


# Pediatric Conditions Encountered by Medical Students

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## Abstract

**Background:** It is challenging to design a pediatric curriculum for medical students with their varying clinical experiences. We sought to describe the patterns of conditions the undergraduate students were exposed to in our peripheral pediatric settings of an Australian medical school.

**Methods:** We conducted a cross-sectional observational anonymized survey of pediatric students, covering 29 presenting conditions encountered over 2018 - 2019. An encounter was defined as one in which the student either took a history with or without performing a physical examination or observed a clinician doing so.

**Results:** Of 239 surveys, 70 (29%) were returned completed. All these students reported seeing a child with fever and a child with breathing difficulties; over 90% saw a child with vomiting and/or diarrhea, or a rash, or a premature neonate. Over 80% saw a child with obesity, a heart murmur, irritability, abnormal development or behavior, failure to thrive or a neonate with respiratory distress. A child protection encounter was reported by 67%. Fewer than 30% saw a child with an abdominal or groin mass, or an ingestion. Three students reported seeing all conditions.

**Conclusions:** The clinical experiences generally matched the pattern of pediatric pathology in our peripheral settings. However, exposure to all the key conditions seems unrealistic for most students.

It is likely that less common presentations such will not be seen by most pediatric students. Academics need effective teaching strategies to optimize learning of these important yet uncommon conditions.

**Keywords:** Pediatric; Student; Peripheral; Learning; Teaching; Encounter

## Introduction

Designing a pediatric curriculum for medical students is challenging [1]. One must balance their clinical exposure to common conditions such as bronchiolitis and uncommon but important conditions such as Kawasaki disease or childhood malignancies. A consensus check list of presenting complaints that could serve as a framework has been described [1]. Previous work in New South Wales, Australia showed a wide variation in the proportion of students who encountered key pediatric presentations [2]. We sought to describe the patterns of conditions the undergraduate students were exposed to in our peripheral pediatric settings of an Australian medical school.

## Materials and Methods

Four standard pediatric student clinical rotations per year in 2018 and 2019 were of 8 weeks' duration, with assessments in a ninth week. Our students were based in one of two metropolitan centers, Campbelltown Hospital, or Blacktown and Mt Druitt Hospitals, or a rural center, Bathurst Base Hospital (Table 1) [3-6]. Students did not rotate between centers. Campbelltown Hospital has a pediatric endocrinology service and a general pediatrician-run echocardiography service. Blacktown and Mt Druitt Hospitals were considered as one site for this study as the pediatric ward was based at Mt Druitt Hospital and the special care nursery (SCN) at Blacktown Hospital. Bathurst Hospital is a rural center and was considered a single site.

Otherwise, all three centers provide the students with exposure to general pediatrics and to neonatal services down to 32 weeks' gestation. Metropolitan-based students had 4 weeks of general pediatric wards and seeing children in the mixed adult-pediatric emergency departments (EDs). In the EDs, students were rostered with pediatric emergency clinicians, and/or saw referred patients in the ED as part of the inpatient pediatric team. They also rotated through 1 - 2 weeks in SCN, 1 week in hospi-

Manuscript submitted September 17, 2022, accepted October 15, 2022  
Published online October 31, 2022

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doi: <https://doi.org/10.14740/ijcp501>

**Table 1.** Demographic Details of Clinical Centers

Center	Campbelltown Hospital	Blacktown Hospital*	Mt Druitt Hospital*	Bathurst Base Hospital
Distance from:				
Sydney Central Business District	60 km	35 km	42 km	201 km
The Children's Hospital at Westmead	52 km	12 km	19 km	179 km
Sydney Children's Hospital	57 km	45 km	48 km	208 km
Approximate catchment population, ≤ 14 years age	25,000 [3]	75,000 [4]		8,000 [5]
	485	5,900		2,600

\*Single teaching center with two clinical sites.

tal clinics and private consulting rooms, and 2 weeks in a school for special purposes (SSP). Some students attended community-based developmental and Aboriginal Health clinics. Rural-based students had 8 weeks in general pediatrics and SCN with exposure to inpatient and outpatient settings. Half a day a week was designated for community visits with time at the local SSPs, as well as in early intervention and other therapy services. We based our list of conditions on the previously described consensus [1], with additional conditions including child protection and neonates affected by maternal substance use. Most definitions of the conditions were straightforward, and had not all been defined in the original paper [1]. However, we provided guidelines for specific conditions (Table 2) to minimize misunderstanding by the students. A descriptive analysis was undertaken.

A cross-sectional observational anonymized paper-based survey (Supplementary Material 1, [www.theijcp.org](http://www.theijcp.org)) was distributed to students at the start of each rotation and returned on the final day. Students were introduced to the study at the start of each of the eight rotations. Participation was voluntary and not associated with assessment. Completion of mandatory logbook requirements of acute respiratory, acute non-respiratory, chronic and SCN-based patients, baby checks and a case history on a child from their SSP placement, was separate to this study. A clinical encounter was defined as one in which the student took a history with or without performing a physical examination or observed a clinician doing so. Any case with two symptoms or signs, such as fever and breathlessness, was accepted as two separate conditions (Supplementary Material 1, [www.theijcp.org](http://www.theijcp.org)). The study was approved by the Western Sydney University Human Research Ethics Committee (approval number H9989). This study was conducted in compliance with

the ethical standards of the responsible institution on human subjects as well as with the Helsinki Declaration.

## Results

Seventy-five of 239 (31%) surveys were returned, of which five were incomplete. Of the 70 responses analyzed, 60 were from the metropolitan sites (34 from Campbelltown center and 26 from the Blacktown and Mt Druitt centers), two from Bathurst the rural center, and eight were unknown. No data on non-respondents were available. There were 1,453 encounters in total, and all the conditions in the survey were encountered by at least 16 students in the study cohort. All 70 students who returned surveys saw children with fever and breathing difficulties. Other very common encounters were with a child with vomiting and/or diarrhea (68, 97%), rash (65, 93%), obesity (62, 89%), a heart murmur (61, 87%) and irritability (61, 87%). Over 90% saw a premature neonate, and over 80% a neonate with respiratory distress or jaundice. Fewer than 30% reported having seen a child with an abdominal or groin mass, ingestion, or "generalized swelling" (Table 2). We compared the number of encounters between the two metropolitan centers (Table 2). To maintain patient confidentiality, we excluded the encounters with child protection concerns and newborns with maternal substance use. We also excluded conditions for which the number of encounters were 10 or fewer at one site over the 2-year study period. To maintain respondent confidentiality, we did not separately analyze the two returned surveys from the rural site at Bathurst Hospital.

Three (4%) of students reported seeing all 29 conditions. Fifty-five (78%) of students had seen children with each of the presenting conditions of fever, respiratory distress, abdomi-

**Table 2.** Definitions of Specific Conditions

Condition	Definition
A febrile infant or child	Fever at least 38 °C
A premature neonate	Less than 37 weeks corrected gestational age or an ex-premature child
An infant or child with an altered level of consciousness	Includes post-ictal
A child or adolescent with abnormal behavior	Includes attention deficit hyperactivity disorder, autistic spectrum disorder, conduct disorder, or non-specified verbal or physical aggression
A child with a disorder of elimination	Includes constipation, encopresis, enuresis
A child with abnormal growth and puberty	Includes tall stature, short stature, delayed and precocious puberty

**Table 3.** Number of Students Who Saw Each Condition

Condition	Number from all sites (%)	Campbelltown Hospital	Blacktown and Mt Druiitt Hospitals
An infant or child with breathing difficulties	70 (100)	34 (100)	26 (100)
A febrile infant or child	70 (100)	34 (100)	26 (100)
An infant or child with vomiting and/or diarrhea	68 (97)	33 (97)	25 (96)
A premature neonate	66 (94)	34 (100)	2(100)
A school aged-child with intellectual disability	66 (94)	34 (100)	24 (92)
A child or infant with a rash	65 (93)	31 (91)	26 (100)
A child with abnormal growth: obesity	62 (89)	31 (91)	21 (81)
A newborn with breathing difficulties	62 (89)	30 (88)	25 (96)
An infant or child with jaundice	62 (89)	29 (85)	25 (96)
A child with a heart murmur	61 (87)	32 (94)	21 (81)
An irritable infant	61 (87)	29 (85)	22 (85)
An infant with abnormal development	60 (86)	29 (85)	23 (88)
A child or adolescent with acute/chronic abdominal pain	59 (84)	28 (82)	21 (81)
A child or adolescent with abnormal behavior	58 (83)	28 (82)	20 (77)
A child with abnormal growth: failure to thrive	58 (83)	30 (88)	19 (73)
An infant or child with an unusual appearance	51 (73)	*	*
A child or adolescent with headache	49 (70)	22 (65)	16 (62)
A newborn, infant or child with child protection concerns	47 (67)	17 (50)	12 (46)
An infant or child with pallor	46 (66)	22	
A newborn affected by maternal substance use	44 (63)	*	*
A child with an abnormal gait	37 (53)	17 (50)	12 (46)
A child with a swollen, tender joints	36 (51)	14 (41)	14 (54)
An infant or child with an altered level of consciousness	36 (51)	*	*
A child with abnormal growth: abnormal stature or puberty	32 (46)	*	*
A child with a disorder of elimination	31 (44)	*	*
An infant or child who bruises easily	23 (33)	*	*
An infant who presents for the 6-week check	21 (30)	*	*
An infant or child with an abdominal or groin mass	20 (29)	*	*
A child who has ingested...	16 (23)	*	*
A child with generalized swelling	16 (23)	*	*

\*Not analyzed as 10 or fewer cases one site.

nal pain, vomiting or diarrhea, and a rash. Fifty-seven (81%) saw the three conditions of jaundice, a premature neonate, and neonatal respiratory distress. At the metropolitan site with the echocardiology clinic, 32/34 (94%) students saw a child with a murmur compared to 29/36 (80%) from the other sites. Additionally, 20/32 (63%) of the students who reported seeing a child with abnormal stature or puberty were based at this site with an endocrinology clinic (Table 3).

## Discussion

In this cross-sectional survey of undergraduate student en-

counters with pediatric conditions, we found very high rates of encounters of children with fever, respiratory difficulties, vomiting and/or diarrhea, and rash. We found very low rates of encounters with an abdominal or groin mass, an ingestion, or “generalized swelling”. Although all conditions were encountered within the total of 1,453 encounters, only three of our 70 respondents saw all conditions we had sought.

The concept of a curriculum based on presenting complaints was described over 25 years ago, with the concept that each clinical presentation would be linked with defined clinical activities including history-taking, physical examination, generation of a differential diagnosis, and appropriate investigations [7]. Pinnock and Jones’ elegant pediatric curriculum

framework with this foundation of presenting complaints was formulated using a consensus approach, based on a modified Delphi technique seeking input from consultant and trainee pediatric clinicians in New Zealand [1]. Such an approach fosters the learning and storage of knowledge that can be retrieved in a clinically relevant way and thus supports the development of clinical reasoning skills [8]. Learning opportunities are case-based and real-life, encouraging deep, as opposed to surface, learning [9].

We found very high rates of encounters of children with fever, respiratory difficulties, vomiting and/or diarrhea, or rash. This probably reflects the epidemiology of childhood hospitalizations in our acute settings with a high burden of asthma and bronchiolitis, gastroenteritis, and other infectious diseases [10]. This means our students were exposed to the conditions they are likely to see in the future as doctors in training. Most students encountered a child with obesity, reflecting both the burden of this disease in Australia and the lower sociodemographic characteristics and ethnic profiles of children in our catchment areas [11]. However, further work is required to ascertain the students' learning of clinical assessment and management of childhood obesity, particularly how to broach the topic with patients and carers. Many students also encountered children with developmental or behavioral concerns, which are the most common problems encountered in Australian general pediatric outpatient settings [12, 13].

Further work is required to explore whether the 67% reporting seeing a child protection case reflects exposure initial assessments, to newborns affected by maternal substance use, or to children in out of home care in outpatient settings. Our SCNs manage neonates from 32 weeks gestation and above 1.5 kg birth weight, and provide non-invasive respiratory support. This accounts for the relatively high rate of encounters of premature neonates and neonates with respiratory distress and/or jaundice.

Student encounters of children with pallor and/or murmurs might reflect children with a febrile viral illness with systemic symptoms, rather than a hematological or pathological cardiac condition. However, a higher proportion of students who encountered a child with a murmur were based at Campbelltown Hospital with its echocardiography-based clinic. Further work is required to explore the clinical settings in which pediatric students encounter children with murmurs and whether these are physiological or pathological with or without other cardiovascular physical findings. Not surprisingly a higher proportion of students who encountered abnormal stature or puberty were based at Campbelltown Hospital with its endocrinology clinic. It is unlikely in a pediatric rotation that all students will have an opportunity to attend an endocrinology clinic. This finding however suggests that teaching of these uncommon conditions of tall and short stature, precocious and delayed puberty should be reinforced elsewhere in our curriculum. In addition, further work is required to determine our students' skills and knowledge in the measuring, charting and interpreting growth patterns of growth and Tanner staging. Reported encounters with children with swollen joints or easy bruising may largely be related to cases of Henoch-Schonlein purpura, given the low prevalence of juvenile idiopathic arthritis [14] and inherited coagulopathies [15].

Low rates of encounters of children with palpable abdomi-

nal masses relate to causes apart from fecal impaction being uncommon. Groin masses were uncommonly encountered; infants with inguinal herniae may present mainly in primary care and are present in only a minority of premature neonates [16]. These low numbers may also reflect that in Australia, major pediatric surgery and surgery in infants is undertaken only in tertiary centers. Few students encountered children with accidental ingestions. Most ingestions are non-lethal, and are not referred to inpatient pediatric teams if child protection is not considered to be an issue. Students may instead see such children in their emergency rotations. Low numbers of encounters with a child with "generalized swelling" reflects the prevalence of nephrotic syndrome [17]. Additionally, "6-week checks" were uncommonly seen. In our settings, this low number of encounters may be due to low numbers of families with private health cover who are therefore less likely to see a private pediatrician. However, students may encounter the 6-week check in their primary care rotations [1].

There are few studies in this area of undergraduate pediatric medical student experience. Uther and Ooi [2] also used this clinical presentation approach to describe the pediatric conditions encountered by their students who were also based in New South Wales. However, we could not make direct comparisons between their larger study and ours. They collected data through logbooks rather than our self-reported approach. Moreover, their students received 4 weeks of specialty exposure in a tertiary hospital with another 4 weeks of general pediatrics also in the tertiary hospital, or in a peripheral center. Our most commonly encountered conditions were however similar to their relatively high rates of encounters of children with breathing difficulties, fever, vomiting and/or diarrhea and rash. Additionally, our finding that relatively fewer students encountered children with generalized swelling, easy bruising, abnormal puberty, and the 6-week check is similar to their findings [2]. However, 54% of their students encountered children with an abdominal or groin mass, compared to our 29%; this might reflect their students' tertiary experience, particularly those who might have been allocated a general surgical rotation. Importantly they found no difference between rural, peripheral and tertiary centers [2]. Similarly Wright and colleagues also used logbooks with different checklist to compare the experiences of urban and rural pediatric medical students in Western Australia [18]. Their list overlapped with but included conditions that we and Uther and Ooi [2] did not, such as dental disease, trauma, and "common congenital problems". Regardless, in this study, the reported experiences of the rural and urban students were similar [18].

Two other studies in this area from Wales and Cambridge in the 1990s used a combination of conditions and presenting complaints that overlapped with ours but included conditions such as nappy rash, visual and hearing impairment, "colic", "insulin dependent diabetes mellitus" and attending a case conference. The list of desired conditions was also almost identical between these two studies [19, 20]. In the Welsh study with a 45% response rate over 3 years, 12% of students had observed a pediatric cardiac arrest and 53% saw a child with "poisoning" during their 7-week rotation [20]. While we did not seek to explore our student experience in cardiac arrest, numbers of both conditions over a short rotation in that study are much higher than would be expected in our centers. Other experi-



ences sought in the Welsh study were strabismus (56% of their cohort), hands on measurement of height or weight (52%), and observing immunizations (61%) [20], all of which might also be seen in primary care in Australia. In a Cambridge-based study [19], the response rate was 93% (103 students) and 96% (123 students) over 2 years. In the first year of this study, 23 of 42 conditions were seen by less than 85% of students. Perhaps not surprisingly, the breadth of their pediatric student experience was inversely related to the number of students at the same hospital site. This challenging situation however may not be under the control of contemporary pediatric academic staff. We have already instituted a novel approach of providing our students with experience away from the health settings in the SSPs. Another approach to increasing student numbers is to explore the possibility of student rotations in the wider community [21] such as in health centers, with early childhood nurse-led clinics, or with child protection services.

In the USA, the results from a study based on student logbooks suggested that undergraduate medical students in private community-based settings saw more patients and more common conditions including acute otitis media, pharyngitis, and attention-deficit hyperactivity disorder compared to their peers based at a university medical center. Those at the university center had more exposure to a category of “infrequent diagnosis” (fewer than one patient per student), a “well child examination”, asthma and cystic fibrosis [22]. In our settings, most infants and children with breathing difficulties will have bronchiolitis, viral-induced wheeze, asthma, non-specific lower respiratory tract infection or pneumonia. Children with cystic fibrosis or other uncommon conditions in our metropolitan area are more likely to directly present to the tertiary center where their subspecialty team is based. It is hard to draw comparisons between this USA study [18] and the Australian-based studies [2, 18] due to the different systems of primary care, particularly the different roles of the general practitioner in Australia [18] versus the primary pediatrician in the USA.

We have a low index of suspicion that findings were deliberately inflated. Previous work suggested that falsification of assessed logbooks is low [23, 24]. Students with lesser clinical exposure may have chosen simply not to undertake or return the survey. There may also have been inadvertent under-reporting of conditions, for example students may not have recognized childhood obesity in a child admitted with an acute illness or in clinic for a concurrent or even related problem such as troublesome asthma.

Previous work examined student logbooks exposed to both tertiary and secondary settings [2] with a requirement for reflection [2], which strengthens the pedagogical basis for learning [25]. Our broad definition of “encounter” is a sensitive, albeit not specific marker for learning. Social cognitive theory proposes vicarious learning [25], as may occur on a ward round with students observing the modelling of a senior clinicians. Although active learning with engagement in the required task [26] is more effective in fostering deep learning, both the seeing and doing are important for learning clinical skills. Bedside teaching on ward rounds also provides teachable moments [27] with opportunity for clinician-teachers to facilitate deliberate skills practice for students [9]. The educational impact of short hospitalizations was felt to be an issue

for student learning over 20 years ago [19]. In our clinical settings, short hospitalizations in general pediatrics mean that a ward round may be the sole opportunity for student experience for “interesting” patients with less common conditions.

A major limitation of our study is the low response rate, reflecting its voluntary nature and possibly leading to selection bias. We suspect only motivated students returned surveys, so our results may represent the maximum proportions who encountered these presentations rather than the general experience of the cohort. However, this still means that certain conditions are less likely to be seen. Another limitation is the single institutional nature of our study, although we did have responses from two metropolitan sites. Although previous work showed no differences between rural, metropolitan and tertiary settings [2, 18], a wider examination of experiences with a larger sample size of, rural and metropolitan pediatric settings would be informative. A further limitation was the marked difference in our survey response rates from rural versus metropolitan contexts, which precluded comparison between these two contexts. In addition, the authors of the original presenting complaints approach to a pediatric curriculum acknowledged that their consensus approach did not include primary care practitioners [1]. In the Australian health setting, a referral from a general practitioner is required for a general pediatric consultation, while all interns and must rotate through EDs. We therefore suggest that drawing on the input of both general practitioners and emergency clinicians in the development of pediatric curricula would be of value.

Teaching of knowledge and skills pertinent to these more uncommon conditions must differ from the delivery of teaching of common conditions. Our students have teaching away from the bedside in skills workshops, case-based discussion groups and clinical reasoning sessions. Such multimodal delivery [28], integrated with mastery and spaced learning [29], and programmatic assessment [30], may assist in the learning and retention of knowledge and skills which pertain to uncommon pediatric conditions. The innovative use of a virtual pediatric patient has been reported to develop undergraduate clinical reasoning skills [31], while a flipped classroom with technology enhanced simulation for pediatric medical students showed improvements in self-reported confidence and skills [32]. Low fidelity simulation combined with e-learning in pediatric resuscitation was shown in one study to improve the knowledge of medical students’ out to 8 months [33]. These technology-based strategies [34] could be utilized for the teaching of uncommon conditions, but require significant technical expertise to design and maintain. Whatever the combination of educational approaches, these learning opportunities should both reinforce clinical experience and foster learning of conditions not encountered *in vivo*.

Using clinical encounters to underpin the pediatric curriculum provides opportunity to align learning objectives, teaching and learning activities, and assessment tasks. Academics are well placed to promote effective learning with deliberate practice [9, 35], integrated in a spiral curriculum [36]. However medical schools may depend on the goodwill, time and expertise of clinical staff to provide bedside experience [37]. Peripheral general pediatric settings facilitate familiarity with students and thus possibly a better understanding of their individual

learning needs. This may balance a narrower clinical exposure. However, teaching an approach to common presentations and to seriously unwell children may also provide a framework for postgraduate work, and foster deep and lifelong learning [38]. Over two decades ago, it was suggested both in Australia and the United Kingdom that an undergraduate pediatric student who is only based in tertiary centers may not be receiving an optimal education [19, 39]. Sharing clinical opportunities across educational and secondary and tertiary health settings may thus be a way forward, harnessing inter-institutional collective teaching expertise. For the moment, peripheral academic pediatricians may need to work within some limitations to maximize benefit from students' clinical encounters.

### Conclusion

The clinical exposure generally matches the pattern of pediatric pathology in our peripheral settings. However, despite a broad definition of a clinical encounter, exposure to all the key conditions seems unrealistic for most students and a sizeable proportion will not encounter common clinical conditions. Less common presentations will not be seen by most pediatric students. Academics need effective teaching strategies to optimize learning of important yet uncommon conditions.

### Supplementary Material

**Suppl 1.** A cross-sectional observational anonymized paper-based survey.

### Acknowledgments

None to declare.

### Financial Disclosure

None to declare.

### Conflict of Interest

None to declare.

### Informed Consent

It was considered that informed consent was obtained from subjects who returned surveys.

### Author Contributions

Conceptualization: ST and JW; methodology: ST and JW; formal analysis: ST; investigation: ST; writing - original draft

preparation: ST; writing - review and editing: SV, PPH, JW, TM, ADM, and JM.

### Data Availability

The authors declare that data supporting the findings of this study are available within the article.

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