PARAMEDIC DIFFERENTIATION OF ASTHMA AND COPD IN THE PREHOSPITAL SETTING IS DIFFICULT

Dr Teresa Williams, Professor Judith Finn, Professor Daniel Fatovich, Professor Gavin D Perkins, Dr Quentin Summers, *Professor Ian Jacobs (died Oct 2014)

Abstract

Introduction Separate Clinical Practice Guidelines (CPG) for asthma and chronic obstructive pulmonary disease (COPD) often guide prehospital care. However, having distinct CPGs implies paramedics can accurately differentiate these conditions. We compared the accuracy of paramedic identification of these two conditions against the emergency department (ED) discharge diagnosis.

Methods A retrospective cohort of all patients transported to ED by ambulance in Perth, Western Australia between July 2012 and June 2013; and identified as 'asthma' or 'COPD' by paramedics. We linked ambulance data to emergency department discharge diagnosis.

Results Of 1,067 patients identified by paramedics as having asthma, 41% had an ED discharge diagnosis of asthma, i.e. positive predictive value (PPV)=41% (95% CI 38%-44%). Of 1,048 patients recorded as COPD, 57% had an ED discharge diagnosis of COPD (PPV 57%; 95% CI 54%-60%). Sensitivity for the paramedic identification of patients diagnosed with asthma or COPD in the ED was 66% for asthma (95% CI 63%-70%) and 39% for COPD (95% CI 36%-41%). Paramedics reported wheezing in 86% of asthma and 55% of COPD patients.

Conclusion Differentiating between asthma and COPD in the prehospital setting is difficult. A single CPG for respiratory distress would be more useful for the clinical management of these patients by paramedics.

PARAMEDIC IDENTIFICATION OF ASTHMA AND COPD IN THE PREHOSPITAL SETTING IS DIFFICULT

INTRODUCTION

Asthma and chronic obstructive pulmonary disease (COPD) account for the majority of chronic respiratory disease in the Western World.[1] Asthma and COPD are both characterized by variable degrees of airflow limitation, and both conditions may co-exist.[2,3] In the Australian 2007–08 National Health Survey among people with asthma, 9% also had COPD.[4] Current prehospital clinical practice guidelines (CPG) require that paramedics differentiate between various respiratory conditions in order to initiate appropriate therapy.

St John Ambulance –Western Australia (SJA-WA) has separate CPGs for asthma and COPD.[5] These CPGs recommend administration of oxygen and bronchodilators (salbutamol and / or ipratropium bromide by nebulizer, spacer or metered dose inhaler [MDI]) for asthma and COPD.[5] Intra-muscular adrenaline (0.5mg) is recommended for severe life threatening asthma. While the management of asthma and COPD outlined in CPGs has evolved over time, the cornerstone of therapy is to administer sufficient oxygen to relieve life-threatening hypoxia and bronchodilators to reduce the work of breathing.

Selecting a CPG to guide management in the prehospital setting relies on correct identification of the condition. However, with little or no diagnostic tools or verifiable past medical history, differentiating these conditions is likely to be difficult.[6-9] The aims of our study were to;
(1) Describe the prehospital clinical presentation and management of patients with paramedic-identified asthma or COPD;
(2) Compare the accuracy of paramedic-identified asthma or COPD against the ED discharge diagnosis; and
(3) Determine the number of patients identified as asthma or COPD in ED but not identified by paramedics as such in the prehospital setting.

METHOD

This was a retrospective cohort study of all patient episodes identified as 'asthma' or 'COPD' by SJA-WA paramedics and transported to a hospital ED in the Perth metropolitan area[10] between July 1, 2012 and June 30, 2013. Approval for the study was granted by the Curtin University Human Research Ethics Committee and the SJA-WA Research Advisory Group.

Perth is the capital city of the Australian State of Western Australia (WA), with a population of 1.9 million residents, constituting 78% of WA's total population.[11] All road-based emergency ambulance services in WA are provided by a single ambulance service provider (SJA-WA).[12] Emergency calls for an ambulance are received by SJA-WA's State Operations Centre, which uses a structured call taking procedure (Medical Priority Dispatch System)[13] to rapidly identify the nature of the call and urgency of the response required. Computer aided dispatch (CAD) is used to identify the location of the closest ambulance to the incident and allocate the call to the respective crew. Clinical data is recorded by the paramedics into an electronic patient care record based on an iPAD platform (ePCR).

In the Perth metropolitan area, SJA-WA emergency ambulances are staffed by paramedics (most with a 3-year University-based Bachelor degree) trained in providing a range of clinical interventions including advanced life support. For each case attended, the paramedic completes an ePCR and includes what they believe to be is the principal patient problem, using one of the SJA-WA problem codes. Problem codes '241' and '243' are assigned for asthma and COPD respectively.

Two databases were used in the study. (1) The SJA-WA database contains patient, service and clinical information (including patient signs and symptoms; problem code and patient urgency) from the ePCR and CAD. Physiological parameters included respiratory rate (RR), oxygen saturation (SpO_2), heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP). Urgency, as recorded by paramedics, is based on the Australasian Triage Scale (ATS).[14] It is has five categories: (1) Resuscitation: immediate; (2) Emergency: within 10 minutes; (3) Urgent: within 30 minutes; (4) Semi-urgent: within 60 minutes; (5) Non-urgent: within 120 minutes; (2) the Emergency Department Information System (EDIS) data[15] that

operates at eight of the metropolitan EDs (93% of SJA-WA transports to Perth hospital EDs July 2012 to June 2013). EDIS contains patient demographic information, admissions, transfers and discharges, and time-tracking information. The principal clinical diagnosis is a mandatory EDIS field and is entered by clinical staff on patient discharge from the ED. The clinical diagnosis is electronically mapped to International Classification of Disease Version 10-Australian Modification (ICD 10-AM) codes.[16] The ICD 10-AM codes used by the clinical staff for the ED discharge diagnosis of asthma were J45.9, J46 and for COPD J40, J44.1, J44.9 (including chronic bronchitis and emphysema). Ambulance and ED databases were linked using probabilistic and deterministic linkage.[17]

All emergency patients (pediatric and adult) in the Perth metropolitan area transported by a SJA-WA road ambulance to one of the 12 metropolitan EDs,[10] were included if the problem code was recorded as '241 - asthma' or '243 - COPD' in the SJA-WA database. For Aim 2 of our study, where we compared paramedic identified asthma and COPD with the ED discharge diagnosis (as the 'gold standard') – only the eight metropolitan EDs that used the EDIS[15] were included, as per our previous study.[18] For Aim 3, we identified those patients with an ED discharge diagnosis of 'asthma' or 'COPD' from the EDIS data but who were not identified by the paramedics as 'asthma' or 'COPD'.

Cohort characteristics described included: patient age (median and interquartile range (IQR)), proportion of female patients, time from SJA-WA receiving the call to arrival at the hospital and urgency of transport to hospital. Time of day was grouped 0001 to 0600, >0600 to 1200, >1200 to 1800 and >1800 to 2400 hours. Categorical variables were compared using Chi-square test. Continuous variables were compared by t-tests or Mann Whitney tests as appropriate. Differences in the initial and pre-ED mean physiological values were examined using paired t tests. Two-sided comparisons with 95% confidence intervals (CIs) were used and p values less than 0.05 were considered statistically significant.

We calculated the positive predictive value (PPV), that is, the proportion of patient episodes identified as asthma by paramedics in the SJA-WA database who also had an ED discharge diagnosis of asthma, i.e. the correct identification of asthma by the paramedics; sensitivity of paramedic identification of asthma, i.e., the proportion of patient episodes with an ED

4

discharge diagnosis of asthma who were 'correctly' identified as asthma by the paramedics; negative predictive value (NPV), i.e. the proportion of patients for whom asthma or COPD were not recorded by paramedics and not identified in EDIS; and specificity, i.e. the proportion of patients without an EDIS diagnosis of asthma or COPD that also do not have asthma or COPD recorded in the ePCR. We repeated the analysis for COPD patients. The calculation of the specificity and NPV included all ED cases in the denominator – not just those with asthma, COPD or other respiratory conditions.

The analyses were performed for asthma and COPD both as separate groups and a combined group, i.e. asthma or COPD. Subgroup analysis for pediatric and adult patients was performed for the asthma group. Statistical analysis was conducted using IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp. Released 2012. Armonk, NY: IBM Corp.)

RESULTS

There were 2,571 patients (36% of 7,130 patients with respiratory conditions) identified by paramedics in the SJA-WA database with asthma or COPD. We excluded 207 patients because they were not transferred to ED, 109 transfers from one ED to another, and three from non–metropolitan areas (Figure 1). Of those who met the selection criteria, 1,117 patients were identified as asthma and 1,135 with COPD. Cohort characteristics are shown in Table 1. Asthma patients were younger (median age 51 [IQR 22-73]) years compared to the COPD group (74 [IQR 67-82], p<0.001) years; 228 (20%) patients in the asthma group were aged less than 16 years compared to 112 (10%) patients in the COPD group. Excluding patients aged less than 16 years, the difference in age remained significant (p<0.001). There were more females in the asthma group (57%) compared to the COPD group (46%). Ten percent of patients in the asthma group and 9% in the COPD group were transported as ATS[14] urgency code '1'. The time of day that patients were transported was significantly different within (p = 0.002) and between (p<0.001) the asthma and COPD groups. COPD patients were transferred more often during the day than at night (1800 and 0600 hours) compared to asthma patients. For patients with asthma there was a significant difference for transport to hospital between 0001-0600 hours versus 1200-1800 hours (p=0.022), 0001-0600 hours versus 1800-2400 hours (p<0.001) and 1200-1800 hours versus 1800-2400

5

hours (p<0.01) with fewer transports between 0001-0600 hours with the most transports occurring between 1800-2400 hours. The differences for when transport to hospital occurred for patients with COPD were significant for all time group comparisons (p=0.005 - <0.001). Fewer patients (n=707, 66%) with asthma were admitted to hospital compared to patients with COPD (n=898, 86%). There were 11 deaths in ED: three patients in the asthma group (youngest patient 52 years) and 8 in the COPD group (youngest patient 62 years). Fifty four patients (5%) reported a history of CO_2 retention, 47 in the COPD group and 7 in the asthma group.

A greater proportion of patients in the asthma group were reported to have a wheeze (86%) compared to patients with COPD (55%). The presence of a cough, the use of accessory muscles and the ability to speak when assessed were similar between groups, as shown in Table 1.

Changes in the physiological values recorded from arrival of the ambulance to just prior to arrival at ED are shown in Table 2. Ninety three percent of patients had at least one SpO_2 value recorded and 88% had two or more SpO_2 values. Mean SpO_2 increased in both the asthma and COPD groups from the initial recording and the recording prior to arrival at ED (both p<0.001). A decrease in mean respiratory rate, heart rate and systolic blood pressure (SBP) also occurred for asthma and COPD patients between the initial recording and prior to ED arrival (p<0.001) but there was a large proportion of patients with missing SBP data: 23% for initial and 33% for pre-ED SBP values for asthma and 11% for initial and 24% for pre-ED SBP values for COPD patients.

Oxygen was administered by paramedics to 91% of asthma patients and 88% of COPD patients respectively. Of the 926 patients in the asthma group and 914 patients in the COPD group who had other interventions documented, almost twice as many patients in the asthma group were administered bronchodilators, 779/926 (84%) compared to the COPD group (406/914 patients, 44%). Of the patients who were reported to have a wheeze, 745/841 (89%) from the asthma group and 356/550 (65%) from the COPD group had a bronchodilator administered. Adrenaline administration was reported in 56 (6%) patients in the asthma group and 7 (1%) patients in the COPD group. Paramedics reported 10 patients

(1%) in the asthma group and 17 (2%) patients in the COPD group received aspirin. Twelve patients (1%) in the asthma group and 17 (2%) in the COPD group received a vasodilator, i.e. glyceryl trinitrate (nitroglycerin) 0.4mg spray or sublingual isosorbide dinitrate.

A total of 2,115 patients were transported to one of the eight EDs that used EDIS. Of the 1,067 patients in the paramedic identified asthma group, 898 (84%) patients were diagnosed with a respiratory condition in ED (Table 3); 433 had an ED discharge diagnosis of asthma, i.e. a positive predictive value of 41% (95% CI 38%-44%); and 204 (19%) were identified as COPD in the ED. Of the 1,048 patients who were identified as COPD by paramedics, 860 (82%) patients were diagnosed with a respiratory condition in ED, of whom 599 were identified as COPD, i.e. a positive predictive value of 57% (95% CI 54%-60%). Thirty one (4%) of the COPD patients were diagnosed as asthma in the ED. A cardiac diagnosis was recorded as the ED discharge diagnosis for 6% of the paramedic identified asthma group and 10% of the paramedic identified COPD cases.

During the study period an ED discharge diagnosis of asthma or COPD was identified in EDIS for 2,204 patients transported to ED by ambulance: 653 (30%) patients were diagnosed as asthma and 1551 (70%) patients were diagnosed as COPD by ED physicians (Table 4). Of the 653 ED asthma patients, 433 were also identified as asthma by the paramedics, i.e. a sensitivity of 66% (95% CI 63%-70%), and 30 patients identified as COPD. In the ED COPD group, 599 patients were identified as COPD by paramedics, i.e. a sensitivity of 39% (95% CI 36%-41%), and 183 as asthma. The NPV was 99.8% for asthma and 99.0% for COPD patients and the specificity was 99.4% and 99.5% respectively. One hundred and thirty-two patients (20%) were identified as other respiratory diseases by paramedics in the ED asthma group and 531 (34%) patients in the COPD group. Respiratory tract infections were the most common problem recorded in this group, as shown in Table 4. Non-respiratory conditions were attributed by the paramedics for 58 (9%) patients in the ED asthma group and 238 (15%) in the ED COPD group. A full description is reported in the Supplementary data.

DISCUSSION

Asthma and COPD are common respiratory conditions encountered in the prehospital setting. Some ambulance services[5,19,20] require paramedics to differentiate between the various respiratory conditions, such as asthma and COPD, to enable the relevant CPG for appropriate prehospital care to be followed. We found paramedics correctly identified asthma in 41% of patients and 57% of COPD patients when compared to the ED discharge diagnosis. Among all patients with an ED discharge diagnosis of asthma and transported to ED by ambulance, two-thirds were identified as asthma by the paramedics. However among the patients with an ED discharge diagnosis of COPD, only a third were identified as COPD by paramedics – although a further 46% were identified as some other respiratory condition. Respiratory tract infections and other causes were the predominant respiratory conditions recorded by paramedics. Respiratory tract infections are a common cause of exacerbation of COPD. Because only one problem code could be used paramedics may not have recorded COPD as the presenting condition. It is likely that the problem code for presenting respiratory conditions was unclear for some of the cases and they were coded as "other causes".

Studies of the accuracy of coding respiratory conditions by paramedics have been limited[6-9,21] and the findings inconsistent, with no consensus on a 'gold standard' for comparisons. Austin et al.[9] in their cluster randomized controlled study of high flow versus titrated oxygen among patients identified by paramedics as acute exacerbation of COPD in an Australian prehospital setting found that only 53% of patients had a confirmed diagnosis of COPD by pulmonary function tests. Ackerman and Waldron[7] conducted a medical chart review to compare paramedic identification of asthma and COPD against ED physician diagnosis and found concordance was 89% for asthma and 97% for COPD and sensitivity was 93% and 83% respectively. However, only three diagnostic categories (cardiac, respiratory and other) were compared rather than actual diagnoses – which could explain the apparent greater accuracy of paramedic diagnosis in this cohort. The study[7] also only included patients from one hospital with its own ambulance service. Pozner et al.[21] conducted a retrospective review of prehospital records in patients with dyspnea and compared the prehospital cause of dyspnea (cardiac; non-cardiac or both) to that indicated by the ED diagnosis on the

medical record.[21] Concordance was high for those cases with a single cause (cardiac or respiratory) of dyspnea identified (83%-86% respectively) but was only 17% for patients assessed by EMS providers as having a combined (cardiac and respiratory) cause of dyspnea.[21] A prospective audit of the use of oxygen in acute exacerbations of COPD in the prehospital, ED and acute care setting in the UK found ambulance crews correctly identified COPD in 32% of 65 patients and asthma in 29% of 65 patients.[6] The variation in methodology between studies makes valid comparison of the results problematic.

The ability of paramedics to differentiate asthma from COPD in clinical practice is complicated by the lack of clear criteria to identify the diseases, no verification of patient medical history and limited diagnostic facilities in the prehospital setting.[22] Clinical diagnosis is fraught with error: spirometry before and after a bronchodilator is the only way that COPD can be diagnosed.[1,23,24] Furthermore, COPD is not seen in the young and is rare before the age of 40 years.[21] SJA paramedics identified 12 patients aged less than 16 years with COPD, which may be coding errors.

From the prehospital perspective, the similarity in presenting signs and symptoms and recommended treatment in CPGs suggest it is inappropriate to ask paramedics to differentiate between asthma and COPD. Irrespective of the ultimate diagnosis of asthma or COPD an important patient-centred clinical management goal is to alleviate patients' respiratory distress[25] by relieving hypoxia and the work of breathing. While different mechanisms are responsible for asthma and COPD, treatment is similar for both conditions, namely: oxygen to relieve hypoxia and oxygen driven nebulized bronchodilators (or MDI particularly in children) to reduce the work of breathing. For CO_2 retainers, controlled oxygen delivery titrated to maintain SpO_2 at 88-92%[26,27] may be required in the prehospital setting. Less than five percent of patients were reported as being a 'CO_2 retainer' in our study. In a RCT conducted in the prehospital setting, Austin[9] found risk of death was reduced by 58% in all patients with COPD (relative risk 0.42, 95% confidence interval 0.20 to 0.89; P=0.02) and 78% with confirmed COPD by lung function tests (0.22, 0.05 to 0.91; P=0.04) when titrated oxygen was administered via nasal cannula compared with high flow oxygen. Respiratory acidosis was decreased in the reduced oxygen group, an effect more likely to be important with longer transports.[9] Similar results were reported by Perrin et al.[28]

and colleagues in patients with asthma. The SpO$_2$ was lower in the COPD group in our study compared to patients in the asthma group.

Considering that the treatment for asthma and COPD in the current prehospital CPGs are similar, and the difficulty in differentiating not only asthma from COPD but also differentiating these conditions from other respiratory conditions, a single CPG for respiratory distress would be more useful in the prehospital setting. It would reduce the complexity of having multiple CPGs that require paramedics to correctly identify individual respiratory conditions in order to deliver the appropriate care. The 2007 U.S. Metropolitan Municipalities' EMS Medical Directors' Consortium categorized respiratory distress into pulmonary oedema/left-sided congestive heart failure and bronchospasm.[29] A single CPG for respiratory distress could recommend oxygen titrated to relieve hypoxia. It should be at the lower end of the recommended range for patients suspected of COPD, i.e. no clear history of asthma, older than 50 years of age and chronic history of breathlessness, or known COPD.[27] Patients with bronchospasm who are in respiratory distress and have wheezing or have a known history of asthma or reactive airways disease should be treated with a beta-agonist bronchodilator. In effect, treatment choices would be the same as having two separate CPGs but a single CPG would emphasize the provision of suitable and timely symptom management.

Limitations of the study include the retrospective review of the data, but the data were collected prospectively on the ePCR. There is no consensus "gold standard" for comparison of the paramedic identification of asthma and COPD. Similar to other studies[8,30,31] we used the ED discharge diagnosis to identify the patient's condition in the prehospital setting, however it has not been validated. The advantages of using the ED discharge diagnosis are its availability and that the diagnosis is being made closest to the time that paramedics identified the patients' condition. However, only one discharge diagnosis is recorded in the EDIS database and patients may have more than one problem. Clinicians may differ in their ranking of what is the most important diagnosis. Furthermore, using the ED diagnosis as the 'gold standard' assumes that ED physicians are able to diagnose and reliably differentiate the two conditions in the ED. The veracity of this assumption is untested and requires further research. Nevertheless, it is the principal diagnosis that is assigned at the end of the

ED episode of care (involving more intensive investigations than that available in an ambulance) and is likely to be more accurate than that recorded in the ambulance ePCR. Six percent of patients did not have an EDIS record and this could be a source of selection bias. Similar to the ED, paramedics can enter only one problem code for the presenting condition on the PCR. It is the paramedic's judgement which condition is recorded when there are two or more conditions that could be the presenting condition, e.g. infective exacerbation of COPD may be recorded as COPD or respiratory infection. This should be considered when interpreting the results. A strength of our study is that a single ambulance service provided services for the entire metropolitan area that facilitated consistency in clinical practice.

CONCLUSION

Asthma and COPD are difficult to differentiate in patients with respiratory distress in the prehospital setting. Presenting signs and symptoms are similar and treatment aims to relieve respiratory distress. It would be useful to look differently at the prehospital management of COPD and asthma and move away from an artificial dichotomy to a single CPG with the focus on symptom management and titration of oxygen sufficient to relieve hypoxia.

REFERENCES

1.   Australian Institute of Health & Welfare (2010). Asthma, chronic obstructive pulmonary disease and other respiratory diseases in Australia. Asthma series. Cat. no. ACM 20. Canberra: AIHW. Viewed 4 July 2013 <http://www.aihw.gov.au/publication-detail/?id=6442468361>.

2.   Alagappan VK, de Boer WI, Misra VK, Mooi WJ, Sharma HS. Angiogenesis and Vascular Remodeling in Chronic Airway Diseases. Cell Biochem Biophys. 2013;67:219-34.

3.   Kim SR, Rhee YK. Overlap Between Asthma and COPD: Where the Two Diseases Converge. Allergy Asthma Immunol Res. 2010;2:209-14.

4.   Australian Institute of Health and Welfare. Australia's Health (2012). Australia's health series no.13. Cat. no. AUS 156. Canberra: AIHW.

5.   St John Ambulance - Western Australia. Clinical practice guidelines for ambulance care in Western Australia (2012). Available from http://www.fair-go.com/docs/Clinical%20Practice%20Guidelines%20V11%2022.07.11.pdf. Last accessed 22 June 2012.

6.   Denniston AKO, O'Brien C, Stableforth D. The use of oxygen in acute exacerbations of chronic obstructive pulmonary disease: a prospective audit of pre-hospital and hospital emergency management. Clin Med. 2002;2:449-51.

7.   Ackerman R, Waldron RL. Difficulty breathing: agreement of paramedic and emergency physician diagnoses. Prehosp Emerg Care. 2006;10:77-80.

8.   Schaider JJ, Riccio JC, Rydman RJ, Pons PT. Paramedic diagnostic accuracy for patients complaining of chest pain or shortness of breath. Prehosp Disaster Med. 1995;10:245-50.

9.   Austin MA, Wills KE, Blizzard L, Walters EH, Wood-Baker R. Effect of high flow oxygen on mortality in chronic obstructive pulmonary disease patients in prehospital setting: randomised controlled trial. BMJ. 2010;341:c5462.

10.   Government of Western Australia Department of Health (2013). WA Public Hospital Activity. Emergency Department service locations and contacts. Available from http://www.health.wa.gov.au/emergencyactivity/locations/index.cfm. Accessed 2 Oct 2013.

11.   Australian Bureau of Statistics (2013). 3218.0 - Regional Population Growth, Australia, 2011-12. Available from http://www.abs.gov.au/ausstats/abs@.nsf/Products/3218.0~2011-12~Main+Features~Western+Australia?OpenDocument. Accessed Sep 2013.

12.   St John Ambulance-Western Australia. St John Ambulance Annual Report 2011/12. Available from http://www.stjohnambulance.com.au/docs/corporate-publications/2011-12-annual-report.pdf?sfvrsn=0. Accessed Sep 2013.

13.   International Academies of Emergency Dispatch® (IAED™). Medical Priority Dispatch System™ (MPDS®) version 12.2. Available from http://www.prioritydispatch.net/ Accessed 2 October 2013.

14.   Australasian College for Emergency Medicine. The Australasian Triage Scale. Emerg Med (Fremantle). 2002;14:335-6.

15.   Department of Health Western Australia (2007). Information Management and Reporting. Emergency Department Data Collection Data Dictionary Version 1.0. Available

from http://www.health.wa.gov.au/healthdata/docs/EDDC_dictionary.pdf. Accessed 2 October 2010.

16.   Commonwealth of Australia. The International Statistical Classification of Diseases and Realted Health Problems, Tenth Revision, Australian Modification (ICD-10-AM) 5th Ed. Sydney, NSW: National Centre for Classification in Health; 2006.

17.   Jaro MA. Probabilistic linkage of large public health data files. Stat Med. 1995;14:491-8.

18.   Williams TA, Finn J, Celenza A, Teng T-H, Jacobs IG. Paramedic Identification of Acute Pulmonary Edema in a Metropolitan Ambulance Service. Prehosp Emerg Care. 2013;17:339-47.

19.   Joint Royal Colleges Ambulance Liaison Committee. UK Ambulance Service Clinical Practice Guidelines (2006). Available http://www2.warwick.ac.uk/fac/med/research/hsri/emergencycare/prehospitalcare/jrcalcstakeholderwebsite/guidelines. Accessed Sep 2013.

20.   Ambulance Victoria (2012). Clinical Practice Guidelines. Available from http://www.ambulance.vic.gov.au/Paramedics/Qualified-Paramedic-Training/Clinical-Practice-Guidelines.html. Accessed Oct 2012.

21.   Pozner CN, Levine M, Shapiro N, Hanrahan JP. Concordance of field and emergency department assessment in the prehospital management of patients with dyspnea. Prehosp Emerg Care. 2003;7:440-4.

22.   Zeki AA, Schivo M, Chan A, Albertson TE, Louie S. The Asthma-COPD Overlap Syndrome: A Common Clinical Problem in the Elderly. J Allergy. 2011;2011:861926.

23.   Australian Lung Foundation and Thoracic Society of Australia and New Zealand. The COPD-X Plan: Australian and New Zealand guidelines for the management of chronic obstructive pulmonary disease, 2006 (available at http://www.copdx.org.au/). Accessed 4 July 2013.

24.   Global initiative for chronic obstructive lung disease. Global strategy for the diagnosis, management and prevention of chronic obstructive pulmonary disease. (Updated 2013). Available from http://www.goldcopd.org/uploads/users/files/GOLD_Report_2013_Feb20.pdf. Accessed 4 July 2013.

25.   American Thoracic Society. Dyspnea. Mechanisms, assessment, and management: a consensus statement. . Am J Respir Crit Care Med. 1999;159:321-40.

26.   McKenzie D, Abramson M, Crockett A, et al. The COPD X Plan: Australian and New Zealand Guidelines for the management of Chronic Obstructive Pulmonary Disease V2.32, 2012 Available from http://www.copdx.org.au/the-copd-x-plan-pdf. Accessed 5 Jul 2013.

27.   O'Driscoll BR, Howard LS, Davison AG, British Thoracic S. BTS guideline for emergency oxygen use in adult patients.[Erratum appears in Thorax. 2009 Jan;64(1):91]. Thorax. 2008;63 Suppl 6:vi1-68.

28.   Perrin K, Wijesinghe M, Healy B, et al. Randomised controlled trial of high concentration versus titrated oxygen therapy in severe exacerbations of asthma. Thorax. 2011;66:937-41.

29.   Myers JB, Slovis CM, Eckstein M, et al. Evidence-based performance measures for emergency medical services systems: a model for expanded EMS benchmarking. Prehosp Emerg Care. 2008;12:141-51.

30.   Dobson T, Jensen JL, Karim S, Travers AH. Correlation of paramedic administration of furosemide with emergency physician diagnosis of congestive heart failure. J Emerg Primary Health Care. 2009;7.

31.   Eckstein M, Suyehara D. Ability of paramedics to treat patients with congestive heart failure via standing field treatment protocols. Am J Emerg Med. 2002;20:23-5.

Figure Legends

Figure 1 Flow chart of patient selection for patients identified as asthma or COPD by paramedics

Figure 1 Flow chart of patient selection for patients identified as asthma or COPD by paramedics

129,996 patients transported by SJA-WA in the metropolitan area with a problem code recorded (transfers to ED from other non-ED hospitals excluded)

7,130 patients with respiratory conditions other than asthma and COPD

9,701 patients transported with respiratory condition

Excluded
- 207 patients not transferred to hospital areas other than ED
- 109 inter ED hospital transfers
- 3 rural transports

2,571 patients with asthma or COPD

1,117 patients with asthma

1,135 patients with COPD

1,067 asthma patients with EDIS record
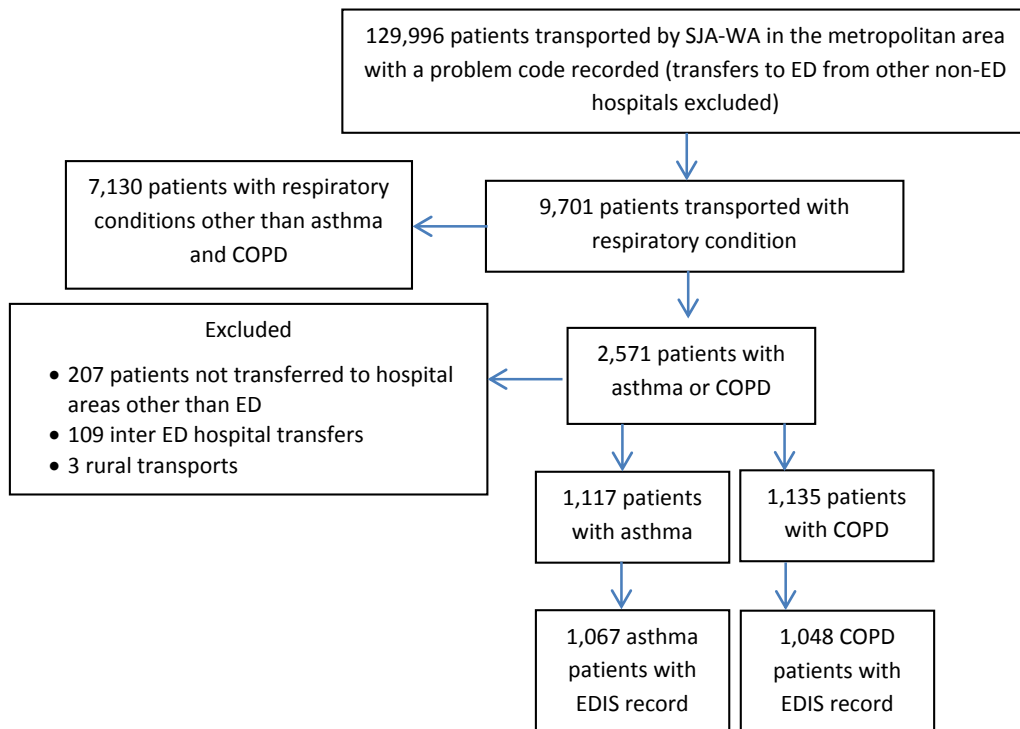
1,048 COPD patients with EDIS record

Table 1 Cohort characteristics (n=2,252) for patient episodes identified by paramedics as Asthma or Chronic Obstructive Pulmonary Disease (COPD)

Characteristic	Asthma N=1117	COPD N=1135	'p' value
Mean age >=16 (SD) years	59 (21)	73 (12)	<0.001
Mean age <16 (SD) years	5.9 (4.0)	5.6 (3.3)	0.82
Median age (IQR) years	51 (22-73)	74 (67-82)	<0.001
10-year age group			<0.001
<20	264 (24)	16 (1)	
20-<30	72 (6)	3 (0.3)	
30-<40	72 (6)	3 (0.3)	
40-<50	136 (12)	38 (3)	
50-<60	121 (11)	57 (5)	
60-<70	122 (11)	269 (24)	
70-<80	157 (14)	373 (33)	
80-<90	145 (13)	327 (29)	
>=90	28 (3)	49 (4)	
Females (%)	57	46	<0.001
Urgency(%)[a][b]			0.62
1. Resuscitation (immediate)	108 (10)	9	
2. Emergency (within 10 minutes)	579 (52)	55	
3. Urgent (within 30 minutes)	378 (34)	33	
4. Semi-urgent (within 60 minutes)	3 (0.3)	3 (0.3)	
5. Non-urgent (within 120 minutes)	0.1	0.1	
Emergency Department discharge destination [c]			<0.001
Admissions			
• ED observation ward or short stay ward	120 (11)	61 (5)	<0.001
• Ward	560 (52)	803 (76)	<0.001
• Transferred to another hospital	27 (2)	34 (3)	0.33
Discharges			
• Discharged	341 (32)	137 (13)	<0.001
• Did not wait, left at own risk, discharged against medical advice	21 (2)	7 (1)	0.01
• Died in ED [d]	3 (0.3)	8 (1)	0.12

Mean time from time call received to arrival at hospital (SD) minutes	43.9 (13.6)	45.7 (14.3)	0.003
Mean number of patients transported per month, May to November (cooler months) versus December to April (warmer months)	126 versus 65	110 versus 73	p<0.001
Time of day			<0.001
• 0001-0600 hours	226 (20%)	178 (16%)	
• 0600---1200 hours	299 (27%)	399 (35%)	
• 1200-1800 hours	270 (24%)	329 (29%)	
• 1800-2400 hours	322 (29%)	229 (20%)	
Respiratory symptoms[e]			
• Wheeze	961 (86%)	621 (55%)	<0.001
• Cough	538 (48%)	536 (47%)	0.63
• Accessory muscle use	266 (24%)	400 (26%)	0.27
• Speech			
o Speak full sentences	163 (15%)	161 (14%)	0.79
o Short sentences	121 (11%)	112 (10%)	0.48
o Words	112 (10%)	95 (8%)	0.19
o Could not speak at all	37 (3%)	37 (3%)	1.00
Medications			
Oxygen [f]	985 (91%)	1,056 (95%)	<0.001
Bronchodilator [g]	779 (84%)	406 (36%)	<0.001
Number of patients with wheeze who received bronchodilator [g]	745 (78%)	356 (57%)	<0.001

[a] percentages may not add up to 100% because of rounding

[b] 3 patients missing in asthma group

[c] asthma patients n=1072 (missing 45) patients; COPD 1050 (missing 85) patients transported to a hospital that did not use the emergency department information system

[d] no children < 16 years died

[e] patients may have more than one respiratory symptom

[f] 34 patients missing in asthma group and 20 patients missing COPD group

[g] 926 patients asthma group and 914 patients COPD group

[h] 841 patients asthma group and 550 patients COPD group

Table 2. Changes in physiological parameters: mean peripheral oxygen saturation (SpO$_2$), respiratory rate (RR), heart rate (HR) and systolic blood pressure, initial and prior to arrival at the Emergency Department (ED), for asthma and COPD groups.

	Asthma n=1117		COPD n=1135	
	Initial value recorded	Prior to arrival at ED	Initial value recorded	Prior to arrival at ED
SpO$_2$ % [a]	93	97	88	95
Respiratory rate - breaths per minute	30	26	30	26
Heart rate - beats per minute	109	106	101	98
Systolic blood pressure - mmHg	136	133	140	137

Missing patients - oxygen saturation [a]

Initial: 79 (7%) asthma patients and 72 (6%) COPD patients
Pre-ED 86 (8%) asthma patients and 80 (7%) COPD patients

Number of patients respiratory rate [b]

Initial 45 (4%) asthma patients and 43 (4%) COPD patients
Pre-ED 46 (4%) asthma patients and 43 (4%) COPD patients

Number of patients heart rate [c]

Initial 43 (4%) asthma patients and 43 (4%) COPD patients
Pre-ED 45 (4%) asthma patients and 44 (4%) COPD patients

Number of patients systolic blood pressure [d]

Initial: 262 (23%) asthma patients and 124 (11%) COPD patients
Pre-ED 365 (33%) asthma patients and 274 (24%) COPD patients

Table 3 The Emergency Department (ED) discharge diagnoses for patients identified by ambulance paramedics as asthma (n=1,067) or COPD (n=1,048)

ED Discharge diagnosis	ED discharge diagnosisICD-10-AM code	Number of patients identified as Asthma by ambulance paramedics N=1067		Number of patients identified as COPD by ambulance paramedics N=1048	
		N	%	N	%
Respiratory		**898**	**84.2**	**860**	**82.1**
COPD; COPD with acute exacerbation, unspecified; infective exacerbation of CAL; non-infective exacerbation of CAL; Bronchitis, not specified acute or chronic	J44.9, J44.1, J40	204	19.1	599	57.2
Asthma, unspecified; rhinitis, allergic with asthma; chronic asthma; bronchitis, acute with asthma; chronic airflow limitation with acute asthma; COPD with acute asthma; acute severe asthma; Status asthmaticus	J45.9, J46	433	40.6	31	3.0
Pneumonia with influenza; pneumonia, viral; pneumonia, lobar; pneumonia, bacterial; pneumonia, atypical	J10.0, J12.9, J13, J15.9, J18.8, J18.9	65	6.1	80	7.6
Chest infection; unspecified acute lower respiratory tract infection	J22	20	1.9	14	1.3
Acute pharyngitis, unspecified; croup; acute upper respiratory tract infection, unspecified	J02.9; J05.0; J06.9	45	4.2	9	0.9
Acute bronchiolitis, unspecified	J21.9	5	0.5	0	0.0
Bronchiectasis	J47	3	0.3	5	0.5
Asthma due to inhalation of fumes; chlorine gas poisoning; Other specified gases, fumes, vapours	J68.3, T59.4, T59.8	4	0.4	1	0.1
Aspiration pneumonitis, pneumonia	J69.0	3	0.3	1	0.1
Pulmonary oedema	J81	1	0.1	6	0.6
Other interstitial pulmonary diseases with fibrosis	J84.1	3	0.3	8	0.8
Pleural effusion not else classified	J90	1	0.1	12	1.1
Other spontaneous pneumothorax; pneumothorax, acute	J93.1	3	0.3	2	0.2
Respiratory failure	J96.9	4	0.4	9	0.9
Pulmonary atelectasis	J98.1	0	0.0	1	0.1
Other unspecified respiratory disorders	J98.8	5	0.5	6	0.6
Respiratory decompensation	J98.9	0	0.0	1	0.1
Pleurisy	R09.1	0	0.0	1	0.1

Respiratory symptoms: haemoptysis; cough; orthopnoea; stridor; hyperventilation not psychogenic; breathlessness, dyspnoea, respiratory distress, shortness of breath, wheezing	R04.2, R05, R06.0, R06.1, R06.4, R06.8	99	9.3	74	7.1
Cardiovascular		**67**	**6.3**	**103**	**9.8**
Infection, non-respiratory		**23**	**2.2**	**19**	**1.8**
Mental health issue		**17**	**1.6**	**4**	**0.4**
Gastrointestinal		**7**	**0.7**	**9**	**0.9**
Other		**55**	**5.2**	**53**	**5.1**

Table 4. The problem code recorded by paramedics for those patients who received an Emergency Department (ED) discharge code of asthma or COPD

Presenting problem identified by paramedics	ED discharge diagnosis of Asthma n=653		ED discharge diagnosis of COPD n=1,551	
	n	%	n	%
Asthma	433	66.3	183	11.8
COPD	30	4.6	599	38.6
Other respiratory	132	20.2	531	34.2
• Pulmonary embolism	0	0	1	0.2
• Non-cardiac APE	3	2.3	28	5.3
• Pneumothorax	1	0.8	3	0.6
• Respiratory tract infection	63	47.7	267	50.3
• Aspiration/ regurgitation	0	0	2	0.4
• Upper airway obstruction	0	0	2	0.4
• Respiratory arrest	0	0	1	0.2
• Other	65	49.2	227	42.7
Allergy (urticaria)	4	0.6	2	0.1
Cardiac	16	2.5	95	6.1
Abdominal	4	0.6	11	0.7
Trauma	1	0.2	10	0.6
Neurological	4	0.6	10	0.6
Infection	1	0.2	12	0.8
Musculoskeletal	1	0.2	9	0.6
Geriatric/debility	2	0.3	5	0.3
Psychosocial	3	0.5	2	0.1
Endocrine/metabolic	0	0.0	3	0.2
Drug/alcohol related	2	0.3	1	0.1
Urology	1	0.2	5	0.3
Ear, Nose and Throat	1	0.2	1	0.1
Hyperthermia	0	0.0	2	0.1
Unspecified illness	18	2.8	70	4.5

n= number of patients   % = percentage   APE = Acute Pulmonary Edema