; OR, odds ratio; SBP, systolic blood pressure; SpO$_2$, saturation level of oxygen in hemoglobin determined by pulse oximetry.

Management and outcomes

The initial ED investigations are summarized in Supplementary Table 1 (Supplemental digital content 1, *http://links.lww.com/EJEM/A226*). Supplementary Table 2 (Supplemental digital content 1, *http://links.lww.com/EJEM/A226*), describes the treatment modalities at the EDs. The most commonly used medical therapies were inhaled β2 agonists (35.6%), antibiotics (29.5%), and corticosteroids (23.7%).

Nearly two-thirds of the total study population were hospitalized after initial care at the ED. 5.5% of patients were admitted to the ICU and 0.6% died in the ED. The overall in-hospital mortality rate was 5.0%. In-hospital mortality rates were 8.7% for LRTI, 7.6% for HF, and 5.6% for COPD patients.

Regional differences

The EURODEM patient population was slightly older than the AANZDEM cohort, median age 69 (53–80) years versus 67 (49–80) years (*P*=0.01).

There were more LRTI, HF, and COPD exacerbations in the EURODEM population, whereas asthma was more frequent in the AANZDEM population. EURODEM patients more often had a previous history of chronic HF, COPD, smoking, and cognitive dysfunction.

A higher ward admission rate was observed in Asia-Pacific than in Europe (60.6 vs. 56.4%, *P*<0.01). However, the proportions of ED deaths (0.9 vs. 0.4%, *P*=0.03) and ICU admissions (8.4 vs. 3.4%, *P*<0.001) were higher in the EURODEM cohort. In-hospital mortality was also significantly higher in EURODEM compared with the AANZDEM cohort (6.5 vs. 4.1%, *P*<0.001).

Discussion

This study describes the epidemiology and contemporaneous management of dyspnea in EDs in Europe and the Asia-Pacific region. Our results confirm that patients presenting to the ED with dyspnea represent a diverse and complex group. The most common causes of dyspnea in the ED were LRTI, decompensated (or acute) HF, COPD exacerbations, and asthma. The high proportion of 'other' diagnoses (including unknown) is somewhat surprising and a salient reminder that the causes of dyspnea are legion and that a careful clinical assessment

is required to differentiate between them. Importantly, our study shows that dyspneic patients require immediate and high-quality care as the majority are admitted to hospital with frequent admissions to intensive care units [12,13]. This study emphasizes the challenges that ED physicians face while striving for accurate and prompt diagnosis and treatment.

The most common diagnoses of dyspnea at the ED were LRTI, HF, COPD exacerbation, and asthma. Our results seem to be in agreement with previous studies: Bilben *et al*. [14] observed that COPD, cardiac failure, and pneumonia accounted for symptoms in 29, 24, and 22% of dyspneic ED patients, respectively. Even though lung and heart diseases were the main causes of dyspnea in the ED, it seems that a pulmonary origin (infection, COPD, and asthma combined) was twice as common than a cardiac origin of dyspnea. This finding might help guide emergency physicians in cases where it is difficult to differentiate between both causes.

The results of our study show a diverse clinical profile of dyspneic patients at the ED in Europe compared with the Asia-Pacific region. Dyspneic ED patients were mostly elderly, with 25% of patients being older than 80 years. There is no sex predilection for this symptom. As expected in an elderly population, patients presented with many comorbidities. These concomitant illnesses can make it difficult to ascertain the specific diagnosis on the basis of clinical presentation in patients with dyspnea, and patients may have mixed disease contributing toward the dyspnea.

In both cohorts, a significant proportion of patients presented with clinical signs suggesting a critical condition: tachycardia (10%), tachypnea (11%), low oxygen saturation (14%), and hypotension (5%). Therefore, high hospital admission rates as well as ICU admission and in-hospital death were in line with disease severity.

Our study confirms that dyspnea is a high-risk condition for in-hospital mortality. We report an in-hospital mortality of 5.0%, which is similar to previously reported mortality rates in acute HF [15], community-acquired pneumonia [16], and COPD exacerbations [17].

Our study shows that there were more ED deaths and ICU admissions in the EURODEM cohort. In-hospital mortality was also higher in Europe. This could be because of the increased frailty of EURODEM patients, suggested by their older age, higher rates of cognitive dysfunction, and pre-existing chronic conditions. Differences in primary care provision might also account for these disparities.

Our study has an important clinical impact for emergency physicians. It shows that acute management of dyspneic patients can be improved. It also highlights the need for an appropriate discharge analysis as dyspnea at the ED was associated with a risk of ICU admission as well as in-hospital death. Our study also showed that in the majority of cases, acute dyspnea was caused by an exacerbation of a pre-existing chronic condition. This emphasizes the importance of chronic disease management in primary care and outpatient settings as preventing exacerbations of chronic HF or COPD could possibly reduce the burden of frequent ED visits and recurrent hospitalizations.

Future research should be directed at understanding the source of the heterogeneities in patient characteristics as well as management differences between regions. Subsequent analyses are planned on subpopulations of the EURODEM and AANZDEM studies by etiology of dyspnea. Future projects will include a more precise description of the four most frequent diseases causing dyspnea. We are also aiming to identify differences between the current real-life management of these diseases and treatment guidelines.

Limitations

Our study has several limitations. As this was a multi-center registry, it should be taken into account that some centers recorded data differently than others. There was also no central committee for the establishment of final diagnosis or the appropriateness of administered treatment. One of the limitations of this work is that in the EURODEM study, more than one diagnosis per patient could be included, whereas in the AANZDEM study, only the principal diagnosis was collected. However, the study sample is large and presents all comers, suggesting generalization of findings. Moreover, local data collectors had the possibility to contact the coordinating center if they had any queries on data collection, therefore minimizing bias. There is also a certain amount of missing data that may have influenced results.

Conclusion

In summary, dyspneic patients represent a heterogeneous group with a wide variety of clinical profiles and etiologies of dyspnea in both hemispheres. The population affected by this symptom is mostly elderly and have high rates of comorbidities. Exacerbations of chronic diseases such as HF and COPD account for a large proportion of dyspneic patients. Dyspnea at the ED was associated with a high rate of ward admission as well as suboptimal short-term outcomes. Our study also showed that the EURODEM patients were more ill than AANZDEM patients, presenting with more comorbidities and higher rates of ICU admission and hospital death.

Acknowledgements

Conflicts of interest
There are no conflicts of interest.

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