Variation in treatment of acute childhood wheeze in Emergency Departments of the United Kingdom and Ireland: an international survey of clinician practice.

Lyttle MD, O' Sullivan R, Doull I, Hartshorn S, Morris I, Powell CVE

Mark D Lyttle
Consultant in Paediatric Emergency Medicine and Senior Research Fellow,
Academic Department of Emergency Care,
Bristol Royal Hospital for Children and the University of the West of England

Ronan O'Sullivan
Department of Emergency Medicine, Cork University Hospital, Cork, Ireland;
School of Medicine, University College Cork, Ireland
Paediatric Emergency Research Unit (PERU), National Children's Research Centre, Dublin 12, Ireland

Iolo Doull
Department of Paediatric Respiratory Medicine and Specialist Cystic Fibrosis Centre
Children's Hospital for Wales, Cardiff

Stuart Hartshorn
Consultant in Paediatric Emergency Medicine, Birmingham Children's Hospital NHS Foundation Trust

Ian Morris
ST6 Paediatric Trainee, Children's Hospital for Wales, Wales Deanery

Colin VE Powell
Consultant in General Paediatrics, Department of Child Health, Children's Hospital for Wales, Cardiff
Senior Lecturer in Child Health, Institute of Molecular and Experimental Medicine, Cardiff University School of Medicine, Cardiff

ON BEHALF OF PERUKI

Word count: 1970

Keywords:
Paediatric, asthma, wheeze, therapy

Corresponding author
Mark D Lyttle
Emergency Department
Bristol Royal Hospital for Children
Bristol
United Kingdom
BS2 8BJ
Mark.lyttle@uhbristol.nhs.uk

ABSTRACT

Objective

National clinical guidelines for childhood wheeze exist, yet despite being one of the commonest reasons for childhood Emergency Department (ED) attendance, significant variation in practice occurs in other settings. We therefore evaluated practice variations of ED clinicians in the UK and Ireland.

Design

Two-stage survey undertaken in March 2013. Stage one examined department practice, and stage two assessed ED consultant practice in acute childhood wheeze. Questions interrogated pharmacological and other management strategies, including inhaled and intravenous (IV) therapies.

Setting and participants

Member departments of Paediatric Emergency Research in the United Kingdom and Ireland (PERUKI) and ED consultants treating children with acute wheeze.

Results

30 EDs and 183 (81%) clinicians responded. 29 (97%) EDs had wheeze guidelines and 12 (40%) had care pathways. Variation existed between clinicians in dose, timing and frequency of inhaled bronchodilators across severities. When escalating to IV bronchodilators 99 (54%) preferred salbutamol first line, 52 (28%) magnesium sulphate ($MgSO_4$) and 27 (15%) aminophylline. 87 (48%) administered IV bronchodilators sequentially and 30 (16%) concurrently, with others basing approach on case severity. 146 (80%) continued inhaled therapy after commencing IV bronchodilators. Of 170 who used IV salbutamol, 146 (86%) gave rapid boluses, 21 (12%) a longer loading dose, and 164 (97%) an ongoing infusion, each with a range of doses and durations. Of 173 who used IV $MgSO_4$, all used a bolus only. 41 (24%) used non-invasive ventilation.

Conclusions

Significant variation in ED consultant management of childhood wheeze exists despite the presence of national guidance. This reflects the lack of evidence in key areas of childhood wheeze and emphasises the need for further robust multi-centre research studies.

INTRODUCTION

Asthma is the commonest chronic medical condition of childhood, with rates in the UK and Ireland amongst the highest in the world.[1-4] It remains a significant cause of mortality and morbidity and the NHS spends £1 billion on asthma annually, with costs higher in children than adults.[4] In the context of increasing childhood admission rates asthma accounts for 64-73% of those for chronic conditions, and wheezing is one of the commonest reasons for hospitalisation overall.[5,6] Whilst there is variation in severity and pathophysiology with overlap between asthma and viral induced wheeze (VIW), wheezing is consistently identified as a leading presentation to Emergency Departments (EDs) in other healthcare settings.[7-8]

National guidelines and quality standards exist for the management of wheezing.[9-11] Many recommendations derive from high quality studies, but some are based on lesser evidence or expert consensus. Paucity of evidence results in guidance which cannot provide detail in some areas, potentially leading to individual interpretation and practice variation as in other systems.[12,13] This may contribute to differences in admission rates, bed days and length of stay across English primary care trusts.[5]

Practice variation may result in poorer health outcomes, unnecessary medical treatments, and increased strain on the healthcare system.[14] Determining baseline practice and identifying variation in wheeze management will highlight areas where implementing existing guidance could improve care, and identify key areas for future research.

We aimed to determine whether variation exists in the clinical care of acute severe childhood wheeze across the UK and Ireland through a survey completed by senior clinical decision makers. The survey examined differences in approach to severe wheeze, and the use of inhaled, oral, and intravenous (IV) therapies.

METHODS

Paediatric Emergency Research in the United Kingdom and Ireland (PERUKI)[15] sites participated in a two-stage survey via Bristol Online Surveys.™ Stage one assessed department practice, including information on clinical practice guidelines (CPG), care pathways (CP), and site-specific features including admission location. In stage two consultants provided information on personal practice including assessment and management, inhaled and IV bronchodilators, escalation of care, and alternative treatments. Returns were collated using Microsoft Excel 2010 and descriptive analysis undertaken. PERUKI is a research collaborative of individuals and departments from England, Ireland, Northern Ireland, Scotland and Wales which comprises paediatric-specific and mixed adult and paediatric EDs that represent secondary and tertiary care.[15] Further information is available at www.peruki.org.

ETHICS

This was confirmed as service evaluation by the research design service at the study lead site.

RESULTS

Thirty centres participated, 183/226 (81%) consultants completed the survey. Responses were obtained from a range of regions, department types and specialties *(Table 1).* Twenty-nine (96.7%) departments had a CPG, 12 (40%) had a CP. All CPGs reflected national guidance with variations mainly in drug and dose selection. Twenty (66.7%) described specific admission locations for children receiving IV therapy. In 15 (75%) this included a Paediatric High Dependency Unit, in 7 (35%) an inpatient ward. In 5 (25%) this included Paediatric Intensive Care (PIC) with 2 mandating PIC if on IV salbutamol.

Assessment and general approach

Most clinicians (113, 61.7%) adopt the same approach in all children 1 year and older. 70 (38.3%) modify clinical care depending on whether the diagnosis is asthma or VIW, with several stating they are less likely to prescribe steroids for VIW. Minor variations exist in intensity of inhaled bronchodilators and timing of IV therapy. Most clinicians use BTS/SIGN criteria[9] to assess severity, the most common being "inability to complete sentences, too breathless to talk/feed" (180, 98.4%), and hypoxia (177, 96.7%). 106 (57.9%) class episodes as severe if "more than one (but not necessarily all) are present". 156 (85.2%) had a peak expiratory flow rate meter (PEFR), but only 22 (14.1%) always use this to assess severity. Those who "sometimes" use PEFR meters do so in "older children", or those with known PEFR. *(Table 2)*

Inhaled bronchodilators

All clinicians use inhaled salbutamol. 117 (63.9%) use nebulisers in the presence of hypoxia, and metered dose inhalers (MDI) in its absence, most commonly giving three doses initially followed by reassessment. 173 (94.6%) use ipratropium bromide at least sometimes; 75 (43.4%) do so immediately, 67 (38.7%) if no response to the first salbutamol dose. Dosages of both vary in general increasing with age, though in some cases the same dose is given across all age ranges, most noticeably in salbutamol MDI. *(Table 3)*

Steroids

All use prednisolone 1-2 mg/kg as the oral steroid of choice; none use dexamethasone. 181 (98.9%) use hydrocortisone as the IV steroid of choice. 73 (39.8%) use IV steroids "only if oral is not tolerated", 46 (25.1%) use IV "when giving IV bronchodilators regardless of whether oral steroid has been given", and 27 (14.8%) use IV "when giving IV bronchodilators if oral steroid has not been given". None use inhaled steroids acutely.

Escalating to intravenous therapy

170 (92.9%) escalate for deteriorating severe wheeze, 166 (90.7%) for life-threatening wheeze, and 141 (77%) if there is no response to inhaled bronchodilators. 167 (91.8%) require more than one criterion; 172 (93.9%) use these on a case-by-case basis. Low numbers use set criteria such as time since starting or total accrued dose of inhaled therapy. 99 (54.1%) use salbutamol as first line IV therapy, 52 (28.4%) magnesium sulphate and 27 (14.8%) aminophylline. 87 (47.5%) give these sequentially depending on response, 30 (16.4%) give them concurrently. 146 (79.8%) continue inhaled bronchodilators while on IV therapy.

Intravenous bronchodilators

170 (92.9%) use IV salbutamol, though in a range of strategies and doses. For the purposes of this study a continuous infusion was defined as a "weight based *rate* (micrograms/kg/min) with no fixed endpoint"; a loading dose as a "weight based *rate* (micrograms/kg/min) given for a set period of time"; and a bolus as a "weight based *dose* (micrograms/kg)". Five general strategies are employed, the most common being "bolus and continuous infusion". For boluses, four doses and seven durations were described. There were ten different continuous infusion rates with over tenfold variation between the lowest and highest. *(Table 4)*

142 (77.6%) use aminophylline, with 127 (89.4%) giving "bolus and infusion". 132 (93%) give a bolus, of which 120 (91%) give 5mg/kg. 5 (3.8%) give each of 6mg/kg or 7.5mg/kg and one 10mg/kg. 120 (91%) give the bolus over 20-30 minutes. Nine continuous infusion rates were described, all at 1mg/kg/hr or less, with 1mg/kg/hr being the most common (68.6%).

173 (94.5%) use magnesium sulphate; all used a bolus with no subsequent infusion. 141 (81.5%) give 40-50mg/kg over 20-30 minutes.

Other therapies

116 (62%) stated that more invasive therapy including intubation was outside their scope of practice. Of 67 (36.7%) who intubate, 62 (93%) use ketamine for induction of anaesthesia. 41 (24%) use non-invasive ventilation, and 4 (2%) use Heliox. Other therapies included adrenaline (4, 2.2%), high flow oxygen (4, 2.2%), calm environment (3, 1.6%), DNAse (2, 1.1%), physiotherapy (1, 0.5%), total histamine blockade (1, 0.5%), intravenous ketamine (1, 0.5%), or monteleukast (1, 0.5%).

DISCUSSION

In establishing baseline practice across a range of sites and clinicians in the UK and Ireland, we have demonstrated variation in management of acute severe childhood wheeze. This exists in assessment and treatment, especially inhaled and IV bronchodilator selection, dosage and frequency, reflecting the paucity of evidence underpinning recommendations.

CPGs such as BTS/SIGN national guidance[9] assist clinicians in healthcare decisions and are underpinned by best available evidence. CPs translate and clarify CPGs, including timing and dosage of treatment, and as a result they streamline management plans across handovers, reduce variability and errors in care, prompt use of best evidence, improve education, and potentially shorten length of stay.[14,16] The CPGs we collected were based on BTS/SIGN guidance[9] varying mainly in bronchodilator selection/dosage and system processes. 40% had a wheeze CP, representing an opportunity to share best practice. In future CPs should capitalise on available technology and be used across all healthcare settings, including primary care, EDs, and inpatient settings.

Variations in inhaled therapy included delivery method, drug selection, dosage and frequency. Most used MDIs in children with no oxygen requirement, though one-fifth always used nebulisers. Most gave the BTS/SIGN salbutamol MDI dose, though some tended towards lower doses in younger children. Ipratropium bromide use is more varied as in other healthcare systems, perhaps due to conflicting literature.[13] However in a recent systematic review children treated with ipratropium

bromide and salbutamol compared to salbutamol alone have lower rates of hospital admission, nausea and tremor, and greater improvement in lung function.[17]

More than half used salbutamol as the first-line IV agent while fewer preferred magnesium sulphate or aminophylline, suggesting equipoise regarding which is most efficacious. To investigate this we asked participants whether they would enrol patients to a randomised controlled trial allocating salbutamol, aminophylline or magnesium sulphate as the first line IV agent, to which 148 (80.9%) responded positively.

Uncertainty exists regarding the optimal dose and administration strategy, especially for salbutamol, contributed to by numerous dosage terminologies. We defined these terms through reference to available CPGs, though some would reserve the term "loading" for a dose which is followed by continuous infusion and "bolus" for a dose not followed by an infusion. There is threefold and tenfold variation in bolus doses and continuous infusion rates respectively, and infrequent usage of loading doses, reflecting the paucity of evidence on the pharmacokinetics of IV salbutamol.[18] BTS/SIGN guidelines suggest a bolus of 15micrograms/kg over 10 minutes, followed by an infusion of 1-5micrograms/kg/minute if required with no loading dose described. Key studies suggest a bolus of 15micrograms/kg[19] or a loading dose of 5micrograms/kg/minute for one hour.[20,21] Respectively these are equivalent to 1.5micrograms/kg/minute[19] (the lower end of guidance), or a total dose of 300micrograms/kg[20,21] (20 times that suggested by guidance). In further analysing the dose given prior to any continuous infusion, there is 60-fold variation between a single 5micrograms/kg dose, and a dose of 5micrograms/kg/minute given for one hour.

Knowledge translation may take several years,[14] though, recent evidence may result in practice change. For example, a recent trial of inhaled magnesium sulphate reported improvement in a subset of children,[22,23] and oral dexamethasone may provide an alternative to prednisolone, appearing at least as effective and more palatable.[24-29]

Variation may be reduced by dissemination of research and sharing of best practice across networks. There is therefore a need for rigorously conducted multicentre research on topics including development of a minimum data set, identification of wheeze phenotypes, and the optimal strategies for treatment of acute severe wheeze. These include studies on inhaled bronchodilators in the first hour, IV bronchodilator selection, dexamethasone compared to prednisolone, and other therapies such as inhaled steroids. Several of these were identified as important to clinicians through a research prioritisation exercise performed by PERUKI.[30] Only in answering these questions can variation be reduced and clinical care improved in this important, common, and potentially life-threatening condition.

LIMITATIONS

This study relied on accurate reporting by individual clinicians. However our approach allowed us to analyse practice of a large number of consultant clinicians from a number of regions, and our high response rate means we are confident we have identified key variations. We did not focus on a wider range of practitioners, but this is reasonable given many EDs have a consultant-delivered service. We have identified variation in practice, but cannot determine best practice. However our methods allow assessment of variation, outline areas for implementation, and highlight areas in which there is a paucity of evidence. We assessed a range of practice points in a short time and identified areas for investigation, the first of which has been completed[31]

CONCLUSIONS

Variation exists in the assessment and treatment of acute severe childhood wheeze across the UK and Ireland. Key areas include inhaled and IV bronchodilator selection, dosage and frequency, reflecting the paucity of evidence. We have identified opportunities for best practice dissemination and highlighted clinical questions which must be answered by robust multicentre research to improve clinical care of this common childhood condition.

COLLABORATORS

The following acted as site lead investigators for this study and were responsible for data collection, sharing guidelines and department procedures, and ensuring completion of surveys: J Barling, University Hospital Southampton NHS Foundation Trust; J Bayreuther, Lewisham and Greenwich NHS Trust, London; C Bevan, Royal Alexandra Children's Hospital, Brighton; T Bolger, Tallaght Hospital, Dublin; D Burke, Sheffield Children's NHS Foundation Trust; V Choudhery, Royal Hospital for Sick Children, Glasgow; J Criddle, Evelina Hospital, London; E Dalzell, Royal Belfast Hospital for Sick Children, Belfast; F Davies, University Hospitals Leicester NHS Trust; C Dieppe, Nottingham Children's Hospital, Nottingham; J Grice, Alder Hey Hospital, Liverpool; G Hadley, St Mary's Hospital, London; S Hartshorn, Birmingham Children's Hospital, Birmingham; A Kidd, Royal Hospital for Sick Children, Edinburgh; I Maconochie, St Mary's Hospital, London; R McNamara, Temple Street Children's University Hospital, Dublin; M Mitchelson, Royal Aberdeen Children's Hospital, Aberdeen; N Mullen, City Hospitals Sunderland Foundation Trust; J Mulligan, University Hospital Crosshouse, Kilmarnock; R O'Sullivan, Cork University Hospital, Cork; R O'Sullivan, Our Lady's Children's Hospital, Crumlin; A Parikh, Royal London Hospital, Barts Health NHS Trust; K Potier, Royal Manchester Children's Hospital, Manchester; S Potter, Bristol Royal Hospital for Children, Bristol; Z Roberts, Children's Hospital for Wales, Cardiff; G Robinson, Royal Derby Hospital, Derby; J Ross, Chelsea and Westminster Healthcare NHS Foundation Trust, London; A Rowland, North Manchester General Hospital, Manchester; JE Smith, Derriford Hospital, Plymouth; S Wong, Royal Free London NHS Foundation Trust, London; P Younge, North Bristol Trust, Bristol.

WHAT IS KNOWN ON THIS TOPIC

Childhood asthma is the most common chronic medical condition of childhood, and one of the most common reasons for attendance to urgent and emergency care and admission to hospital.

National guidance exists for the management of acute childhood wheeze, though there is a paucity of evidence in some areas of practice.

Variation in treatment and investigation of acute childhood wheeze has been demonstrated in other settings, and variation in hospitalisation rates across primary care trusts exists in our setting.

WHAT THIS STUDY ADDS

Across the UK & Ireland variation exists in the treatment of acute severe childhood wheeze, especially in inhaled and intravenous bronchodilator selection, dosage and frequency.

We have identified key areas of variation, which require further exploration to determine their impact at the patient interface.

There is an urgent need for multicentre studies to address the paucity of evidence for management of severe childhood wheeze to inform recommendations.

REFERENCES

1. Asthma UK: facts and FAQs. Available at http://www.asthma.org.uk/asthma-facts-and-statistics. Accessed 2nd March 2014.

2. Facts & Figures on Asthma. Available at http://www.asthma.ie/node/164. Accessed 2nd March 2014.

3. Manning PJ, Goodman P, O'Sullivan A, Clancy L. Rising prevalence of asthma but declining wheeze in teenagers (1995-2003): ISAAC protocol. *Ir Med J. 2007* Dec;100(10):614–5.

4. Paton J. Asthma: standards of care. *Arch Dis Child*. 2013;98:928-929.

5. Child and Maternal Health Intelligence Network, Asthma Disease Management Information Toolkit. Available at http://atlas.chimat.org.uk/IAS/dmit. Accessed 2nd March 2014.

6. Gill PJ, Goldacre MJ, Mant D, Heneghan C, Thomson A, Seagroatt V, Harnden A. Increase in emergency admissions to hospital for children aged under 15 in England, 1999–2010: national database analysis. *Arch Dis Child.* 2013;98(5):328–34.

7. Alpern ER, Stanley RM, Gorelick MH, Donaldson A, Knight S, Teach SJ, Singh T, Mahajan P, Goepp JG, Kuppermann N, Dean JM, Chamberlain JM for the Pediatric Emergency Care Applied Research Network. Epidemiology of a pediatric emergency medicine research network: the PECARN Core Data Project. *Pediatr Emerg Care* 2006;22(10):689–99.

8. Acworth J, Babl F, Borland M, Ngo P, Krieser D, Schutz J, Pitt R, Cotterell E, Jamison S, Neutze J, Lee M. Patterns of presentation to the Australian and New Zealand Paediatric Emergency Research Network. *Emerg Med Australas* 2009;21(1):59–66.

9. British Thoracic Society/Scottish Intercollegiate Guidelines Network. British Guideline on the Management of Asthma. 2012. Available from: http://www.brit-thoracic.org.uk/Portals/0/Guidelines/AsthmaGuidelines/sign101. Accessed 2nd March 2014.

10. National Institute for Health and Care Excellence. Quality Standard (QS25) - Asthma (including children and young people). 2013. Available at http://guidance.nice.org.uk/QSD/27. Accessed 2nd March 2014.

11. Papadopoulos NG, Arakawa H, Carlsen K-H, Custovic A, Gern J, Lemanske R, et al. International consensus on (ICON) pediatric asthma. *Allergy* 2012;67(8):976–97.

12. Stanley RM, Teach SJ, Mann NC, Alpern ER, Gerardi MJ, Mahajan PV, Chamberlain JM for the Pediatric Emergency Care Applied Research Network. Variation in ancillary testing among pediatric asthma patients seen in emergency departments. *Acad Emerg Med* 2007;14(6):532–8.

13. Babl FE, Sheriff N, Borland M, Acworth J, Neutze J, Krieser D, Ngo P, Schutz J, Thomson F, Cotterell E, Jamison S, Francis P. Paediatric acute asthma management in Australia and New Zealand: practice patterns in the context of clinical practice guidelines. *Arch Dis Child* 2008;93(4):307–12.

14. Scott SD, Grimshaw J, Klassen TP, Nettel-Aguirre A, Johnson DW. Understanding implementation processes of clinical pathways and clinical practice guidelines in pediatric contexts: a study protocol. *Implement Sci* 2011;6(1):133.

15. Lyttle MD, O'Sullivan R, Hartshorn S, Bevan C, Cleugh F, Maconochie I on behalf of PERUKI. Pediatric Emergency Research in the UK and Ireland (PERUKI): developing a collaborative for multicentre research. *Arch Dis Child* 2014;archdischild–2013–304998.

16. Cunningham S, Logan C, Lockerbie L, Dunn MJG, McMurray A, Prescott RJ. Effect of an integrated care pathway on acute asthma/wheeze in children attending hospital: cluster randomized trial. *J Pediatr* 2008;152(3):315–20.

17. Griffiths B, Ducharme FM. Combined inhaled anticholinergics and short-acting beta2-agonists for initial treatment of acute asthma in children. *Cochrane Database of Syst Rev* 2013;8:CD000060.

18. Starkey E, Mulla H, Sammons H, Pandya H. Intravenous salbutamol for childhood asthma: evidence based medicine? *Arch Dis Child* (In press).

19. Browne GJ, Trieu L, Van Asperen P. Randomized, double-blind, placebo-controlled trial of intravenous salbutamol and nebulized ipratropium bromide in early management of severe acute asthma in children presenting to an emergency department. *Crit Care Med* 2002;30(2):448–53.

20. Shann F. Dose of intravenous infusions of terbutaline and salbutamol. *Crit Care Med* 2000;28(6):2179–80.

21. Shann F. Intravenous salbutamol. *Pediatr Crit Care Med* 2003;4(1):128.

22. Powell C, Kolamunnage-Dona R, Lowe J, Boland A, Petrou S, Doull I, et al. Magnesium sulphate in acute severe asthma in children (MAGNETIC): a randomised, placebo-controlled trial. *Lancet Respir Med* 2013;1(4):301–8.

23. Powell C, Dwan K, Milan SJ, Beasley R, Hughes R, Knopp-Sihota JA, et al. Inhaled magnesium sulfate in the treatment of acute asthma. *Cochrane Database Syst Rev* 2012;12:CD003898.

24. Cronin J, McCoy S, Nally S, Kennedy U, Crispino-O'Connell G, Walsh S, O'Sullivan R. A Randomised Trial of Dexamethasone Versus Prednisolone in the Treatment of Acute Paediatric Asthma Exacerbations. *Arch Dis Child* 2012(1);97(Suppl 2):A109–A109.

25. Hames H, Seabrook JA, Matsui D, Rieder MJ, Joubert GI. A palatability study of a flavored dexamethasone preparation versus prednisolone liquid in children. *Can J Clin Pharmacol* 2008;15(1):e95–98.

26. Qureshi F, Zaritsky A, Poirier MP. Comparative efficacy of oral dexamethasone versus oral prednisone in acute pediatric asthma. *J Pediatr* 2001;139(1):20–6.

27. Greenberg RA, Kerby G, Roosevelt GE. A comparison of oral dexamethasone with oral prednisone in pediatric asthma exacerbations treated in the emergency department. *Clin Pediatr (Phila)* 2008;47(8):817–23.

28. Altamimi S, Robertson G, Jastaniah W, Davey A, Dehghani N, Chen R, Leung K, Colbourne M. Single-dose oral dexamethasone in the emergency management of children with exacerbations of mild to moderate asthma. *Pediatr Emerg Care* 2006;22(12):786–93.

29. Keeney GE, Gray MP, Morrison AK, Levas MN, Kessler EA, Hill GD, Gorelick MH, Jackson JL. Dexamethasone for Acute Asthma Exacerbations in Children: A Meta-analysis. *Pediatrics* 2014;peds.2013–2273.

30. Hartshorn S, Bevan C, Cleugh F, Lyttle M, Maconochie I, O'Sullivan R. What are the research priorities of paediatric emergency medicine clinicians in the United Kingdom and Ireland? An international survey. *Arch Dis Child* 2014;99(Suppl1):A5-A6.

31. Morris I, Lyttle M, Doull I, O'Sullivan R, Powell C. What intravenous treatment is currently being administered for acute severe wheeze in childhood in emergency departments around the UK and Ireland? *Arch Dis Child* 2014;99(Suppl 1):A39-A40.

TABLES

Table 1: Respondent characteristics

	Number of respondents	% of respondents	Number of sites
Country			
England	134	73.2	20
Scotland	21	11.5	4
Ireland	18	9.8	4
Wales	7	3.8	1
N Ireland	3	1.6	1
Department			
Generic Emergency Department	73	39.9	
General Paediatrics/Child Health*	72	39.3	
Children's Emergency Department	38	20.8	
Specialty			
General Paediatrics	63	34.4	
Paediatric Emergency Medicine	60	32.8	
Emergency Medicine (EM)	28	15.3	
EM with Paediatric subspecialty interest	18	9.8	
Consultant in Respiratory Paediatrics	7	3.8	
Other†	7	3.8	

*General paediatrics/child health includes those with other paediatric subspecialty interests

†Other includes those with additional paediatric subspecialty interests

Table 2: Assessment of acute wheeze

	Number	%
Do you assess and manage asthma and acute viral induced wheeze differently?		
No	113	61.7
Yes	70	38.3
Which of the following do you use to classify episode as severe?*		
Can't complete sentences/too breathless to talk or feed	180	98.4
Low oxygen saturations	177	96.7
High respiratory rate	152	83.1
High pulse rate	131	71.6
Do you class the episode as severe if?		
More than one, not necessarily all are present	106	57.9
Any are present in isolation	72	39.3
Only if all are present	5	2.7
Does your department have a Peak Expiratory Flow Rate meter?		
Yes	156	85.2
No	16	8.7
Don't know	11	6.0
If you have one, do you use it to determine severity?		
Sometimes	90	57.7
No	44	28.2
Yes	22	14.1

*values given in survey as per British Thoracic Society guidance

Table 3 – dosage regimes of inhaled salbutamol and ipratropium

	<2 years n (%)		**2-<5 years n (%)**		**5-<12 years n (%)**		**≥12 years n (%)**		**Same for all n (%)**
Salbutamol MDI (number of puffs)									
2	1	(0.6)	0	(0)	0	(0)	0	(0)	112 (60.2)
4	2	(1.2)	2	(1.2)	0	(0)	0	(0)	
5	12	(7.4)	9	(5.4)	1	(0.6)	1	(0.6)	
6	20	(12.3)	16	(9.6)	6	(3.6)	2	(1.2)	
8	2	(1.2)	4	(2.4)	0	(0)	0	(0)	
10	112	(69.1)	125	(75.3)	148	(89.2)	146	(89.6)	
12	1	(0.6)	1	(0.6)	3	(1.8)	6	(3.7)	
Other	12	(7.4)	9	(5.4)	8	(4.8)	8	(4.9)	
Salbutamol nebuliser (dose in milligrams)									
1.25	3	(1.8)	0	(0)	0	(0)	0	(0)	16 (32.3)
2.5	152	(90.5)	146	(84.4)	7	(4)	2	(1.2)	
5	7	(4.2)	20	(11.6)	155	(89.1)	166	(96)	
Other	6	(3.6)	7	(4)	12	(6.9)	5	(2.9)	
Ipratropium MDI (number of puffs)									
1	3	(5.7)	3	(5.8)	0	(0)	0	(0)	34 (19.5)
2	24	(45.2)	22	(42.3)	17	(34)	16	(32)	
4	14	(26.4)	15	(28.8)	13	(26)	12	(24)	
5	2	(3.8)	2	(3.8)	1	(2)	1	(2)	
6	3	(5.7)	5	(9.6)	5	(10)	7	(14)	
8	0	(0)	0	(0)	7	(14)	8	(16)	
10	1	(1.9)	1	(1.9)	2	(4)	2	(4)	
Other	6	(11.3)	4	(7.7)	5	(10)	4	(8)	
Ipratropium nebuliser (dose in micrograms)									
62.5	12	(7.7)	1	(0.6)	0	(0)	0	(0)	27 (15.5)
125	58	(37.2)	42	(26.9)	5	(3.2)	2	(1.3)	
250	73	(46.8)	104	(66.7)	97	(61.8)	65	(41.4)	
500	6	(3.8)	2	(1.2)	49	(31.2)	87	(55.4)	
Other	7	(4.5)	7	(4.5)	6	(3.8)	3	(1.9)	

Note: Figures in parentheses represent percentage based on number of people who give a dose in the age group

MDI: Metered Dose Inhaler

Table 4 – Intravenous salbutamol regimes

	Number	%
Which regimen do you use for intravenous salbutamol		
Bolus then continuous infusion	126	68.3
Loading dose then continuous infusion	12	6.6
Continuous infusion	12	7.1
Bolus only	5	2.7
Bolus, then loading dose, then continuous infusion	7	3.8
Don't use	13	7.1
Other	8	4.4
Do you use a bolus dose?		
Yes	146	85.9
No	24	14.1
What dose do you give as a bolus?		
15 micrograms/kg	89	61
5 micrograms /kg if <2 yr, 15 micrograms/kg if ≥2 yr	54	37
5-10 micrograms/kg	1	0.7
5 micrograms/kg	2	1.4
Duration of bolus dose (minutes)		
10	68	46.6
5	38	26
15	15	10.3
20	12	8.2
5-10	9	6.2
5-15	2	1.4
30	2	1.4
Do you give a loading dose		
No	149	87.6
Yes	21	12.4
What loading dose do you use?		
5 micrograms/kg/min	21	100
What duration do you load over? (minutes)		
60	16	76.2
60-120	5	23.8
Do you use a continuous infusion?		
Yes	164	96.5
No	6	3.5
What dose regimen do you use (micrograms/kg/min)		
1-5	76	46.3
1-2	52	31.7
1	12	7.3
0.5-6	9	5.5
2-5	9	5.5
1-3	2	1.2
0.5-1	1	0.6
0.6-1	1	0.6
1-6	1	0.6
5	1	0.6