Intervention overuse in paediatric care in Australian metropolitan general practice

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Background and objective
General practitioner (GP)-provided low-value paediatric primary care (LVC)/intervention overuse is not routinely evaluated. The aim of this paper is to evaluate prevalence, associated GP characteristics and cost of GP-provided LVC for five common paediatric conditions.

Methods
Patient-level data were extracted from 22 practices in Sydney and Melbourne. GPs were surveyed and costs of LVC were evaluated.

Results
LVC was provided in 628/6182 (10.2%) consultations, including antibiotics for upper respiratory tract infections (511/4469, 11.4%). GPs practising for >15 years demonstrated increased risk of providing LVC (risk difference [RD] 9.8 %; 95% confidence interval [CI]: 4.0 to 15.6), and LVC occurred less at private versus bulk billing practices (RD 7.2 %; 95% CI: 2.9 to 11.5) and with female versus male GPs (RD −4.5%; 95% CI: −8.7 to −0.4). Estimated LVC cost was $17,254.15, extrapolated to $41.2 million when applied to all Australian LVC paediatric visits.

Discussion
Low-level intervention overuse continues among urban GPs. Targeted quality improvement approaches addressing associated GP characteristics might strengthen paediatric care.

THE UNITED NATIONS CONVENTION ON THE RIGHTS OF THE CHILD, to which Australia is a signatory, states that 'children and young people have the right to the highest attainable standard of healthcare' emphasising 'the development of primary health care' for children.[1,2] The Royal Australasian College of General Practitioners' (RACGP) 'First do no harm' initiative and the Royal Australasian College of Physicians' (RACP) EVOLVE initiative (led by RACP members to drive high-value, high-quality care in Australia and Aotearoa New Zealand) provide guidance for physicians on the avoidance of intervention overuse paediatric or low-value care (LVC).[3,4] LVC is defined as the delivery of health services where no or a disproportionately low benefit is obtained relative to financial cost.[5] To date, the paediatric LVC literature has placed greater emphasis on hospital-delivered care rather than primary healthcare, yet the larger volume of care is delivered in primary care settings.[6,7]

In Australia, the last large-scale analysis of paediatric care quality was conducted through the CareTrack Kids study (2012–13).[8] Adherence to clinical practice guideline recommendations for 17 common childhood conditions was 59.8% (95% confidence interval [CI]: 57.5 to 62.0) among clinicians across primary, secondary and tertiary healthcare. For example, for asthma, the adherence to guideline-concordant care was lower among primary care providers (54.4%; 95% CI: 46.0 to 62.5) compared with paediatricians (77.7%; 95% CI: 40.5 to 97.0), emergency departments (ED; 79.9%; 95% CI: 70.6 to 87.3) and inpatient care (85.1%; 95% CI: 76.7 to 91.5).[9] Whether healthcare quality for children provided by general practitioners (GPs) has changed over the past decade is unknown.

The aim of the current study was to analyse the prevalence of LVC across five common paediatric conditions. Associated GP practice and individual GP characteristics, as well as the financial cost of LVC care, were evaluated.

Methods

Data collection

This study used baseline data collected between 1 May 2021 and 31 March 2022 as part of the Strengthening Care for Children (SC4C) trial.[10]

Practicesthen received an integrated GP–paediatrican intervention using a stepped wedge cluster randomised control design. Within the catchment area of two Primary Health Network (PHN) areas (North Western Melbourne Primary Health Network [NWMPHN] and Central and Eastern Sydney Primary Health Network [CESPHN] in Victoria and New South Wales respectively), 22 general practice clinics were recruited (11 in each PHN). The regions were selected for high paediatric referral rates to their local paediatric hospital, and interest from the PHNs in participating in the trial. General practices signed a memorandum of understanding with the research team to participate and a licence agreement to install the software clinical data extraction tool (GRHANITE; The University of Melbourne [UoM], Melbourne, Vic, Australia) in their electronic medical record (EMR) system.[11] Patient data extracted through GRHANITE included: patient characteristics (sex, age) and clinical information such as reason for visit, medication and investigations ordered. GRHANITE technologies provide a secure, de-identified ethical acquisition of data for research purposes, developed and managed by the UoM. GRHANITE was remotely embedded in the computer software of participating general practices to extract de-identified routinely collected data on all paediatric appointments throughout the trial period.

In this paper, we report de-identified primary care data for all children aged 0–18 years who presented to participating GP practices from the time the study started, through the baseline (ie control) period of the trial (11 months).

Natural language processing

Reason for visit as described in a free-text field was categorised based on a previous pilot study.[12] Any uncertainties in categorisation were resolved between three paediatric authors (HH, RL and TM). A natural language processing (NLP) algorithm was then developed by the School of Computing and Information Systems at the UoM to automatically transform GP EMR clinical text of 'reason for visit' or diagnosis into structured clinical data, based on systematised nomenclature of medicine clinical terminology (SNOMED CT).

GPs sometimes recorded several reasons for a visit, but for the purposes of this analysis, we only coded the first reason entered. LVC for five common childhood conditions: asthma/wheeze (1–18 years); bronchiolitis (<1 year); constipation/abdominal pain (<18 years); upper respiratory infections (<18 years); and infant crying and reflux (<1 year) was defined for each condition to be consistent with RACP's EVOLVE initiative top 'not to do' practices for children (Table 1).[3]

Surveys

GPs completed baseline surveys reporting GP characteristics such as age, gender, number of years in practice, number of children seen per week, any formal training in paediatrics and their use of HealthPathways (clinical practice guidelines for primary healthcare providers aimed at assisting with delivery of high-quality care). Questions pertaining to the GPs' knowledge and confidence in paediatric practice were also asked.

Statistical analysis

Clinical and demographic data for patients were extracted from site EMRs using GRHANITE. GP survey data were collected in REDCap (Vanderbilt University, Nashville, TN, USA). The general practice clinics and GP characteristics were described with proportions. LVC was summarised by diagnosis and LVC indicator (intervention overuse), individual GP, GP practice and child characteristics. GP indicators for LVC were evaluated using mixed effects logistic regression models including random effects at the GP practice and individual GP level. Because of the clustering of GPs within practices, a mixed effects multi-level (hierarchical) model was used where GPs are nested within a practice. This model assumed an exchangeable within-cluster correlation structure with cluster (GP practice and GP) random effects (eg correlation between any two individuals in the same cluster is constant). All data were analysed using Stata version 18 (Stata Corp LLC, College Station, TX, USA).

Financial cost analysis

For each of the five conditions and associated instances of LVC described above, a cost was estimated. The frequencies of health service utilisation (visits, investigations, prescriptions) were taken from the GRHANITE data set, as per analyses above. Each frequency of resource use was multiplied by a unit cost for that care, which was sourced from the Medical Benefits Schedule (consultations and investigations) and the Pharmaceutical Benefits Scheme (prescriptions). Total costs for each LVC item were summed from all resource components and are presented in 2024 Australian dollars. The cost estimates relating to our observed consultations were scaled to estimate national expenditure based on 78.74% of children having a GP visit each year and an average of 3.6 visits per child.[13] This percentage was applied to the 5,709,124 children aged 0–17 years in Australia,[14] and multiplied by average LVC per child with LVC obtained from our study.

Ethics

Human research ethics committee (HREC) approval was granted by The Royal Children's Hospital Ethics Committee in August 2020 (Project ID: 65955) and site-specific HRECs.

Results

Data were collected between May 2021 and March 2022 from 22 GP practices evenly spread between New South Wales and Victoria and included 120 GPs providing consultations for at least one of the five LVC conditions. In total, during this baseline period, there were 49,932 paediatric consultations at these practices. Table 2 outlines the characteristics of participating GPs and GP practices.

In total, 6182 GP consultations dealt with one of the targeted conditions, with 628/6182 (10.2%) of consultations delivering LVC as defined by our criteria (Table 1). The most common area of LVC was overuse of antibiotics for upper respiratory tract infections (URTIs) involving 511/4469 (11.4%) paediatric consultations; in addition, 77/1092 (7%) of consultations received antibiotics for asthma/wheeze. LVC was lowest for constipation/non-specific abdominal pain with 22/495 (4.4%) consultations receiving unnecessary imaging. For children with crying/fussy infant/colic, only 9/193 (4.7%) consultations resulted in prescription for a proton pump inhibitor or simethicone.

Table 1. Definition of sentinel conditions and of low-value care for these conditions[3]

Conditions	Intervention	Population
Asthma		
Prescription	Antibiotics (oral)	Children aged 12 months to <18 years who present with asthma, wheeze or bronchitis
Test	Chest X-ray	
Test	Pathology	
Prescription	Combination therapy of inhaled corticosteroids with long-acting beta-2 agonist	Children aged 12 months to <12 years who present with asthma, wheeze or bronchitis
Prescription	Short-acting beta-2 agonist/stimulant alone without inhaled corticosteroid	Children aged 12 years to <18 years who present with asthma, wheeze or bronchitis
Bronchiolitis		
Prescription	Antibiotics (oral)	Children aged <12 months who present with bronchiolitis, wheeze or respiratory syncytial virus infection
Prescription	Antivirals	
Prescription	Corticosteroids (nebulised, oral, IM, IV)	
Prescription	Nebulised hypertonic saline	
Prescription	Beta-2 agonists	
Prescription	Adrenaline (nebulised, IM or IV)	
Test	Chest X-ray	
Constipation and non-specific, non-acute abdominal pain		
Test	Any imaging	Children aged <18 years who present with constipation or abdominal pain, including any visits where the patient presents with (constipation, abdominal, bowel encopresis, irritable bowel syndrome, defaecation, tummy, soiling, faecal incontinence, stool incontinence, stool holding) AND classified by natural language processing as (pain syndrome OR constipation/bowels)
URTI		
Prescription	Antibiotics (oral)	Children aged <18 years who present to a GP for: • upper respiratory tract infection • upper respiratory infection • URTI • sore throat/throat infection • cold/cough/blocked nose
Infant crying and reflux		
Prescription	• Acid suppression therapy • Proton pump inhibitors • Histamine-2 receptor antagonists	Infants aged <12 months who present to a GP for: • colic • unsettled/irritability • reflux • gastroesophageal reflux
Prescription	Anti-reflux medications – reflux suppressant	
Prescription	Anticholinergic medications	
Prescription	Colic mixtures (eg gripe water)	
Prescription	Simethicone	

GP, general practitioner; IM, intramuscular; IV, intravenous; URTI, upper respiratory tract infection.

For the specified conditions, 628 consultations received 692 unnecessary interventions at a cost of $17,254.15 in total for this study. When scaled to estimate all Australian low-value GP presentations for children, this cost would increase to $41,159,073 (Table 3).

GPs who had been practising the longest (>15 years vs <15 years) were 9.8% (95% CI: 4.0 to 15.6) more likely to practise LVC. Females were 4.5% (95% CI: 0.4 to 8.7) less likely to provide LVC compared to male colleagues. Over advancing years of practice, females had a 2.2 % (95% CI: 0.5 to 4.9), 2.6 % (95% CI: 0.4 to 5.7) and 5.1 % (95% CI: 0.4 to 10.7) reduced difference in risk after practising for <6 years, 6–15 years or >15 years respectively compared to males (Table 4). GP utilisation of HealthPathways was not associated with a reduction in LVC (–0.8%, 95%CI: –4.9 to 3.3). LVC was practised less at private billing than at bulk billing practices (7.2% , 95% CI: 2.9 to 11.5).

Discussion

Our data represent the first assessment of paediatric LVC in primary care in Australia since 2013. Overall, for children presenting with any of five common conditions at urban practices across two states, 628/6182 (10.2%) received LVC for asthma, bronchiolitis, URTI, constipation/abdominal pain or infant crying/reflux. The relatively low prevalence of LVC provided by the cohort of GPs in our study is encouraging. The CareTrack Kids study assessed guideline-concordant care, a more complex construct, where over 40% of clinicians demonstrated poor adherence to clinical guidelines.[8] For specific conditions such as asthma, guideline adherence was 54.4% by GPs (95% CI: 46.0 to 62.5).[9] LVC for asthma in our study was documented in 118/1092 (10.8%) of children. The methodology of the CareTrack Kids study including in-depth medical record review for indicators of both overuse and underuse of interventions likely accounts for some of this difference.

Experience brings many benefits to clinical care; however, the biggest predictor of LVC in this study was increased years of practise. Our data are not the first to describe this relationship. Waning clinical knowledge and adherence to current

Table 2. Characteristics of consenting individual GP and GP practices

Characteristics	n/N (%)
General practices (n)	**22**
State	
New South Wales	11/22 (50.0)
Victoria	11/22 (50.0)
Billing type	
Bulk billing	15/22 (68.2)
Mixed billing	4/22 (18.2)
Private billing	3/22 (13.6)
SEIFA out of 5	
2	2/22 (9.1)
3	5/22 (22.7)
4	4/22 (18.2)
5	11/22 (50.0)
No. consenting GPs per practice	Median=5.0 (Range 3.0–11.0)
GPs (n)[A]	120
Gender	
Male	45/103 (43.69)
Female	58/103 (56.31)
Missing	17 observations
Years of practice	
<6	21/102 (20.59)
6–15	46/102 (45.10)
>15	35/102 (34.31)
Missing	18 observations
Average no. paediatric patients seen per week	
<11	15/102 (14.71)
11–20	43/102 (42.16)
>20	44/102 (43.14)
Missing	18 observations
Formal paediatric healthcare training	
Yes	30/102 (29.41)
No	72/102 (70.59)
Missing	18 observations

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Table 2. Characteristics of consenting individual GP and GP practices (cont'd)

Characteristics	n/N (%)
General practices (n)	**22**
Uses HealthPathways[B]	
Strongly disagree	14/101 (13.86)
Disagree	41/101 (40.59)
Agree	40/101 (39.60)
Strongly agree	6/101 (5.94)
Missing	19 observations
GP knowledge/confidence	
I am confident that I know how paediatric services are organised	68 (67.33)
Missing	19 observations
I am confident that I know how to access paediatric services for my patients	81 (80.20)
Missing	19 observations
I am confident that I have the knowledge to manage child health issues	89 (88.12)
Missing	19 observations
I am confident that I have the skills to manage child health issues	87 (86.14)
Missing	19 observations
Culture and learning	
Reported strong general practice culture	17 (14.17)
Reported strong general practice learning climate	21 (17.50)

[A]Two GPs, one in each state, were involved at two different practices. They completed baseline questionnaires at both practices. Their first baseline questionnaire is included.

[B]GPs were asked the following question: 'I use HealthPathways regularly for paediatric care?'.

GP, general practitioner; SEIFA, Socio-Economic Indexes for Areas.

standards of care through time out of formal training has previously been described.[15,16] Interventions such as the integrated model of care evaluated through the large SC4C trial, provides an opportunity for paediatricians to support GPs within their practices.[10] Our study demonstrated that HealthPathways was not a statistically significant factor in reducing the risk of LVC. Our analysis offers no explanation for this. It might be that guidelines alone were insufficient to reduce LVC, but they are often a necessary component to practice change, alongside other factors such as education and audit and feedback.[15]

It is important to note that our data provide only a glimpse into the practice of GPs. Whether management decisions were based on reasons that were not apparent in our data set or were for administrative reasons such as referrals, repeat prescriptions or healthcare planning was beyond the scope of data we had access to through GRHANITE. It is conceivable that in some cases medications such as antibiotics might have been appropriately prescribed but interpreted as LVC by our analysis. Trevena et al highlight that rather than providing LVC, GPs might be providing hidden value when conducting visits, including those for administrative reasons. As indicated in our dataset, often more than one problem was managed, involving care coordination or treatment effect monitoring at these encounters.[17]

The Australian government has recently introduced prescribing by pharmacists for a limited number of conditions to support enhanced consumer access to healthcare. Some future conditions will include paediatric treatment, and it will be critical that training and ongoing monitoring and evaluation of appropriate prescribing occurs to limit LVC.

In this study, we demonstrated an extra cost of over $17,000 for providing LVC. The true cost is underestimated, as we have excluded downstream costs involved in each intervention such as time taken by GPs to review and feedback results to patients, or costs of extra visits to the GP to receive results. A study in the USA estimated that USD$227 million was spent on 20 low-value services in 2014 for privately insured children, with families paying one-third of the cost out-of-pocket.[18]

Strengths and limitations

The SC4C study included a large sample of GP practices, enabling the extraction of rich data from medical records reflecting GP practise for large numbers of children. However, we sampled metropolitan practices only, and practices self-selected to participate. In addition, only 43.7% of participating GPs compared to a national average in 2022 of 51.2% were male;[19] therefore, this was not nationally representative. SC4C baseline data were collected during the COVID-19 pandemic that saw intermittent lockdowns in Melbourne and Sydney. Fewer children attended in-person at GP practices, and reduced numbers of paediatric consultations during this period might make our results for the conditions we selected conservative. Children also experienced fewer infections[20] and anecdotal data suggest families were less likely to take children for tests (eg X-rays) due to fear of catching COVID-19. Assessment of LVC as opposed

Table 3. Summary of LVC provided among patients presenting with common conditions

Diagnosis	LVC intervention	Total no. presenting with condition (n)	No. who received LVC interventions (n)[A]	Percentage receiving LVC	No. LVC interventions (n)[A]	Unit cost (AUD)	Cost of LVC Intervention(s) (AUD)
Asthma or wheeze		1092	118	10.8	140		$2945.17
	Antibiotics				77		$1562.67
	Amoxicillin or Amoxil (Glaxosmithkline Australia)				62	$20.39	$1264.18
	Cephalexin or Keflex (Lilly, Australia)				2	$20.39	$40.78
	Erythromycin				0	$27.86	$0.00
	Cefuroxime				0	$23.36	$0.00
	Azyrthromycin or Zithromax (Pfizer, Australia)				2	$7.30	$14.60
	Clarythromycin or Klacid (Abbott, Australia)				3	$21.34	$64.02
	Augmentin duo (Glaxosmithkline, Australia)				1	$34.52	$34.52
	Rulide (Arrow Pharma, Australia) or Roxithromycin				6	$20.70	$124.20
	Doxycycline				1	$20.37	$20.37
	X-ray				6		$365.50
	Chest				2	$51.05	$102.10
	Other				4	$65.85	$263.40
	Pathology				53		$949.00
	Full blood count				17	$16.95	$288.15
	Electrolytes, urea, creatinine				8	$15.65	$125.20
	Liver function tests				10	$17.70	$177.00
	Calcium, magnesium, phosphate				0	$17.70	$0.00
	Immunoglobulin E				6	$23.00	$138.00
	Radioallergosorbent test				7	$26.80	$187.60
	C-reactive protein				2	$9.70	$19.40
	Erythrocyte sediment rate				3	$4.55	$13.65
	Combination therapy of inhaled corticosteroids with long-acting beta-2 agonist				2		$68.00
	Symbicort (AstraZeneca, Australia)				2	$34.00	$68.00
	Breo (Glaxosmithkline, Australia)				0	$30.00	$0.00
	Short-acting beta-2 agonist/ stimulant alone without inhaled corticosteroid				16		$480.00

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Table 3. Summary of LVC provided among patients presenting with common conditions (cont'd)

Diagnosis	LVC intervention	Total no. presenting with condition (n)	No. who received LVC interventions (n)[A]	Percentage receiving LVC	No. LVC interventions (n)[A]	Unit cost (AUD)	Cost of LVC Intervention(s) (AUD)
Bronchiolitis <1 year		92	10	10.9	11		$270.87
	Antibiotics				2		$27.89
	Amoxicillin or Amoxil				1	$20.59	$20.59
	Augmentin				0	$34.52	$0.00
	Azithromycin				1	$7.30	$7.30
	Corticosteroids (nebulised, oral, intramuscular or intravenous				7	$26.14	$182.98
	Beta-2 agonists				2	$30.00	$60.00
Constipation and non-specific, non-acute abdominal pain		495	22	4.4	22		$2227.40
	Any imaging				22		$2227.40
	Plain X-ray abdomen or abdominal X-ray				7	$65.85	$460.95
	Ultrasound – abdomen				12	$118.25	$1419.00
	Ultrasound – kidneys, ureters and bladder				1	$106.45	$106.45
	Ultrasound – abdomen and pelvis				2	$120.50	$241.00
Upper respiratory infection		4469	511	11.4	512		$11,616.88
	Antibiotics				512		$11,616.88
	Amoxicillin or Amoxil or Maxamox (Sandoz, Australia)				423	$23.10	$9771.30
	Clarythromycin or Klacid				8	$21.34	$170.72
	Azyrthromycin or Zithromax				15	$7.30	$109.50
	Cephalexin, Keflex, Cefalexin or Ibilex (Viatris, Australia)				34	$23.10	$785.40
	Aspecillin (Viatris, Australia) or phenoxymethylpenicillin				13	$23.10	$300.30
	Rulide or Roxithromycin				12	$23.72	$284.64
	Erythromycin				7	$27.86	$195.02
Crying/fussy infant/colic		193	9	4.7	9		$193.83
	Proton pump inhibitors				8		$175.84
	Omeprazole or Losec (CHEPLAPHARM Arzneimittel GmbH, Germany)				6	$21.98	$131.88
	Esomeprazole, Nexium (AstraZeneca, Australia)				2	$21.98	$43.96
	Simeticone				1	$17.99	$17.99
Overall LVC		6182	628	10.2	692		$17,254.15

[A]More than one LVC intervention might have occurred for a given condition (eg antibiotics + X-ray – this is not depicted).

LVC, low-value care.

Table 4. GP practice/GP factors associated with LVC

Factors	LVC (n/N)	Probability[A] (%)	Risk difference % (Confidence intervals)	*P* value
GP – Years of practice				
<6	27/671	5.5		
6–15	229/2824	6.4	0.9 (–2.7 to 4.5)	0.62
>15	302/1989	15.3	9.8 (4.0 to 15.6)	<0.01
GP – Gender				
Male	450/2980	11.7		
Female	109/2514	7.2	–4.5 (–8.7 to –0.4)	0.03
GP male gender years of practice				
<6	15/437	6.6	Reference	
6–15	183/1483	7.9	Reference	
>15	252/1060	17.3	Reference	
GP female gender years of practice				
<6	12/234	4.3	–2.2 (–4.9 to 0.5)	0.11
6–15	46/1341	5.3	–2.6 (–5.7 to 0.4)	0.09
>15	50/929	12.1	–5.1 (–10.7 to 0.4)	0.07
GP clinic billing				
Bulk billing	561/5000	10.5		
Mixed billing	44/383	12.3	1.8 (–6.7 to 10.3)	0.68
Private billing	23/799	3.3	–7.2 (–11.5 to –2.9)	<0.01
GP self-reported regular use of HealthPathways				
Disagree	347/2735	9.8		
Agree	182/2468	9.0	–0.8 (–4.9 to 3.3)	0.69

[A]Model-fitted marginal probabilities of LVC and marginal risk differences displayed as percentages. The final model used was a mixed effects logistic regression model including random effects for both GP practice and GP.

GP, general practitioner; LVC, low-value care.

to intervention over- and underuse might also underestimate low-quality care provided by GPs. GPs sometimes recorded several reasons for a visit, but for the purposes of this analysis, as discussed in the methods section, we only coded the first reason entered and, as such, underestimate the complexity of GP care for children. GHRANITE only extracts main data fields and not progress notes, which often provide more detail from the GPs about each visit but are harder to de-identify. Nevertheless, de-identified patient-level data extraction through the GRHANITE software provides an opportunity to obtain more comprehensive, confidential data on GP care provided than has previously been available.[21] GP practices and individual GPs self-selected to participate in the SC4C study, creating possible selection bias towards more high-functioning GPs, potentially contributing to relatively low levels of LVC care seen in our study. The practices were, however, located in both high- and low-income urban localities, and were included if they reported large volumes of paediatric consultations, broadening the generalisability of these results. More extensive ongoing review of guideline-concordant paediatric care provided by GPs in urban, regional and rural areas is required to confirm whether our findings represent a genuine improvement in the standard of paediatric care offered by GPs. Follow-up studies using the same intervention are currently underway in rural areas.

Conclusion

Our data reflect that in urban practices in NSW and Victoria participating in the SC4C trial, children and young people received appropriate care from their GPs. Only around 10% were found to receive care that does not meet the 'highest attainable standards'. Nevertheless, LVC might cause harm and involves unnecessary expenditure on interventions. Our assessment of LVC provides a way for policymakers to determine which conditions and/or GP characteristics might be associated with the provision of LVC and direct quality improvement initiatives towards them. Ongoing monitoring of the healthcare quality provided for children and young people is needed across all parts of the health system and settings including rural and remote areas. GP factors associated with LVC might inform a targeted quality improvement approach to strengthening paediatric primary healthcare.

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