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Aim: There are minimal data to guide the continuing medical education of general paediatricians working in non-tertiary hospitals. The aim of this study was to determine the procedural and resuscitation skills required by non-tertiary paediatricians and the frequency with which these skills are utilised.

Methods:

Over a 12 month period (December 2012 to December 2013), each of the 11 paediatricians involved in acute inpatient care at University Hospital Geelong (UHG) completed a weekly on-line survey regarding their inpatient clinical experience. This included procedures performed or directly supervised as well as their resuscitation involvement.

Results:

Each of the 11 paediatricians who managed inpatients on a regular or semi-regular basis during the study period agreed to participate and each completed all of the weekly surveys. There were 7 UHG paediatricians with an inpatient appointment (each with a 0.27 Full Time Equivalent (FTE) paediatrician workload) and 4 paediatricians providing inpatient cover on a locum basis. Over the course of 12 months, each 0.27 FTE paediatrician was on average involved in 11.3 neonatal, 1.7 infant and 2.4 child resuscitations and performed 0.9 intubations.

Conclusions:

Paediatricians working at non-tertiary hospitals are required to perform and supervise critical procedural and resuscitation skills, but have limited opportunities to maintain proficiency in such skills. General paediatric training and consultant paediatrician Continuing Medical Education programs should ensure the acquisition and maintenance of the procedural and resuscitation skills required for the management of seriously ill children in non-tertiary acute care settings.

Key words: Training; resuscitation; procedural skills; endotracheal intubation

What is already known on this topic

1. Paediatricians working in non-tertiary centres continue to manage a substantial and demanding volume of acute illnesses.
2. Paediatricians working at non-tertiary hospitals are required to perform a variety of procedures and to lead paediatric resuscitations.
3. Data regarding the scope of procedural skills required and the frequency with which procedural and resuscitation skills are utilised has been lacking.

What this paper adds

1. Paediatricians working in non-tertiary centres perform a large variety of procedures and take a leading role in resuscitations.
2. Apart from intravenous cannulation, paediatricians working in non-tertiary hospitals utilise procedural and resuscitation skills infrequently.

3. Alternative ways for non-tertiary paediatricians to maintain their procedural and resuscitation skills are required.

SOURCES OF SUPPORT

None

CONFLICTS OF INTEREST

None

In the 1990's, Hewson *et al* showed that developmental-behavioural problems were the most common and difficult presentations managed by Australian paediatricians working outside the tertiary system.¹ In recognition of this challenge, the Royal Australasian College of Physicians (RACP) mandated that trainees spend at least 6 months in developmental-behavioural paediatrics. It is however important to recognise that non-tertiary paediatricians also manage a substantial and demanding volume of acute illnesses. Indeed, there has been an increase in paediatric presentations and admissions to non-tertiary emergency departments and hospitals,² encompassing a broad range of neonatal, general paediatric and subspecialty paediatric conditions. Non-tertiary paediatricians must therefore be proficient in leading resuscitations and performing many procedures.

Few studies have addressed the frequency with which procedural and resuscitation skills are utilised by non-tertiary paediatricians. Feigin *et al* found in Texas in 1996 that non-tertiary paediatricians were required to perform a variety of procedures and lead resuscitations, but with insufficient frequency to maintain these skills.³ This study was however limited by retrospective design and a very low (54%) response rate. Consistent with this, Hewson *et al* found that in a regional Australian hospital, paediatricians only performed endotracheal intubation on average once every 3 years.⁴ Similarly, intraosseous (IO) insertion is an important but infrequently used skill.⁵

In order to inform training and Continuing Medical Education (CME) programs, the aim of this study was to determine the procedural and resuscitation skills required by paediatricians working at a large non-tertiary hospital as well as the frequency with which these skills are utilised.

SETTING

The University Hospital Geelong (UHG) services the Barwon region of Victoria, Australia. The Barwon region covers an area of 7923.5 square kilometres and includes a range of metropolitan and urban environments. As at the 2011 Census, the population of the Barwon region was 271,015, of whom 69,320 were children $\leq$ 19 years old.^{6,7,8,9} There were 3,583 babies born in the Barwon region during 2012.¹⁰

UHG is a general tertiary hospital that provides Level 2 paediatric hospital services. UHG is located 1 hour (77km) from the nearest tertiary paediatric centre, The Royal Children's Hospital (RCH), Melbourne. Acute paediatric services include: a 28 bed general paediatric ward for acute medical and surgical inpatient admissions; a 13 cot Special Care Nursery (SCN), which can provide CPAP; and a busy Emergency Department (ED) staffed by ED specialists, with support provided by the paediatric department. A service providing high dependency and limited intensive care to children, with co-management by adult intensivists and paediatricians within the adult intensive care unit (ICU), was established in the 18 months preceding the study period.

At the time of this study, paediatricians in Geelong also provided 24 hour cover to a private maternity hospital, the St John of God Hospital, which included an 8 cot SCN. There was one paediatrician on ward service each week who was responsible for the public hospital inpatients during working hours. Out of hours, a single paediatrician was 'on call' for both the public and private hospitals. There was 24 hour paediatric registrar cover at the public hospital.

METHODS

We invited all paediatricians who practiced acute care paediatrics between 28 December 2012 and 20 December 2013 at the Geelong public (UHG) and private (St John of God) hospitals to complete a weekly electronic survey. This survey pertained to their workload over the preceding 7 day period. The survey was created using REDCap (Research Electronic Data Capture) tools hosted at The Murdoch Children's Research Institute.¹¹ REDCap is a secure, web-based application designed to support data capture for research studies. The survey had previously been developed over a 4 month pilot period.

A link to the survey was sent via e-mail to the paediatricians just prior to each Friday paediatric grand round. This allowed the survey to be completed on the participating paediatricians' computers, tablets or smart phones. Participants who had not completed the survey within 4 days of receiving the link were sent a reminder e-mail and/or text message. The survey asked the paediatricians to report, with reference to the preceding 7 days, their:

- Inpatient workload, including delivery attendances and instances of recall to the hospital whilst 'on call';
- Instances of taking a leading role in the management of the seriously ill child requiring resuscitation; and
- Procedures performed or directly supervised.

Resuscitation was defined as taking a leading role, in person, in the management of a seriously ill child (as defined by the need for intubation, and/or the administration of at least 40mL/kg IV fluid bolus(es) within a period of 1 hour and/or the administration of more than 5 minutes of Inspiratory Positive Pressure Ventilation (IPPV) and/or the requirement for IO or central venous access).

The paediatricians documented procedures performed by themselves as the first attempt, those performed after a Junior Medical Staff member (JMS) was unsuccessful and procedures they directly supervised a JMS performing.

Survey results are reported either as averages per 0.27 Full Time Equivalent (FTE) paediatrician workload or as averages per 10,000 population served. Coincidentally, however, either way of reporting the data is equivalent as there ended up being approximately 10,000 children per 0.27 FTE paediatrician during the study period. The 0.27 FTE was chosen as this is the FTE appointment held by each of the 7 Geelong Hospital paediatricians with an inpatient appointment. The remaining 4 paediatricians provided inpatient cover on a locum basis. The data are presented as mean (95% confidence interval [CI]) for normally distributed variables and median (interquartile range [IQR]) for skewed distributions.

Ethics approval was granted by the Barwon Health Human Research Ethics Committee (HREC). This research conforms to the provisions of the Declaration of Helsinki. All authors had full access to the reported data.

RESULTS

Each of the 11 paediatricians who managed inpatients on a regular or semi-regular basis during the study period agreed to participate and each completed all of the weekly surveys. The median delay between the survey being sent to the participating paediatricians and survey completion was 0 days (IQR 0 – 3). The paediatricians had an average of 9.9 years of post-FRACP experience (range 0 – 33 years). There were 7 Geelong Hospital paediatricians with an inpatient appointment (each with a 0.27 Full Time Equivalent (FTE) paediatrician workload) and 4 paediatricians providing inpatient cover on a locum basis.

The paediatricians reported a wide range of training backgrounds and skills. Ten of the paediatricians completed the majority of their training in Australia and one in New Zealand. Two completed some of their postgraduate training in the UK and four spent short periods of their training (3-9 months) in developing countries including India, Nepal and Vietnam. Many had had further training in specific areas. These included paediatric intensive care, neonatology, paediatric emergency medicine, paediatric rehabilitation medicine, child abuse, infectious diseases and paediatric oncology. One of the paediatricians was dual trained in general paediatrics and neonatology. Most of the paediatricians reported a specific subspecialty area of interest, on which they focused their Continuing Medical Education and tended to see more patients with these problems.

One 'on call' period was defined as being between 1800 and 0800 hours on weekdays (14 hours) as well as each 12 hour period on weekends and public holidays (i.e., the rostered 'on call' between 0800 and 0800 hours on these days would constitute 2 'on call' periods). This resulted in there being 478 'on call' periods during the study period. The average number of 'recalls' (being called in to the hospital whilst on call, excluding being called in to attend deliveries) for each 'on call' period was 1.21 (95% CI 1.08 to 1.33) (0.7 for the public hospital and 0.5 for the private hospital).

The number of deliveries attended throughout the year was 128 (95% CI 114 to 143) for every 0.27 FTE employment loading (10.6 (95% CI 0 to 27.2) at the public hospital and 118 (95% CI 103 to 132) at the private hospital). The number of deliveries attended by a paediatrician, per 100 babies born in the region, was 25.0 (95% CI 22.2 to 27.9). Of these, 2.1 (95% CI 0 to 5.3) per 100 babies born in the

region were attended at the public hospital and 23.0 (95% CI 20.1 to 25.9) were attended at the private hospital.

The rates over the year of involvement in resuscitation are shown in Figure 1. For the purposes of this study, a neonate is defined as being equal to or less than 28 days old, an infant between 29 days and one year of age, and a child being older than one year of age.

Results for the 4 most commonly performed procedures are shown in Figure 2 and results for the remainder of procedures performed at least once throughout the year in Figure 3. Intravenous cannulation, starting babies on CPAP, administering Inspiratory Positive Pressure Ventilation (IPPV) to neonates and lumbar puncture were the 4 most commonly performed procedures. During the year, each 0.27 FTE paediatrician performed 0.9 and supervised 1.6 neonatal intubations. No paediatrician performed a non-neonatal intubation and each 0.27 FTE paediatrician supervised 0.3 non-neonatal intubations.

DISCUSSION

To our knowledge, this is the first Australian study to document the resuscitation and procedural skills experience of non-tertiary paediatricians. We found that non-tertiary paediatricians were required to lead the resuscitation of unwell children and to perform and supervise the performance of a large variety of procedures on multiple occasions each year, but have limited opportunity to maintain the relevant skills. The frequency of practice required to maintain proficiency in such skills has not been determined but is likely to be greater than the paediatricians have reported in this study.

A substantial proportion of Australian paediatricians report that cardiorespiratory resuscitation is among the 'hardest clinical conditions to manage', and list neonatal resuscitation and birth asphyxia among the 'most dangerous cases that could have been managed better.'¹² Endotracheal intubation is a life-saving procedure that can be very difficult. In the present study, we found that each 0.27 FTE paediatrician performed less than 1 neonatal intubation over the year. By comparison, anaesthetic registrars are required to complete a minimum of 150 paediatric intubations during their training, including 20 in children under 2 years of age (ANZCA Volume of practice and workplace-based assessment requirements for the specialised study units <http://www.anzca.edu.au/training/2013-training-program>).

The strengths of this study include complete participation among all relevant paediatricians in the study region, weekly data collection and a 100% survey completion rate during the entire study period. Limitations include that the definition for 'resuscitation' that was used may have been too stringent and may not have fully captured the paediatricians' resuscitation experience. Anecdotally there were additional cases of significantly unwell children whose management was directed by paediatricians, but who fell short of fulfilling the study definition for requiring resuscitation.

This study was limited to the Barwon region and the results may not be generalizable to all non-tertiary centres. Smaller centres may not have the same level of registrar or consultant cover and this would influence paediatrician exposure to resuscitation and procedural opportunities. We have expressed our results in per capita or per 0.27 FTE paediatrician terms in an attempt to assist generalizability of our findings to other non-tertiary centres. It may be reasonable to expect, however, that in smaller non-tertiary centres, paediatricians may have even more limited opportunities to maintain their resuscitation and procedural skills. Further limitations

of the study include the lack of data regarding the context in which procedures were performed, including the supporting staff present. We also failed to record the background experience of the paediatricians with each procedure, which has been shown to influence skill retention.¹³

Strategies to support general paediatricians to maintain their resuscitation and procedural skills are required. High fidelity simulation is a tool utilised by many acute care health professionals to practice both the procedural skills of a resuscitation as well as the communication skills required to lead a good resuscitation team.^{14,15} Simulation allows staff to participate and practice rare but life-threatening scenarios in a 'safe' environment. Simulation has traditionally had a role in the teaching of new skills for trainees, and completion of an Advanced Paediatric Life Support course (APLS) or equivalent is a mandatory part of paediatric training. Increasingly, however, regular participation in simulation is recognised as a safe and practical means for maintaining skills that are critical but used infrequently.^{14,16}

Future research is needed to assess the efficacy of various options for maintaining procedural and resuscitation skills. This includes options to ensure that multidisciplinary teams communicate and work effectively together when managing unwell patients. Future research should also investigate the impact of supporting staff and the environment on the performance of resuscitation and procedural skills as well as the frequency with which such skills should be practiced to acquire and maintain proficiency.

CONCLUSIONS

Paediatricians working at non-tertiary hospitals are required to perform and supervise critical procedural and resuscitation skills, but have limited opportunities to maintain proficiency in such skills. General paediatric training and consultant paediatrician CME programs should be designed to ensure the acquisition and maintenance of the procedural and resuscitation skills required for the practice of non-tertiary acute care paediatrics.

POTENTIAL CONFLICT OF INTEREST

None declared.

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■ Number Per 10,000 population < 19 yrs

■ Number Per 0.27 FTE

Neonate Infant Child

Figure 1 – Instances leading role resuscitation (2012/2013)

FTE, full time equivalent paediatrician appointment

Figure 2 – Rates most commonly performed procedures per 10,000 population < 19 years (2012/2013)

JMS, Junior Medical Staff member

Figure 3 – Rates per 0.27 FTE less common procedures (2012/13)

JMS, Junior Medical Staff member

FTE, full time equivalent paediatrician appointment

ORIGINAL ARTICLE

Survey of procedural and resuscitation requirements for paediatricians working in a non-tertiary centre: Implications for training

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