Case mix, learning opportunities and reflections from rural and urban medical student logs of paediatric cases.

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This thesis is presented for the degree of Master of Rural and Remote Medicine,

The University of Western Australia

Rural Clinical School,

School of Medicine

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THESIS DECLARATION

I, Helen Mary Wright, certify that:

This thesis has been substantially accomplished during enrolment in the degree.

This thesis does not contain material which has been submitted for the award of any other degree or diploma in my name, in any university or other tertiary institution.

No part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of The University of Western Australia and where applicable, any partner institution responsible for the joint-award of this degree.

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The research involving human data reported in this thesis was assessed and approved by The University of Western Australia Human Research Ethics Committee Approval number: RA/4/1/5497

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Technical assistance was kindly provided by Michael Clark, Research Assistant for data entry and Tessa Burkitt for RCSWA maps described in Papers One and Two.

This thesis contains published work and/or work prepared for publication, some of which has been co-authored.

Signature: 

Date: 19th August 2019

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AUTHORSHIP DECLARATION: CO-AUTHORED PUBLICATIONS

This thesis contains work that has been published and prepared for publication.

Details of the work: Wright HM, Maley MAL, Playford DE, Nicol P, Evans SF. Paediatric case mix in a rural clinical school is relevant to future practice. BMC medical education. 2017;17(1):237(1).
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Co-author signatures and dates:

Sharon F. Evans and Moira A. Maley 5th June 2019

Student signature: 

Date: 26th November 2018

I, Denese Playford, certify that the student statements regarding their contribution to each of the works listed above are correct.

Coordinating supervisor signature: 

Denese E. Playford Date: 6th July 2019

"The patient mix offers different experiences on which reflection and assessment can be made by the trainee themselves, by the trainer, or eventually, by an external preceptor.(2)" - De Jong

INTRODUCTION TO THE THESIS

This thesis is in agreement with The University of Western Australia Masters Rules for the content and format of a thesis and is presented as a series of papers.

Medical schools world-wide use rural locations as alternative learning environments(3). Rural clinical schools can provide solutions to reduced access to patients in tertiary centres(1), and address maldistribution of medical practitioners by attracting students to the rural workforce(4). Medical student clinical encounters should be analysed to ensure appropriate case mix in these diverse training sites(5).

The Rural Clinical School of Western Australia (RCSWA) was established in 2002 with funding from the Australian government, to create a locally trained rural workforce(6). It was part of a national strategy to proactively respond to rural workforce deficits. Consequently, 25% of all medical students in WA undertake an integrated longitudinal clerkship, including paediatrics, over a ten-month

academic year, in rural community settings. The remaining 75% continued to undertake urban blocks in four terms, rotating through paediatrics, obstetrics and gynaecology, general practice and internal medicine.

There were initial concerns from urban tertiary academic paediatricians about appropriate paediatric case mix in the RCSWA. As the RCSWA academic mentor in paediatrics, based in the urban school, and with recent experience as a rural paediatrician, I had knowledge of the clinical experiences in paediatrics available to both RCSWA and urban students. Direct comparisons of rural and urban case mix have been recommended(7) so I decided to research the cases students actually encounter. All rural and urban students are required to log paediatric patients; these could be used as documented evidence of clinical encounters.

A literature review was undertaken with the assistance of a UWA librarian on current publications regarding logging generally, and specifically of paediatrics cases in MedLine, Web of Science and AustHealth. Search terms included case complexity, child health, community, learning styles, logging (paper and electronic), medical student, paediatrics, reflection, rural, learning opportunities, longitudinal clerkships, postgraduate and undergraduate. The search was repeated in 2016.

The literature review affirmed that student logs are used extensively throughout medical schools to document patient encounters(8), with potential benefits for students and faculty. Logs can provide information to assist faculty in comparing different sites and between different organisations(9).

There are few reports of medical student logs of paediatric case mix(10, 11), with only one visionary, but small and dated, study from WA(12). The study most relevant to the RCSWA was more recently undertaken in the USA, where paediatric patient logs between a University Medical Practice (UMP) and nine Community Private Practices (CPP) during an eight week placement were compared(11). The context and method of this paper is considered in detail in published paper one.

Given the national development of Rural Clinical Schools, there was therefore a need for current Australian research to be undertaken to provide contextualised information on student logging of paediatric cases, which could be used nationally, and could contribute to the literature internationally. The hypothesis of this first exploration was that urban and rural students would encounter core paediatric cases despite diverse clinical settings.

As logs can assist students in identifying their learning needs, potential gaps in their learning, and allow opportunity for reflection(9), the detailed reading undertaken in the first exploration allowed investigation of a second aim: to determine if students optimised their learning by highlighting areas for discussion by medical educators with students, defined as feedback learning opportunities (FLOs), within each case logged. That logs provide substantial opportunities for learning is the rationale for asking both undergraduate and postgraduate trainees to complete case logs as a core part of their acquisition of competencies.

Lastly, this study also allowed a subsidiary exploration, which asked if there was any difference in reflection between rural and urban students, as students are known to vary their reflections in different contexts(13). This was preliminary work as a pilot for future study, so the initial data is given in the thesis appendix.

The research questions

1. Do rural and urban medical students log core paediatric cases?

2. Are there differences in learning opportunities between rural and urban medical student logs of paediatric cases?

3. Are there differences in medical student reflection on paediatric cases when logged in rural or urban contexts?

Data collection and statistical analysis

Urban students logged twenty hand-written paediatric cases, and rural students a minimum of twenty-five cases using an electronic logging platform. Rural clinical students provide consent for use of their logs at the start of each year; consent was obtained from urban students for their logs to be used for the research project, with approval from the University of Western Australia's Human Research Ethics Office. Each case had a unique identifier and student initials.

Exclusions

Patients over 18 years of age and obstetric cases where there was no involvement with the newborn were excluded. Cases logged in General Practice (GP) by rural students were excluded to allow comparison with urban students who didn't log cases in the GP context. The rural data set was compared pre and post GP exclusions, which confirmed no difference in case mix or FLOs with this restriction. For operational reasons term one urban students were unable to be included in the dataset. We have data demonstrating the pattern of logging was similar for each of the urban terms, and that there were similar numbers of urban students throughout the terms. Rural students also followed the same logging pattern.

Data cleaning was undertaken using pivot tables to ensure a complete data set by addressing missing data, and removing duplicate logs.

Reliability

Intra-rater reliability was assessed after the first 100 logs were entered. The research project was set up with intent to co-mark with a rural paediatrician and a GP during the data collection phase of the project for reliability. This was attempted several times and was finally undertaken near completion of the study.

Data presentation

Terminology and illustrations were carefully chosen to present results optimally. Healthcare settings was the term used for the location where the patient was seen; primary, secondary and tertiary level of healthcare was numerical to differentiate from primary, secondary and tertiary case complexity.

Results were incorporated into the document text where possible. Tables and figures were clarified for the reader by simplifying comparisons of different parameters.

Examples of decisions made about presentations of results:

- Paper 1 Figure 3 (page 38): 'Overall proportion of discipline assigned per symptom' The mix of generalist and paediatric specialties was considered for each symptom within the case.
- Paper 1 Table 3 (page 41): 'Overall presenting problems by age group, for rural and urban students compared to AIHW MDC codes as percent.'
    - Newborns were excluded from AIHW MDC codes, as these were routine obstetric deliveries.
    - The top eight presenting problems were included, with the small number remaining group as 'other' to allow comparison of all cases.
- Paper 2 Table 6 (page 71): 'Feedback Learning Opportunities (FLOs) by case complexity' originally contained cases with no FLOs, minor and

major FLOs, however this was difficult for the reader to interpret. The final version therefore shows only major FLOs within each category.

- Minor findings, such as social FLOs by complexity, and FLOs within diagnostic categories were not included in publications, as conclusions should not be made from small numbers.

PREFACE TO PUBLISHED PAPER ONE

"Paediatric case mix in a rural clinical school is relevant to future practice"

Given the relative paucity of information about paediatrics experiences of medical students, the first paper asked the core research question for this thesis: Do rural and urban medical students log core paediatric cases? Demographic and clinical data collected was based on quantified paediatric patient criteria used to ensure compliance with Liaison Committee Medical Education standards(14). This included age group (neonate, infant, child, adolescent), presenting complaint (eg. cough, fever, diarrhoea, newborn check etc), organ system (eg. respiratory, gastrointestinal, cardiovascular), location of consultation (eg. general practice, Aboriginal Medical Service, nursing post, emergency department, outpatient, inpatient, child development clinic). The first five logged presenting symptoms, including the most appropriate discipline to manage that symptom were entered. Final diagnoses were categorised into broad groups, as this is more practical than individual diagnoses, in keeping with previous research(14).

Rationale:

Medical graduates in Australia were reported to feel unprepared to deal with paediatric patients as junior doctors(15) so case mix was compared to Major Diagnostic Categories of Paediatric Hospital Admissions from the Australian Institute of Health and Welfare(AIHW)(16). The AIHW an independent statutory agency that provides national statistics using Australian Refined Diagnosis Related Groups (AR-DRGs) as a patient classification system to report on clinically meaningful patient case mix.

Paper One research questions:

This paper aimed to address the first research question - Do rural and urban medical students log core paediatric cases?

To answer, we asked the following:

- Does a rural clinical school provide a paediatric case mix relevant to future practice?
- How does the paediatric case mix as logged by rural students compare with that by urban students?

References for the bridging chapters

See page 89.

Paper One: Paediatric case mix in a rural clinical school is relevant to future practice.

Wright HM, Maley MAL, Playford DE, Nicol P, Evans SF. BMC medical education. 2017;17(1):237(1).

Wright *et al. BMC Medical Education* (2017) 17:237
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BMC Medical Education

RESEARCH ARTICLE Open Access

Paediatric case mix in a rural clinical school is relevant to future practice

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Abstract

Background: Exposure to a representative case mix is essential for clinical learning, with logbooks established as a way of demonstrating patient contacts. Few studies have reported the paediatric case mix available to geographically distributed students within the same medical school. Given international interest in expanding medical teaching locations to rural contexts, equitable case exposure in rural relative to urban settings is topical. The Rural Clinical School of Western Australia locates students up to 3500 km from the urban university for an academic year. There is particular need to examine paediatric case mix as a study reported Australian graduates felt unprepared for paediatric rotations.
We asked:
Does a rural clinical school provide a paediatric case mix relevant to future practice? How does the paediatric case mix as logged by rural students compare with that by urban students?

Methods: The 3745 logs of 76 urban and 76 rural consenting medical students were categorised by presenting symptoms and compared to the Australian Institute of Health and Welfare (AIHW) database Major Diagnostic Categories (MDCs).

Results: Rural and urban students logged core paediatric cases, in similar order, despite the striking difference in geographic locations. The pattern of overall presenting problems closely corresponded to Australian paediatric hospital admissions. Rural students logged 91% of cases in secondary healthcare settings; urban students logged 90% of cases in tertiary settings. The top four presenting problems were ENT/respiratory, gastrointestinal/urogenital, neurodevelopmental and musculoskeletal; these made up 60% of all cases. Rural and urban students logged similar proportions of infants, children and adolescents, with a variety of case morbidity.

Conclusions: Rural clinical school students logged a mix of core paediatric cases relevant to illnesses of Australian children admitted to public hospitals, with similar order and pattern by age group to urban students, despite major differences in clinical settings. Logged cases met the curriculum learning outcomes of graduates. Minor variations were readily addressed via recommendations about logging. This paper provides evidence of the legitimacy of student logs as useful tools in affirming appropriate paediatric case mix. It validates the rural clinical school context as appropriate for medical students to prepare for future clinical paediatric practice.

Background

Exposure to patients is essential to clinical learning. As learners experience more clinical cases they develop illness scripts which progress their clinical reasoning and diagnostic skills(17). Learners need to build a database of cases to assist with their clinical reasoning(18), including an appropriate case mix with a variety of diseases. A systematic review of case mix and clinical competence showed higher case exposure was positively correlated with medical students' self-reported confidence and level of comfort(2). One study showed improved Observed Structured Clinical Examination (OSCE) performance in students with more self-directed clinical exposure(19).

Log books have long been utilised to verify self-directed exposure to cases and to accurately reflect learning environments in undergraduate and postgraduate settings(8, 14, 20, 21). However, the focus so far has been on students learning in urban settings.

Given the numerous reported benefits(6, 22-24), there is international interest in expanding undergraduate and postgraduate medical teaching locations to rural contexts. It is therefore useful to demonstrate equitable case exposure and resultant learning can occur in rural relative to urban locations, particularly in paediatrics.

A US study by McCurdy and colleagues reported differences in paediatric case mix for students within the same university, but placed in different

geographical locations(11). Students at the tertiary University Medical Practice (UMP) logged more uncommon disorders and cases with allergy, diabetes and fever. In comparison, students placed in Community Private Practices (CPP) up to 475 miles (764kms) from UMP logged more routine illnesses, eye, growth and mental health problems. The most common diagnoses (excluding health supervision) were 44.6% ENT/respiratory, 8.1% well children, 6.4% skin, 5.9% gastrointestinal/urogenital, 2.1% mental health, 1% neurodevelopmental, 0.8% fever and 0.7% musculoskeletal. However, McCurdy focused on private office practice, which may be systematically different from rural practice at large. Rural practice in Australia, for example, is based on a primary care model, where cases are mostly referred to specialists by the general medical practitioner (GMP)(25).

One limited early study from Western Australia (WA) showed three-week rural selective placements of six students in paediatrics gave adequate exposure to paediatric cases compared with urban controls(12). However, the study was of insufficient size and duration to verify quantity and quality of an appropriate case mix.

In WA, 25% of students undertake paediatrics in the Rural Clinical School of Western Australia (RCSWA), the remaining 75% in the urban programme, based in the state capital city. The RCSWA is well placed to provide a comprehensive overview of case logging in rural and remote contexts. This widely dispersed school locates students in 13 RCSWA sites, in groups of three to ten students, up to 2175 miles (3500km) from the university's city campus for

an entire academic year. With respect to standardised geographical categories, all RCSWA sites are either rural (RA2-3) or remote (4-5), shown in Figure 1(26). During the forty-week rural Integrated Clerkship, students have their entire exposure to the paediatrics curriculum, making paediatrics an ideal discipline of study. The full curriculum comprised Paediatrics, Obstetrics and Gynaecology, General Practice (GP) and General Medicine concurrently. Students were predominantly community based, with access to small regional hospitals. Teaching was mostly by General Practitioners (GPs); few sites had specialist paediatric services.

Urban students undertook four separate 10-week block rotations in the same teaching disciplines as rural students. Paediatrics teaching was predominantly by specialist medical, nursing and allied health staff, based mainly in the tertiary paediatric hospital. Some placements were within secondary hospitals. All attended community placements in the capital city.

An academic paediatrician (HW) worked with the rural and urban Schools to ensure equitable learning outcomes including "primary care level of clinical skills and knowledge of the child"(27). Rural and urban students had the same learning outcomes and completed the same summative written and OSCE assessments.

A study of Australian medical graduates suggested they felt unprepared for paediatrics in their first year of postgraduate practice(15). Multiple factors could contribute to this, including inadequate case mix. Logs are a resource to

demonstrate a paediatric case mix relevant to future clinical practice. Also, to establish if paediatric case mix is comparable, despite marked geographical differences.

We therefore asked:

Does a rural clinical school provide a paediatric case mix relevant to future practice?

How does the paediatric case mix as logged by rural students compare with that by urban students?

Methods

Logs submitted in 2011 were reviewed following written consent from medical students in their penultimate year at the University of Western Australia (UWA). Ethics approval was obtained – UWA RA/4/1/5497. Urban students' handwritten logs were transcribed by a research assistant; rural students entered cases into a custom-built personal web database(28). Clinical data was categorised by the lead researcher (HW), previously a rural paediatrician, currently an urban specialist general paediatrician and medical educator.

Each case was categorised into an overall presenting problem, which was compared to paediatric separations by major diagnostic category (MDC) from the Australian Institute of Health and Welfare (AIHW). AIHW is an independent statutory agency that provides annual reports based on national statistics. It uses an internationally recognised patient classification system to report on

clinically meaningful patient case mix (16). Table 1 shows categories of overall presenting problems with correlating AIHW MDC codes (excluding neonates). This indicates prevalence of paediatric presentations to public hospitals in Australia.

Inclusions and Exclusions

Urban students were required to log 20 written cases, and included those from terms 2 to 4 due to logistic considerations. Rural students were required to log a minimum of 25 cases, with the option to log more. As urban students were not required to log cases in General Practice, rural cases logged in GP surgeries were excluded from the rural data set before comparison. Core Paediatric Cases from the Unit Guidebook directed logging and are listed in Appendix 1(27).

Protocol of Data collation for analysis

The categorisation of data was based on Li et al(14). Age group (neonate to 28 days), infant (to 1 year), child (2-12 years), adolescent (13-17 years); presenting complaint (e.g. cough); and organ system (e.g. respiratory) were documented.

Case classification

The first five logged presenting symptoms of each case were entered into the data set, including the most appropriate discipline to manage that symptom. There are multiple definitions of what constitutes a generalist(29). 'Generalist' was allocated if HW considered a general medical professional without specialist

skills could manage the symptom. For example, an infant presenting with fever, respiratory distress and cough would have generalist entered for fever and cough but paediatric medicine entered for respiratory distress if that resulted in paediatric review or admission. A child presenting with vomiting and abdominal pain had generalist assigned for the vomiting and a paediatric surgeon for the abdominal pain if they were admitted with suspected appendicitis. Developmental assessments undertaken by students on a well child were allocated generalist when normal and developmental paediatrician when there was developmental delay. Each case was assigned a proportion of disciplines, such as 40% generalist, 20% paediatric medicine and 40% developmental.

Cases were seen in various clinical settings, coded as Levels 1 to 3. Level 1 were primary care. Level 2 were secondary care (e.g. general hospital inpatients). Level 3 were tertiary care such as sub-specialist clinics (e.g. rural visiting paediatric cardiology).

Statistical Analysis

Excel data were imported into SAS (SAS Institute Inc C, NC, USA version 9.4). Rural-urban comparisons were made using Chi square and Fisher's exact test (two-sided) for frequency data, and Student t-test for continuous data. Cell X^2 was estimated to test which cells were significantly different from their expected values as a guide to interpretation. Analyses were confined to the level of the logged cases only and differences within student sets of logs were not considered relevant to the research questions.

Results

All 77 rural students consented; one withdrew and was not included. There were 145 urban students in 2011, 107 in terms 2 to 4 were eligible for recruitment and 76 (71%) consented to participate. Figure 2 shows the 3745 cases logged with exclusions, resulting in 1516 urban and 1518 rural logs.

Rural students logged more patients seen in Level 1 and 2 healthcare settings than urban ($p < 0.0001$). The majority of paediatric cases logged by rural students were in Level 2 (91%). Urban students logged 90% of paediatric cases in Level 3, with 9% in Level 2, shown in Table 2.

Rural students logged more patients seen outside medical facilities such as home and school ($p < 0.001$) and more outpatients (21% v 10% $p<0.001$). A higher proportion of cases were logged by urban students in emergency departments (46% v 30%, $p<0.001$), as inpatients (45% v 40% $p=0.002$) and at child development centres (2.5% v 0.9% $p=0.001$).

Do medical students in a rural clinical school log a case mix of paediatric patients relevant to future practice?

Rural and urban students logged core paediatric cases. The top four presenting problems of ENT/respiratory, gastrointestinal/urogenital, neurodevelopmental and musculoskeletal made up 60% of all cases logged and appeared in similar order for rural and urban, shown in Table 3. The pattern of overall presenting problems corresponded to Australian paediatric public

hospital admissions. Gastrointestinal/urogenital presentations logged by all students were 16.2% compared to 16.9% AIHW, musculoskeletal 7.0 % compared to 10.8%, skin 5.3% compared to 5.2% and mental health 3.8% compared to 3.5%.

There were some reasonable differences between student logs and AIHW MDCs. For example, developmental assessments were included as neurodevelopmental presentations in this study, contributing to a higher proportion of student logs (11.0% compared to 5.1%). Students logged more well children and children with fever as the presenting problem compared to AIHW (4.6% v 2.9% and 6.7% v 2.6%). ENT/respiratory presentations logged by all students were lower than AIHW (27.1% compared to 34.8%); this is most likely related to student choice of cases to log.

How does the case mix of paediatric cases logged by rural students compare to urban?

Although all students logged similar proportions of infants, children and adolescents, rural students logged significantly more neonates, ($p< 0.001$), 40% of whom were well. Urban students logged more neonates with ENT/respiratory problems than rural (23% v 12%) and more cases with a neonatal presentation (such as preterm) compared to rural (29% v 16%). No rural students logged neonates with fever. Rural students logged fewer fever cases in all age groups ($p=0.0001$).

Rural students logged a higher proportion of patients with mental health issues (5.2%) than urban (2.4%), particularly in children aged 1 to 12 years ($p=0.0001$). Rural students logged more outpatient cases with mental health issues than urban students (77% compared with 59%).

More adolescents logged by rural students had gastrointestinal/urogenital symptoms compared to urban (24% v 17%). Rural students logged more eye problems and cases with issues relating to growth; urban students logged more cases with allergy, diabetes and fever ($p<0.001$). Fewer than one case of growth problems, allergy and diabetes was logged per student by both urban and rural students.

The number of symptoms documented by the students in their logs was analysed as an indication of morbidity (Table 4). Both groups logged the same proportions of cases with five or more symptoms, which made up nearly half the cases logged. Rural students recorded significantly more cases with only one symptom ($p < 0.001$).

Each symptom was assigned as generalist or to a paediatric specialty and is shown in Figure 3. There was no significant difference in the average proportion of generalist symptoms within the cases, with 56.7% for rural and 53.5% for urban ($p=0.68$). The pattern of discipline distribution was similar between rural and urban, with 30% of logs having at least one symptom allocated to paediatric medicine, 11.1% to emergency medicine and 7.5% to developmental paediatrics. The only significant difference was 1.2% of rural

cases and 4.2% of urban cases being predominantly general surgical (p<0.0001). Cases where all symptoms were assigned as generalist comprised 29.0% of rural logs compared to 22.8% of urban logs (p=0.0001).

Year outcomes

There was no significant difference in end of year written and OSCE assessments between urban and rural student for the 221 students who completed the academic year (p= 0.42 and 0.93 respectively).

Discussion

This paper asked if students in a rural clinical school log a case mix of paediatric patients relevant to future clinical practice, and how case mix compares to urban student logs. We have shown medical students in rural and urban Western Australia logged common paediatric problems that were similar to Australian public hospital paediatric separations, despite major differences in clinical settings and without specific instruction on which cases to log. Similarities between urban and rural case mix of logs were noteworthy, with similar order and pattern by age group, and for cases with five or more symptoms. This is consistent with views Longitudinal Integrated Clerkships offer similar if not better learning opportunities, and result in similar academic performances, for paediatrics(23). The majority of symptoms logged were those that could be managed by a generalist, aligning with the curriculum learning outcomes of medical graduates.

The top four overall presenting problems of ENT/respiratory, gastrointestinal/urogenital, neurodevelopmental, and musculoskeletal were similar for rural and urban students. The comparison with public hospital data was deliberate as AIHW MDCs indicate the paediatric presentations junior doctors encounter in WA. MDCs are also available for private hospitals, however graduates in WA generally train in the public system, and students infrequently encounter paediatric admissions in private hospitals. This data reports separations, namely admissions to hospital, so does not reflect presentations seen as outpatients. This could explain some variation between student logs and AIHW data. For example, well patients and children with fever and neurodevelopmental cases logged in outpatients or emergency departments may not be admitted to hospital.

Differences may also reflect student preferences for case logging, for example ENT/respiratory cases, as logs were not a complete record of cases seen. AIHW data being from mid 2011 to mid 2013, and inclusion of 18 year olds by AIHW may also contribute.

Minor variations between rural and urban logs reflect the relative strengths and weaknesses of the rural or urban experience and can be addressed via recommendations for student logging, structured teaching, curriculum changes, or require no change as the logs reflect clinical practice. To improve case mix, rural students were encouraged by the academic mentor to limit logs of well children. Although low in number, given the clinical importance of the

presentation of the febrile child, rural students have been encouraged to log more cases with fever.

Cases with allergy, growth and diabetes problems were under-represented by rural and urban students but are covered in the structured teaching of the curriculum. Students have been recommended to log these cases to improve confidence managing them as graduates.

The majority of logged symptoms could be managed by a general medical professional without specialist skills. General surgery was the only discipline with a significant difference between rural and urban. Surgery has since been added to the rural curriculum, which should address this.

Children with mental health problems comprise a large proportion of presentations to general practice and paediatricians(30), however these were only 4% of all cases logged. Rural students logged a significantly higher proportion of mental health case presentations, which represents a strength of the rural experience in paediatrics. The difference may relate to the rural lower acuity outpatient setting relative to urban tertiary ED, where urban students logged a large proportion of their cases. Given the high prevalence of mental health issues in Australian children, especially outside major metropolitan centres(31), these presentations are important for students' learning. Rural and urban students undertake structured teaching in child mental health, and urban students attend community placements, including child and adolescent mental health services.

Well baby checks are an important skill for medical students. Rural students logged many well baby checks. Urban students completed an obstetrics rotation immediately prior to paediatrics, where they were required to undertake baby checks. Urban students may have therefore selectively logged fewer neonates, but more neonates who were unwell. Rural students have been advised to log more unwell neonates.

How this Australian study compares to the US study

The case mix of WA student logs generally aligned with the findings by McCurdy and colleagues. Our study extends and adds to the literature by providing a comparison of student logs of paediatric cases to national hospital separations as one component of preparation for practice. The most commonly logged case in the McCurdy study was routine health surveillance (18%), with the well child (8.1%), similar to WA rural students (6.1%).

In WA, students logged fewer ENT/respiratory, but more gastrointestinal/urogenital, neurodevelopmental and fever cases among the top presentations. These may be explained by differences in the healthcare systems between Australia and the USA, and the requirement to log all paediatric patients seen during the eight-week rotation in the McCurdy study. Since WA students had relatively few restrictions on their logging, they could be more selective with their cases.

Limitations

Although the urban and rural students were using paper versus online logging systems respectively, the different mode of logging is unlikely to have influenced types of cases logged; the learning objectives were the same and each instrument had been tailored for the students' learning setting with common design intent and locally driven implementation(32).

Another potential limitation includes the sampling timeframe for urban students. Although we excluded term 1, there is no reason to believe that term 1 would be different to terms 2 to 4. The choices students made of cases to log remain comparable, even though the settings were different. As the case mix was remarkably similar to AIHW admissions, this suggests rural and urban students sampled appropriately, despite not logging every case encountered. The large number of cases analysed in this study demonstrates the cases logged by urban and rural students cover the core curriculum and are comparable for the paediatric cases they are likely to encounter in hospitals as postgraduates.

Conclusions

This study presents substantial evidence that a rural clinical school can provide an appropriate paediatric case mix in a Longitudinal Integrated Clerkship, outside a traditional urban university setting. Similarities between urban and rural logs were striking. Where there were minor differences, these were readily addressed. We have affirmed rural clinical schools as an appropriate placement for medical students to learn paediatrics relevant to future practice.

List of abbreviations:

AIHW - Australian Institute of Health and Welfare

CPP - Community Private Practices

ENT – ear, nose and throat

GP - general medical practitioner

GP - General Practice

GPs - General Practitioners

MDC - major diagnostic category

OSCE - Observed Structured Clinical Examination

RCSWA - Rural Clinical School of Western Australia RCSWA

UMP - University Medical Practice

UWA - University of Western Australia

WA - Western Australia

Declarations:

Ethics approval and consent to participate:

Ethics approval was obtained from the University of Western Australia Ethics Committee approval RA/4/1/5497. Consent to participate and for publication was obtained from students.

Availability of data and materials:

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors report no declarations of interest.

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Authors' contributions:

HW was responsible for study concept. Study design was by HW, MM, DP, PN and SE. HW was the main contributor to acquisition of data. SE undertook data analysis. HW, MM and SE were involved in interpretation of data. HW, MM, DP, PN and SE have all been involved in drafting the manuscript and revising it critically for important intellectual content. HW, MM, DP, PN and SE have given final approval of the version to be published; have participated sufficiently in the work to take public responsibility for appropriate portions of the content; and have agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Figures

Figure 1. RCSWA sites in Western Australia with United Kingdom superimposed for comparison. All sites are located in outer regional, remote or very remote Australia.

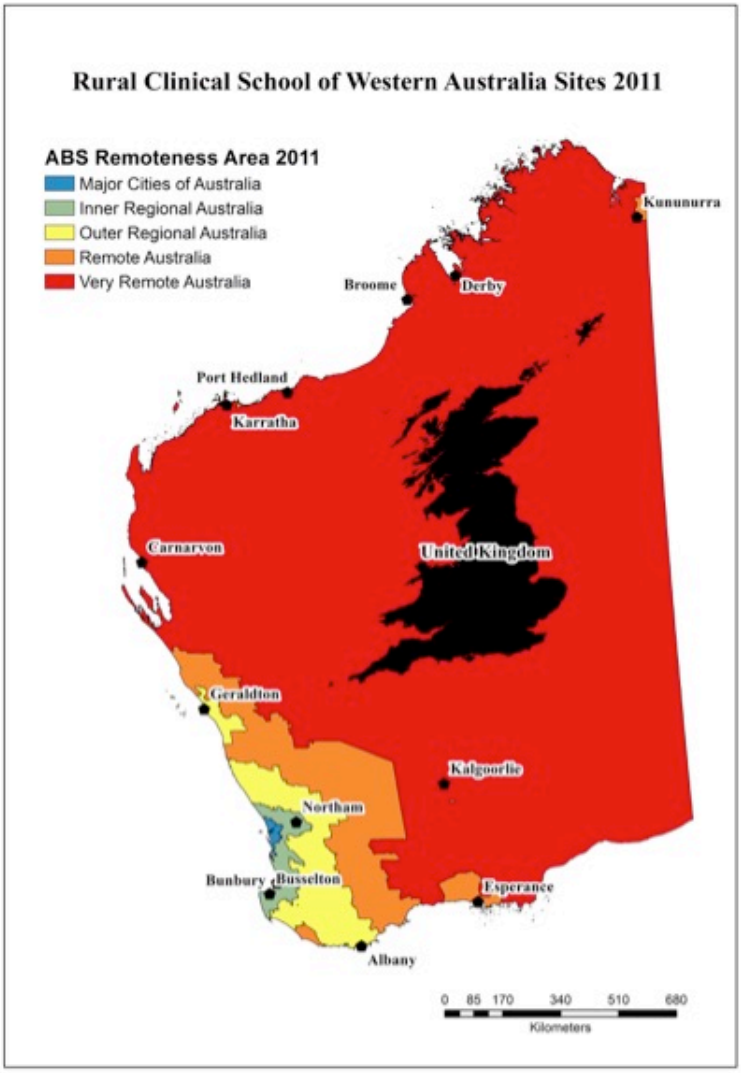


Figure 2. Overall cases logged for urban and rural students with exclusions.

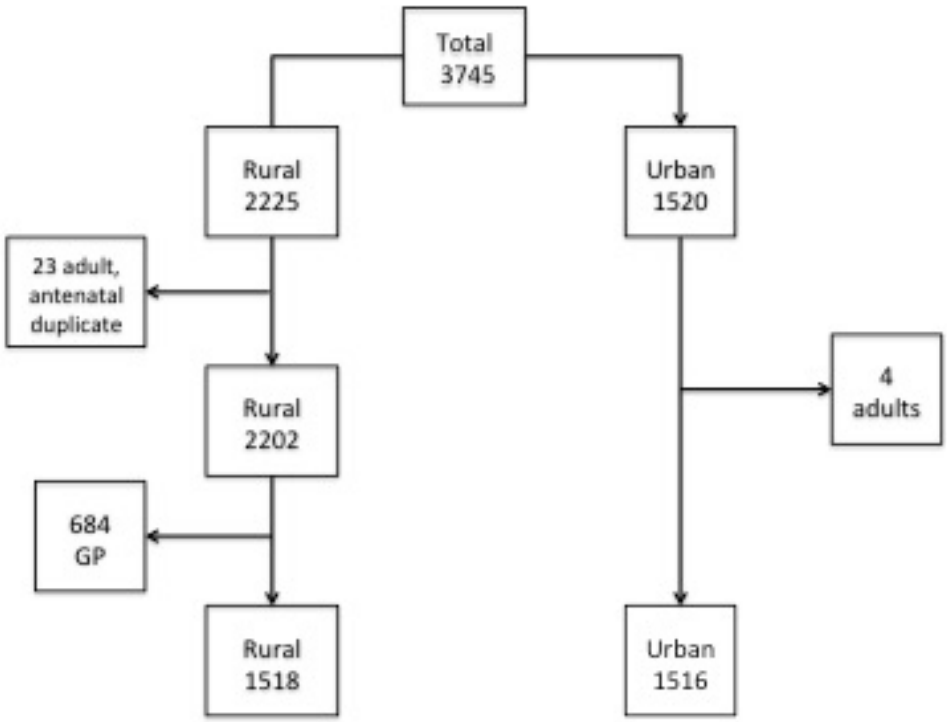
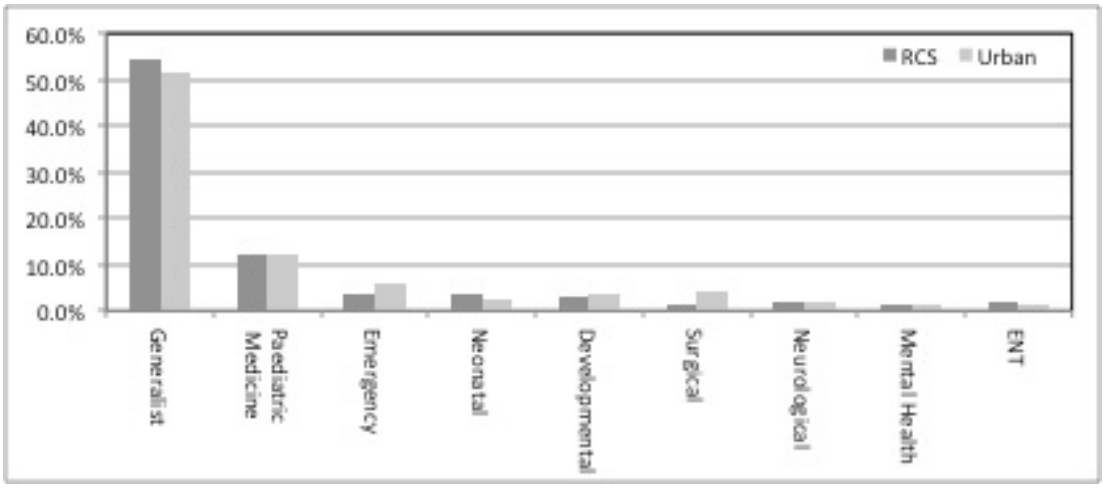


Figure 3. Overall proportion of discipline assigned per symptom.



Tables Paper One

Table 1. Categories of Overall Presenting Problem with AIHW MDC codes and examples.

Overall Presenting Problem allocated to student log	**Examples – includes symptoms and diagnoses**	**AIHW MDC code**
Respiratory/Ear Nose and Throat (ENT)	Cough, neck lump, stridor, otitis media	03 and 04
Gastrointestinal/urogenital	Diarrhoea, urinary tract infection, abdominal pain	06, 07, 11 and 12
Neurodevelopmental	Developmental delay, seizure, cerebral palsy	01
Musculoskeletal	Fractures, joint pain, limp	08
Skin	Rash, laceration, burn, cellulitis	09 and 22
Well child	Newborn and 6 week checks, immunisations, crying infant	24
Mental health	School refusal, anxiety, depression, autism	19 and 20
Fever	Febrile child, Kawasaki disease	Nil
Eye	Red eye, eye trauma, periorbital cellulitis	02
Growth	Obesity, short stature, failure to thrive	10
Cardiac	Congenital heart disease, murmurs, faints	05
Neonatal	Preterm, neonatal jaundice	15
Syndromes	Down's syndrome, Williams syndrome	Nil
Allergy	Allergic rhinitis, anaphylaxis, food allergy	03
Haematology/oncology	Leukaemia, neuroblastoma, anaemia	16 and 17
Diabetes	Type 1 and Type 2 diabetes	10
Not otherwise specified	Refugee, metabolic, dental, hypothyroid	13, 14 and 21

Table 2. Healthcare settings of rural and urban logged paediatric cases.

Age group	Care setting									
	Level 1 (Primary)		Level 2 (Secondary)		Level 3 (Tertiary)		Total		%	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Neonate	8	0	181	11	6	58	195	69	12.9%	4.5%
Infant	11	2	241	21	8	303	260	326	17.1%	21.5%
Child	16	4	799	97	67	855	882	956	58.1%	63.1%
Adolescent	2	0	167	15	12	150	181	165	11.9%	10.9%
Total	**37**	**6**	**1388**	**144**	**93**	**1366**	**1518**	**1516**		
%	2.4%	0.4%	91.4%	9.5%	6.1%	90.1%				

Table 3. Overall presenting problems by age group, for rural and urban students compared to AIHW MCD codes as percent.

*excluding newborns

Rural	Neonate		Infant		Child		Adolescent		Rural total n	%	Urban	Neonate		Infant		Child		Adolescent		Urban total n	%	AIHW %
ENT / Resp	25	12.8%	101	38.9%	233	26.4%	25	13.8%	384	**25.3%**	**ENT / Resp**	16	23.2%	147	45.1%	240	25.1%	17	10.3%	420	**27.7%**	**34.8%**
Gastro/ Urinary	23	11.8%	36	13.9%	143	16.2%	44	24.3%	246	**16.2%**	**Gastro/ Urinary**	8	11.6%	48	14.7	160	16.7%	29	17.6%	245	**16.2%**	**16.9%**
Neuro/ develop	4	2.1%	24	9.2%	110	12.5%	14	7.7%	152	**10.0%**	**Neuro/ develop**	4	5.8%	22	6.8%	119	12.5%	27	16.4%	172	**11.3%**	**5.1%**
Musculo skeletal	6	3.1%	3	1.2%	77	8.7%	22	12.2%	108	**7.1%**	**Musculo skeletal**	1	1.5%	4	1.2%	75	7.9%	24	14.6%	104	**6.9%**	**10.8%**
Fever	0	0.0%	22	8.5%	47	5.3%	2	1.1%	71	**4.7%**	**Fever**	6	8.7%	27	8.2%	96	10.0%	4	2.4%	133	**8.8%**	**2.6%**
Skin	6	3.1%	16	6.2%	75	8.5%	11	6.1%	108	**7.1%**	**Skin**	0	0.0%	16	4.9%	65	6.8%	11	6.7%	92	**6.1%**	**5.2%**
Well child	79	40.5%	13	5.0%	0	0.0%	0	0.0%	92	**6.1%**	**Well child**	5	7.3%	17	5.2%	25	2.6%	0	0.0%	47	**3.1%**	**2.9%**
Mental health	0	0.0%	1	0.4%	59	6.7%	19	10.5%	79	**5.2%**	**Mental health**	0	0.0%	2	0.6%	15	1.6%	20	12.1%	37	**2.4%**	**4.0%**
Other	52	26.7%	44	16.9%	138	15.6%	44	24.3%	278	**18.3%**	**Other**	29	42.0%	43	13.2%	161	16.7%	33	20.0%	266	**17.5%**	
Total %	195 **12.9**		260 **17.1**		882 **58.1**		181 **11.9**		1518		**Total %**	69 **4.5**		326 **21.5**		956 **63.1**		165 **10.9**		1516		

Table 4. Symptoms recorded per case: cases with five or more symptoms made up nearly half the cases logged.

Number of symptoms	Rural	%	Urban	%	Total	%
1	256	16.8%	76	5.0%	332	10.9%
2	197	13.0%	218	14.4%	415	13.7%
3	211	13.9%	306	20.2%	517	17.0%
4	212	14.0%	266	17.6%	478	15.8%
> = 5	642	42.3%	649	42.8%	1291	42.5%
Total	1518	100%	1515	100%	3033	100%

Published appendix

Core Paediatric Cases

- The seriously ill child
- Acute or persistent cough, stridor and/or wheeze
- Difficulty in breathing, respiratory distress
- Vomiting
- Acute or chronic diarrhoea
- The spectrum of growth in children – failure to thrive through to obesity
- Acute or recurrent abdominal pain
- The infant who is irritable, crying and/or unsettled, or has poor feeding
- Fever and sepsis including febrile convulsion
- Rash
- Headaches
- Seizures
- Trauma including fractures, head injury, burns and scalds
- Dental trauma or maldevelopment
- Limp and structural deformities of the legs and hips
- Developmental delay
- Behavioural, learning and mental health problems including autism spectrum disorders, ADHD and depression/anxiety
- The child with a chronic health problem
- The abused child
- Common congenital problems

CONCLUSION TO PAPER ONE

The first paper 'Paediatric case mix in a rural clinical school is relevant to future practice'(1) provided evidence to answer the research question: Do rural and urban medical students log core paediatric cases? It showed that there was substantial evidence that rural and urban students in Western Australia log paediatric cases relevant to future practice. It demonstrated the many similarities in the paediatric cases logged by rural and urban students, with the majority being common paediatric presentations. The pattern of presenting problems generally aligned with Australian paediatric public hospital admissions, with differences relating to categorisation of cases and student logging choices. The majority of symptoms logged could be managed by a general medical professional, so should prepare graduates for clinical practice as junior doctors.

Whilst this first paper confirmed medical students in both settings log an appropriate quantity and variety of paediatric cases relevant to those they will encounter in practice, further questions about the educational value of these cases remained and were examined in the second paper.

PREFACE TO PAPER TWO

"Feedback learning opportunities from medical student logs of paediatric patients."

"Feedback, based on contacts with patients, is a central aspect of learning…(33)" – Hattie & Timperley

The second paper addressed the research questions that could now be asked after establishing basic equity between the logs. So in this paper, we asked: are there differences in learning opportunities between rural and urban medical student logs of paediatric cases?

Learning opportunities were originally labelled as 'missed learning opportunities, however this was changed to 'feedback learning opportunities' (FLOs) as responsibility lies with the medical educator to identify those when reviewing logs and providing feedback. The results of this study caused a major re-think of the importance of feedback as a core part of students' logging.

FLO categories were determined based on themes that emerged during the initial study, based on the paediatrics mentor seeing significant areas of potential feedback inherent in gaps in the students' logs. These were categorised as being medical, professionalism, insufficient, clinical

reasoning, student wellbeing, quality and safety, and sociocultural, with examples of each provided subsequently in paper two. FLOs were graded as minor, multiple minor, major, multiple major and dangerous/unacceptable.

The first 100 logs were analysed in depth to set the parameters for the study. This subset showed over 90% of logs had two or fewer FLOs. Thus, the two most relevant FLOs were included for analysis. This captured all major FLOs whilst optimising and standardising data collection.

'Feedback learning opportunities from medical student logs of paediatric patients' was submitted to BMC Medical Education in September 2018, and is under consideration for publication, in response to peer review from a prior submission to Teaching and Learning in Medicine in February 2018.

Rationale

Logs can assist students and their teachers in identifying learning needs and potential gaps in learning. Students should consider all clinical problems for each patient(17), however log omissions and errors are known to occur(34).

In this study, student logs were reviewed for frequency and severity of log omissions and errors. These were originally labelled 'missed learning opportunities, however this was changed to 'feedback learning opportunities' as it became clear from the consistency in the categories of information missed, that these omissions and errors provide a rich resource

for the medical educator to identify and teach from when reviewing logs and providing feedback.

As a core part of their curriculum, medical students are directed to learn from a variety of cases with different clinical contexts and complexities(35). However, the extent to which they do so has not been tracked. Therefore, further details were analysed to determine whether students' omissions or errors were related to healthcare setting or case complexity.

Paper Two Research questions:

This paper aimed to address the second research question: 'Are there differences in learning opportunities between rural and urban medical student logs of paediatric cases?'

To answer, we asked the following:

- How often do feedback learning opportunities (FLOs) occur?
- What are the case complexities of rural compared to urban paediatric logs?
- Do more complex cases result in more feedback learning opportunities (FLOs)?

References for the bridging chapters

- See page 89.

Paper Two

Feedback learning opportunities from medical student logs of paediatric patients.

Abstract

Background

Medical students learn from diverse clinical experiences. Logs of clinical encounters present valuable feedback learning opportunities (FLOs). Medical educators can provide students with specific, timely feedback to improve learning by considering all clinical problems, developing clinical reasoning skills, and encouraging accuracy. Are there differences in FLOs between students in diverse learning contexts?

The medical programme in Western Australia provides this context, with parallel placements. Rural students are dispersed in community based Rural Clinical School sites; urban students mainly in the tertiary children's hospital. Questions about the educational value of student logs were examined in this study.

Methods

Completion of at least 20 logged paediatric cases was a barrier assessment for all students in their penultimate year at the University of

Western Australia. FLOs were circumstances where a medical educator could provide valuable feedback to improve the students' learning experience. FLOs were subcategorised as medical, professionalism, insufficient, clinical reasoning, student wellbeing, quality and safety, and sociocultural. Major FLOs required recommendations from a medical educator; minor FLOs included simple omissions. Cases were assigned an overall primary, secondary or tertiary complexity.

Results

Each group comprised 76 consenting students, providing 1516 urban and 1518 rural paediatric logs for analysis, after exclusions. FLOs occurred often, with significantly more for rural compared to urban students (56% v 49% $p<0.0001$). The increased rural FLOs were mostly minor.

Major FLOs occurred in over a third of cases, with no significant difference between rural 33% and urban 35% logs ($p=0.24$). Medical FLOs accounted for 64% of rural and 75% of urban FLOs ($p<0.0001$). All students logged mostly primary and secondary complexity cases (67% rural; 61% urban). Major medical FLOs increased with increasing patient complexity, particularly for urban students.

Discussion

Case logs are a valuable resource for medical educators to enhance students' learning experiences by providing meaningful feedback. FLOs occurred frequently in student logs of paediatric patients, and were mostly medical. There are many potential benefits for students from identifying

FLOs, as feedback from a medical educator may enable conversations about cases to enhance learning. This study strengthens recommendations for regular review and timely feedback on student logs.

Background

Exposure to a varied case mix offers diverse clinical experiences from which medical students can learn, and medical educators can provide feedback(2). Appropriate case mix, including cases from different clinical settings and of varied complexity, is essential to support clinical learning(2, 17).

Feedback on cases that students have encountered is central to, and can greatly influence, learning. Feedback has been defined as information provided about some aspect of the appraisee's performance or understanding(33). The rationale for providing feedback to medical students on their patient logs is that this intervention can improve learning. Since medical students are known to under-recognise diagnoses(34), they may need guidance to consider all clinical problems for each patient. Clinical teachers can provide learners with specific feedback to develop clinical reasoning skills(17). Additionally, timely feedback can assist with consolidating accurate and appropriate entries, or in correcting inaccuracies(36).

Medical student logs can therefore present numerous valuable feedback learning opportunities (FLOs). To establish the additional

educational benefits for feedback presented by student logs, it is important to examine FLOs in logs of varying complexity. Given differences in learning contexts for students, it is also important to establish whether there are differences in FLOs between students in diverse placements. The medical programme in Western Australia provides this context, with parallel rural and urban placements.

Student placements

In Western Australia, 25% of medical students are widely dispersed up to 2175 miles (3500km) from the university's city campus in a Rural Clinical School (RCSWA), for an entire academic year. RCSWA sites are all classified as rural or remote(26); all are regarded as rural in this paper. Rural students are predominantly community based, compared with urban students who are based mainly in the tertiary children's hospital.

We have previously reported alignment of the quantity and variety of paediatric presentations logged by rural and urban medical students with Australian paediatric hospital admissions(1). Students' logs corresponded closely to major diagnostic categories (MDCs) from the Australian Institute of Health and Welfare (AIHW). Students logged over 90% of cases in the hospital setting - secondary level for rural and tertiary level for urban. Urban students logged nearly half their cases in the Emergency Department, compared with 30% of cases logged by rural students. Only 10% of cases logged by urban students were outpatients.

Whilst our earlier study confirmed medical students log an appropriate quantity and variety of paediatric cases relevant to those they will encounter in practice (1), further questions about the educational value of these cases remain and are examined in this study with respect to learning opportunities in each log:

How often do feedback learning opportunities (FLOs) occur?
What are the case complexities of rural compared to urban paediatric logs?
Do more complex cases result in more feedback learning opportunities (FLOs)?

Methods

Logging instructions to students

Urban students were required to log and submit 20 paediatric cases in a written logbook. They were instructed to note clinical problems, history, examination, investigations, working diagnosis and differentials, a problem based management plan and reflection on learning. Specific requirements for cases logged were two outpatients; one Aboriginal child, where it was essential to apply holistic case management; and two developmental assessments.

Rural students were required to log a minimum of 25 paediatric cases electronically using a custom-built web database. Cases were from the core paediatric presentations in the guidebook. Specific requirements for

cases logged were 10% Aboriginal cases; and 10% to include personal and professional development topics. Details included patient demographics, where students encountered cases, the clinical problem(s), differential diagnosis and formulation and follow-up. Case logs were to be discussed monthly with a medical educator, with three timetabled reviews during the year to demonstrate adequate numbers and quality of cases.

Satisfactory completion of these logged cases was a barrier assessment for urban and rural students.

Logs submitted in 2011 were reviewed by HW, an academic mentor with both the urban and rural Schools, following consent from medical students in their penultimate year at the University of Western Australia (UWA). Consent, ethics approval, inclusions, exclusions and log categorisation were detailed in the previous paper(1).

Feedback learning opportunities (FLOs)

To meet with educational best practice, feedback needs to give specific information regarding learning, including confirming if a student is correct or incorrect, advising if more information is required, restructuring understandings, or providing alternatives to learning(33).

Logged cases were reviewed by HW to identify where feedback from a medical educator could be provided to students, defined as Feedback Learning Opportunities (FLOs) in this study. FLOs were subcategorised as

medical, professionalism, insufficient, clinical reasoning, student wellbeing, quality and safety, and sociocultural. General principles of how these subcategories could help students learn from logging are shown below.

Medical: where the student should have included other medical aspects of the case; Professionalism: where logs suggested the student may benefited from a discussion about professional issues or behaviours with a medical educator; Insufficient: logs with inadequate clinical information; Clinical reasoning: logs where there was no working diagnosis, or incomplete differential diagnosis; Student wellbeing: where the log raised concerns about student welfare; Sociocultural: where students needed to log relevant social history; Quality and safety: cases with a potential adverse outcome.

FLO severity:

Appropriate logs where feedback was not required were coded as no FLO. We used 'could' or 'should' as terms to determine FLO severity, defined as minor or major. FLOs were determined as major if a student should have had recommendations made by a teacher about the content of the case logged, as the FLO was sufficient to warrant feedback. Minor FLOs included simple omissions or lack of information, where a medical educator could have provided some feedback, however this was desirable not a necessity. Scoring and examples are provided in Paper Two Appendix.

Case complexity

In our analysis we categorised paediatric cases by assigning each log an overall primary, secondary or tertiary case complexity for the whole case. Coding conventions for complexity were that if a logged case needed subspecialist input – eg. diabetes, paediatric surgery, tertiary visiting outpatients then it was coded as tertiary complexity. If the case could have been admitted to a secondary hospital under care of the paediatrics team, or could have been seen in a general paediatric outpatient clinic then it was coded as secondary complexity. If the case could be managed by a GP then it was coded as primary complexity. Newborns were coded as primary complexity if uncomplicated; secondary if involvement of the paediatric team was required; tertiary if neonatal care or transfer was required.

Statistical Analysis

Excel data were imported into SAS (SAS Institute Inc Cary, NC, USA V9.4). Rural-urban comparisons were made using Chi square and Fisher's exact test for frequency data. The cell X^2 test was used for clarification to identify parts of tables where dependencies between row and column categories may exist.

Inter- and intra-rater agreement for patient complexity was undertaken. Inter-rater agreement with an experienced rural general paediatrician was measured using a weighted Cohen's Kappa coefficient as the complexity was ordered from primary to secondary to tertiary.

Agreement for whether a student had a significant missed learning opportunity was measured using a simple Kappa coefficient.

Results

There were 76 consenting students in each of the urban and rural groups. After exclusions (predominately cases seen in rural general practices) there were 1516 urban and 1518 rural paediatric logs for analysis.

How often do feedback learning opportunities (FLOs) occur?

FLOs occurred in more than half of cases logged, with significantly more for rural compared to urban students ($p<0.0001$). For rural students, 666 (43.9%) of cases had no FLO, 618 (40.7%) had one FLO and 234 (15.4%) had more than one FLO; for urban students 778 (51.3%) had no FLO, 612 (40.4%) had one FLO and 125 (8.2%) had more than one FLO ($p<0.0001$).

Major FLOs occurred in over a third of cases logged, but with no significant difference between rural 32.6% (495/1518) and urban 34.7% (526/1516) logs ($p=0.24$).

FLO subcategories

Medical FLOs were the most common, accounting for 64.0% (545/852) of all rural and 75.2% (555/738) of all urban FLOs ($p<0.0001$). Rural students had significantly more FLOs relating to professionalism

issues (14.6% v 7.1% $p < 0.001$); insufficient clinical information (8.6% v 1.5% $p < 0.001$); relating to clinical reasoning (5.4% v 3.8% $p = 0.03$); and regarding student wellbeing (0.5% v none $p = 0.016$). Urban students had significantly more quality and safety FLOs than rural students (4.8% v 2.2% $p < 0.001$).

What are the case complexities of rural compared to urban paediatric logs?

Students logged paediatric cases with a variety of overall clinical complexities across all healthcare settings. Despite urban students logging the majority of cases in a tertiary healthcare setting, most were of primary and secondary complexity. Although the distribution patterns of case complexity appeared essentially the same (rural - 21% primary, 46% secondary and 33% tertiary; urban - 18% primary, 43% secondary and 39% tertiary), urban students logged significantly more cases of tertiary complexity than rural students ($p=0.0018$), shown in Table 5.

The breakdown of case complexity for cases logged in emergency departments was the same regardless of the rural or urban setting. Cases of primary complexity made up more than a third of those logged by all students in an emergency department.

However, the patterns of inpatient and outpatient logs were different between urban and rural students, when analysed specifically. More than half the cases rated as tertiary complexity cases logged by urban students were inpatients (307/589). In contrast, more than a third of these highly

complex cases were seen as outpatients by rural students (169/498). More than half the rural inpatient logs were of secondary level complexity, with significantly more primary, and fewer tertiary complexity inpatients than urban cases logged ($p<0.0001$). Urban students logged significantly fewer outpatients of secondary complexity compared to rural.

Do more complex cases result in more feedback learning opportunities (FLOs)?

Table 6 demonstrates the pattern of major FLOs by case complexity. The striking finding is the increase in major medical FLOs with increasing patient complexity, particularly for urban students where 32.1% of tertiary complexity logs had a major medical FLO ($p<0.001$), with 19.5% for rural students. None of the other major FLO categories increased with increasing complexity.

More major FLOs occurred in rural primary complexity cases logged compared to urban (30.7% v 22.3%) $p=0.025$. There was no difference for secondary complexity cases (31.3% v 32.7%) $p=0.60$. Consequently, fewer tertiary complexity cases logged by rural students had some form of FLO (35.7% v 42.6% $p=0.021$).

Inter-rater agreement for patient complexity with a rural general paediatrician was 0.95 (95% CI 0.86, 1.00) and for major FLO was 0.94 (CI 0.82, 1.00). Similarly, intra-rater agreements were 0.87 (0.73, 1.00) and 0.88 (0.72, 1.00) respectively.

Discussion

Case logs are a valuable resource for medical educators to enhance students' learning experiences by providing meaningful feedback. Feedback learning opportunities (FLOs) occur often in medical student logs of paediatric patients, particularly in cases with multiple medical problems. This study strengthens recommendations for regular review(32) and timely feedback on student logs(14).

We asked:

How often do feedback learning opportunities (FLOs) occur?

What are the case complexities of rural compared to urban paediatric logs?

Do more complex cases result in more feedback learning opportunities (FLOs)?

How often do feedback learning opportunities (FLOs) occur?

Feedback learning opportunities (FLOs) occurred frequently, and were mostly medical, with students failing to maximise all possible medical aspects of the case, fitting with previous research(34, 37). There are many potential benefits for students from identifying FLOs, as feedback from a medical educator may enable conversations about the cases to enhance learning. Feedback provides information about a students' understanding and should be specific, correct inaccuracies, provide advice, restructure understandings, and/or provide alternatives(33).

Medical FLOs discussions could guide students to consider all aspects of the case(34) such as co-existing diagnoses, developmental assessment or adolescent health issues. Professionalism FLOs could stimulate conversations encouraging reflection, suggest use of medical terminology, and debating ethical issues to aid personal and professional development(38). Clinical reasoning FLOs could form the basis for a discussion to assist students with their diagnostic skills from a clinical case(17). Insufficient FLOs could result in discussions about ensuring relevant details are included in logs. Sociocultural FLOs may result in discussions about cigarette smoking, the impact of living in a remote area, or cultural issues relevant to the case. Quality and safety MLOs may open discussions about patient safety, such as incorrect management or drug errors, which are increasingly being recognised as important in medical student education(39). Wellbeing FLOs may identify students who should meet a medical educator for academic or personal support, if required(8).

Rural students had more FLOs overall, however there was no difference in major FLOs between rural and urban students. Reassuringly, the increased FLOs identified for rural students were minor. These may be explained by increased insufficient and professionalism FLOs by rural students, which have been addressed by amending logging requirements following this study, and are unlikely to have future implications.

What are the case complexities of rural compared to urban paediatric logs?

This study demonstrates that urban and rural clinical schools in WA provide medical students with a variety of patient complexities, adding to previously published research showing appropriate quantity and variety of paediatric cases logged(1) . Students mostly log primary and secondary complexity cases, in keeping with the curriculum learning outcomes for urban(27) and rural medical graduates(40).

Emergency departments are frequently used by rural and urban students to log paediatric cases. Rural students logged the same proportions of primary, secondary and tertiary case complexities in rural EDs as urban students, although fewer in number. The large proportion of primary complexity cases logged in emergency departments by students is in keeping with 15.4% of paediatric presentations to Australian EDs allocated Category 5 using the Australasian Triage Scale, suggesting a low level of urgency(41).

Paediatricians see a wide range of medical, behavioural and developmental cases in outpatient clinics(30). Rural outpatient clinics, including visiting specialist clinics by paediatricians and subspecialists(42), are a valuable resource for rural students to log secondary and tertiary complexity paediatric cases. Urban students in this study logged a low proportion of cases in outpatients, underutilising this as a learning resource, particularly for secondary complexity outpatients.

Varying referral and admission patterns for rural patients in Australia(43) may explain the different patterns of inpatient and outpatient logs between urban and rural students. Hospital admissions by rural GPs increase with remoteness(44), so rural cases with reduced patient acuity may be more likely to be admitted than urban. The higher proportion of rural primary complexity inpatients reflects the health needs of the rural community, and is therefore relevant to rural medical students' learning. Indeed, smaller hospitals have been proposed as the best setting to train medical students in core conditions(45).

Do more complex cases result in more feedback learning opportunities (FLOs)?

Feedback from a medical educator on paediatric patients with multiple medical problems is recommended, as a substantial proportion of tertiary complexity cases logged had a major medical FLO. The increased major medical FLOs identified in tertiary complexity cases logged by urban students compared to rural students may relate to higher acuity patients, as most logs were of tertiary paediatric hospital inpatients.

In conclusion, regular review of logs with feedback may help students recognise the full learning potential of paediatric patients, and identify inaccuracies which can be corrected whilst still a medical student.

Limitations

The contrasting logging methods used by rural and urban students could explain some of the differences observed in this study. Although

students using electronic logs recorded more patient problems in one study(46), the overall influence of written or electronic logs on the accuracy of clinical information recorded is unclear(8).

Logs reflect one aspect of students' actual learning experiences, so FLOs may have been overestimated as logs document only what the student has recorded. It is also possible students had received feedback from medical educators, or counselling, about confronting clinical scenarios logged. However, this would reinforce our recommendations for timely log review and feedback to identify and address these.

Students' own style and degree of student supervision are variables which influence student learning(2). Awareness of the students' learning approach (deep or surface) may have been useful as a surface learning approach may underlie some of the insufficient FLOs.

Analysing logs for FLOs assumes all students were given equivalent instruction on how to log using best practice. We have assumed equivalent supervision by medical educators in urban and rural sites. The increased number of professionalism FLOs by rural students may be related to the requirement for rural, but not urban students, to log 10% of cases relating to personal and professional development. However, as these logs constituted a relatively small proportion of FLOs, this difference is worthy of note but not of concern.

This study was not designed to determine if students chose to strategically log less complex patients. However, the finding that students log mostly primary and secondary cases fits with clinical practice, so student choice is unlikely to have highly influenced the complexity of cases logged.

Interpretation of the logs as entered by the student is subjective, however the same criteria were used for both urban and rural logs. The potential for bias was minimised, as HW has experience in urban and rural clinical settings as well as working in the urban and rural clinical schools.

Ideally, review of the patients' medical records in parallel with the students' logs would have provided more comprehensive clinical information, perhaps increasing the quantity of medical FLOs, and strengthening the recommendations for feedback. As logs were de-identified this step was not possible. However, the large number of logged cases analysed in this study allowed a greater breadth of FLO type and grade to be compared for the two student groups.

This study examined logs from one clinical discipline, paediatrics, and identified a large number of potential feedback opportunities. These findings may reflect the extent of FLOs in medical student logs more broadly. Further research using the methods described could be undertaken to confirm this for other disciplines.

Generalisability

The data presented in this paper provides evidence that most medical students would benefit from feedback on paediatric cases logged. The general acceptance of case-based discussions in medical education provides the structure for this kind of formative feedback to occur(47). Whilst the detail undertaken in this study goes beyond the scope of most marking processes, our data provide an evidence-based approach to better analyse and report back to learners about their cases.

Conclusions

Student logs of paediatric patients contain many feedback learning opportunities, so timely review and feedback is strongly recommended for their educational benefit to be realised. Student logs evidence clinical encounters but more importantly, students' current thinking. Logging can provide teachers with opportunities to have meaningful conversations with students during feedback sessions. These data indicate that there is an educational imperative for medical educators to review cases logged to enhance the learning experience.

List of abbreviations:

AIHW - Australian Institute of Health and Welfare

FLOs - feedback learning opportunities

MDCs - major diagnostic categories

RCSWA – Rural Clinical School of Western Australia

UWA - University of Western Australia

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Declarations:

Ethics approval was obtained from the University of Western Australia Ethics Committee approval RA/4/1/5497. Consent to participate and for publication was obtained from students.

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

The authors report no declarations of interest.

Authors' contributions:

HW was responsible for study concept. Study design was by HW, MM, DP, PN and SE. HW was the main contributor to acquisition of data. SE undertook data analysis. HW, MM and SE were involved in interpretation of data. HW, MM, DP, PN and SE have all been involved in drafting the manuscript and revising it critically for important intellectual content. HW, MM, DP, PN and SE have given final approval of the version to be published; have participated sufficiently in the work to take public responsibility for

appropriate portions of the content; and have agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Tables Paper Two

Table 5: Case complexity across healthcare settings for urban and rural case logs

	Case Clinical Complexity						Total %	
	Primary		Secondary		Tertiary			
Location	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Emergency %	164 35.8%	237 33.5%	202 44.1%	294 41.6%	92 20.1%	176 24.9%	458 30.2%	707 46.6%
Inpatient %	117 16.9%	14 2.3%	353 50.9%	285 47.0%	223 32.2%	307 50.7%	693 45.7%	606 40.0%
Outpatient %	22 6.8%	17 11.2%	131 40.7%	41 27.0%	169 52.4%	94 61.8%	322 21.1%	152 10.0%
Other* %	13 28.9%	5 9.8%	18 40.0%	34 66.7%	14 31.1%	12 23.5%	45 3.0%	51 3.4%
Total	316	273	704	654	498	589	1518	1516
% of cases	20.8%	18.0%	46.4%	43.1%	32.8%	38.9%		

* other included school, home, overseas electives

Table 6: Feedback learning opportunities by complexity.

	Case Clinical Complexity							
	Primary (%)		Secondary (%)		Tertiary (%)		Total	
Major TFO	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Any Major TFO	97 (30.7%)	61 (22.3%)	220 (31.3%)	214 (32.7%)	178 (35.7%)	251 (42.6%)	495 (32.6%)	526 (34.7%)
Medical	30 (9.5%)	30 (11.0%)	115 (16.3%)	138 (21.1%)	97 (19.5%)	189 (32.1%)	242 (15.9%)	357 (23.5%)
Profession - alism	49 (15.5%)	19 (7.0%)	69 (9.8%)	37 (5.7%)	63 (12.7%)	43 (7.3%)	181 (11.9%)	99 (6.5%)
Clinical reasoning	15 (4.7%)	9 (3.3%)	41 (5.8%)	22 (3.4%)	22 (4.4%)	17 (2.9%)	78 (5.1%)	48 (3.2%)
Insufficient	20 (6.3%)	2 (0.7%)	65 (9.2%)	11 (1.7%)	36 (7.2%)	7 (1.2%)	121 (8.0%)	20 (1.3%)
Social	2 (0.6%)	3 (1.1%)	6 (0.9%)	10 (1.5%)	2 (0.4%)	15 (2.5%)	10 (0.7%)	28 (1.8%)
Quality and Safety	9 (2.8%)	13 (4.8%)	14 (2.0%)	34 (5.2%)	6 (1.2%)	23 (3.9%)	29 (1.9%)	70 (4.6%)
Wellbeing	0 (0%)	0 (0%)	1 (0.1%)	0 (0%)	6 (1.2%)	0 (0%)	7 (0.5%)	0 (0%)
Total cases	316	273	704	654	498	589	1518	1516

Paper Two Appendix

Feedback learning opportunities (FLOs) scoring, and examples

TFOs were scored from 0 to 5 (0 – none, 1 – one minor, 2 multiple minor, 3 one major, 4 more than one major and 5 incorrect/dangerous information in the student log.

Medical

"Could have reviewed tracheo-oesophageal fistula and potential complications."

"Could have reviewed allergic rhinitis and ADHD."

"Should have explored eczema."

"Stridor not explored."

Professionalism

"Review of this log book an opportunity to improve written communication."

"..concerning terminology that could be addressed by review of their logging."

Insufficient

"Should have more detail."

"Minimal info in case."

"Insufficient examination."

Clinical reasoning

"Incorrect diagnosis concern."

"Needed to include pertussis in differential."

Wellbeing

"Student needs debrief post child sexual assault case."

"Student needs debrief." – post stillbirth.

Quality and safety

"Unsafe to give trimeprazine to under 2 year old."

Socio-cultural

"Opportunity to reflect on issues for Aboriginal child from rural community."

"Should have smoking history in child with multiple asthma presentations."

"Social history required for recurrent ear disease."

"Should have identified need to use an interpreter."

CONCLUSION TO PAPER TWO

Students logged paediatric cases with a variety of complexities across all healthcare settings, although there were some differences between cases logged by rural and urban students. It was worthwhile examining the feedback opportunities across context because FLOs occurred in more than half of cases logged. This has significant implications for how logs are used as an educational tool.

Major FLOs occurred in over a third of cases logged, but with no significant difference between rural and urban students. Major medical FLOs increased with increasing patient complexity, which suggests that medical educators' could most effectively direct input to students' most complex cases.

The second paper confirmed that FLOs occurred frequently, that rural and urban complexities differed, and that complex cases resulted in more FLOs. Since we could not guarantee that this feedback actually occurred, we were interested to see how students responded to their own cases, with respect to depth and breadth of their own recorded reflection. This was a subsidiary question, and is included in the next chapter as an appendix.

THESIS APPENDIX: STUDENTS' REFLECTION

"Becoming a medical expert thus requires engagement in practice and appropriate reflection, which can be stimulated by feedback from coaches(2)." – de Jong

The publication 'Paediatric case mix in a rural clinical school is relevant to future practice' addressed research question one 'Do rural and urban medical students log core paediatric cases?' The paper 'Feedback learning opportunities from medical student logs of paediatric patients' addressed research question two 'Are there differences in learning opportunities between rural and urban medical student logs of paediatric cases?'

Logs also allow opportunity for student reflection(9). The requirements for reflection recognise the need for students to be professional throughout their course, however students are known to vary their reflections in different contexts(13). Given the marked difference in learning environments between rural and urban schools, we aimed to determine if this was mirrored in their reflections on paediatric cases when logged in the contrasting learning environments.

Rationale

Reflection has been widely used in medical education for years, with many definitions, including “a metacognitive process that occurs before, during and after situations with the purpose of developing greater understanding of both the self and the situation.” Reflection can be used by health professionals for learning through experiences, to develop therapeutic relationships, and to develop professional practice by responding to complex situations(48).

Some have suggested levels of reflection can be reliably discerned(13), with several published scales(49) (50). Vertical reflections include different levels of reflection on experiences. Surface reflections tend to be more descriptive and less analytical than the deeper levels, which are less frequently demonstrated(13).

External factors, such as the diverse learning environment provided by rural and urban clinical schools, can influence reflection(13). Rural students are immersed in a community for a full academic year, while urban students undertake blocks of teaching over a few weeks so may not develop the same emotional response from cases. Rural students work closely with some medical coordinators, whereas urban students have infrequent contact with academic staff. This guided reflection from a mentor in a supportive educational environment may enhance student motivation for reflective learning(51).

However, the extent to which guidance is necessary for reflection to occur is not known. The present analysis may be helpful in considering whether unprompted reflection can occur for medical students without external direction.

Appendix Research question

The third research question aimed to find out if there are differences in medical student reflection on paediatric cases when logged in rural or urban contexts. Student reflection on learning in student logs was assessed by HW.

To answer, we asked the following: 'Are there differences in medical student reflection on paediatric cases when logged in rural or urban contexts?'

Method

Reflection was required by urban students in their written logs but was not mandatory for rural students in their electronic logs. Given this discrepancy, although the original plan was to publish the reflection comparisons between urban and rural students, on academic advice it was felt this would not add to knowledge on reflection, except at a local level. Given this

discrepancy, systematic comparisons of reflections between the two groups could not be made.

Instead, a pilot was undertaken to provide data to inform future research once reflection was standardised across the rural and urban Schools. To incorporate reflections from clinical learnings from the case, HW graded all 3745 student logs in relation to clinical content using the following grading scale, similar to that used in UWA for medical school assessments:

Unacceptable – no reflection or wrong;
Borderline – minimal/few words;
Clear pass – reflection on one aspect of case;
Good – case reflection with detailed comment on one aspect of case or reflection on more than one aspect of case;
Excellent – detailed reflection on more than one aspect of case;
Outstanding - detailed reflection on more than one aspect of case with depth of understanding of issues.

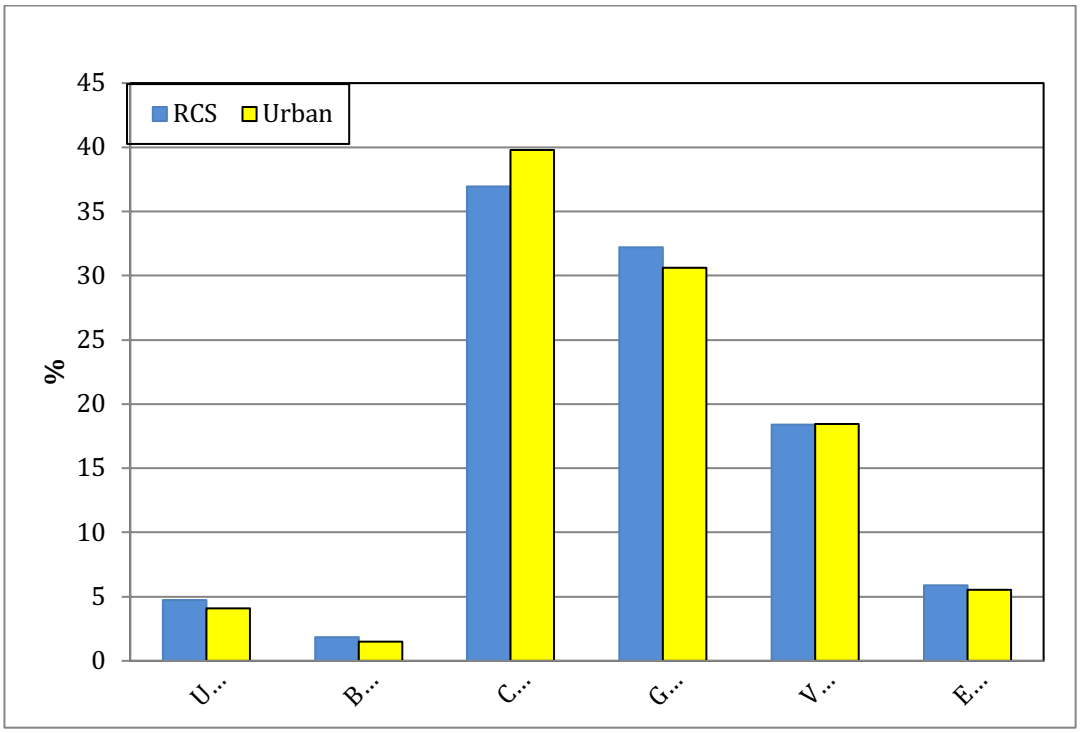
Results

The majority of student reflections were assessed by HW as reflecting on one or more aspects of the case (69.8%), with no significant difference between rural and urban student reflections p=0.62. Those with minimal or no reflections comprised 7.1%; and students with detailed or in-depth reflections comprised 24.1%.

The numerical distribution of reflections are shown in the figure below, where the scores range from unacceptable on the far left, to outstanding on the far right. The majority were "clear pass" or "good"

Thesis Appendix Table

Table 7: Grading of student reflections from clinical case



Conclusion

Given the different requirements for reflection for the rural and urban students, this finding was reassuring. It suggests the majority of students are adequately reflecting on their learning from logs of paediatric cases despite variable logging instructions and medical educator support for reflection across sites.

When reflection instructions are standardised across the urban and rural sites we hope to repeat this research, including published grading scales in the analysis.

References for the bridging chapters

See page 89.

SUMMARY OF THE THESIS

This research addressed the following questions:

1. Do rural and urban medical students log core paediatric cases?

2. Are there differences in learning opportunities between rural and urban medical student logs of paediatric cases?

3. Are there differences in medical student reflection on paediatric cases when logged in rural or urban contexts?

We have provided evidence that medical students across Western Australia log core paediatric cases, with a variety of complexities across all healthcare settings. Differences between cases logged by rural and urban students are minor, and appropriate to student learning as they reflect the desired learning outcomes and distinct learning environments. FLOs occurred in more than half of cases logged. The majority of students are adequately reflecting on their learning from logs of paediatric cases. These affirm recommendations for review and feedback on student logs.

Strengths and weaknesses

The strengths of this project include:

- the large number of logs analysed (3745 cases)

- expert statistical input into study design, data cleaning, analysis and interpretation from a statistician with many years of experience in clinical and medical education research.

There are some weaknesses, mainly relating to:

- omissions and exclusions
- differences between rural and urban students
- case classification and analysis
- reliability and validity

Omissions and exclusions

The logs of term one urban students weren't included for logistical reasons. It would have been preferable to include term one student logs, however all students undertook the same four rotations with the same learning objectives so there is no reason to believe their logging would be different to subsequent terms.

Including urban GP presentations was desirable, however this was not required of urban students and it was not possible to collect that data. Urban GP presentations therefore had to be excluded. Rural GP cases were also excluded as statistical analysis found no difference in the rural data with rural GP cases excluded.

Differences between rural and urban students

There were unavoidable differences between the rural and urban students relating to logging formats, and requirements for reflection. Some of the variations observed could be explained by differences in case logging formats, as previous studies have shown under-reporting of core cases logged electronically(37). Students are known to take time to adjust to electronic logging(52), which may explain some of the minor FLOs compared to urban paper logs. The overall influence of written or electronic logs on the accuracy of clinical information recorded is unclear(8).

The discrepancy regarding different student requirements for reflection was acknowledged. Further research can be undertaken when reflection instructions are standardised across the urban and rural sites.

Case classification and analysis

The methods used for case classification have limitations, but are justifiable. We considered published recommendations to use broad diagnostic groups rather than specific diagnoses for case classification(14). Additionally, the study was not designed with permission to access patient notes to confirm a diagnosis.

We affirm the use of disciplines per symptom, including generalism. Generalist primary care medical practitioners are central to Australia's healthcare system, with recommendations for evaluation of the generalist content of medical curricula in different contexts(29). A learning outcome

for the students was a primary care level of clinical skills and knowledge of the child(27).

Comparing logs to AIHW DRGs provided pragmatic evidence addressing concerns of Australian medical graduates, however we acknowledge mapping them to core cases from student learning objectives would have strengthened the study. We accept that specific requirements for logs, such as Aboriginal cases and PPD topics could have been included in the analysis.

Reliability and validity

Inter-rater reliability was measured near completion of the project. Using a single clinician with extensive, recent rural and urban experiences as a paediatrician to assign clinical aspects of data entry was advantageous. However, there was potential for bias. Multiple attempts were made to obtain inter-rater reliability, which was finally undertaken near completion of the study but would have been preferable during data entry. The use of unvalidated case classification and FLO rubric are acknowledged as a limitation.

Finally, we recognise student logs are solely a record of what is documented. Students may have recognised and addressed the learning opportunities identified but not entered them in their logs. Regardless, review of student logs with medical educators will facilitate discussion to address these issues.

Future directions

This study has generated ideas for future research, including

- comparing rural sites over time
- comparing student groups between sites
- using the study methods for ongoing quality improvement activity within the curriculum to validate educational decisions

Outcomes

This research provides evidence that rural and urban medical students in Western Australia log paediatric cases

- with presenting problems aligning with Australian paediatric public hospital admissions
- appropriate to the learning outcomes of the curriculum to produce generalist medical practitioners
- with a variety of complexities across all healthcare settings
- which frequently contain opportunities for medical educators to provide feedback to students on learning
- where the majority of students reflect on at least one aspect of the case

The data has been used to

- inform students and teachers that the paediatric cases they encounter will prepare them for professional practice
- make modifications to student logging in the RCSWA
- improve feedback from medical educators

Conclusion

Rural and urban and rural clinical schools provide paediatric cases with a variety of complexities relevant to future practice. The differences shown are appropriate to student learning as they reflect the desired learning

outcomes and distinct learning environments of the students. Regular review and timely feedback on student logs by medical educators are strongly recommended to address feedback learning opportunities and review student reflection.

Research Timeline

2011: Pilot project compared fourteen case-matched urban students from one term and rural students from the whole year. It indicated similar case mix, however a larger study was required for enhanced statistical power, more detail such as complexity and clinical settings, as well as comparing students across a whole academic year.

2012: Early career research grant from RCSWA - $30,000. Feedback on the application was provided by a research committee including rural paediatricians, physicians, General Practitioners (GPs) and rural researchers.

2012: Ethics approval was obtained from the University of Western Australia Human Research Ethics Office.

2012: Research Assistant was recruited and entered student demographics into database in Excel with training by statistician, Sharon Evans.

2015: Sabbatical March to October to complete data entry and data cleaning using pivot tables, data analysis.

2016 to 2018: Paper writing and journal submissions.

Presentations

2011: Association for the Study of Medical Education conference, UK

The pilot project was presented, with feedback from overseas colleagues.

2012: Rural Health West conference, WA

Research proposal and pilot study was presented with feedback from rural GPs.

2015: Faculty of Medicine, Dentistry and Health Sciences Symposium, UWA

Research proposal and pilot study presented with feedback from Faculty.

2015: RCSWA Medical Coordinators meeting

Provisional results were presented with feedback from rural GPs and paediatricians.

2017: RCSWA Medical Coordinators meeting

Results were presented with feedback from rural GPs and paediatricians.

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