Paediatric terminology in the Australian health and health-education context: a systematic review

1 RAMONA CLARK | MELISSA LOCKE | ANDREA BIALOCERKOWSKI

2 Menzies Health Institute Queensland, Griffith University, Gold Coast, Qld, Australia.

Correspondence to Ramona Clark at Menzies Health Institute Queensland, c/o School of Allied Health Sciences, Griffith University, Gold Coast, Qld 4222, Australia. E-mail: Ramona.Clark2@griffithuni.edu.au

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ABBREVIATIONS

NICHD Eunice Kennedy Shriver
National Institute of Child
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ment

AIM This study aimed to identify paediatric terminology used in the Australian health and health-education context, propose a standardized framework for Australian use, and compare it with a US-based framework.

METHOD Australian health and health-education websites were systematically searched using a novel hierarchical domain-specific search strategy to identify grey literature containing paediatric terminology. Webpages published from 2009 to February 2014, with a '.gov.au' or '.edu.au' domain and no advertising, were included. Paediatric terms were analysed with power-law distributions. Age definitions were grouped using a chi squared test automatic interaction detection analysis ($p < 0.05$).

RESULTS In total, 34 paediatric terms and 197 unique age definitions were identified in 613 webpages. Terms displayed a language distribution, although definitions had semantic and lexical ambiguity. Age definitions were divided into four statistically different groups ($F = 245.3$, $p < 0.001$). Four paediatric terms with distinct age definitions were proposed based on Australian data: 'infant: 0 to <1 year', 'early childhood: 1 year to <5 years', 'child: 5 years to <13 years', and 'young person: 13 years to <22 years'. These recommendations were broader than the US-based comparison.

INTERPRETATION This is a starting point for standardizing Australian paediatric terminology, and a method for exploring paediatric terminology in other countries.

Paediatric terms with overlapping age ranges from birth to adulthood are used interchangeably throughout the world, with variability both within and between nations.¹⁻⁴ In Australia, there are no universally accepted paediatric definitions within health and health-education contexts.^{1,4,5} Australia's Macquarie Dictionary Online defines 'paediatrics' as the study and treatment of children,⁶ but does not define the term 'child'. The definition of the term 'child' may include the relationship to their parents or the transitional age range before adulthood.^{5,6} This may add to confusion. 'Child' is defined as 'a baby or infant' or as a young person determined by statute to be 'less than 17' or 'under 18 or 21 years' in Australian law.⁶ Age of consent, and health-care access and eligibility may differ in children and young people owing to biological, developmental, or psychosocial differences,² and by geographical location.⁷ A consenting young person, parent, or carer may access universal child health services provided in Australia within a primary health-care model.⁸ These services can be accessed directly or by referral, often by a general practitioner.⁸ Consent refers to a young person having adequate maturity and mental capacity with a legal recognition of competence with no set age.^{7,9} Age of legal consent often ranges from 14 to 18 years, depending on Australian federal, state, and

territory jurisdictions,^{7,9,10} and may be defined using different paediatric terms. Current paediatric term variability has thus created confusion throughout the health-care setting.^{7,9,11,12}

Consistent definitions are required to strengthen the communication between departments, facilities, and families.¹³⁻¹⁵ Chronological age groupings for paediatric terms allow health practitioners, young people, parents, and carers to classify an individual easily, without additional assessments, for health-care access and eligibility.² The internet is often the first source parents, carers, and young people will refer to when searching for information about child development or health-care eligibility and access.^{14,16-18} Young people are particularly vulnerable to ambiguous terminology, both because of an increased use of the internet for health information¹⁶ and a reduced ability to obtain relevant information from websites.¹⁷ Personally Controlled Electronic Health Records allow health practitioners, parents, and young people to view and share health information with the use of a standard terminology. However, the Systematised Nomenclature of Medicine-Clinical Terms -Australia dataset used in the personally controlled electronic health records lacks clear age definitions for paediatric terms. Confusion about age eligibility

requirements caused by ambiguous paediatric terms could restrict access and delivery of child health services.^{15,16,19,20}

To facilitate the consistent use of paediatric terms, the US Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) developed a framework to consolidate paediatric terms mapped to medical terminology datasets, including the Systematised Nomenclature of Medicine–Clinical Terms. This framework has been proposed as a requirement for interpreting and sharing research and education resources within the USA and internationally.^{2,4,21} However, differences exist between the US and Australia’s legal age, health-care delivery, and education systems.²² No clear definitions of paediatric terms used within Australia’s health and health-education systems have been identified in the literature, and there has been no documented comparison with the NICHD’s proposed framework. Williams et al.² proposed that the first step towards standardization of paediatric terminology is to identify terms currently used nationally before comparing them with international definitions.

The aims of this study were (1) to systematically identify paediatric terms and definitions used in publically accessible Australian health and health-education sources, (2) to compare paediatric terms and definitions and contrast these with the NICHD definitions, and (3) to consolidate paediatric terminology and definitions to suggest a framework for use in the Australian health and health-education context.

METHOD

A systematic review was undertaken to address the study aims. Grey literature accessed from websites in the form of government and education reports and documents, fact sheets, and policy statements,^{23,24} in addition to other publically accessible website sources, were the focus of this study.

Search terms

Recommendations from previous studies^{25–27} were combined to create a comprehensive and reproducible search strategy to identify paediatric terminology contained in over 300 publically accessible Australian health and health-education websites. The paediatric-specific search terms used for this study are presented in Table I.

Search strategy

The internet was searched from 18 to 28 February 2014 to identify paediatric terms and their definitions used in the Australian health and health-education context. The search strategy is described in Figure 1. Search engines and databases were not used to identify data, as they do not adequately search for these types of document, with the exception of Journal Citation Reports, which were used to access Australian journals.²⁸ Websites were included if they met critical appraisal guidelines:^{29–32} (1) website was a non-commercial Australian site identified by ‘.gov.au’ or ‘.edu.au’ domains,^{30,31} not excluding Australia’s Macquarie

What this paper adds

- A novel search strategy identified Australian paediatric terminology from health and health-education websites.
- Ambiguous paediatric terminology was found.
- Four paediatric terms with distinct age ranges addressed this ambiguity.
- Australian age ranges were broader than the US-based comparison.

Dictionary Online;⁶ (2) webpage was modified or updated within 5 years of the search date;^{30,31} (3) webpage contained no advertising.³⁰

Websites were divided into five categories to facilitate systematic searching of linked webpages: (1) federal, state, and territory government, (2) health practitioners, (3) hospitals and health care, (4) Australian journals—their scope and guidelines, (5) dictionaries and national statistics. Webpages that did not contain information pertaining to health or health education were excluded from this study. Paediatric terms were identified from webpages using the internet browser’s ‘find’ function to systematically search for a group of terms (contained in Table I). Definitions of all identified terms were searched by reviewing surrounding paragraphs. An additional search using the terms ‘aged’ and ‘years’ was performed when definitions were not found through reviewing paragraphs. Webpages accessed via a click-through were reviewed using the same strategy. If no paediatric terms or associated definitions were found at a tertiary webpage level, the search was considered exhausted. A glossary of terms underpinning the internet search method is provided in Table II. Specific search strategies for each website category are listed in Appendix S1 (online supporting information).

Data handling and analyses

Data extraction

The three authors agreed upon website selection. One author (RC) extracted paediatric terms and associated definitions from identified webpages, noting the webpage hierarchy level and geographical origin. Spelling variations and plural terms were recorded once per webpage before being truncated to a single term. Grouped terms were separated into individual terms, and definitions were separated into a single term with a single minimum and maximum age defi-

Table I: Paediatric-specific search terms^a

Adolescen

Bab
Child
Early year
Infan
Junior
Juvenile
Kid
Neonat
Newborn
Paediatric
Pediatric

^aExpanded search terms were used (e.g. neonat=neonate, neonates, neonatal, neonatology, neonatologist).

Figure 1: Systematic search strategy used to identify paediatric terminology and associated age definitions.

Table II: Glossary of terms underpinning the search methods

Website	A set of related webpages served from a single web domain (e.g. gov.au)
Source website	An overarching website likely to contain links to similar websites of relevant information or key webpages (e.g. Australia.gov.au)
Primary website	A direct link accessed via the source website (e.g. Health.gov.au)
Secondary website	A direct link accessed via the primary website
Webpage	A hierarchy of documents accessed by a click-through from a website (e.g. Australia.gov.au/about us)
Homepage	Initial level of webpage hierarchy (i.e. no links)
Primary webpages	A webpage accessed via one-click through from the homepage (e.g. Australia.gov.au/about)
Secondary webpages	A webpage accessed via two click-throughs (e.g. Australia.gov.au/people/children)
Tertiary webpages	A webpage accessed via three or more click-throughs
Click-through	Process of clicking on an internal link by using the mouse to click on a button, tab, or embedded URL

‘terms with text definition(s)’, and ‘terms with age definition(s)’.

Data analyses

Paediatric terminology. The Statistical Package for the Social Sciences version 22 (IBM SPSS Statistics, Armonk, NY, USA) was used for all analyses. Power-law distributions were used to summarize the frequency of specific paediatric terminology identified within the Australian health and health-education context. The type–token ratio was calculated as an index of lexical diversity by dividing the number of unique terms (type) by the total number of terms (token).³³ Kalankesh et al.³³ suggested an appropriate sample for language analysis has a type–token ratio of less than 0.1. Terms containing an age definition were subjected to further analysis.

Paediatric definitions. Minimum and maximum age definition(s) were analysed using descriptive statistics. Unique definitions were calculated by removing duplicate combinations of terms and age ranges. Ambiguity was calculated by measuring semantic differences (same terms with different definitions) and lexical differences (different terms with the same definition). A decision-tree analysis, using non-parametric chi squared test automatic interaction detection,

inition for analysis (e.g. ‘children and adolescents from 6 to 18y’ became ‘child=from 6y’, ‘adolescent=up to 18y’). Terms were separated into three groups: ‘terms only’,

was used to group paediatric terms with homogenous age ranges ($p < 0.05$). Categories were then re-analysed until they could not be further divided into significantly different ($p < 0.05$) subcategories or would contain less than 5% of the total terms and age definitions ($n = 30$) as recommended by Ritschard.³⁴ A Bonferroni adjustment was used to maintain a $p < 0.05$ significance, with a threshold of significance determined based on the number of subdivisions.

RESULTS

The search strategy identified 312 unique websites and reviewed 613 unique webpages that met the inclusion criteria (Fig. 1). There was an unequal geographical distribution of webpages, with age definitions predominantly published in the Australian Capital Territory ($n = 146$, 39.9%). Larger distributions were found in New South Wales ($n = 65$, 17.8%), Victoria ($n = 45$, 12.3%), and Western Australia ($n = 43$, 11.7%), with the remainder divided between Queensland ($n = 22$, 6.0%), South Australia ($n = 17$, 4.6%), Northern Territory ($n = 13$, 3.6%), and Tasmania

($n = 13$, 3.6%). There were also two definitions from external Medical Subject Heading sites ($n = 2$, 0.5%). Tertiary webpages contained nearly half (46.4%) of all paediatric age definitions. The remaining definitions were distributed between primary webpages (26.5%), secondary webpages (19.6%), and homepages (7.5%).

Paediatric terminology

Four hundred and four (65.9%) webpages contained paediatric terminology, with 188 unique terms grouped into 34 common paediatric terms. The Pareto distribution of paediatric terms displayed in Figure 2 shows that the top 21% of terms ('child', 'young person', 'paediatric', 'youth', 'adolescent', 'infant', and 'baby') accounted for 72% of cumulated terms with a type-token ratio of 0.012. Nearly one-third of cumulated terms comprised 'Child'.

Paediatric definitions

Of all identified terms, 23.9% were defined. When reduced to common terms, 73.5% had a definition. Paediatric defi-

Figure 2: Paediatric term frequency and cumulative percentage of paediatric term occurrence ($n = 1786$).

1 nitions were found in 148 unique webpages (24.1%), and
 2 comprised 46 (18.9%) unique text definitions and 197
 3 (81.1%) unique age definitions (Fig. 1). Semantic ambigu-
 4 ity was found, with 19 out of 23 common terms having
 5 more than one definition. Lexical ambiguity was found,
 6 with 129 definitions having more than one common term.
 7 'Junior' was the only common term that had a single
 8 unique definition 'from 4 years up to 6 years'. The deci-
 9 sion-tree analysis identified four groups of paediatric terms
 10 that were significantly different with respect to mean age
 11 ($F=245.3$, adjusted $p<0.001$), as determined by the Bonfer-
 12 roni-adjusted threshold of significance ($p<0.013$) (Fig. 3).
 13 Mean ages (SD) for each of the identified groups were
 14 10 months (SD 1y), 3 years 1 month (SD 2y 6mo), 7 years
 15 4 months (SD 6y), and 16 years 10 months (SD 5y 1mo).
 16 The SDs demonstrated that age ranges in group 3 dis-
 17 played the largest amount of overlap. Ages in group 3
 18 overlapped with each of the other three groups and con-
 19 tained the largest proportion of definitions ($n=267$
 20 [44.7%]).

DISCUSSION

23 This study used a novel approach to systematically identify,
 24 review, and synthesize information contained in publically
 25 accessible grey literature and websites within health and
 26 health-education contexts. The use of a hierarchical

domain-specific search strategy increased the repeatability
 of a search and reduced bias towards selecting popular
 webpages.³⁵ Search strategies using external or internal
 search engines (e.g. Google) use algorithms based on
 dynamic user interaction to determine a webpage's popu-
 larity.^{36–38} High numbers of irrelevant hits often result in
 screening only the most popular webpages,^{31,37} which have
 no direct relationship to webpage credibility.²⁸ Webpage
 hierarchies allow effective internal navigation of large web-
 sites such as government and education domains.^{39,40} Gov-
 ernment and education domains require federal approval,
 explaining the increased skew of webpages originating from
 the Australian Capital Territory. Despite using a hierarchi-
 cal search strategy, a paucity of paediatric definitions was
 found compared with paediatric terms, with most buried
 deep within a website's hierarchy. Deep hierarchies can
 lead to undiscoverable content.^{17,40} This may affect patient
 care if paediatric terms are misinterpreted without a defini-
 tion.²⁰ Paediatric terms should therefore be defined with
 an age range and consistently used across health and
 health-education contexts. This is the minimum recom-
 mendation before a standard paediatric terminology can be
 developed.

A standard paediatric terminology for the Australian
 health and health-education contexts is proposed using lan-
 guage distributions and cluster analysis of paediatric terms

Figure 3: Paediatric term classification based on homogenous age definitions.

and age-range definitions. By viewing paediatric terms as a specialized vocabulary, a power law analysed language and found seven (21%) of the identified paediatric terms accounted for the majority of identified terms. This was less skewed than typical 80/20 Pareto distributions,⁴¹ which may highlight the interchangeable use of terms. The low type-token ratio in this study suggested an appropriate sample for language analysis.³³ Similar datasets from electronic health records used by general practitioners in England have viewed terms as a language distribution.^{33,41} Language distributions can assist in selecting paediatric terms to develop standard paediatric terminology when used in combination with an age definition.

Age ranges did not explicitly demarcate a third of the paediatric definitions found in this study. Defining paediatric terms by chronological age, where able, will reduce confusion about health-care access and information interpretation by stakeholders, such as health practitioners, young people, parents, and carers.^{1,2} Eliminating semantic and lexical ambiguities will reduce the confusion further.^{19,20,42} Semantic ambiguity was addressed first, using a chi squared test automatic interaction detection analysis decision-tree analysis, to statistically group homogenous age definitions. Ages were clustered into four groups to create a single calculated mean and age range using the SD. Chi squared test automatic interaction detection analysis has previously been used in health-care research to determine characteristics of patients for medical attendance⁴³ and trauma outcomes.⁴⁴ Lexical ambiguity was then addressed by selecting a representative term from the Pareto distribution for each of the groups 1–4: ‘infant’, ‘early childhood’, ‘child’, and ‘young person’ (see column 1 in Table III).

Groups from the chi squared test automatic interaction detection analysis lacked distinct age ranges (mean and SD) required for clear terminology.¹ This is consistent with Contopoulos-Ioannidis et al.,³ who identified extensive overlap of paediatric age groups within recent publications of paediatric randomized control studies. Greater variance was found in older age groups of this study, which may be explained by differences in determining consensual age between Australian states and territories.^{7,9,45,46} Ages

calculated for each group were also not in whole years. Defining maximum age ranges in whole years up to the birthday of the subsequent minimum age (e.g. 5 to <13y) would assist in preventing confusion about age inclusion.¹¹ Distinct and inclusive age ranges for each of the four groups were proposed by manually adjusting the SDs to obtain age ranges in whole numbers, while maintaining a mean age close to the chi squared test automatic interaction detection analysis calculated mean. Consensus was gained between the researchers to eliminate semantic ambiguity and derive the final age-range definitions for each of the groups: ‘infant: 0 to <1 year’, ‘early childhood: 1 year to <5 years’, ‘child: 5 years to <13 years’, ‘young person: 13 years to <22 years’ (see column 2 in Table III).

The four age groups were then compared with the framework proposed by the NICHD (Table III). The groups identified within this study had broader age ranges. ‘Infant’ was the most consistent group, which coincided with the NICHD’s ‘Infancy stage’ from 0 years to 12 months or 1 year. This study’s ‘Early childhood’ group encompassed both the NICHD’s ‘toddler’ and ‘early childhood’ groups. The minimum age range for ‘Child’ is lower than the NICHD’s comparable ‘middle childhood’ minimum age. This chronological period parallels the Australian education system, coinciding with start of school.⁴⁷ The ‘Child’ group also included definitions for the term ‘paediatric’, which appeared to consistently represent a broadly used term that included individuals from 0 years (birth) until 18 years (the Australian legal age). This may support the use of ‘paediatric’ as a separate umbrella term to encompass all individuals who are not yet adults (0 to <18y). The maximum age of <22 years for ‘Young person’ is older than the national legal age in Australia and extends beyond the NICHD framework. The NICHD’s framework is recommended as a starting point for the standardization of paediatric terminology.^{2,4} Comparison with the NICHD’s framework will allow the identification of unique population differences. The unique differences identified within this study support further investigation of paediatric terminology within the Australian health and health-education context, as well as in other geographical areas, to inform the development of an international set of paediatric terms and definitions. As a first stage, we recommend the four proposed terms, with the broader age definitions identified for use in the Australian health and health-education context (Table III).

The age groupings within this study are representative of ages most frequently contained in Australian health and health-education grey literature and websites. Consensus is required to determine if the maximum age range for ‘young person’ should extend beyond the Australian legal age of 18 years. Care must be taken to ensure these definitions are also the most clinically appropriate.^{2,3,11} Williams et al.² supported chronological age groupings for paediatric definitions as a proxy for biological, developmental, or psychological stages because of the ease in which health practitioners, parents, carers, and young people can classify

Table III: Comparison of proposed paediatric terminology with the NICHD age stages

Current study		NICHD	
Term	Definition	Term	Definition
Infant	0 to <1y	Infancy stage	Birth–12mo
Early childhood	1 to <5y	Toddler stage	13mo–2y
		Early childhood	2–5y
Child	5 to <13y	Middle childhood	6–11y
Young person	13 to <22y	Early adolescence	12–18y
		Late adolescence	19–21y

NICHD, *Eunice Kennedy Shriver* National Institute of Child Health and Human Development.

individuals. However, it is acknowledged that specific areas of paediatric research and clinical practice may require narrower age ranges, depending on clinical rationale. For example, 'neonates', who are typically defined as being from 0 to 28 days, could be a subgroup of 'infants' owing to well-documented specific clinical needs.^{2,3} Researchers and clinicians working with children in a specific context may also require additional classification through assessment of biological or psychological markers,⁵ and researchers may require additional criteria to determine an individual's capacity to consent irrespective of age.⁷ Williams et al.² suggested that the next step towards standardization of international paediatric terminology is to gain consensus from experts about physiological, cognitive, and developmental differences in paediatric individuals.

Knowledge translation activities are required both to inform health practitioners, researchers, and policy makers, particularly in government, about the inconsistencies of paediatric terminology identified within documents and to initiate a change towards standardization. A governance model, for example as described by Kahn et al.,¹ may underpin future work in implementing standard paediatric terminology, such as that proposed in this study. Using consistent paediatric terminology nationally, such as in the personally controlled electronic health records and government websites, may aid in minimizing confusion experienced by key stakeholders. Currently, owing to differences in federal, state, and territory health funding across Australia, variability exists in eligibility, based on age, for health services. A young person can therefore be ineligible to receive services in the state in which they reside, despite being eligible to receive the same services in a tertiary centre located in another jurisdiction, which may also be geo-

graphically closer. Such variability may lead to confusion experienced by young people, parents, or carers when accessing services, or by health practitioners when referring individuals to their nearest tertiary centre. Age differences may also affect researchers when recruiting participants into studies.

Health practitioners, researchers, and policy makers need to be aware of the ambiguous paediatric terminology within the Australian health and health-education context. Using consistent paediatric terms with an age range when communicating with other health professionals, researchers, and policy makers, as well as with young people, parents, or carers, will aid in reducing confusion to maximize health-care delivery and research translation. The unique characteristics of Australian paediatric terminology support the definitions 'infant: 0 to <1 year', 'early childhood: 1 year to <5 years', 'child: 5 years to <13 years', and 'young person: 13 years to <22 years' as a starting point for use within Australian health and health-education contexts. The innovative method of identifying and analysing publically accessible paediatric terminology can be used to explore paediatric terminology in other nations before international standards can be developed.

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SUPPORTING INFORMATION

The following additional material may be found online:

Appendix S1. Specific search strategies for Australian health and health-education websites.

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standard framework for the analysis of microeconomic behavior. Nevertheless, it also led to the development of a new class of strategic form games. The number of competitors in the industry is that the structure of the game is a main component. At the micro level, are exogenous variables and important works on entry by firms (M. Henceforth) we open the 'black box'.

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there is no room for extra profits as mark-ups are zero and the number of firms (set) values are not determined by the market. Blanchard and Kiyotaki (1987), perfect competition in general equilibrium models of aggregate demand and supply in the classical framework assuming monopolistic competition between an exogenous number of firms.

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dynamic responses of mark-ups consistent with the VAR evidence.

sation by Markov processes. The number of competitors and the impact of demand shocks on the demand.

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standard and supply shocks. Most of the standard framework for the analysis of microeconomic behavior. The number of competitors and the impact of demand shocks on the demand.

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