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ORIGINAL RESEARCH

Asia, Australia and New Zealand Dyspnoea in Emergency Departments (AANZDEM) study: Rationale, design and analysis

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Abstract

***Objectives*:** Shortness of breath is a common reason for ED attendance. This international study aims to describe the epidemiology of dyspnoea presenting to EDs in the South East Asia-Pacific region, to compare disease patterns across regions, to understand how conditions are investigated and treated, and to assess quality of care.

***Methods/Design*:** This is a prospective, interrupted time series cohort study conducted in EDs in Australia, New Zealand, Singapore, Hong Kong and Malaysia of consecutive adult patients presenting to the ED with dyspnoea as a main symptom. Data were collected over three 72 h periods in May, August and October 2014 (autumn, winter and spring), and included demographics, comorbidities, mode of arrival, usual medications, pre-hospital 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 and outcome of patients presenting to ED with dyspnoea. Secondary outcomes of interest are seasonal and geographic comparisons of diagnoses and outcomes, disease-specific descriptions of epidemiology, investigation, treatment and disposition, and compliance with treatment guidelines.

***Discussion*:** This novel study will explore dyspnoea from the viewpoint of the patient's symptom (shortness of breath) rather than that of a single disease. The results will provide robust data about the epidemiology, investigation, treatment and disposition of this diverse patient group. The obtained data also have the potential to inform service planning and to quantify the proportion of patients with mixed cardiac and respiratory disease.

Key words: *dyspnoea, emergency department, epidemiology.*

Introduction

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

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Until recently, emphasis has been on disease-specific studies. Little is known about 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.

A recent pilot study in Europe found that 53% of patients had a respiratory cause for their symptoms, 22% had a cardiac cause, and that 15% had both cardiac and respiratory components. Sixty per cent were admitted to hospital, with 36% discharged from ED (EURODEM pilot study, S. Laribi, pers. comm., MEMC Congress, Marseilles, France, September 2013). The results of this pilot study suggest that patients with dyspnoea 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. This pilot study's sample was too small to explore whether guidelines were followed.

In many ways, this pilot study raised more questions than it answered. Also, data were derived solely from Europe where disease distribution and clinical practice might be different from Australia, Asia and New Zealand, and EDs might be used differently by local populations. The Asia, Australia and New Zealand Dyspnoea in Emergency Departments (AANZDEM) study aims to describe the epidemiology of dyspnoea presenting to ED in the South East Asia-Pacific region, to compare disease patterns across regions, to understand how conditions are investigated and treated, and to assess quality of care.

Methods/Design

Study design and governance

This is a prospective, interrupted time series cohort study conducted in EDs in Australia, New Zealand, Singapore, Hong Kong and Malaysia.

The project was overseen by a steering committee made up of researchers from across Australia, New Zealand, Singapore and Hong Kong. Potential members were selected and invited to participate based on their demonstrated interest in emergency medicine research, especially epidemiology and/or dyspnoea-related research. The steering committee contributed to development of the study materials, site recruitment, ethics approval processes in their region, and developing and analysis plan. They will also contribute to data analysis and interpretation and reporting.

Project materials

The data collection instrument (Appendix S1) and the data dictionary (Appendix S2) were developed by an iterative process by the steering committee. This process was informed by the EURODEM pilot study data collection form and personal communication from that study's lead investigator (S. Laribi) about additional data that that study found would have been useful to collect. Important data added in the AANZDEM study included ethnic classification, country, climactic classification, expanded comorbidities including eGFR and immunosuppression, revision of the chronic medications list to reflect agents used in the South-East Asia-Pacific region, a prehospital care section representative of ambulance practice in the region, expansion of the investigations' section to include imaging, and revision of the treatment section to reflect current and emerging treatments in our region. We elected to collect in-hospital outcome rather than 30 day outcome because, in the opinion of the steering committee, EDs were unlikely to have the resources for consistent 30 day follow up, the loss to follow up rate would be substantial and unbalanced across the region, and the human research ethics approval processes would require patient consent that would in all likelihood reduce numbers of patients included and introduce significant bias. The data form was piloted on a small sample of cases not in the study period for validation.

Site selection and participation

EDs were eligible to participate if they were an accredited ED according to local national criteria. Participation was by an expression of interest process. Directors of eligible EDs were contacted by email with an outline of the project and invited to participate. Those interested identified a local lead who was responsible for conduct of the project. Fifty-five EDs expressed interest to participate, including metropolitan, regional, rural and private ED. The AANZDEM study coordinating centre at the Joseph Epstein Centre for Emergency Medicine Research (Melbourne, Australia) provided assistance with human research ethics committee (HREC) applications and other required site approval and governance processes.

Sites outside the Asia, Australia and New Zealand region were not approached to participate. This was largely a logistic decision. That said, we were aware that a similar study was being conducted in Europe – the EURODEM study. We approached that leaders of that study and collaborated to design and conduct both studies in a way that will allow most of the data to be combined for analysis.

Patient selection and data collection

Eligible patients were consecutive adult patients with dyspnoea as a main symptom at ED presentation attending the ED during the three 72 h study periods (13–16 May 2014; 12–15 August 2014; 14–17 October 2014). These dates were chosen to represent different seasons (autumn, winter and spring) in the region and to match data collection periods in a parallel European study, as well as to test the belief among emergency clinicians that respiratory illness is a major contributor to increased ED caseload in winter. Summer was not included because of funding limitations. Local data collectors were instructed that dyspnoea was considered a main symptom if it was listed as a symptom at presentation or triage (systems vary slightly in how patient reception occurred).

Data were collected onto the validated data form by local clinician-investigators, nurses or doctors. These

investigators were supplied with a detailed data dictionary (Appendix S2). Local data collectors were instructed to contact the coordinating centre by phone if they had any queries regarding data collection processes or data definitions. Data were then entered as de-identified data into a password-secured central study database managed by the Clinical Informatics and Data Management Unit, Faculty of Medicine, Nursing and Health Sciences, Monash University. Data collected included patient characteristics, comorbidities, mode of arrival, usual medications, pre-hospital treatment, initial assessment (clinical assessment and vital signs), investigations performed in ED (laboratory tests, electrocardiogram [ECG], imaging, etc.) and results, treatment in the ED, ED diagnosis, disposition from ED, in-hospital outcome and final hospital diagnosis (Appendix S1).

Outcomes of interest and analysis

The primary outcomes of interest are the epidemiology and outcome of patients presenting to ED with dyspnoea. Secondary outcomes of interest are seasonal and geographic comparisons of diagnoses and outcomes, disease-specific descriptions of epidemiology, investigation, treatment and disposition, and compliance with treatment guidelines. A draft analysis plan is shown in Table 1. We also hope to be able to undertake analysis of resource use, in particular seasonal variation in admissions. Unfortunately, the ethics approvals and funding restrictions will not allow longer-term follow up.

Analysis will primarily be descriptive statistics, comparisons of proportions and measures of associations (Chi Square) and, where relevant, multivariate analysis. A formal sample size calculation was not performed as this is largely a descriptive study; however, it is anticipated that data on >2000 patients will be collected. This is considered adequate data for most of the analysis methods being considered. Subgroup analyses will be contingent on adequate numbers of cases in the final study sample. Comparison with similar data being collected in Europe will also be undertaken, subject to agreements regarding data sharing being reached.

Human research ethics approvals

HREC approval was obtained for all sites according to local requirements. All regions except Queensland (Australia) approved retrospective data collection from medical records without requiring patient consent. In some jurisdictions (NSW, New Zealand, Queensland), this could be done as a multi-site application. In other jurisdictions, site by site approval was required. In Queensland, the HREC required patient consent. Eligible patients were contacted either in person in ED or by letter, with an explanation of the study and a patient information and consent form. Consent could be verbal (in person or by phone), written, by email or short messaging service (SMS) according to local health service requirements.

Discussion

This project takes 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 many might have mixed disease or significant comorbidity.

The results about the present study should inform us how common shortness of breath is as a main symptom in ED, the distribution of causes (overall and by region), treatment, investigation and disposition from ED, in-hospital outcome, and compliance with clinical practice guidelines for major diagnostic groups. It will also be able to identify if there is significant variations in practice across the region.

A novel aspect of the present study is its ability to identify the proportion of patients with mixed cardiac and respiratory disease. These patients are usually excluded from disease-specific studies but, if the European pilot study findings are substantiated, might make up a significant proportion of cases. These patients pose challenges in diagnosis and management. In fact, on occasions, guidelines for management of individual conditions might be in conflict.[5] Our findings might be able to quantify this conflict and assist development of treatment pathways for mixed diseases.

The results of the present study also have the potential to assist hospitals and health systems with service planning. We will explore whether there is seasonal variation in attendances for dyspnoea and/or in its causes or admission rate. This might have implications for ED staffing, ED infection control management and hospital bed management.

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AANZDEM Steering Committee

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

AANZDEM Study Group (includes all hospitals that expressed interest in participation, identified a project lead and for which an ethics approval was submitted).

Richard McNulty (Blacktown and Mt Druitt Hospitals NSW), Clifford Tan (Canterbury Hospital), David Lord Cowell (Dubbo Hospital NSW), Anna Holdgate and Nitin Jain (Liverpool Hospital NSW), Tracey Devillecourt (Nepean Hospital NSW), Alan Forrester and Kendall Lee (Port Macquarie Hospital NSW), Dane Chalkley (Royal Prince Alfred Hospital NSW), Mark Gillett and Lydia Lozzi (Royal North Shore Hospital NSW), Stephen Asha (St George Hospital NSW), Martin Duffy (St Vincent's Hospital Sydney NSW), Gina Watkins (Sutherland Hospital NSW), Richard Stone (Cairns Hospital QLD), David Rosengren (Greenslopes Private Hospital QLD), Jae Thone (Gold Coast Hospital QLD), Shane Martin (Ipswich Hospital QLD), Ulrich Orda (Mt Isa Hospital QLD), Ogilvie Thom (Nambour Hospital QLD), Frances Kinnear (Prince Charles Hospital QLD), Rob Eley (Princess Alexandra

TABLE 1. *Data analysis plan*

Analysis no.	Inclusion criteria	Outcome of interest	Comments
AANZDEM sites			
1	All patients; all sites	Epidemiology and outcome of 'dyspnoea'	Descriptive: Demographics, diagnoses, ED disposition and hospital outcome
2	All patients; all sites	Seasonal variation in ED presentations for dyspnoea	Comparison of patient numbers, proportion of total ED cases, diagnosis distribution, ED disposition and outcome across the three seasonal windows ± implications for service planning
3	Patients with final diagnosis of pulmonary embolism	Tests, treatment, disposition and outcome	Descriptive, regional variation in practice (subject to patient numbers per region)
4	Patients with final diagnosis of cardiac failure	Tests, treatment, disposition and outcome	Descriptive, guideline compliance, regional variation in practice (subject to patient numbers per region)
5	Patients with final diagnosis of COPD	Tests, treatment, disposition and outcome	Descriptive, guideline compliance, regional variation in practice (subject to patient numbers per region)
6	Patients with final diagnosis of pneumonia (or equivalents)	Tests, treatment, disposition and outcome	Descriptive, guideline compliance, regional variation in practice (subject to patient numbers per region)
7	Patients with final diagnosis of asthma	Tests, treatment, disposition and outcome	Descriptive, guideline compliance, regional variation in practice (subject to patient numbers per region)
8	All patients; all sites	Geographical and climate zone variation	Comparison of diagnostic distribution and outcome across the three climate zones (temperate, subtropical and tropical). Subject to patient numbers
9	Regional subsets (subject to patient numbers)	Epidemiology and outcome of 'dyspnoea'	Descriptive: Demographics, diagnoses, ED disposition and hospital outcome
10	Patients arriving by ambulance (Australia and New Zealand)	Epidemiology and pre-hospital treatment	Descriptive: Demographics, diagnoses, pre-hospital treatment
Combined AANZDEM and EURODEM sample (subject to data-sharing agreements)			
11	All patients; all site	Compare epidemiology and outcome of 'dyspnoea'	Descriptive: Demographics, diagnoses, ED disposition and hospital outcome
12	Patients with final diagnosis of cardiac failure	Compare tests, treatments and outcome	Compare tests, treatments and outcome between Europe and AANZDEM region
13	Patients with final diagnosis of COPD	Compare tests, treatments and outcome	Compare tests, treatments, guideline compliance and outcome between Europe and AANZDEM region
14	Patients with final diagnosis of pneumonia (subject to adequate numbers)	Compare tests, treatments and outcome	Compare tests, treatments and outcome between Europe and AANZDEM region
15	Patients with final diagnosis of pulmonary embolism (subject to adequate numbers)	Tests, treatment, disposition and outcome	Descriptive plus comparison of tests, treatments and outcome between Europe and AANZDEM region
16	Patients with final diagnosis of asthma (subject to patient numbers)	Tests, treatment, disposition and outcome	Compare tests, treatments, guideline compliance and outcome between Europe and AANZDEM region

AANZDEM, Asia, Australia and New Zealand Dyspnoea in Emergency Departments.

Hospital QLD), Alison Ryan (Queen Elizabeth II Jubilee Hospital QLD), Douglas Morel (Redcliffe Hospital QLD), Christopher May (Redlands Hospital QLD), Jeremy Furyk (Townsville Hospital QLD), Graeme Thomson (Angliss Hospital VIC), Simon Smith and Richard Smith (Bendigo Hospital VIC), Andrew Maclean and Michelle Grummisch (Box Hill Hospital VIC), Alistair Meyer (Casey Hospital VIC), Robert Meek (Dandenong Hospital VIC), Pamela Rosengarten (Frankston Hospital VIC), Barry Chan and Helen Haythorne (Knox Private Hospital VIC), Peter Archer (Maroondah Hospital VIC), Simon Craig and Kathryn Wilson (Monash Medical Centre VIC), Jonathan Knott (Royal Melbourne Hospital VIC), Peter Ritchie (Sunshine Hospital VIC), Michael Bryant (Footscray Hospital VIC), Stephen MacDonald (Armadale Hospital WA), Tom Lee (Joondalup Health Campus Hospital WA), Mlungisi Mahlangu (Peel Health WA), David Mountain (Sir Charles Gairdner Hospital WA), Ian Rogers (St John of God Murdoch Hospital WA), Tobias Otto (Queen Elizabeth Hospital SA), Peter Stuart and Jason Bament (Modbury Hospital SA), Michelle Brown (Royal Hobart Hospital TAS), Peter Jones (Auckland City Hospital New Zealand), Renee Greven-Garcia (Hawkes Bay Hospital New Zealand), Michael Scott (Hutt Valley Hospital New Zealand), Thomas Cheri (Palmerston North Hospital New Zealand), Mai Nguyen (Wellington Regional Hospital New Zealand), Colin A Graham (Prince of Wales Hospital Hong Kong), Chi-Pang Wong and Tai Wai Wong (Pamela Youde Nethersole Eastern Hospital Hong Kong), Ling-Pong Leung (Queen Mary Hospital Hong Kong), Chan Ka Man (Tuen Mun Hospital Hong Kong), Ismail Mohd Saiboon (Hospital Universiti Kebangsaan Malaysia), Nik Hisamuddin Rahman (Hospital Universiti Sains Malaysia), Wee Yee Lee (Changi General Hospital Singapore), Francis Chun Yue Lee (Khoo Teck Puat Hospital Singapore), Win Sen Kuan (National University Hospital Singapore), Sharon Klim, Kerrie Russell and Anne-Maree Kelly (AANZDEM coordinating centre), Gerben Keijzers and Said Laribi (steering committee), and Charles Lawoko (Victoria University, statistician).

Competing interests

A-MK is a member of the editorial board and reviewer for *Emergency Medicine Australasia*. GK, AH, PJ, JK and JF are section editors for *Emergency Medicine Australasia*.

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Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Appendix S1. AANZDEM study case report form.
Appendix S2. AANZDEM study manual and data dictionary.