Received: 3 July 2020 | Revised: 3 August 2020 | Accepted: 20 August 2020

DOI: 10.1111/apa.15551

REGULAR ARTICLE

ACTA PÆDIATRICA NURTURING THE CHILD WILEY

Prescribing in a paediatric emergency: A PERUKI survey of prescribing and resuscitation aids

Haiko Kurt Jahn[1,2] | Ingo Henry Johannes Jahn[3] | Damian Roland[4] | Wilhelm Behringer[5] | Mark Lyttle[6,7] | Paediatric Emergency Research in the United Kingdom, Ireland (PERUKI)

[1]Emergency Department, Royal Belfast Hospital for Sick Children, Belfast, UK

[2]Friedrich Schiller University Jena, Jena, Germany

[3]School of Mechanical Engineering, University of Queensland, Brisbane, Australia

[4]Emergency Department, Leicester Royal Infirmary, University of Leicester, Leicester, UK

[5]Centre for Emergency Medicine, University of Jena, Jena, Germany

[6]Emergency Department, Bristol Royal Hospital for Children, Bristol, UK

[7]Faculty of Health and Applied Sciences, University of the West of England, Bristol, UK

Correspondence
Haiko Kurt Jahn, The Royal Belfast Hospital for Sick Children, Falls Road, Belfast, UK BT12 6BA.
Email: haiko.jahn@doctors.org.uk

Funding information
This research was undertaken as part of the lead author's MD research regarding medical app use in emergency medicine at the Friedrich Schiller University of Jena, Germany. This research received no grant or funding from any agency in the public, commercial or not-for-profit sector.

Abstract

Aim: The aim was to investigate the use of paper-based and electronic prescribing and resuscitation aids in paediatric emergency care from a departmental and individual physician perspective.

Methods: A two-stage web-based self-report questionnaire was performed. In stage (i), a lead investigator at PERUKI sites completed a department-level survey; in stage (ii), individual physicians recorded their personal practice.

Results: The site survey was completed by 46/54 (85%) of PERUKI sites. 198 physicians completed the individual physicians' survey. Individual physicians selected the use of formulary apps for checking of medication dosages nearly as often as hardcopy formularies. The APLS WETFLAG calculation and hardcopy aids were widely accepted in both surveys. A third of sites accepted and half of the individual physicians selected resuscitation apps on the personal mobile device as paediatric resuscitation aids.

Conclusion: Our survey shows a high penetrance of the British National Formulary app, a success of NHS digital policy and strategy. Despite potential advantages, many physicians in our survey do not use resuscitation apps. Reluctance to engage with apps is likely to be multifactorial and includes human factors. These obstacles need to be overcome to create a digital healthcare culture.

KEYWORDS

child, mHealth, paediatrics, resuscitation

Abbreviations: APLS, Advanced Paediatric Life Support Course, Advanced Life Support Group (ALSG), UK; BNF, British National Formulary; BNFc, British National Formulary for Children; ED, Emergency Department; NHS, National Health Service, UK; PERUKI, Paediatric Emergency Research in the United Kingdom and Ireland; PICU, Paediatric Intensive Care Unit; RCPCH, Royal College of Paediatrics and Child Health; UK, United Kingdom; WETFLAG calculation, Weight, Energy/Electricity, Endotracheal Tube, Fluid, Lorazepam, Adrenaline, Glucose (APLS, ALSG, UK).

1 | INTRODUCTION

Medication is generally provided in prefilled syringes and ready-made infusions, decreasing prescription and administration errors in adult practice. In paediatrics, age- and weight-based prescribing increases the risk of medication errors, which are more likely to cause harm.[1] In the UK, this has resulted in various projects by the Royal College of Paediatrics and Child Health (RCPCH) in partnership with others to pool and share resources such as the Meds IQ project and Medicines for Children (https://www.medicinesforchildren.org.uk/).[2] Several strategies, including non-technical solutions such as double checking have been employed to mitigate this risk. Resuscitation and the management of critically ill or injured patients follow standardised algorithms. Studies of simulated paediatric resuscitation events have found that medication errors commonly occur during all stages of paediatric resuscitation and may be a major unrecognised source of morbidity and mortality.[3,4] Age- and weight-based reference charts and tables with pre-calculated drug dosages are one solution, especially to decrease potentially fatal 10-fold errors.[5-8]The Advanced Paediatric Life Support (APLS) course has recently changed their teaching from an age-based calculation method to the use of a reference table to address this.[7,8] Amalgamation of these tools into digital aids to reduce human error is an area of continued development.[9,10]

The aim of the survey was to investigate the use of these aids including digital platforms, both from an institutional and an individual clinician perspective, which as yet has not been described.[7,8] Previous work suggested a lack of institutional mobile device provision and restrictive use policies, which may affect uptake of digital aids.[11] Gaining a deeper understanding of this matter will help to inform future developments and best practise.

Key Notes

- We investigate the use of paper-based and electronic prescribing and resuscitation aids in paediatric emergency care.
- The use of formulary apps in routine emergency prescribing is now nearly as widespread as the use of more traditional tools, and this was not the case for resuscitation apps
- It is unclear what the obstacles to a digital healthcare culture are with regard to the use of paediatric resuscitation apps.

2 | METHOD

A two-stage survey was undertaken between July 31, 2017 and January 14, 2018 following a pilot testing phase; both were delivered online via SurveyMonkey (www.surveymonkey.com). Survey content was derived by the lead researcher from previous literature examining mobile device and medical app use by clinicians and medical students,[12,13] and refined iteratively by an expert panel to ensure content validity and reliability.

The first stage (site survey) focused on departmental practices and policy, including acceptable and preferred prescribing and resuscitation aids; the second stage (individual clinician survey) focused on which aids individual clinician chose.

Stage 1, the site survey was distributed to Paediatric Emergency Research in the United Kingdom and Ireland (PERUKI) sites,[14] a collaborative paediatric emergency medicine research network which includes mixed (adult/paediatric) and stand-alone paediatric EDs from urban and rural settings; one response was sought on behalf of each site.[11]

Stage 2, the individual physician survey was targeted at physicians providing emergency care. The survey was distributed via (i) PERUKI site leads, (ii) the Royal College of Emergency Medicine newsletter and website, and (iii) social media.

Questions included multiple selection and free-text answers.[11] The survey collected data regarding the use of prescribing aids (hardcopy formulary, electronic formulary app, local guidelines hardcopy and electronic and the use of search engines) and the use of resuscitation aids (WETFLAG calculation, reference folders, printed crib sheets, medical apps Broselow tape, from memory). The stage 1 (site survey) investigated which of these are aids acceptable to use at each site, whilst the stage 2 (individual physician survey) investigated which aids individual physicians would select as part of their standard practise, and the impact of local mobile device policies. Only survey questions relevant to this manuscript are listed in Appendix S1.

2.1 | Statistical analysis

Microsoft Excel (Version 16.18) was used to undertake descriptive analysis of complete responses; responses with incomplete information were excluded. Open ended responses from the surveys were initially coded and organised into key themes by the lead author and then verified by the co-authors to support rigour of analysis, trustworthiness and reliability in the interpretation of the data. Responses with regard to the selection of the same resuscitation aid for example printing of crib sheets in general and printing of crib sheets for infusions were combined in the analysis.

2.2 | Ethics

This survey investigated departmental and individual practice and therefore did not require formal ethics review according to the Framework for Health and Social Care Research (UK).[15] Consent was implied by participation.

3 | RESULTS

Of 54 PERUKI sites, 46 (85%) responded to the site survey; 20/46 (43%) were stand-alone paediatric EDs and 26/46 (57%) saw adults and children. We received 198 complete and 45 incomplete survey responses. Only the complete survey responses were included in the analysis. Of the 198 respondent, two thirds worked at PERUKI sites. Demographics are listed in Table 1.

Half of the individual clinicians reported that they were aware of their institution's mobile device policy. Of the respondents that were aware of the policy, 52/99 (53%) were allowed, 3/99 (3%) were not allowed, 27/99 (27%) were not allowed, but their use was tolerated and 17/99 (17%) did not know if they are allowed to use a personal mobile device in the clinical environment (Tables 2 and 3a).

In the site survey, the use of a formulary book 46/46 (100%) was the leading accepted prescribing aid to look up and prescribe medications in routine paediatric emergency care, followed by the use of local electronic guidance 43/46 (94%) and formulary apps on the personal devices 37/46 (80%) (Table 2).

Most individual physicians 132/198 (67%) selected the hardcopy formulary book followed by formulary apps on personal devices 127/198 (64%) and local electronic guidance 111/198 (56%) (Table 2) as the tool they would use. Free-text responses commented on the use of other aids such as desktop computer to check medication dosages (eg BNF online; eMC (https://www.medicines.org.uk/emc)) 5/9; no preference for any modality, that is whatever is available 2/9; checking with the pharmacist (incl. hardcopy monographs written by pharmacy) 1/9; local guidance (WATCH drug sheet) 1/9; difficulty with BNF/BNFc app Athens login 1/9. Regional variations with regard to the selected prescribing aids by individual clinicians are listed in Table 2.

With regard to paediatric resuscitation, 40/46 (87%) sites accepted the use of the APLS WETFLAG calculation, 26/46 (56%) the use of a hardcopy reference tables to look up medication dosages and to make up infusions, 21/46 (46%) the printing of reference charts, 14/46 (30%) the use of the personal mobile device and 6/46 (13%) use of the institutional mobile device to calculate medication dosages and to make up infusions (Table 3a). Six out of seven free-text responses listed the use of desktop-based calculators (*CrashCall*, *SCOTstar*, *STRS*, *KIDS*) as a further accepted option, and one the use of hardcopy resuscitation charts (*SPARC Cards*).

The APLS WETFLAG calculation was the most commonly selected method by individual physicians 156/198 (79%). All other resuscitation aids to look up medication dosages and to make up infusions were selected less frequently, including the use of hardcopy reference tables 118/198 (56%), the use of apps on personal devices in 100/198 (51%) and the printing of reference charts 61/198 (46%) (Table 3a). Free-text responses commented on the use of other aids, including regional and local desktop-based drug calculators (including the combination of multiple aids) 13/22; senior clinician guidance 3/22; do not work in resus 3/22; from memory 1/22; local charts (SPARC chart) 1/22; and personal aid memoir 1/22.

Regional variations with regard to the selected resuscitation aids by individual clinicians are listed in Table 3b.

TABLE 1 Demographics individual clinician survey

What is your gender?	Female: 47%, 93/198 Male: 53%, 105/198
Could you select your region?	England: 65%, 129/198 Northern Ireland: 14%, 27/198 Scotland: 10%, 19/198 Wales: 7%, 13/198 Republic of Ireland: 5%, 10/198
If you work at a PERUKI site, could you kindly select the site…	Respondents working at a PERUKI site: 66%, 130/198
What is your role?	Consultants (Attending): 52%, 103/198 General Practitioners: 1%, 1/198 Trainee Doctors: 47%, 94/198
Are you aware of your institution's mobile device policy?	Aware of institution's mobile device policy: 51%, 101/198

4 | DISCUSSION

In this survey, we investigated the current use of prescribing and resuscitation aids in paediatric emergency care in the United Kingdom and Ireland. The overall response rate was high for the site survey and therefore likely represents a valid snapshot of the current departmental approach in paediatric emergency care in the UK and Ireland. The individual physician survey provided data from a large sample across a range of ED types in the UK and Ireland, both from PERUKI and none PERUKI sites.

The use of formulary apps for prescribing is an example of high penetration of digital app technology in paediatric emergency care. Our survey data show that nearly as many physicians selected a formulary apps (eg BNF/BNFc) as a prescribing aid as selected the use of more traditional aid (eg hardcopy formulary). The use of formulary apps on personal devices is accepted practice at the majority of surveyed sites. The BNF/BNFc app was launched in 2012 to improve accessibility and contemporaneous accuracy, has taken a leading role in the NHS digital strategy and is consistently chosen as the most popular and widely used medical app.[16,17] Likely reasons include ease of use and ready access, being free to download, standardised national guidance and the ability to perform frequent updates.[16,17] Despite these advantages, hardcopy formularies still marginally predominate. This is mirrored, and likely reinforced, by departmental policies as reported in a previous survey.[11] This suggests a potential disconnect between local institutional policies, individual clinician practice and NHS digital strategy.[18]

In contrast, paediatric resuscitation sees a much lower use of digital aids. The leading accepted paediatric resuscitation aid was the APLS WETFLAG calculation. This most likely reflects penetrance of APLS training in the UK and Ireland. It requires manual

TABLE 2 (a) Accepted prescribing aids and mobile device policy, (b) Accepted prescribing aids regional variation

(a) Accepted prescribing aids and mobile device policy

		Individual Physician Survey: Physician selection n; %					
				Department has reported mobile device policy			
	Site Survey n; %	Total	Department has no reported mobile device policy	Allowed	Not allowed	Not allowed, but tolerated	I do not know
Total responses	46	198	99	52	3	27	17
hardcopy formulary book (eg BNF/BNFc)	46; 100%	132; 67%	66; 67%	30; 57%	3; 100%	20; 74%	14; 78%
Personal device electronic formulary (eg BNF/BNFc)	37; 80%	127; 64%	62; 63%	35; 66%	1;33%	20; 74%	10; 56%
Institutional device electronic formulary (eg BNF/BNFc)	22; 48%	15; 8%	7; 7%	8; 4%	0	4; 15%	0
Local guidelines (electronic version)	43; 94%	111; 56%	56; 57%	13; 23%	0	12; 44%	13; 72%
Local guidelines (hardcopy)	25; 54%	48; 24%	26; 26%	12; 23%	1; 33%	6; 22%	4; 22%
Online search engine to check dose	17; 37%	20; 10%	12; 12%	6; 11%	0	1; 4%	1; 6%

(b) Accepted prescribing aids regional variation

	Total	England	Northern Ireland	Scotland	Wales	Republic of Ireland
Total responses	198	129	27	19	13	10
hardcopy formulary book (eg BNF/BNFc)	132; 67%	81; 63%	21; 78%	11; 68%	12; 92%	5; 50%
Personal device electronic formulary (eg BNF/BNFc)	127; 64%	94; 73%	13; 48%	7; 37%	8; 62%	5; 50%
Institutional device electronic formulary (eg BNF/BNFc)	15; 8%	11; 9%	1; 4%	1; 5%	1; 8%	1; 10%
Local guidelines (electronic version)	111; 56%	76; 59%	10; 37%	12; 63%	7; 54%	6; 60%
Local guidelines (hardcopy)	48; 24%	21; 27%	8; 30%	7; 37%	4; 31%	2; 20%
Online search engine to check dose	20; 10%	13; 10%	0	2; 11%	1; 8%	4; 40%

TABLE 3 (a) Accepted resuscitation aids and mobile device policy; (b) Accepted resuscitation aids regional variation

(a) Accepted resuscitation aids and mobile device policy

		Individual Physician Survey: Physician selection n; %					
				Department has mobile device policy			
Resuscitation Aids	Site Survey n; %	Total	Department has no mobile device policy	Allowed	Not allowed	Not allowed, but tolerated	I do not know
Total responses	46	198	99	52	3	27	17
WETFLAG calculation	40; 87%	156; 79%	80; 81%	40; 75%	2; 67%	21; 78%	15; 83%
Hardcopy/folder age/weight-based reference table	26; 56%	118; 60%	57; 58%	34; 64%	0	15; 56%	12; 67%
Print age/weight-reference charts (eg excel)	21; 46%	61; 31%	34; 34%	13; 64%	1; 33%	7; 26%	7; 39%
Medical App (personal device)	14; 30%	100; 51%	50; 51%	28, 53%	0	11; 41%	13; 72%
Medical App (institutional device)	6; 13%	19; 10%	12; 12%	3, 6%	0	4; 15%	3; 17%
Broselow tape	2; 4%	8; 4%	7; 7%	1; 2%	0	0	1; 6%
From Memory	Not applicable	10; 5%	5; 5%	4; 8%	0	1; 4%	0

(b) Accepted resuscitation aids regional variation

	Total	England	Northern Ireland	Scotland	Wales	Republic of Ireland
Total responses	198	129	27	19	13	10
WETFLAG calculation	156; 79%	98; 76%	24; 89%	18; 95%	10; 77%	6; 60%
Hardcopy/folder age/weight-based reference table	118; 60%	88; 68%	5; 19%	14; 74%	8; 62%	3; 30%
Print age/weight-reference charts (eg excel)	61; 31%	45; 35%	2; 7%	10; 53%	2; 15%	2; 20%
Medical App (personal device)	100; 51%	66; 51%	21; 78%	5; 26%	3; 23%	5; 50%
Medical App (institutional device)	19; 10%	3; 2%	13; 48%	1; 5%	0	2; 20%
Broselow tape	8; 4%	2; 2%	1; 4%	2, 11%	0	3; 30%
From Memory	10; 5%	4; 3%	1; 4%	0	2; 15%	0

calculations, which can increase cognitive load at the start of the resuscitation process, creating a situation which is prone to error.[7] APLS has recognised this and now advocates the use of a hardcopy reference table.[8] In our survey, two thirds of individual physicians use hardcopy reference tables and one-third print reference tables using desktop-based drug calculators to decrease cognitive load during the resuscitation process. The latest development is digital aids in the form of resuscitation apps with age as the entry point for algorithms. This also removes the burden of manual calculation and can provide detailed instructions on how to make up medications. For example, the *PaediatricEmergencies* [9] app provides near instantaneous access to resuscitation algorithms, drug doses and instructions on how to make up infusions. The *PaediatricEmergencies* [9]-related PICU calculator app has been shown by their developer to be superior in paediatric inotrope prescribing compared to using the BNFc hardcopy, with even medical students outperforming paediatric consultants.[19] Similar data have been reported for the PedAMINES app.[20] There is potential

for bias in these reported studies, as the investigator teams also created these apps. Further external validation studies, which replicate these findings, would strengthen their validity and potentially aid uptake. The higher selection of resuscitation app by individual physicians in Northern Ireland may be related to the fact that the regional retrieval service has published its own regional resuscitation app.[9] This also serves as an example of how a resuscitation app like any other aid has been integrated, both within local and regional guidance to improve the quality of care provided. Clinicians have to be aware that apps from other regions or countries may not be applicable to their setting. Other examples of resuscitation apps from the UK include the NeoMate app (Neonatal Transfer Service London),[10] the Paediatric Emergency Tool app (South Thames Retrieval Service)[21] and the Mersey Burns App[22] among others. Despite these potential advantages, resuscitation apps were accepted aids at only a third of sites and only half of the individual physicians selected them.

Previous work did not suggest any harm from medical app use,[11] and the use of a resuscitation app on a mobile device is no different to using desktop-based calculator to print reference charts[21,23-25] or a hardcopy reference tables.[7,8,26] The use of an app at the bedside however may be more convenient and quicker for individual clinicians.[19] Reluctance to engage with apps is likely to be multifactorial and incorporate human factors. These likely include low initial trust in reliability of technological advances (eg device failure) especially in the most of dire of circumstances. Clinicians are therefore likely default to tried and tested methods (eg WETFLAG calculation). This approach may also help clinicians to focus on the task ahead and may be part of an ingrained mental preparation process, that is the Zen of resuscitation.[27]

The survey showed that individual physicians rarely selected institutional compared to personal mobile device as platforms to run electronic aids for prescribing and resuscitation. Only a minority of sites reported the use of an institutional mobile device. One site reported that they use an in-house charity donated iPad to run a resuscitation app.[11] Extrapolation from previous work suggests this most likely due to a lack of availability of institutional mobile devices, leading staff to default to their personal devices.[11,28] Previous research has shown that clinicians are happy to use their personal mobile devices for work purposes.[28] Respondents in our site survey reported that free or low purchase cost of apps are enablers of medical app use in general; therefore, the availability of mobile devices and the cost of apps may influence uptake of this technology.

Another reason for the reduced uptake of digital aids for resuscitation in this survey was restrictive use policies concerning personal mobile devices. The individual physician survey shows clearly that as soon as mobile device used is tolerated individual physicians are using digital aids. Future work should specifically explore existing institutional barriers, if obstacles to a digital healthcare culture are to be overcome.

A large proportion of respondents selected multiple aids. It can be postulated that this might be a practice that represents a safety-check mechanism to reduce errors related to cognitive burden. This may be especially advantageous in children, who because of underlying syndromes or medical problems may be small or large for their age.[7] The *Broselow tape*,[29] an aid which takes this into account, was not widely used, though it was beyond the remit of this survey to explore the reasons for this.

5 | LIMITATIONS

Both surveys asked about acceptable aids to be used in prescribing and resuscitation. While responses may have been influenced by the availability and support of certain aids in their individual institution, the wide geographic spread across the UK and Ireland reduces this risk of bias, with results more likely to reflect a true snapshot of current practice. Those completing the site survey were instructed to do so from a departmental point of view, not their own practice. The individual physician survey was distributed through different channels including personal contact, colleges and societies, and social media; it is therefore impossible to calculate a response rate, but the volume of responses from a wide geographic distribution increases the validity of our findings. Respondents may also be from a self-selecting population that engage with PERUKI, embrace digital technology and therefore introduce bias; however, distribution through PERUKI and other channels, and the wide spread of respondents should have countered this. We did not specifically explore why respondents used a given aid or how often these aids are used, or whether users had seen any impact from the use of digital platforms.

6 | CONCLUSION

Our survey shows a high penetrance of the BNF/BNFc app in paediatric emergency care, a success of NHS digital policy that provides a free national formulary app. Anyone currently not providing such an app may wish to investigate this based on the UK experience. Our survey showed that many respondents selected multiple aids in resuscitation to allow for cross-checking. Resuscitation apps do not yet show a high penetrance in the resuscitation setting despite potential advantages. Reluctance to engage with apps is likely to be multifactorial and incorporate human factors. Our data show that restrictive use policy and lack of infrastructure are likely causes. Others potential causes include low initial trust in the reliability of this technological advance and are areas that require further investigation. These obstacles need to be overcome to create a digital healthcare culture.

ACKNOWLEDGEMENTS

Authors acknowledge Robin Marlow and Vanessa Libal for the review of the questionnaire. The following individuals acted as site leads for the mobile device app project: Roger Alcock, Forth Valley Royal Hospital, Larbert; Mark Anderson, Great North Children's Hospital, Newcastle upon Tyne; Andrew Appelboam, Royal Devon and Exeter Hospital; Michael Barrett, Children's Health Ireland at Crumlin; Roisin Begley, North Middlesex Hospital; Terri Bentley, Royal

United Hospital, Bath; Turlough Bolger, Children's Health Ireland at Tallaght; Nanette Bothma, Derriford Hospital, Plymouth; Fiona Bowles, Queen Alexandra Hospital, Portsmouth; Adrian Boyle, Addenbrookes Hospital, Cambridge University NHS Trust; Adam Brown, Southmead Hospital, Bristol; Craig Brown, Royal Aberdeen Children's Hospital; Jen Browning, Royal Hospital for Sick Children, Edinburgh; Derek Burke, Sheffield Children's Hospital; Nabila Burney, Chelsea & Westminster NHS Foundation Trust; Fleur Cantle, King's College Hospital, London; Kirsty Challen, Royal Preston Hospital; John Criddle, Evelina London Children's Hospital; Sharryn Gardner, Southport and Ormskirk Hospital NHS Trust; Eleanor Glenday, St Richard's Hospital, Chichester; Sylvester Gomes, Barking, Havering & Redbridge University Hospitals NHS Trust; Chris Gough, Nottingham University Hospitals NHS Trust; Saqib Hasan, Royal Hospital for Children, Glasgow; Lisa Kehler, Royal Wolverhampton NHS Trust; Mike Linney, St Richard's Hospital, Chichester; Dan Magnus, Bristol Royal Hospital for Children; Julie-Ann Maney, Royal Belfast Hospital for Sick Children; Christopher McKie, City Hospitals Sunderland NHS Foundation Trust; Shrouk Messahel, Alder Hey Children's Hospital NHS Foundation Trust; Ruud Nijman, St Mary's Hospital London; Maggie Nyirenda, University Hospital Lewisham; Ronan O'Sullivan, Cork University Hospital; Ami Parikh, The Royal London Hospital; Katherine Potier, Royal Manchester Children's Hospital; Colin Powell, University Hospital of Wales, Cardiff; Marimuthu Rajeshkumar, Darlington Memorial Hospital; Darren Ranasinghe, Southampton Children's Hospital; Gisela Robinson, Derbyshire Children's Hospital; Damian Roland, Leicester Royal Infirmary; Alex Scott, James Cook University Hospital, Middlesbrough; Augustine Smithies, Hull Royal Infirmary; Clare Thompson, Leeds General Infirmary; Emily Walton, Royal Alexandra Children's Hospital, Brighton; Shye-Wei Wong, Royal Free Hospital, London. Open access funding enabled and organized by Projekt DEAL.

CONFLICT OF INTEREST

None.

DATA AVAILABILITY STATEMENT

A sub-analysis of the PERUKI medical app survey was undertaken. Data concerning prescribing and resuscitation in the UK and Ireland are presented within this article. The PERUKI medical app survey data are available via the lead author and the University of Jena.

ORCID

Haiko Kurt Jahn https://orcid.org/0000-0003-2308-1221

REFERENCES

1. Sutcliffe K,Sutcliffe K, Stokes G, O'Mara-Eves A, et al.Paediatric medication error: A systematic review of the extent and nature of the problem in the UK and international interventions to address it. EPPI - Centre, Social Science Research Unit, Institute of Education, University of London: EPPI - Centre; 2014.
2. Clinical Standards and Quality Improvement team RCoPaCH. Meds IQ - sharing QI resources for paediatric medicines safety https://www.rcpch.ac.uk: Royal College of Paediatrics and Child Health. Available from URL https://www.rcpch.ac.uk/resources/meds-iq-sharing-qi-resources-paediatric-medicines-safety
3. Kozer E, Seto W, Verjee Z, et al. Prospective observational study on the incidence of medication errors during simulated resuscitation in a paediatric emergency department. *BMJ*. 2004;329(7478):1321.
4. Porter E, Barcega B, Kim TY. Analysis of medication errors in simulated pediatric resuscitation by residents. *West J Emerg Med*. 2014;15(4):486-490.
5. Larose G, Levy A, Bailey B, Cummins-McManus B, Lebel D, Gravel J. Decreasing prescribing errors during pediatric emergencies: a randomized simulation trial. *Pediatrics*. 2017;139(3):e20163200.
6. Craig S, Dirnbauer N. *Paediatric Emergency Medication Book*. 2nd edn. Craig S, editor. Monash Health: Monash Health, 2018.
7. Marlow RD, Wood DLB, Lyttle MD. Comparing the usability of paediatric weight estimation methods: a simulation study. *Arch Dis Child*. 2019;104(2):121-123.
8. Samuels M, Wieteska S. *Advanced paediatric life support: a practical approach*, 6th edn. Chichester, West Sussex, UK; Hoboken, NJ, USAJohn Wiley & Sons Ltd; 2016.
9. itdcs. Paediatric Emergencies. Version 1.20 ed. Apple App Store<time aria-label="15 July 2018" class="version-history__item__release-date" data-test-we-datetime="" datetime="15 Jul 2018">15 Jul 2018.
10. C K. NeoMate appstore.com: NTS Neonatal Transfer Service London, 2017. [3.1.2:[Neonatal Resuscitation App].
11. Jahn HK, Jahn IH, Roland D, Lyttle MD, Behringer W. Mobile device and app use in paediatric emergency care: a survey of departmental practice in the UK and Ireland. *Arch Dis Child*. 2019;104(12):1203-1207.
12. Payne KFB, Wharrad H, Watts K. Smartphone and medical related App use among medical students and junior doctors in the United Kingdom (UK): a regional survey. *BMC Med Inform Decis Mak*. 2012;12(1):121.
13. Sayedalamin Z, Alshuaibi A, Almutairi O, Baghaffar M, Jameel T, Baig M. Utilization of smart phones related medical applications among medical students at King Abdulaziz University, Jeddah: a cross-sectional study. *J Infect Public Health*. 2016;9(6):691-697.
14. 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):602-603.
15. Framework health social care research [Framework for Health and Social Care Research in the UK] Available from URL https://www.hra.nhs.uk/planning-and-improving-research/policies-standards-legislation/uk-policy-framework-health-social-care-research/
16. Hardyman W, Bullock A, Carter-Ingram S, Pugsley L, Stacey M. *eLearning in Health Conference: collaboration, sharing and sustainability in the current environment. The iDoc project: using smartphone technology with foundation doctors across Wales*. BirminghamUniversity of Aston; 2011.
17. Haffey F, Brady RR, Maxwell S. Smartphone apps to support hospital prescribing and pharmacology education: a review of current provision. *Br J Clin Pharmacol*. 2014;77(1):31-38.
18. Manning K, Williams A.Information and technology for better careHealth and Social Care Information Centre Strategy 2015–2020: Health and Social Care Information Centre Strategy, 2015. Available from URL: https://digital.nhs.uk/binaries/content/assets/legacy/pdf/c/c/hscic-strategy-2015-2020-final-310315.pdf
19. Flannigan C, McAloon J. Students prescribing emergency drug infusion utilising smartphones outperforms consultants using BNFCs. *Resuscitation*. 2011;82.
20. Siebert JN, Ehrler F, Combescure C, et al. A mobile device application to reduce medication errors and time to drug delivery during simulated paediatric cardiopulmonary resuscitation: a multicentre, randomised, controlled, crossover trial. *Lancet Child Adolesc Health*. 2019;3(5):303-311.

21. Paediatric emergency drugs, evelina Children's hospital, guys and St Thomas' NHS trust, 2018. Available from URL http://itunes.apple.com/gb/app/paediatric-emergency-drugs/id415663345?mt=8%20
22. Barnes J, Duffy A, Hamnett N, et al. The Mersey Burns App: evolving a model of validation. *Emerg Med J*. 2015;32(8):637-641.
23. Service NWNWPT. CrashCall Calculators 2018. Available from URL http://www.nwts.nhs.uk/documentation/crashcall
24. Service SPR. ScotSTAR Calculator 2018. Available from URL http://www.snprs.scot.nhs.uk/
25. Hospital KNBCs. KIDS Drug Calculator (web-based and app), 2018 Available from URL: http://kids.bwc.nhs.uk/healthcare-professionals-2/drug-calculator/
26. Dowd H, Fernandez de Castillo B, and Wyllie J. SPARC: an integrated prehospital and hospital resuscitation tool to aid in the immediate care of sick and injured children. *Crit Care*. 1997;1:P127.
27. Herrigel E. *Zen in the Art of Archery*. Later Printing ed. New York: Vintage Books, 1999.
28. Patel RK, Sayers AE, Patrick NL, Hughes K, Armitage J, Hunter IA. A UK perspective on smartphone use amongst doctors within the surgical profession. *Ann Med Surg (Lond)*. 2015;4(2):107-112.
29. Luten RC, Zaritsky A, Wears R, Broselow J. The use of the Broselow tape in pediatric resuscitation. *Acad Emerg Med*. 2007;14(5):500-501. author reply 1–2.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Jahn HK, Jahn IH, Roland D, Behringer W, Lyttle M; Paediatric Emergency Research in the United Kingdom, Ireland (PERUKI). Prescribing in a paediatric emergency: A PERUKI survey of prescribing and resuscitation aids. *Acta Paediatr*. 2020;00:1–8. https://doi.org/10.1111/apa.15551