TITLE PAGE

Defining significant childhood illness and injury in the Emergency Department

- a consensus of UK and Ireland expert opinion

Authors' affiliations

Peter John Lillitos. Email: plillitos@doctors.org.uk

Consultant Paediatrician

[1] Royal Hospital for Sick Children, Sciennes Road, Edinburgh, EH9 1LF, UK.

Mark D Lyttle. Email: mdlyttle77@gmail.com

Consultant & Senior Research Fellow in Paediatric Emergency Medicine

[2] Bristol Royal Hospital for Children, Upper Maudlin Street, Bristol, BS2 8BJ, UK.

[3] Academic Department of Emergency Care, University of the West of England, Bristol, BS34 8QZ, UK.

Damian Roland. Email: dr98@leicester.ac.uk

Honorary Associate Professor in Paediatric Emergency Medicine

[4] SAPPHIRE Group, Health Sciences, University of Leicester, University Road, Leicester, LE1 7RH, UK

[5] Paediatric Emergency Medicine Leicester Academic (PEMLA) group, Children's Emergency Department, University Hospitals of Leicester NHS Trust, Infirmary Square, Leicester, LE1 5WW, UK

Colin VE Powell. Email: cpowell@sidra.org

Honorary Professor of Child Health and General Paediatrician

[6] School of Medicine, Cardiff University, Cardiff, CF10 3AT, UK

[7] Senior Attending Physician, Department of Emergency Medicine, Sidra Medicine, Doha, Qatar.

Julian Sandell. Email: julian.sandell@poole.nhs.uk

Consultant Paediatrician

[8] Poole Hospital NHS Trust, Longfleet Road, Poole, Dorset, BH15 2JB, UK

Andrew Rowland. Email: andrew.rowland@pat.nhs.uk

Consultant in Paediatric Emergency Medicine and Honorary Professor (Paediatrics)

[9] The School of Health and Society, The University of Salford, Frederick Road, Salford, M6 6PU, UK

[10] North Manchester General Hospital, The Pennine Acute Hospitals NHS Trust, Delaunays Road, Manchester, M8 5RB, UK

Susan M Chapman. Email: sue.chapman@gosh.nhs.uk

Gulf Regional Clinical Manager for Great Ormond Street Hospital

[11]Great Ormond Street, London, WC1N 3JH, UK

[12] UCL Great Ormond Street Institute for Child Health, WC1N 1EH, UK

Ian Maconochie. Email: i.maconochie@ic.ac.uk

Consultant in Paediatric Emergency Medicine , Adjunct Reader Imperial College

[13] Department of Paediatric Emergency Medicine, Imperial College NHS Trust, Praed Street, London, W2 1NY, UK

On behalf of PERUKI and GAPRUKI

Corresponding author: Peter J Lillitos. Edinburgh Royal Hospital for Sick Children, Sciennes Road, Edinburgh, EH9 1LF, UK. Email: plillitos@doctors.org.uk. Tel: +44 (0)7769675601

Main document word count: 3486 (excluding abstract, tables, figures, references, headings)

Abstract word count: 250

Competing interest statement

All authors have completed the Unified Competing Interest form (available on request from the corresponding author) and declare: no support from any organisation for the submitted work, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.

Transparency declaration:

The lead author (the manuscript's guarantor) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Ethical approval statement:

No formal research ethical approval was required for this study as it was a survey of health professionals identified via established research networks. Participation was deemed as consent.

Funding statement:

This study was not in receipt of funding or sponsorship.

Patient involvement statement:

There was no patient involvement in this study.

What additional unpublished data from the study: there is no unpublished data from this study

Summary boxes:

What is already known on this subject:

- The usefulness of paediatric early warning scores (PEWS) in the emergency department (ED) for identifying the sick child lacks evidence

- Further study in this area has been identified as a research priority by paediatric emergency medicine clinicians

- To date, no standardised definitions of what constitutes significant illness in the ED exists as endpoints to assess these tools

What this study adds:

- UK and Ireland experts in acute and emergency paediatrics have reached consensus on 154 conditions that would be regarded as significant; for 37 conditions consensus was not reached.
- These identified conditions can now be used for future research to investigate the performance of PEWS and other safety systems in the ED setting

ABSTRACT

BACKGROUND: Clarifying whether paediatric-early-warning-scores (PEWS) accurately predict significant illness is a research priority for UK and Ireland paediatric emergency medicine (EM). However a standardised list of significant conditions to benchmark these scores does not exist.

OBJECTIVES: To establish standardised significant illness endpoints for use in determining the performance accuracy of PEWS and safety-systems in Emergency-Departments (ED), using consensus of expert opinion in the UK and Ireland.

DESIGN: Between July-2017 to February-2018, 3 online Delphi rounds established consensus on "significant" clinical conditions, derived from a list of common childhood illness/injury ED presentations. Conditions warranting acute hospital admission in the opinion of the respondent were defined as "significant", using a five-part Likert-scale. Consensus was a-priori ≥80% (positive or negative). 258 clinical conditions were tested.

PARTICIPANTS-&-SETTINGS: Eligible participants were consultants in acute or EM paediatrics, or adult EM, accessed via 53 PERUKI (Paediatric-Emergency-Research-in-the-UK-&-Ireland)'s research collaborative sites, and 27 GAPRUKI (General-and-Adolescent-Paediatric-Research-in-the-UK-&-Ireland) sites, 17 which overlap with PERUKI.

MAIN-OUTCOME-MEASURES: Create a list of conditions regarded as "significant" with ≥80% expert consensus.

RESULTS: 43(68%) of 63 PERUKI and GAPRUKI sites responded; 295 experts were invited to participate. Participants in Rounds-One, Two and Three were 223(76%), 177(60%) and 148(50%) respectively; 154 conditions reached positive consensus as "significant"; one condition reached negative consensus (uncomplicated Henoch–Schönlein purpura); 37 conditions achieved non-consensus.

CONCLUSIONS: A list of significant childhood conditions has been created using UK and Irish expert consensus, for research purposes, for the first time. This will be used as the benchmark endpoint-list for future research into PEWS/safety-systems performance in EDs.

Word count: 250 words

INTRODUCTION

The need to verify whether scoring systems are able to accurately predict severe illness or injury in the Emergency Department (ED), has been highlighted as one of the top research priorities for paediatric emergency medicine in the UK and Ireland[1]. For this reason, there is a need to define significant childhood illness and injury in the ED to facilitate quality research in this area.

BACKGROUND

Early recognition of potential severe illness in children and young people is the focus of clinical care, research, policy-making and public interest[2-4]. Since the 2008 UK Confidential Enquiry into Maternal And Child Health (CEMACH) recommended the introduction of Paediatric Early Warning Scores (PEWS) for in-patient paediatric wards to reduce morbidity and mortality[5], numerous PEWS have been introduced. However no score has yet demonstrated an impact on reducing mortality for hospitalised children[6-8] and their effectiveness in detecting significant illness in the ED lacks firm evidence of efficacy[9]. For ED purposes, most scores have been retrospectively modelled, the endpoints chosen for validation purposes are variable and poorly defined[10], with the studies showing varying accuracy between different scoring systems in identifying the sick child or the child who requires hospital admission[11-14]. In one such study[12] the authors compiled their own list of significant illness definitions, which they then used as a benchmark to assess PEWS performance. It is unknown however whether their list is reflective of a broader group of expert opinion and there is currently no agreed or standardised list of significant paediatric conditions, illnesses or injuries in existence, against which the efficacy of PEWS and the systems around the use of such scores can be measured.

STUDY OBJECTIVES

To facilitate future PEWS research in the ED, this study set out to create a benchmark list defining the significant acute paediatric conditions that warrant an acute hospital admission from the ED, using a consensus of UK and Ireland expert opinion. This list could then be used as a robust endpoint dataset against which to assess the performance of PEWS and other safety scoring systems.

METHODS

Participant recruitment

An online, three-round Delphi survey of paediatric emergency medicine (PEM), general paediatric and emergency medicine (EM) consultants in the UK and Ireland was conducted using the web-based *Smart Survey (smartsurvey.co.uk)* tool. The Delphi period was between July 2017 to February 2018. Each round ran for four weeks, separated by 4-6 weeks to allow analysis and interpretation of responses. The study was led by *Paediatric Emergency Research in the UK & Ireland (PERUKI)*[15] in association with *General and Adolescent Paediatric Research in the UK & Ireland (GAPRUKI).* PERUKI is a collaborative PEM research network whose membership at the time consisted of 53 EDs, with a mix of secondary and tertiary sites in urban and rural locations. GAPRUKI had 27 sites, 17 of which overlapped with PERUKI. Consultants from these two networks were chosen as participants as they form the most senior level of expertise and clinical decision making. Participants were identified as follows:

PERUKI: Round One potential participants were identified by the study site lead at participating PERUKI sites; this number of potential participants was shared with the study team to determine the overall denominator for response rates. The number of suitable consultants varied at each PERUKI site from 1 to 12. Site leads were kept updated on progress, and reminders were sent two weeks and one week before closing. In subsequent rounds, respondents to the preceding round were invited directly by the study team. Site leads were again kept updated throughout these rounds, with email reminders sent at the same intervals.

GAPRUKI: In Round One, the GAPRUKI chair contacted all Consultant members. In subsequent rounds all those who responded to the preceding round were invited through the same email invitation as PERUKI participants. The GAPRUKI chair sent reminders for Round One, and the PERUKI study lead sent reminders for Rounds Two and Three.

Delphi methodology

Delphi surveys involve a series of sequential rounds interspersed by controlled feedback to gain the most reliable consensus from a group of experts[16-18]. We adopted a modified Delphi process[16] whereby after each round, the statements that achieved consensus were eliminated, and statements that did not achieve consensus carried through to the next round of questioning. This approach was taken to maximise participation in the study through minimising responder fatigue and is an established mode of conducting a consensus-based Delphi.

Definitions

For the purposes of the study, the term "acute hospital admission" was used as the focus for defining the significance of the illness or injury, since the decision to admit to hospital reflects a key judgement an ED clinician must make on the balance of risk. The qualifying term "suspected" was included in some statements for certain conditions as, in the ED environment, clinicians are often presented with undifferentiated illness with the final diagnosis being made at a later stage. Participants were provided with relevant definitions in each round.

"Acute hospital admission" was defined as an acute admission to hospital including short inpatient stays of under 24 hours (e.g. to Short Stay Units or Children's Assessment Units), or the transfer and admission to other offsite in-patient units. It did not include referral to outpatients, ED or other review clinics, or planned future elective admission.

"Suspected" illness was defined from the point of view of the respondent being the assessing clinician and covered those clinical situations where sufficient concerns existed to admit for ongoing treatment, diagnostics, or close observation. In some of the clinical situations being evaluated, this would have included those in whom the diagnosis had been confirmed. This definition was dependent on the individual sites' available facilities and access to diagnostic tests, which was expected to vary dependent on the respondent's clinical setting.

Survey construction

Previous work[12] was called upon to act as a template to classify diagnoses into illness categories (e.g. respiratory) and then we as a study group created the list of diagnoses we thought were significant and covered the majority of ED presentations. Round One consisted of 161 statements on clinical conditions from the following 17 illness and injury categories: infection, respiratory, cardiac, gastroenterology, neurology, trauma, surgery, allergy, dermatology, endocrine and metabolic, toxicology, musculoskeletal, haematology, renal, safeguarding, mental health and miscellaneous.

For each condition, respondents were asked whether they agreed that the condition was significant enough to warrant acute admission to hospital, with admission being used as a proxy for significant illness or injury. A five-part Likert scale was used for answers: strongly disagree (1), disagree (2), neutral (3), agree (4), strongly agree (5). We aimed to use up to three survey rounds, as per accepted Delphi practice.

In Round One respondents had the opportunity to suggest additional conditions and scenarios they thought would warrant hospital admission from the ED. These suggestions were then tested in Round Two. After each round, statements that did not achieve consensus were either repeated or modified in subsequent rounds, according to the following:

- Original Round One statements re-included if the phrasing of the statement was deemed to have sufficient clarity by the study team and no feedback to the contrary given by respondents
- Where subgroups of severity/risk were highlighted, original Round One statements were included with further relevant statements
- Where Round One feedback highlighted that the original statement was ambiguous and needed more clarity, the statement was rephrased and included
- Pooling of some statements together into one where appropriate (to reduce statement numbers and so minimise responder fatigue)

Round Three only included statements suggested by Round One respondents which did not achieve consensus in Round Two. Statements that had been carried through from Round One to Round Two were not included again in Round Three as they had already been through the process of expert opinion re-testing. All statements not achieving consensus after a single round of testing were, therefore, given an opportunity for a second round of re-testing.

The response "I do not look after children with this condition" was introduced in Rounds Two and Three, following feedback from respondent's neutral answers in Round One. This intervention sought to reduce the number of neutral responses and, therefore, increase the yield of positive or negative agreement. When this response was given, it was excluded from the percentage consensus calculation for that condition. A sample of the survey questions are available to view as online supplementary material.

Ethics

No formal research ethical approval was required for this study as it was a survey of health professionals identified via established research networks. Participation was deemed as consent.

Analysis

The study team set group consensus as a *priori* 80% agreement either side of the Likert scale i.e. 80% total of strongly disagree and disagree (negative consensus), or 80% total of strongly agree and agree (positive consensus). Accepted practices of Delphi consensus parameters often quote a threshold of 70% agreement, though this is not a rule[17-19]. Since a proxy outcome for significant illness (admission) was being used, a higher threshold was chosen to ensure that the level of consensus was more robust. For statements on which consensus was reached, median and interquartile ranges (IQR) were calculated from the five-point Likert scale results. For statements which did not reach consensus, medians and IQRs were used to demonstrate the spread of opinion in the responses. Analysis was conducted using MedCalc Statistical Software version 17.9.2, Belgium.

RESULTS

A total of 295 consultants, identified as being available from PERUKI and GAPRUKI site leads, were invited to participate (**Figure 1**). Two hundred and twenty three (79%) participated in Round One, 177 (60%) participated in Round Two and 148 (50%) participated in Round Three. The greatest proportion of respondents (61.1%) came from an EM background (either Adult EM, EM with PEM, or Paediatrics with PEM) (**Table 1**). Most participants (61%) were based in a tertiary centre (**Table 1**). Forty three (68%) of 63 sites responded.

Table 1. Speciality background of survey respondents and category of centres responding.

Speciality	Response total (percentage)
Emergency Medicine with speciality PEM	39 (17.7)
Paediatrics with speciality PEM	61 (27.6)
Emergency Medicine	35 (15.8)
General Paediatrics	83 (37.6)
Other speciality	3 (1.4)
Speciality not disclosed by participant	2 (0.9)
Tertiary Centre	136 (61.0)
District General (Local) Hospital	77 (34.5)
Other Facility	10 (4.5)

Abbreviation: PEM - Paediatric Emergency Medicine

A summary of the percentage level of positive consensus for each illness category by Delphi round is given (**Table 2**). Categories with less overall acuity such as musculoskeletal, safeguarding and miscellaneous conditions seemed to score lower levels of agreement between the rounds.

Table 2. Summary of number of statements reaching ≥80% positive consensus in each round. Percentages with number of consensus statements out of total number of statements tested are displayed. Grey boxes denote that no statement in that category was tested.

	Round 1 % (n/denominator)	Round 2 % (n/denominator	Round 3 % (n/denominator)
Infection	65.5 (19/29)	58.3 (7/12)	100.0 (2/2)
Respiratory	100.0 (7/7)	100.0 (3/3)	
Cardiac	81.3 (13/16)	57.1 (4/7)	
Gastroenterology	44.4 (4/9)	66.7 (4/6)	0.0 (0/1)
Neurology	71.4 (15/21)	25.0 (2/8)	0.0 (0/2)
Trauma	61.5 (8/13)	75.0 (6/8)	
Surgery	93.3 (14/15)	100.0 (1/1)	
Allergy	50.0 (1/2)	0.0 (0/1)	
Dermatology	33.3 (1/3)	25.0 (1/4)	0.0 (0/1)
Endocrine	90.9 (10/11)	0.0 (0/1)	
Toxicology	100.0 (1/1)	100.0 (1/1)	
Musculoskeletal	0.0 (0/3)	25.0 (1/4) (25.0 (1/4) negative consensus)	
Haematology	66.7 (4/6)	80.0 (4/5)	
Renal	42.9 (3/7)	42.9 (3/7)	
Safeguarding	14.3 (1/7)	50.0 (1/2)	0.0 (0/1)
Mental health	57.1 (4/7)	100.0 (2/2)	
Miscellaneous	25.0 (1/4)	36.4 (4/11)	28.6 (2/7)

Round One

The flow of statements through the Delphi are summarised (**Figure 2**). All 161 Round One illness/injury statements were answered by all respondents. 106 statements (65.8%) reached ≥80% positive consensus; none reached ≥80% negative consensus. The mean percentage of neutral responses was significantly greater for statements not reaching consensus versus those meeting consensus; 28.0% (95% CI 26.1% to 29.9%) and 4.7% (95% CI 3.8% to 5.5%) respectively (p=0.01).

Round Two

Round Two consisted of 83 statements of which 23 were new statements suggested by Round One respondents, and 60 were statements originating from Round One which did not reach consensus; some of the original statements were made into separate statements according to the methodology described above. An exception to Round Two statement inclusion was made for *Pneumothorax: tension or non-tension.* Though this reached our threshold for consensus, respondent feedback strongly suggested this should be separated into three different statements: (i) Tension pneumothorax, (ii) Non-tension pneumothorax not related to trauma (defined as any of: >2cm on CXR, patient is breathless, patient has an oxygen requirement, post needle aspiration the patient is clinically no better or the pneumothorax is still > 2cm on CXR), and (iii) Non-tension pneumothorax secondary to trauma.

All 83 statements were answered by all respondents, of which 44 (53%) reached ≥80% positive consensus. One statement (*new presentation of uncomplicated Henoch–Schönlein purpura*) reached negative consensus. Of the 60 Round One originating statements, 33 (55.0%) reached consensus and of the 23 new statements, 12 (52.2%) reached consensus.

Round Three

Round Three consisted of 14 statements which all originated from the 11 new statements in Round Two that did not achieve consensus. All 14 statements were answered by all respondents, of which 4 (28.5%) reached ≥80% positive consensus. No conditions reached ≥80% negative consensus.

Across all three rounds, 154 conditions reached ≥80% positive consensus and one condition (*new presentation of uncomplicated Henoch–Schönlein purpura*) reached ≥80% negative consensus (online supplementary **Table 1**). Thirty seven statements did not reach consensus (online supplementary **Table 2**). For statements reaching positive consensus the median Likert scale responses ranged between 4 to 5, whereas statements not reaching consensus had median Likert scale responses ranging between 2 to 4. The process of re-phrasing Round One statements not reaching consensus achieved consensus in 33 statements in Round Two originating from Round One and consensus of 4 statements in Round Three not reaching consensus in Round Two. Adding the answer option in Round Two of "I do not look after children with this condition" resulted in two conditions (status dystonicus and newly presenting infantile spasms) reaching consensus in Round Two that would not have reached the 80% threshold for consensus had the new response option not been available.

Figure 1. Summary of enrolment

(FIGURE 1 GOES HERE)

Figure 2. Flow of statements through the Delphi

(FIGURE 2 GOES HERE)

DISCUSSION

A list of significant paediatric emergency conditions has been derived by a panel of experts, through this modified Delphi study, to facilitate future research into the performance of PEWS and other safety systems in EDs. This list consists of 154 conditions (with accompanying degree of severity where relevant) across 17 illness and injury categories warranting acute admission from the ED to hospital in the opinion of these senior clinical decision makers.

The strength of this study has been the achievement of multicentre expert consensus for the majority of the illness and injury scenarios. The level of expert agreement is high, i.e. an 80% consensus threshold which is above most baselines set in the literature[16-18]. The study was intentionally anonymised to eliminate the introduction of

persuasive bias that can arise from dominant individuals. Statements not reaching agreement in Round One were refined according to participant feedback. Participants were given the opportunity to offer further suggestions on significant presentations, which were then tested in Round Two. Statements not reaching consensus after a single round of testing all underwent a second round of testing, ensuring that the same rigor of evaluation by expert opinion was applied to each suggested condition.

Consensus was not achieved on 37 statements, demonstrating that for many conditions management will vary widely depending on the child's clinical presentation, clinician experience, individual practise and the available resources. Variation in opinion for these statements was reflected in the wider range of median statement responses ranging from 2 (Disagree) to 4 (Agree); in the qualitative feedback this was evident in frequently encountered statements such as "medicine is not black and white." This statement was also seen for some conditions that achieved consensus, especially (i) if conditions could present in ways differing from those described, or (ii) if there were exceptional circumstances preventing the normal practice of admitting a child, if circumstances had been otherwise. An example of the latter would be the use of ambulatory antibiotics when in-patient bed availability was insufficient, resulting in the child returning to the department for each drug dose administration. Such considerations only served to highlight to the study team that the need for hospital admission is not a fixed categorical decision and will vary depending on the unique circumstances surround each case. For ED purposes, we used the term "suspected" to define many of the statements as the job of an ED clinician is decision making on the balance of suspicion and risk assessment, with often the final diagnosis being made later in time. The number of children staying in hospital for less than 24 hours is increasing[20]. Therefore, we included short inpatient stays of less than 24 hours (including in Short Stay Units or Children's Assessment Units) in our definition of "acute admission" to capture the respondents concern that the presenting condition was significant enough to delay discharge home from the ED, such as to allow a period of observation or acute treatment.

Round Two statements were refined and re-phrased when needed, based on the data and written feedback from Round One respondents. After Round One it became apparent that some respondents were giving neutral answers for statements involving conditions they did not typically encounter. As a result, the option of "I do not look after

children with this condition" was introduced for subsequent rounds, to reduce neutral answers. Both of these interventions boosted the yield of statements reaching consensus.

This study improves upon the methodology employed in previous preliminary work[12] where the authors retrospectively assigned a classification of "minor" or "significant" along with a physiological system to diagnoses of children presenting to that ED during the study period. It was recognised that if prospective work on PEWS was to be undertaken, there was a need for a more standardised list of conditions, created using systematic methodology to reflect a broader consensus of expert opinion, hence the purpose of this current work.

Limitations

The majority of responders were based in emergency care but most participants (65.2%) came from a paediatric background either in PEM (27.6%) or General Paediatrics (37.6%), meaning that the bulk of opinion was formed by professionals specifically trained in paediatrics. Most respondents were from tertiary centres and so our results may not be representative of opinion from non-tertiary centres where resources and management pathways may differ. Separate speciality subgroups analysis was not performed. The survey was confined to the UK and Ireland, and therefore these results may not be applicable in different healthcare settings where the types of disease, and disease prevalence and presentations may differ along with management practices, cultural attitudes and available resources. Since 68% of all the PERUKI and GAPRUKI sites that were invited to participate responded, this study does not reflect the opinion of the 32% of sites that failed to respond. At study sites, staff who were not PERUKI or GAPRUKI affiliated were not prevented from taking part in the survey if they so wished. This allowed us to be as representative as possible, though we appreciate that the survey was not distributed to every Emergency Department in the UK & Ireland, and not every single view will be captured due to the unavailability of some staff. Each round saw a predictable reduction in the number of sites responding i.e. responder fatigue. "Acute admission" was taken as the study's defining criteria, being readily measurable, clearly definable, and less open to interpretation. Clearly, this does not imply that illnesses not requiring acute hospital admission are of no significance – many such conditions are now managed in ambulatory settings, in outpatient departments, in review clinic or admitted electively at a later opportunity. However, for ED purposes where a key part of a clinician's role is establishing whether a patient can be safely discharged (or not), defining illness/injury as "significant" using the

measure of whether the condition warrants “acute” hospital admission was deemed an appropriate measure. We acknowledge that this list of conditions is not backed up by data to support the need for admission based on the risk of morbidity or mortality; rather this list reflects current opinion of experts in this field. It could be argued that the study team (unintentionally, or otherwise) created a bias towards “agree” responses from the outset by creating a list of statements around conditions that they considered to be significant, covering the majority of significant paediatric ED presentations. Testing every possible paediatric ED presentation would have overcome this potential for bias, but this would have resulted in an unwieldy number of scenarios making such a survey undeliverable. This pragmatic approach represents the key common clinical conditions which present to UK and Ireland EDs.

This study’s achievement is the creation of a standardised list of statements that have been agreed by a consensus of expert opinion. It is important to note, however, that the primary of aim of this research was to develop a set of measures to act as a tool for future research purposes, such as the validation of PEWS and child safety systems in the ED. This list was not designed or validated to provide clinical guidance or be used to judge quality of care between hospitals. Given that respondents were informed that the list was to be established for research purposes, it is possible that different answers with a different list would have arisen, should a specifically defined clinical emphasis have been placed in the expert’s thoughts, rather than our defined research intent.

In conclusion, through consensus opinion a list of 154 paediatric illnesses and injuries warranting acute admission to hospital from the ED has been established. This robust list of conditions can now be used to investigate the performance of PEWS and other child patient safety initiatives in the UK & Ireland systems, and potentially other countries with similar health care settings.

Word count: 3417 (excluding abstract, tables, figures, references, headings)

Competing interests: none

Sources of funding received: no funding was received for this study

ACKNOWLEDGEMENTS

We thank all participants in this study, including the following who acted as study site leads in participating centres, and were responsible for identifying and reminding participants when rounds were open: Roger Alcock, Forth Valley Royal Hospital, Larbert; Yasmin Baki, University College Hospital, London; Michael Barrett, Our Lady's Children's Hospital, Crumlin; Jane Bayreuther, University Hospital Southampton; Turlough Bolger, Tallaght Children's Hospital; Jen Browning, Royal Hospital for Sick Children, Edinburgh; Fleur Cantle, King's College Hospital, London; Kirsty Challen, Lancashire Teaching Hospitals; Charlotte Clements, North Middlesex Hospital, London; Sharon Floyd, Western Sussex Hospitals NHS Trust; Steven Foster, Royal Hospital for Children, Glasgow; John Furness, County Durham & Darlington NHS Foundation Trust; Chris Gough, Nottingham Children's Hospital, Nottingham; Sharon Hall, Queen Elizabeth Hospital, Woolwich; David Hanna, Bristol Royal Hospital for Children; Stuart Hartshorn, Birmingham Children's Hospital; Michelle Jacobs, Watford General Hospital; Heather Jarman, St George's Hospital, London; Lisa Kehler, Royal Wolverhampton NHS Trust; Jonathan Lowe, Derriford Hospital, Plymouth; Julie-Ann Maney, Royal Belfast Hospital for Sick Children; Roisin McNamara, Temple Street Children's University Hospital, Dublin; Shrouk Messahel, Alder Hey Children's Hospital, Liverpool; Helen Mollard and Alice Downes, Leeds General Infirmary; Niall Mullen, Sunderland Royal Hospital; Ronan O'Sullivan, Cork University Hospital; Gareth Patton, Royal Aberdeen Children's Hospital; Katherine Potier, Royal Manchester Children's Hospital; Colin Powell, Children's Hospital for Wales, Cardiff; Mohammed Rahman, Royal Alexandra Children's Hospital, Brighton; Shammi Ramlakhan, Sheffield Children's Hospital; Gisela Robinson, Royal Derby Hospital; Damian Roland, Leicester Royal Infirmary; James Ross, Chelsea and Westminster Hospital, London; Neil Thompson, St Mary's Hospital, London; Esther Wilson, Musgrove Park Hospital, Taunton.

References

1. Hartshorn S, O'Sullivan R, Maconochie IK, et al. Establishing the research priorities of paediatric emergency medicine clinicians in the UK and Ireland. *Emerg Med J* 2015;32(11):864-8. doi: 10.1136/emermed-2014-204484 [published Online First: 2015/02/14]
2. Royal College of Paediatrics and Child Health. 2018 [Available from: https://www.rcpch.ac.uk/Policy accessed 25.03.2018]
3. Scottish-Patient-Safety-Programme. 2018 [Available from: http://ihub.scot/spsp/maternity-children-quality-improvement-collaborative-mcqic/paediatric-care/ accessed 25.03.2018]
4. Pearson GA, Ward-Platt M, Harnden A, et al. Why children die: avoidable factors associated with child deaths. *Arch Dis Child* 2011;96(10):927-31. doi: 10.1136/adc.2009.177071 [published Online First: 2010/06/10]
5. Pearson GA, Why Children Die: A Pilot Study 2006; England (South West, North East and West Midlands), Wales and Northern Ireland. London: CEMACH. 2008 [Available from: http://www.publichealth.hscni.net/sites/default/files/Why%20Children%20Die%20-%20a%20pilot%20study%202006.pdf accessed 25.03.2018]
6. Chapman SM, Wray J, Oulton K, et al. Systematic review of paediatric track and trigger systems for hospitalised children. *Resuscitation* 2016;109:87-109. doi: 10.1016/j.resuscitation.2016.07.230 [published Online First: 2016/08/09]
7. Maconochie IK, de Caen AR, Aickin R, et al. Part 6: Pediatric basic life support and pediatric advanced life support: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. *Resuscitation* 2015;95:e147-68. doi: 10.1016/j.resuscitation.2015.07.044 [published Online First: 2015/10/20]

8. Parshuram CS, Dryden-Palmer K, Farrell C, et al. Effect of a Pediatric Early Warning System on All-Cause Mortality in Hospitalized Pediatric Patients: The EPOCH Randomized Clinical Trial. *JAMA* 2018;319(10):1002-12. doi: 10.1001/jama.2018.0948 [published Online First: 2018/02/28]
9. Roland D, Oliver A, Edwards ED, et al. Use of paediatric early warning systems in Great Britain: has there been a change of practice in the last 7 years? *Arch Dis Child* 2014;99(1):26-9. doi: 10.1136/archdischild-2012-302783 [published Online First: 2013/09/03]
10. Lambert V, Matthews A, MacDonell R, et al. Paediatric early warning systems for detecting and responding to clinical deterioration in children: a systematic review. *BMJ Open* 2017;7(3):e014497. doi: 10.1136/bmjopen-2016-014497 [published Online First: 2017/03/16]
11. Bradman K, Maconochie I. Can paediatric early warning score be used as a triage tool in paediatric accident and emergency? *Eur J Emerg Med* 2008;15(6):359-60. doi: 10.1097/MEJ.0b013e3283026208 [published Online First: 2008/12/17]
12. Lillitos PJ, Hadley G, Maconochie I. Can paediatric early warning scores (PEWS) be used to guide the need for hospital admission and predict significant illness in children presenting to the emergency department? An assessment of PEWS diagnostic accuracy using sensitivity and specificity. *Emerg Med J* 2016;33(5):329-37. doi: 10.1136/emermed-2014-204355 [published Online First: 2015/11/05]
13. Lillitos PJ, Maconochie IK. Paediatric early warning systems (PEWS and Trigger systems) for the hospitalised child: time to focus on the evidence. *Arch Dis Child* 2017;102(6):479-80. doi: 10.1136/archdischild-2016-312136 [published Online First: 2017/04/12]
14. Roland D, Lewis G, Fielding P, et al. The Paediatric Observation Priority Score: A System to Aid Detection of Serious Illness and Assist in Safe Discharge. *Open Journal of Emergency Medicine* 2016;04(02):38-44. doi: 10.4236/ojem.2016.42006
15. Lyttle MD, O'Sullivan R, Hartshorn S, et al. Pediatric Emergency Research in the UK and Ireland (PERUKI): developing a collaborative for multicentre research. *Arch Dis Child* 2014;99(6):602-3. doi: 10.1136/archdischild-2013-304998 [published Online First: 2014/03/13]
16. Boulkedid R, Abdoul H, Loustau M, et al. Using and reporting the Delphi method for selecting healthcare quality indicators: a systematic review. *PLoS One* 2011;6(6):e20476. doi: 10.1371/journal.pone.0020476 [published Online First: 2011/06/23]
17. Hsu C-C, Sandford BA The Delphi Technique: Making Sense Of Consensus. *Pract Assess Res Eval* 2007
18. Powell C. The Delphi technique: myths and realities. *Journal of advanced nursing* 2003;41:376-82.
19. Diamond IR, Grant RC, Feldman BM, et al. Defining consensus: a systematic review recommends methodologic criteria for reporting of Delphi studies. *J Clin Epidemiol* 2014;67(4):401-9. doi: 10.1016/j.jclinepi.2013.12.002 [published Online First: 2014/03/04]
20. Gill PJ, Goldacre MJ, Mant D, et al. 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. doi: 10.1136/archdischild-2012-302383 [published Online First: 2013/02/13]