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Where are the Paediatricians? An International Survey to Understand the Global Paediatric Workforce

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Abbreviations:

Sustainable Development Goals – SDGs
Gross Domestic Product – GDP
Interquartile Range – IQR
International Pediatric Association - IPA

Contributors' Statement Page

Dr. Harper and Dr. Russ conceptualized and designed the study, designed the data collection instruments, coordinated and supervised data collection, drafted the initial manuscript, and reviewed and revised the manuscript.

Dr. Nganga, Dr. Armstrong, Dr. Forsyth coordinated data collection, reviewed and revised the manuscript.

Dr. Ham assisted with design of the data collection instrument including piloting, and reviewed and revised the manuscript.

Dr. Keenan advised the international approach, aided with data collection, reviewed and revised the manuscript.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Abstract

Objective: To describe the global paediatric workforce and understand geographic differences in the work performed by paediatricians.

Design: Survey of identified paediatric leaders in each country.

Setting: Paediatric association leaders worldwide

Main outcome measures: Paediatrician numbers, provision of primary care for children, age of transition to adult care.

Results: Responses were obtained from 121 countries (73% of countries approached). The number of paediatricians per 100,000 children ranged from a median of 1 (IQR 0-1) in low income countries to 72 (IQR 44-118) in high income countries. Africa and South-East Asia reported the lowest pediatrician density (median of 1 paediatrician per 100,000 children, IQR 0-3 and median of 4, IQR 3-9, respectively), and fewest paediatricians entering the workforce. 82% of countries reported transition to adult care by age 18 and 39% by age 15. Most countries (91%) but only 64% of low income countries reported provision of paediatric preventative care ($p<0.001$). Systems of primary care provision varied widely. A majority of countries (63%) anticipated increases in their paediatric workforce in the next decade.

Conclusions: Paediatrician density mirrors known inequities in health provider distribution. Fewer paediatricians are entering the workforce in areas with already low paediatrician density, which may exacerbate disparities in child health outcomes. In some regions, children transition to adult care during adolescence, with implications for health care training and delivery. Paediatrician roles are heterogeneous worldwide, and country-specific strategies should be utilized to address inequity in child health provision.

What is Known about This Subject:

Significant discrepancy between burden of disease and distribution of health professionals has been documented.

Various structures are in place for paediatric care across the globe.

The global distribution of pediatricians, their role in providing care to children and the structure for child health systems in various countries are not known.

What This Study Adds:

There are inequities in both paediatrician distribution and numbers of new paediatricians entering the workforce in areas with high child mortality.

Most countries provide some regular primary care for children, but the systems to provide that care are highly variable.

In many areas, children transition from paediatric care in early adolescence, with implications for training and care delivery.

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Introduction

The discrepancy between the global burden of disease and the distribution of health professionals has been well-described.(1-9) Areas with the highest disease burden have the lowest percentage of health professionals, exacerbating the impact of the health workforce deficit. The World Health Organization has identified an index of 4.45 health workers (physicians, nurses, and midwives) per 1000 population necessary to meet the sustainable development goals (SDGs) by 2030.(6) Countries are called on to set specific targets for numbers of health workers including physicians and health specialists depending upon their needs and health services structure.

Child health was a focal point in the millennium development goals and continues to be important in the SDGs. Epidemiologic shifts towards non-communicable diseases, a renewed focus on optimizing child development, the unique health needs of adolescents, and emphasis on reducing morbidity not just mortality, all require renewed deliberation about how health care for children is delivered and advanced.(10-12) Differing health system designs lead to wide variability in the roles that paediatricians and other child health providers fill in supporting the health of a country's children. Understanding those roles is vital to providing equitable and quality health care and to developing appropriate training competencies for all child health professionals.

Some regional efforts have been undertaken to understand where paediatricians are working and what roles they play, but the paediatric workforce worldwide has not been previously described.(6, 13-15) Similarly, while health systems have been described on country and sometimes regional levels, a global understanding of health care systems for children and their variation can provide valuable information for potential reforms at country level.

The goal of this study was to examine the global status of the paediatric workforce and to better understand geographic differences in the types of work that paediatricians undertake in the provision of child health care. Our objectives were to identify the number of paediatricians globally, examine paediatric workforce expectations, understand who provides children with regular promotive and preventative care, and to learn when children transition out of paediatric care to adult care.

Methods

Survey development

An online survey was developed using REDCap, an electronic survey tool.(16) The survey queried the number of paediatricians per country, expected workforce changes, primary care provision for children, and age of transition to adult care. Faculty at Boston Children's Hospital initially piloted the survey with cognitive interviewing to improve question clarity. The refined survey was further piloted and edited with paediatric leaders within the Global Paediatric Education Consortium representing Europe, Asia, Africa, and the Middle East.(17) As the internationally agreed upon languages for communication between paediatric societies in the International Paediatric Association (IPA) are English, French and Spanish, the final survey was translated into French and Spanish by DR Interpreting, Inc. Translated surveys were sent to native French and Spanish speakers to confirm accuracy of the translation.

Study Sample

The survey was distributed to identified paediatric leaders with a goal of attaining one response per country or economy. Countries and economies for inclusion were defined as the

193 UN member countries plus the 5 World Bank Economies (Hong Kong, Macau, Palestine, Puerto Rico and Taiwan) with populations of over 500,000 people, for a total of 198 countries and economies. The survey was initially distributed in May 2015 via email to the lead delegates from the 121 countries with active membership in the IPA at that time. Regional and subspecialty societies that did not function at the country level were excluded. The survey was sent to non-respondents each week for three consecutive weeks. In a second phase, contact was made with paediatric leaders within the non-responding countries, as well as an additional 45 countries in which paediatric leadership was identified through contacts known to the author group, networks from the Global Paediatric Education Consortium, International Paediatric Academic Leaders Association, Harvard University, the American Academy of Paediatrics Section of International Child Health, or through contacts with country Ministries of Health. Paediatric leaders from non-responding countries who were in attendance at the International Paediatric Congress in August 2016 were also identified and approached.

A majority of countries (73) had a single response. Of those countries with duplicate responses to the survey, 30 had only one complete response and 17 required further review by the authors (BH and CR). Of those, seven countries had identical duplicate responses, or the response that was most complete was selected. Ten countries were contacted to clarify duplicate responses, and 9 clarified. One country had two responses with some variation, and the respondents could not be reached for clarification; for that country the response from the president of the country's paediatric association was used.

Country statistics for populations under age 18 were obtained from publically available UNICEF country statistics.(18) Income and GDP classifications were based on 2016 World Bank groupings.

Statistical Analysis

Paediatric workforce characteristics were described using frequencies, medians and interquartile ranges where appropriate. Comparisons between regions were calculated using Kruskal-Wallis tests and Fisher's exact tests, while comparisons between GDP categories were calculated using non-parametric tests for trend and Cochran-Armitage trend tests. Data was analyzed using Stata (StataCorp. 2015. *Stata Statistical Software: Release 14*. College Station, TX: StataCorp LP).

The study protocol was reviewed by the Institutional Review Board at Boston Children's Hospital and deemed not human subjects research.

Results

Responses were received from 95 (79%) of the 121 countries with IPA membership, and 121 (73%) of the 166 total countries and economies for which a contact was identified. In total, this represented 61% of the global 198 countries and economies. Eight countries responded in French, ten in Spanish, and the remainder in English.

There were 32 countries for whom no contact was identified and therefore no survey sent, and 45 countries that did not respond to the survey (Table 1). No contact identified and non-responder countries did not vary significantly from responder countries by GDP ($p=0.18$), but did vary by region ($p=0.002$). Countries with no contact identified had significantly smaller populations than those targeted, with a median population of 274,000 ($p<0.001$).

The number of paediatricians reported was normalized against the population of children under 18 years old in each country to obtain a paediatrician density ratio (Figure 1).

Paediatrician density varied significantly by GDP, ranging from a median of 1 paediatrician per 100,000 children in low income countries to a median of 72 paediatricians per 100,000 children in high income countries ($p<0.001$, Table 2). In addition, significant variability was seen by region ($p<0.001$, Table 3). The lowest density was seen in Africa (median of 1 paediatrician per 100,000 children, interquartile range (IQR) 0-3) and South-East Asia (median of 4 paediatricians per 100,000 children, IQR 3-9) as compared with a global median of 30 paediatricians per 100,000 children (IQR 5-70)and 59 and 87 per 100,000 children (IQR 40-110, and 50-140) in North America and Europe, respectively.

The number of new paediatricians entering the workforce also varied by GDP classification ($p=0.01$) and by region ($p<0.001$). In low income countries, the paediatric workforce gained a median of 10 new paediatricians per year, or 0.08 per 100,000 children, while in high income countries the median was 60 new paediatricians per year, or 3 per 100,000 children (Table 2). In Africa, countries anticipated a median of 5 new paediatricians (0.08 per 100,000 children) per year as compared to a global median of 30 (1.44 paediatricians per 100,000 children) (Table 3).

Age of transition out of paediatric care did not vary by gross domestic product (GDP, Table 2) but did vary by region ($p<0.001$, Table 3). Notably, in South-East Asia, Africa, and the Eastern Mediterranean, over 65% of countries reported that children transitioned from paediatric care by age 15 years, whereas less than 45% of countries reported transition by age 15 in South and Central America and less than 15% in Europe, North America, and the Western Pacific.

Most countries (91%) responded affirmatively when asked "*do children in your country receive regular preventative and promotive care throughout childhood (well-child checks,*

growth monitoring, nutrition assessment, parenting advice, anticipatory guidance, immunization) by either a physician or non-physician health care provider?" This rate was considerably lower in low-income countries, where only 64% of countries reported regular primary care ($p<0.001$, Table 2). The type of provider seen for primary paediatric care varied (Figure 2). Worldwide, children see non-physicians as the primary care provider a median of 28% of the time (Table 2, Table 3, IQR 9-59%). If children saw a physician, that person was a paediatrician (rather than general physician, family physician or medical officer) a median of 33% of the time.

Discussion

This international survey of paediatricians is the first, to our knowledge, to report data on paediatrician density and the roles that paediatricians play in provision of care for children on a global scale. This study identified wide variability in paediatrician density, consistent with health workforce findings of physicians as a whole.(5, 8, 19) Areas with the highest burden of paediatric mortality and morbidity had the lowest paediatrician density, and paediatricians are joining the workforce at lower rates in those same regions. One reason for this inequity may be the existence of a training capacity gap, with fewer avenues to train paediatricians or fewer opportunities for employment in areas with an already low workforce. Some high-income countries have already undertaken more detailed analysis of their paediatric workforce, and used this to inform investment and education policy.(14, 20-24)

Another explanation could be the impact of internal or external migration on access to paediatric care. Both have multiple drivers, including job satisfaction, healthy work environment, adequate supplies, feeling of support, and appropriate recognition.(2, 25, 26)

Within countries, there is often a significant misdistribution of health care professionals towards large, wealthy urban areas.(1, 2, 25, 27) More detailed data on intra-national distribution of paediatricians would be valuable in understanding and seeking to address these disparities of access. Migration between countries has also been well documented.(1, 2, 8, 26) While there are no clear data on the impact of this 'brain drain' in paediatrics, in both the United States and UK, it is estimated that one-third of the paediatrician workforce are international medical graduates.(28, 29) Efforts to improve salaries, work environments and career opportunities may be effective means of decreasing external migration.(30-32)

This study identified that many children transition from paediatric care to adult care by age 15, relatively early in adolescence. Age of transition varied by region but not by country income, suggesting that it may be more associated with cultural or professional norms around transition to adulthood rather than workforce planning. Improved understanding of the systems of care for adolescents is critical among UN, WHO and Lancet Commission calls for increased focus, expertise and research on adolescent-specific care.(10-12) With early transition to adult care, advancing the adolescent health agenda may require a defined framework for adolescent services and multisectoral approach that engages youth within their communities.

Our study demonstrated that while most countries offered some form of broadly defined preventive care to children, this primary care role is often filled by non-physicians or generalists. In both high and low income countries, task shifting and task sharing have been important and often successful methods for improving access to care and addressing health costs while retaining quality of care.(33-37) Most countries continue to explore the appropriate skills mix for providing care, particularly in community settings. Optimizing this skills mix will require inter-professional collaboration and training to promote successful multidisciplinary primary care.

System planning needs to account for and support the primary role of family and the informal care structures that may exist in communities. A thoughtful country-level approach is required to balance development of preventive and community interventions, alongside secondary and tertiary level services with appropriate referral structures.

Workforce studies, including this one, may not capture all of the specific roles that health professionals play, including leadership in health care systems, policy, and government; educators and researchers in universities; and community advocates. A robust national workforce strategy needs to account for these roles, and country-level human resources for health planning should establish a target density for the paediatrician workforce in relation to their expected roles within the system. Designation of tasks such as provision of primary care and age of transition to adult care would need to be considered in order to appropriately define paediatric workforce requirements. Analysis of skills mix needs should also incorporate anticipated epidemiologic changes including a reduction in infectious causes of under-5 mortality, an increase in the proportion of neonatal mortality, and a shift towards chronic diseases in children.(12, 38) As countries work to scale-up their health care workforce these baseline data can help inform development strategies.(39, 40)

This study has several limitations. We found no validated tool that would appropriately meet our study objective, therefore developed the survey de novo. Despite piloting the survey among multiple countries, cultures, and languages, it is possible that some terms, while commonly used, may have been interpreted differently in different settings, particularly among respondents for whom French, English or Spanish was not their native language. All data were collected as survey responses, usually from a single representative in each country. While we targeted experts at the national paediatric association level who would have knowledge of the

state of paediatrics and child health in that nation, responses could vary among individuals particularly for more subjective questions. While we achieved a high level of response globally, there were regional gaps, with particular low responses from West Africa and the Western Pacific. Countries with low physician density and population were similarly underrepresented in this sample. These challenges may have been due to language or internet access difficulties, absence of or less active national paediatric organization or simply limited paediatric presence in those countries. This study was focused on paediatricians, a small component in any country of the human workforce related to child health and health systems. However, paediatricians are important resources for countries, with substantial understanding of child health needs who can also help support country development of child health services and provide guidance for the continuum of care for children and families.

Conclusion

As the global community seeks universal health coverage and works to address the known shortage in healthcare workers, care should be taken to meet the health workforce needs of the world's children and adolescents. Clarification of paediatrician roles and accompanying skill mix is important in developing health workforce capacity to meet those needs. This study described the state of the paediatric workforce worldwide with notable variability in paediatrician density and roles in different countries. A training capacity gap in countries with high disease burdens may exacerbate the problem of a small workforce relative to healthcare needs. These findings highlight the need for country specific child health workforce strategies, assisted by the development of standardized tools to monitor health care capacity and outcomes as countries focus on meeting the SDGs for child health.

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Table 1: Characteristics of responder, non-responder, and no contact identified groups

	Responder	Non-responder	No contact identified	*P* value*
Countries, no. (%)	121 (61)	45 (23)	32 (16)	
GDP classification[1]				0.18
Low income, no. (%)	14 (12)	12 (27)	5 (16)	
Lower middle income, no. (%)	30 (25)	12 (27)	8 (25)	
Upper middle income, no. (%)	34 (28)	12 (27)	12 (38)	
High income, no. (%)	43 (36)	9 (20)	7 (22)	
Region[2]				0.002
Africa, no. (%)	23 (19)	17 (38)	6 (19)	
South-East Asia, no. (%)	8 (7)	1 (2)	1 (3)	
South and Central America, no. (%)	19 (16)	8 (18)	5 (16)	
Western Pacific, no. (%)	12 (10)	4 (9)	13 (41)	
Eastern Mediterranean, no. (%)	15 (12)	6 (13)	1 (3)	
North America, no. (%)	3 (2)	1 (2)	0	
Europe, no. (%)	41 (34)	8 (18)	6 (19)	
Country population,[3] median in thousands (IQR)	10,824 (4,503-43,417)	7,237 (2,175-17,468)	274 (98-1,208)	<0.001
Country population <18 years,[4] median in thousands (IQR)	3,744 (1,081-14,144)	3,248 (798-9,500)	113 (27-581)	0.08
Number of physicians per 100,000 population,[6] median (IQR)	158 (43-290)	62 (8-241)	46 (19-147)	0.002

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* *P* values for the comparison between type of contact categories were calculated using Fisher's exact tests for categorical variables and Kruskal-Wallis tests for continuous variables.

Table 2: Results by GDP Classification

	World (N=121)	Low Income (N=14)	Lower Middle Income (N=30)	Upper Middle Income (N=34)	High Income (N=43)	*P* value*
Number of pediatricians per country, median (IQR)	675 (170-3,600)	70 (25-200)	625 (320-5,000)	1,700 (256-6,000)	1,400 (500-3,500)	<0.001
Number of pediatricians per 100,000 children <18 years[1], median (IQR)	32 (5-74)	1 (0-1)	6 (3-32)	30 (15-60)	72 (44-118)	<0.001
Number of new pediatricians entering the workforce each year per 100,000 children <18 years in country[1], median (IQR)	1.45 (0.42-3.07)	0.08 (0.03-0.18)	0.42 (0.18-1.06)	1.36 (0.57-2.09)	3.10 (2.05-4.06)	0.01
Number of countries reporting Transition from pediatric care†						
by age 12 years, no. (%)	3 (3)	0	3 (10)	0	0	0.13
by age 15 years, no. (%)	47 (39)	9 (64)	15 (50)	13 (39)	10 (23)	0.002
by age 18 years, no. (%)	98 (82)	14 (100)	27 (90)	26 (79)	31 (72)	0.01
by age 21 years, no. (%)	118 (98)	14 (100)	30 (100)	33 (100)	41 (95)	0.18
Countries reporting regular pediatric promotive and preventive care received, no. (%)	110 (91)	9 (64)	26 (87)	33 (97)	42 (98)	<0.001
Percentage of primary care provided by non-physician, median (IQR)	28 (9-59)	82 (70-85)	35 (10-68)	28.5 (2-51)	24 (9-45)	0.01
Percentage of primary care provided by general physician, family doctor, or medical officer, median (IQR)	21 (11-36)	12 (7-16)	24 (14-42)	18 (10-27)	23 (10-36)	0.76
Percentage of primary care provided by pediatrician, median (IQR)	33 (13-57)	17 (8-22)	27 (12-46)	44 (23-56)	46 (7-73)	0.04
Number of physicians per 100,000 population,[2] median (IQR)	125 (21-269)	6 (3-12)	43 (18-142)	149 (67-229)	283 (195-369)	<0.001

[1] The State of the World's Children 2016 Statistical Tables. (2016, June 27). Retrieved October 31, 2017, from https://data.unicef.org/resources/state-worlds-children-2016-statistical-tables/

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**P* values for the comparison between GDP classifications were calculated using nonparametric tests for trend for continuous variables and Cochran-Armitage trend tests for categorical variables.

† Age of transition from pediatric care not reported by one country in the upper middle income group.

Table 3: Results by Region

	World (N=121)	Africa (N=23)	South-East Asia (N=8)	South and Central America (N=19)	Western Pacific (N=12)	Eastern Mediterranean (N=15)	North America (N=3)	Europe (N=41)	*P* value*
GDP classification[1]									<0.001
Low income, no. (%)	14 (12)	11 (48)	1 (13)	1 (5)	0	1 (7)	0	0	
Lower middle income, no. (%)	30 (25)	6 (26)	6 (75)	4 (21)	5 (42)	5 (33)	0	4 (10)	
Upper middle income, no. (%)	34 (28)	5 (22)	1 (13)	12 (63)	1 (8)	4 (27)	1 (33)	10 (24)	
High income, no. (%)	43 (36)	1 (4)	0	2 (11)	6 (50)	5 (33)	2 (67)	27 (66)	
Number of pediatricians per country, median (IQR)	650 (180-3,500)	70 (22.5-167)	500 (320-3,700)	1,200 (30-5,500)	2,900 (600-5,600)	650 (425-3000)	25,000 (2,667-80,000)	1,545 (500-4,500)	<0.001
Number of pediatricians per 100,000 children <18 years,[2] median (IQR)	30 (5-70)	1 (0-3)	4 (3-9)	47 (10-60)	32 (20-60)	30 (10-50)	59 (40-110)	87 (50-140)	<0.001
Number of new pediatricians entering the workforce each year per 100,000 children <18 years in country,[2] median (IQR)	1.44 (0.42-3.07)	0.08 (0.04-0.14)	0.42 (0.35-0.79)	1.47 (1.05-2.67)	1.44 (0.60-3.06)	0.80 (0.37-2.19)	5.61 (1.66-9.57)	3.08 (1.86-4.05)	<0.001
Transition from pediatric care†									
by age 12 years, no. (%)	3 (3)	1 (4)	0	2 (11)	0	0	0	0	0.25
by age 15 years, no. (%)	47 (39)	16 (70)	6 (75)	8 (44)	1 (8)	11 (73)	0	5 (12)	<0.001
by age 18 years, no. (%)	98 (82)	23 (100)	7 (88)	15 (83)	8 (67)	15 (100)	2 (67)	29 (71)	<0.001
by age 21 years, no. (%)	118 (98)	23 (100)	8 (100)	18 (100)	11 (92)	15 (100)	2 (67)	41 (100)	0.01
Countries reporting regular pediatric promotive and preventive care received, no. (%)	110 (91)	19 (83)	7 (88)	19 (100)	11 (92)	10 (67)	3 (100)	41 (100)	0.002
Percentage of primary care provided by non-physician, median (IQR)	28 (9-58)	81 (53-85)	50 (35-68)	32 (17-61)	11 (5-27)	18.5 (17-26)	30 (12-32)	13 (3-33)	<0.001
Percentage of primary care provided by general physician, family doctor, or medical officer, median (IQR)	19.8 (11-56)	17 (12-25)	17 (10.9-38)	18 (12-28)	36 (15-46)	20.8 (14-24)	17 (17-17)	22 (9-49)	0.83
Percentage of primary care provided by pediatrician, median (IQR)	33 (13-59)	3 (2-16)	27 (20-33)	26 (23-55)	50 (46-71)	59 (47-69)	51 (51-51)	48 (26-73)	<0.001
Number of physicians per 100,000 population,[3] (median, IQR)	125 (21-269)	10 (5-20)	39 (21-73)	113 (62-178)	122 (44-191)	149 (62-196)	252 (227-263)	329 (269-393)	<0.001

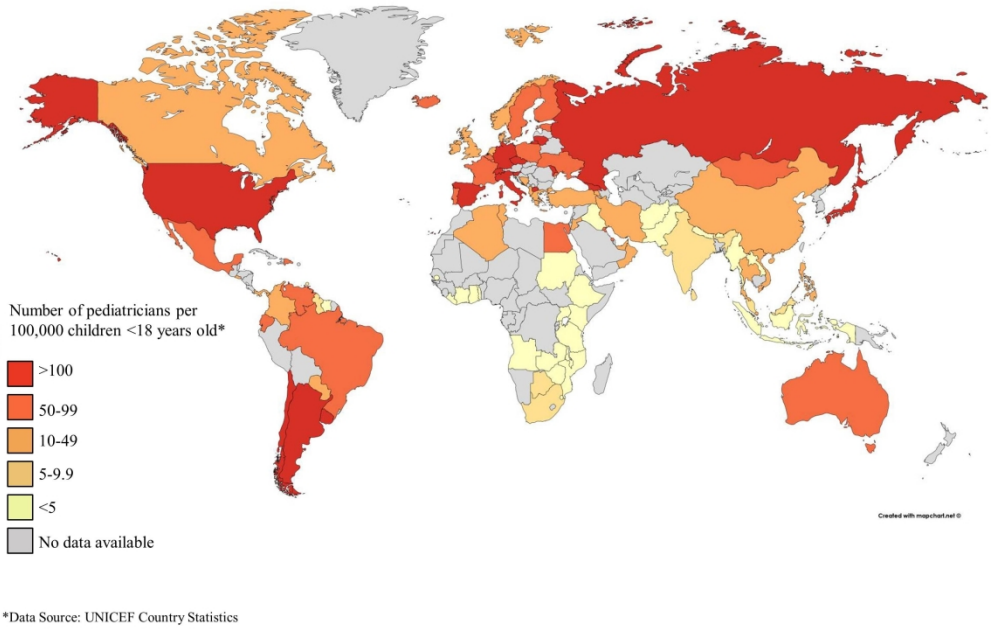
[1] World Bank list of economies (2017) [Internet]. World Bank. Available from: http://databank.worldbank.org/data/download/site-content/CLASS.xls

[2] The State of the World's Children 2016 Statistical Tables. (2016, June 27). Retrieved October 31, 2017, from https://data.unicef.org/resources/state-worlds-children-2016-statistical-tables/

[3] The 2016 update, Global Health Workforce Statistics, World Health Organization, Geneva (http://www.who.int/hrh/statistics/hwfstats/).

* *P* values for the comparison between regions were calculated using and Fisher's exact tests for categorical variables and Kruskal-Wallis tests for continuous variables.
† Age of transition from pediatric care not reported by one country in the South and Central America region.

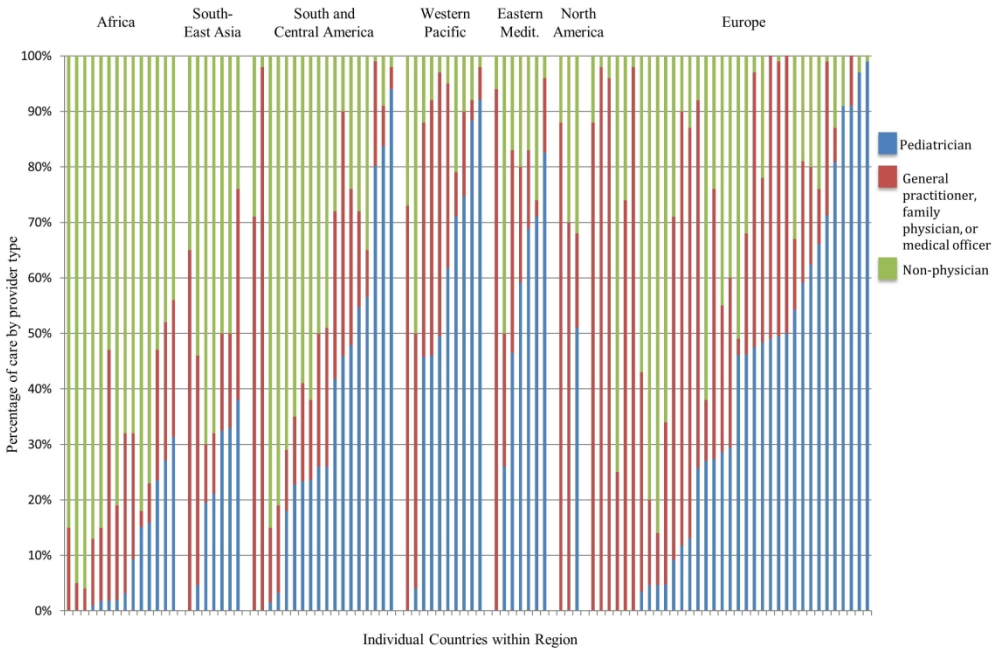
Figure 1: Pediatrician density per 100,000 children <18 years old*



*Data Source: UNICEF Country Statistics

254x190mm (300 x 300 DPI)

Figure 2: Type of provider seen for Primary Care



254x190mm (300 x 300 DPI)

International Pediatrics Survey

Please complete the survey below.

Thank you!

This survey is designed to learn more about how many pediatricians are practicing, who provides medical care for children, and how pediatricians are trained in your country.

Some of the questions ask for specific numbers and may be difficult for you to answer. Please answer to the best of your knowledge. If there is someone who would be better able to answer a question in your country, please tell us their contact information by emailing beth.harper@childrens.harvard.edu or in the comment box at the end of the survey. Thankyou!

What language do you prefer for this survey? ◯ English

Country Name _____

Your email address _____

General Practice Information

In [country], is there specific clinical care for children, separate from care for adults?

- ◯ Yes
- ◯ No

At approximately what age do children in [country] transition out of specific pediatric care to adult care?

- ◯ < 10 years
- ◯ 10-12 years
- ◯ 13-15 years
- ◯ 16-18 years
- ◯ 19-21 years
- ◯ >21 years

(Years)

Do children in [country] receive regular preventative and promotive care throughout childhood (well-child checks, growth monitoring, nutrition assessment, parenting advice, anticipatory guidance, immunization) by either a physician or non-physician health care provider?

- ◯ Yes
- ◯ No

If a child is receiving regular preventative and promotive care in [country], what type of provider will he or she see?

Non-physician provider 100% of the time	Non-physician provider and Physician equally	Physician 100% of the time

(Place a mark on the scale above)

If a child is seeing a PHYSICIAN for regular preventative or promotive care in [country], what type of physician will he or she most often see?

General physician, Family physician, or Medical officer 100% of the time	General physician, Family physician, Medical officer OR Pediatrician equally	Pediatrician 100% of the time

(Place a mark on the scale above)

In [country], if you visited the following types of institutions, how likely is it that a Pediatrician would be working there?

General or primary care clinic	○	○	○	○
Public or Government-run hospital	○	○	○	○
Faith-based hospital	○	○	○	○
Private hospital	○	○	○	○
Academic/referral center	○	○	○	○

Pediatrics Workforce

Approximately how many pediatricians (including pediatricians and pediatric sub-specialists) are currently working in [country]?

_____

(If unable to estimate, please leave blank. Please estimate number of persons, even if part-time.)

Please check all of the types of pediatric subspecialty care that are currently available in [country].

- ☐ Adolescent Medicine
- ☐ Pediatric Allergist
- ☐ Pediatric Anesthesiologist
- ☐ Pediatric Cardiologist
- ☐ Child Development/Developmental Medicine
- ☐ Pediatric Dermatologist
- ☐ Pediatric Ear, Nose, and Throat surgeon
- ☐ Pediatric Endocrinologist
- ☐ Pediatric Gastroenterologist
- ☐ Geneticist
- ☐ Pediatric Hematologist Pediatric
- ☐ Immunologist Pediatric
- ☐ Infectious Disease Pediatric
- ☐ Intensivist (PICU) Metabolic
- ☐ Disease Specialist Pediatric
- ☐ Nephrologist / Renal
- ☐ Neonatologist (NICU) Pediatric
- ☐ Neurologist Pediatric Oncologist
- ☐ Pediatric Ophthalmologist
- ☐ Pediatric Orthopedist
- ☐ Pediatric Pulmonologist
- ☐ Pediatric Psychiatrist
- ☐ Pediatric Rheumatologist
- ☐ Pediatric Surgeon Pediatric
- ☐ Urologist
- ☐ (Please select all that apply)

What percentage of pediatricians working in [country] work in the following areas?

	None	< 5%	5-25%	25-50%	50-75%	75-95%	>95%	100%
Public Sector only	◯	◯	◯	◯	◯	◯	◯	◯
Private Sector only	◯	◯	◯	◯	◯	◯	◯	◯
Both in the Public and Private Sector	◯	◯	◯	◯	◯	◯	◯	◯

Approximately how many NEW pediatricians are entering the workforce in [country] each year? _____
(If unable to estimate, please leave blank)

Based upon the number of NEW and RETIRING pediatricians each year in [country], what are workforce expectations over the next 10 years?

◯ Increase
◯ Decrease
◯ Stable

Education and Training in Pediatrics

Are there post-graduate training programs in Pediatrics in [country]?
◯ Yes
◯ No

How many post-graduate training programs in pediatrics are there in [country]?
_____

Is there a published directory or list of these programs?
◯ Yes
◯ No

Is this directory or list available on the internet?
◯ Yes No
◯

Please list the website or provide a link:
_____

Is there someone we may contact to obtain the directory or list?
◯ Yes
◯ No

Please include the name and contact information below:
_____

Please list as many of the programs as possible, along with contact information if available.
_____

Is there a national or regional accreditation organization that accredits programs in [country]?
◯ Yes
◯ No

What is the name of the accrediting organization or organizations?
_____

Are any of the programs in [country] accredited?
◯ Yes - all Yes -
◯ some No
◯

The following questions aim to understand how many years of training it takes to become a pediatrician in [country].

Is a university degree required prior to beginning medical school?
◯ Yes
◯ No

How many years of medical school, at a minimum, are required? _____

How many years of general medicine training or internship that is not specific to pediatrics? _____

How many years of post-graduate training specific to pediatrics? _____

Is additional supervised time in practice required to register as a specialist?
◯ Yes
◯ No

How many years of additional supervised practice is required to register as a specialist? _____

In [country], are there national standardized guidelines/requirements for postgraduate pediatric training?
◯ Yes
◯ No

Is there a standardized curriculum (i.e., national curriculum) in place for pediatric post-graduate training programs?
◯ Yes
◯ No

What body is in charge of the standardized (i.e. national) curriculum? _____

Is there a published resource of post-graduate training program requirements?
◯ Yes
◯ No

Please include a link to the website for this resource or contact information _____

Are there pediatric sub-specialty training opportunities in your country?
◯ Yes
◯ No
(We define sub-specialty training as training within a particular field of pediatrics, for example pediatric endocrinology or pediatric cardiology)

Please check all of the pediatric sub-specialties for which there are training programs in [country].

- ☐ Adolescent Medicine
- ☐ Pediatric Allergist Pediatric
- ☐ Anesthesiologist Pediatric
- ☐ Cardiologist
- ☐ Child Development/Developmental Medicine
- ☐ Pediatric Dermatologist
- ☐ Pediatric Ear, Nose, and Throat surgeon
- ☐ Pediatric Endocrinologist
- ☐ Pediatric Gastroenterologist
- ☐ Geneticist
- ☐ Pediatric Hematologist Pediatric
- ☐ Immunologist Pediatric
- ☐ Infectious Disease Pediatric
- ☐ Intensivist (PICU) Metabolic
- ☐ Disease Specialist Pediatric
- ☐ Nephrologist / Renal
- ☐ Neonatologist (NICU) Pediatric
- ☐ Neurologist Pediatric Oncologist
- ☐ Pediatric Ophthalmologist
- ☐ Pediatric Orthopedist
- ☐ Pediatric Pulmonologist
- ☐ Pediatric Psychiatrist
- ☐ Pediatric Rheumatologist
- ☐ Pediatric Surgeon Pediatric
- ☐ Urologist
- ☐ (Select all that apply)

We greatly appreciate any additional information, clarifications, or comments you may have! Please tell us about them here.

THANK YOU for your participation! You will receive a copy of the report when available. If you have additional questions or concerns, please enter them below or email us at beth.harper@childrens.harvard.edu

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Where are the Paediatricians? An International Survey to Understand the Global Paediatric Workforce

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Where are the Paediatricians? An International Survey to Understand the Global Paediatric Workforce

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Abbreviations:

Sustainable Development Goals – SDGs
Gross Domestic Product – GDP
Interquartile Range – IQR
International Pediatric Association - IPA

Contributors' Statement Page

Dr. Harper and Dr. Russ conceptualized and designed the study, designed the data collection instruments, coordinated and supervised data collection, drafted the initial manuscript, and reviewed and revised the manuscript.

Dr. Nganga, Dr. Armstrong, Dr. Forsyth coordinated data collection, reviewed and revised the manuscript.

Dr. Ham assisted with design of the data collection instrument including piloting, and reviewed and revised the manuscript.

Dr. Keenan advised the international approach, aided with data collection, reviewed and revised the manuscript.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Abstract

Objective: Our primary objective was to examine the global paediatric workforce and to better understand geographic differences in the number of paediatricians globally. Secondary objectives were to describe paediatric workforce expectations, who provides children with preventative care, and when children transition out of paediatric care.

Design: Survey of identified paediatric leaders in each country.

Setting: Paediatric association leaders worldwide

Main outcome measures: Paediatrician numbers, provision of primary care for children, age of transition to adult care.

Results: Responses were obtained from 121 countries (73% of countries approached). The number of paediatricians per 100,000 children ranged from a median of 0.5 (IQR 0.3-1)in low income countries to 72 (IQR 4-118) in high income countries. Africa and South-East Asia reported the lowest pediatrician density (median of 0.8 paediatricians per 100,000 children, IQR 0.4-3and median of 4, IQR 3-9, respectively), and fewest paediatricians entering the workforce. 82% of countries reported transition to adult care by age 18 and 39% by age 15. Most countries (91%) but only 64% of low income countries reported provision of paediatric preventative care ($p<0.001$, Cochran-Armitage trend test). Systems of primary care provision varied widely. A majority of countries (63%) anticipated increases in their paediatric workforce in the next decade.

Conclusions: Paediatrician density mirrors known inequities in health provider distribution. Fewer paediatricians are entering the workforce in areas with already low paediatrician density, which may exacerbate disparities in child health outcomes. In some regions, children transition to adult care during adolescence, with implications for health care training and delivery. Paediatrician roles are heterogeneous worldwide, and country-specific strategies should be utilized to address inequity in child health provision.

What is Known about This Subject:

Significant discrepancy between burden of disease and distribution of health professionals has been documented.

Various structures are in place for paediatric care across the globe.

The global distribution of pediatricians, their role in providing care to children and the structure for child health systems in various countries are not known.

What This Study Adds:

There are inequities in both paediatrician distribution and numbers of new paediatricians entering the workforce in areas with high child mortality.

Most countries provide some regular primary care for children, but the systems to provide that care are highly variable.

In many areas, children transition from paediatric care in early adolescence, with implications for training and care delivery.

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Introduction

The discrepancy between the global burden of disease and the distribution of health professionals has been well-described.(1-9) Areas with the highest disease burden have the lowest percentage of health professionals, exacerbating the impact of the health workforce deficit. The World Health Organization has identified an index of 4.45 health workers (physicians, nurses, and midwives) per 1000 population necessary to meet the Sustainable Development Goals (SDGs) by 2030.(6) Countries are called on to set specific targets for numbers of health workers including physicians and health specialists depending upon their needs and health services structure.

Child health was a focal point in the Millennium Development Goals and continues to be important in the SDGs. Epidemiologic shifts towards non-communicable diseases, a renewed focus on optimizing child development, the unique health needs of adolescents, and emphasis on reducing morbidity not just mortality, all require renewed deliberation about how health care for children is delivered and advanced.(10-12) Differing health system designs lead to wide variability in the roles that paediatricians and other child health providers fill in supporting the health of a country's children. Understanding those roles is vital to providing equitable and quality health care and to developing appropriate training competencies for all child health professionals.

Some regional efforts have been undertaken to understand where paediatricians are working and what roles they play, but the paediatric workforce worldwide has not been previously described.(6, 13-15) Similarly, while health systems have been described on country and sometimes regional levels, a global understanding of health care systems for children and their variation can provide valuable information for potential reforms at country level.

The goal of this study was to examine the global status of the paediatric workforce and to better understand geographic differences in the types of work that paediatricians undertake in the provision of child health care. Our objectives were to identify the number of paediatricians globally, examine paediatric workforce expectations, understand who provides children with regular promotive and preventative care, and to learn when children transition out of paediatric care to adult care.

Methods

Survey development

An online survey was developed using REDCap, an electronic survey tool.(16) The survey queried the number of paediatricians per country, expected workforce changes, primary care provision for children, and age of transition to adult care. (Supplement 1) Faculty at Boston Children's Hospital initially piloted the survey with cognitive interviewing to improve question clarity. The refined survey was further piloted and edited with paediatric leaders within the Global Paediatric Education Consortium representing Europe, Asia, Africa, and the Middle East.(17) As the internationally agreed upon languages for communication between paediatric societies in the International Paediatric Association (IPA) are English, French and Spanish, the final survey was translated into French and Spanish by DR Interpreting, Inc. Translated surveys were sent to native French and Spanish speakers to confirm accuracy of the translation.

Patient and public involvement

Patients and the public were not directly involved in the design of this study.

Study Sample

The survey was distributed to identified paediatric leaders with a goal of attaining one response per country or economy. Countries and economies for inclusion were defined as the 193 UN member countries plus the 5 World Bank Economies (Hong Kong, Macau, Palestine, Puerto Rico and Taiwan) with populations of over 500,000 people, for a total of 198 countries and economies. The survey was initially distributed in May 2015 via email to the lead delegates from the 121 countries with active membership in the IPA at that time. Regional and subspecialty societies that did not function at the country level were excluded. The survey was sent to non-respondents each week for three consecutive weeks. In a second phase, contact was made with paediatric leaders within the non-responding countries, as well as an additional 45 countries in which paediatric leadership was identified through contacts known to the author group, networks from the Global Paediatric Education Consortium, International Paediatric Academic Leaders Association, Harvard University, the American Academy of Paediatrics Section of International Child Health, or through contacts with country Ministries of Health. Paediatric leaders from non-responding countries who were in attendance at the International Paediatric Congress in August 2016 were also identified and approached.

A majority of countries (73) had a single response. Of those countries with duplicate responses to the survey, 30 had only one complete response and 17 required further review by the authors (BH and CR). Of those, seven countries had identical duplicate responses, or the response that was most complete was selected. Ten countries were contacted to clarify duplicate responses, and 9 clarified. One country had two responses with some variation, and the respondents could not be reached for clarification; for that country the response from the president of the country's paediatric association was used.

Country statistics for populations under age 18 were obtained from publically available UNICEF country statistics.(18) Income and GDP classifications were based on 2016 World Bank groupings.

Statistical Analysis

Paediatric workforce characteristics were described using frequencies, medians and interquartile ranges where appropriate. Comparisons between regions were calculated using Kruskal-Wallis tests and Fisher's exact tests, while comparisons between GDP categories were calculated using Cuzick's non-parametric tests for trend and Cochran-Armitage trend tests. Data was analyzed using Stata (StataCorp. 2015. *Stata Statistical Software: Release 14*. College Station, TX: StataCorp LP).

The study protocol was reviewed by the Institutional Review Board at Boston Children's Hospital and deemed not human subjects research.

Results

Responses were received from 95 (79%) of the 121 countries with IPA membership, and 121 (73%) of the 166 total countries and economies for which a contact was identified. (Supplement 2). In total, this represented 61% of the global 198 countries and economies. Eight countries responded in French, ten in Spanish, and the remainder in English.

There were 32 countries for whom no contact was identified and therefore no survey sent, and 45 countries that did not respond to the survey (Table 1). No contact identified and non-responder countries did not vary significantly from responder countries by GDP (p=0.18, Fisher's exact test), but did vary by region (p=0.002, Fisher's exact test), with more no contact

identified countries located in the Western Pacific, and more non-responders in Africa. Countries with no contact identified had significantly smaller populations than those targeted, with a median population of 274,000 as compared with a median population of 10 million in responder countries ($p<0.001$, Kruskal-Wallis test).

The number of paediatricians reported was normalized against the population of children under 18 years old in each country to obtain a paediatrician density ratio (Figure 1). Paediatrician density varied significantly by GDP, ranging from a median of 0.5 paediatricians per 100,000 children in low income countries to a median of 72 paediatricians per 100,000 children in high income countries ($p<0.001$, Nonparametric trend test, Table 2). In addition, significant variability was seen by region ($p<0.001$, Kruskal-Wallis test, Table 3). The lowest density was seen in Africa (median of 0.8 paediatricians per 100,000 children, interquartile range (IQR) 0.4-3) and South-East Asia (median of 4 paediatricians per 100,000 children, IQR 3-9) as compared with a global median of 32 paediatricians per 100,000 children (IQR 5-74 and 59 and 87 per 100,000 children (IQR 38 109, and 49-135) in North America and Europe, respectively.

The number of new paediatricians entering the workforce also varied by GDP classification ($p=0.01$, Nonparametric trend test) and by region ($p<0.001$, Kruskal-Wallis test). In low income countries, the paediatric workforce gained a median of 10 new paediatricians per year, or 0.08 per 100,000 children, while in high income countries the median was 60 new paediatricians per year, or 3 per 100,000 children (Table 2). In Africa, countries anticipated a median of 5 new paediatricians (0.08 per 100,000 children) per year as compared to a global median of 30 (1.44 paediatricians per 100,000 children) (Table 3).

Age of transition out of paediatric care did not vary by gross domestic product (GDP, Table 2) but did vary by region ($p<0.001$, Fisher's exact test, Table 3). Notably, in South-East Asia, Africa, and the Eastern Mediterranean, over 65% of countries reported that children transitioned from paediatric care by age 15 years, whereas less than 45% of countries reported transition by age 15 in South and Central America and less than 15% in Europe, North America, and the Western Pacific.

Most countries (91%) responded affirmatively when asked "*do children in your country receive regular preventative and promotive care throughout childhood (well-child checks, growth monitoring, nutrition assessment, parenting advice, anticipatory guidance, immunization) by either a physician or non-physician health care provider?"* This rate was considerably lower in low-income countries, where only 64% of countries reported regular primary care ($p<0.001$, Cochran-Armitage trend test, Table 2). The type of provider seen for primary paediatric care varied (Figure 2). Worldwide, children see non-physicians as the primary care provider a median of 28% of the time (Table 2, Table 3, IQR 9-59%). If children saw a physician, that person was a paediatrician (rather than general physician, family physician or medical officer) a median of 33% of the time.

Discussion

This international survey of paediatricians is the first, to our knowledge, to report data on paediatrician density and the roles that paediatricians play in provision of care for children on a global scale. This study identified wide variability in paediatrician density, consistent with health workforce findings of physicians as a whole.(5, 8, 19) Areas with the highest burden of paediatric mortality and morbidity had the lowest paediatrician density, and paediatricians are

joining the workforce at lower rates in those same regions. One reason for this inequity may be the existence of a training capacity gap, with fewer avenues to train paediatricians or fewer opportunities for employment in areas with an already low workforce. Some high-income countries have already undertaken more detailed analysis of their paediatric workforce, and used this to inform investment and education policy.(14, 20-24)

Another explanation could be the impact of internal or external migration on access to paediatric care. Both have multiple drivers, including job satisfaction, healthy work environment, adequate supplies, feeling of support, and appropriate recognition.(2, 25, 26) Within countries, there is often a significant misdistribution of health care professionals towards large, wealthy urban areas.(1, 2, 25, 27) More detailed data on intra-national distribution of paediatricians would be valuable in understanding and seeking to address these disparities of access. Migration between countries has also been well documented.(1, 2, 8, 26) While there are no clear data on the impact of this 'brain drain' in paediatrics, in both the United States and UK, it is estimated that one-third of the paediatrician workforce are international medical graduates.(28, 29) Specific efforts to reverse these trends include a focus on providing access to medical training to students from low resource settings, as exemplified by the Latin American School of Medicine (ELAM) in Cuba, and efforts to develop pediatric residency programs in low and middle income countries.(30, 31) Additional efforts to improve salaries, work environments and career opportunities may also be effective means of decreasing external migration.(32-34)

This study identified that many children transition from paediatric care to adult care by age 15, relatively early in adolescence. Age of transition varied by region but not by country income, suggesting that it may be more associated with cultural or professional norms around transition to adulthood rather than workforce planning. Improved understanding of the systems

of care for adolescents is critical among UN, WHO and Lancet Commission calls for increased focus, expertise and research on adolescent-specific care.(10-12) With early transition to adult care, advancing the adolescent health agenda may require a defined framework for adolescent services and multisectoral approach that engages youth within their communities.

Our study demonstrated that while most countries offered some form of broadly defined preventive care to children, this primary care role is often filled by non-physicians or generalists. In both high and low income countries, task shifting and task sharing have been important and often successful methods for improving access to care and addressing health costs while retaining quality of care.(35-39) Most countries continue to explore the appropriate skills mix for providing care, particularly in community settings. Optimizing this skills mix will require inter-professional collaboration and training to promote successful multidisciplinary primary care. System planning needs to account for and support the primary role of family and the informal care structures that may exist in communities. A thoughtful country-level approach is required to balance development of preventive and community interventions, alongside secondary and tertiary level services with appropriate referral structures.

Workforce studies, including this one, may not capture all of the specific roles that health professionals play, including leadership in health care systems, policy, and government; educators and researchers in universities; and community advocates. A robust national workforce strategy needs to account for these roles, and country-level human resources for health planning should establish a target density for the paediatrician workforce in relation to their expected roles within the system. Designation of tasks such as provision of primary care and age of transition to adult care would need to be considered in order to appropriately define paediatric workforce

requirements. Analysis of skills mix needs should also incorporate anticipated epidemiologic changes including a reduction in infectious causes of under-5 mortality, an increase in the proportion of neonatal mortality, and a shift towards chronic diseases in children.(12, 40) As countries work to scale-up their health care workforce these baseline data can help inform development strategies.(41, 42)

This study has several limitations. We found no validated tool that would appropriately meet our study objective, therefore developed the survey de novo. Despite piloting the survey among multiple countries, cultures, and languages, it is possible that some terms, while commonly used, may have been interpreted differently in different settings, particularly among respondents for whom French, English or Spanish was not their native language. All data were collected as survey responses, usually from a single representative in each country. While we targeted experts at the national paediatric association level who would have knowledge of the state of paediatrics and child health in that nation, responses could vary among individuals particularly for more subjective questions. While we achieved a high level of response globally, there were regional gaps, with particular low responses from West Africa and the Western Pacific. Countries with low physician density and population were similarly underrepresented in this sample. These challenges may have been due to language or internet access difficulties, absence of or less active national paediatric organization or simply limited paediatric presence in those countries. This study was focused on paediatricians, a small component in any country of the human workforce related to child health and health systems. However, paediatricians are important resources for countries, with substantial understanding of child health needs who can also help support country development of child health services and provide guidance for the continuum of care for children and families.

Conclusion

As the global community seeks universal health coverage and works to address the known shortage in healthcare workers, care should be taken to meet the health workforce needs of the world's children and adolescents. Clarification of paediatrician roles and accompanying skill mix is important in developing health workforce capacity to meet those needs. This study described the state of the paediatric workforce worldwide with notable variability in paediatrician density and roles in different countries. A training capacity gap in countries with high disease burdens may exacerbate the problem of a small workforce relative to healthcare needs. These findings highlight the need for country specific child health workforce strategies, assisted by the development of standardized tools to monitor health care capacity and outcomes as countries focus on meeting the SDGs for child health.

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Table 1: Characteristics of responder, non-responder, and no contact identified groups

	Responder	Non-responder	No contact identified	*P* value
Countries, no. (%)	121 (61)	45 (23)	32 (16)	
GDP classification[1]				0.18*
Low income, no. (%)	14 (12)	12 (27)	5 (16)	
Lower middle income, no. (%)	30 (25)	12 (27)	8 (25)	
Upper middle income, no. (%)	34 (28)	12 (27)	12 (38)	
High income, no. (%)	43 (36)	9 (20)	7 (22)	
Region[2]				0.002*
Africa, no. (%)	23 (19)	17 (38)	7 (21)	
South-East Asia, no. (%)	8 (7)	1 (2)	1 (3)	
South and Central America, no. (%)	19 (16)	8 (18)	5 (16)	
Western Pacific, no. (%)	12 (10)	4 (9)	13 (41)	
Eastern Mediterranean, no. (%)	15 (12)	6 (13)	0	
North America, no. (%)	3 (2)	1 (2)	0	
Europe, no. (%)	41 (34)	8 (18)	6 (19)	
Country population,[3] median in thousands (IQR)	10,824 (4,503-43,417)	7,237 (2,175-17,468)	274 (98-1,208)	<0.001**
Country population <18 years,[4] median in thousands (IQR)	3,744 (1,081-14,144)	3,248 (798-9,500)	113 (27-581)	0.08**
Number of physicians per 100,000 population,[6] median (IQR)	158 (43-290)	62 (8-241)	46 (19-147)	0.002**

World Bank list of economies (2017) [Internet]. World Bank. Available from: http://databank.worldbank.org/data/download/site-content/CLASS.xls

[2] Region classification based on "WHO regional offices." World Health Organization, World Health Organization, 2017, www.who.int/about/regions/en/.

[3] Population, total. (2017, September 18). Retrieved October 09, 2017, from https://data.worldbank.org/indicator/SP.POP.TOTL

[4] The State of the World's Children 2016 Statistical Tables. (2016, June 27). Retrieved October 31, 2017, from https://data.unicef.org/resources/state-worlds-children-2016-statistical-tables/

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* *P* values were calculated using Fisher's exact tests for categorical variables

** *P* values were calculated using Kruskal-Wallis tests for continuous variables (based on chi-square statistics with 2 degrees of freedom.)

Table 2: Results by GDP Classification

	World (N=121)	Low Income (N=14)	Lower Middle Income (N=30)	Upper Middle Income (N=34)	High Income (N=43)	*P* value
Number of pediatricians per country, median (IQR)	650 (180-3,500)	70 (25-200)	600 (250-5,000)	1,700 (256-6,000)	1,400 (500-3,500)	<0.001**
Number of pediatricians per 100,000 children <18 years[1], median (IQR)	32 (5-74)	0.5 (0.3-1)	6 (3-32)	30 (15-60)	72 (44-118)	<0.001**
Number of new pediatricians entering the workforce each year per 100,000 children <18 years in country[1], median (IQR)	1.44 (0.42-3.07)	0.08 (0.03-0.18)	0.45 (0.02-0.93)	1.36 (0.57-2.09)	3.10 (2.05-4.06)	0.01**
Number of countries reporting transition from pediatric care†						
by age 12 years, no. (%)	3 (3)	0	3 (10)	0	0	0.13*
by age 15 years, no. (%)	47 (39)	9 (64)	15 (50)	13 (39)	10 (23)	0.002*
by age 18 years, no. (%)	98 (82)	14 (100)	27 (90)	26 (79)	31 (72)	0.01*
by age 21 years, no. (%)	118 (98)	14 (100)	30 (100)	33 (100)	41 (95)	0.18*
Countries reporting regular pediatric promotive and preventive care received, no. (%)	110 (91)	9 (64)	26 (87)	33 (97)	42 (98)	<0.001*
Percentage of primary care provided by non-physician, median (IQR)	28 (9-58)	82 (70-85)	34 (11-61)	28.5 (2-51)	24 (9-45)	0.01**
Percentage of primary care provided by general physician, family doctor, or medical officer, median (IQR)	21 (11-36)	12 (7-16)	24 (14-42)	18 (10-27)	23 (10-36)	0.76**
Percentage of primary care provided by pediatrician, median (IQR)	33 (13-57)	17 (8-22)	30 (12-49)	44 (23-56)	46 (7-73)	0.04**
Number of physicians per 100,000 population,[2] median (IQR)	158.1 (43.4-290.0)	6.6 (3.0-12.0)	76.6 (20.1-154.6)	158.1 (85.4-246.3)	299 (196.4-379.1)	<0.001**

[1] The State of the World's Children 2016 Statistical Tables. (2016, June 27). Retrieved October 31, 2017, from https://data.unicef.org/resources/state-worlds-children-2016-statistical-tables/

[2] The 2016 update, Global Health Workforce Statistics, World Health Organization, Geneva (http://www.who.int/hrh/statistics/hwfstats/).

**P* values were calculated using Cuzick's nonparametric tests for trend for continuous variables (based on Z statistics with 1 degree of freedom).

***P* values were calculated using Cochran-Armitage trend tests for categorical variables (based on chi-square statistics with 1 degree of freedom).

† Age of transition from pediatric care not reported by one country in the upper middle income group.

Table 3: Results by Region

	World (N=121)	Africa (N=23)	South-East Asia (N=8)	South and Central America (N=19)	Western Pacific (N=12)	Eastern Mediterranean (N=15)	North America (N=3)	Europe (N=41)	*P* value
GDP classification[1]									<0.001*
Low income, no. (%)	14 (12)	11 (48)	1 (13)	1 (5)	0	1 (7)	0	0	
Lower middle income, no. (%)	30 (25)	6 (26)	6 (75)	4 (21)	5 (42)	5 (33)	0	4 (10)	
Upper middle income, no. (%)	34 (28)	5 (22)	1 (13)	12 (63)	1 (8)	4 (27)	1 (33)	10 (24)	
High income, no. (%)	43 (36)	1 (4)	0	2 (11)	6 (50)	5 (33)	2 (67)	27 (66)	
Number of pediatricians per country, median (IQR)	650 (180-3,500)	70 (23-167)	500 (320-3,700)	1,200 (30-5,500)	2,900 (600-5,600)	650 (425-3000)	25,000 (2,667-80,000)	1,545 (500-4,500)	<0.001**
Number of pediatricians per 100,000 children <18 years,[2] median (IQR)	32 (5-74)	0.8 (0.4-3)	4 (3-9)	47 (9-64)	32 (17-64)	25 (5-49)	59 (38-109)	87 (49-135)	<0.001**
Number of new pediatricians entering the workforce each year per 100,000 children <18 years in country,[2] median (IQR)	1.44 (0.42-3.07)	0.08 (0.04-0.14)	0.42 (0.35-0.79)	1.47 (1.05-2.67)	1.44 (0.60-3.06)	0.80 (0.37-2.19)	5.61 (1.66-9.57)	3.08 (1.86-4.05)	<0.001**
Transition from pediatric care†									
by age 12 years, no. (%)	3 (3)	1 (4)	0	2 (11)	0	0	0	0	0.25*
by age 15 years, no. (%)	47 (39)	16 (70)	6 (75)	8 (44)	1 (8)	11 (73)	0	5 (12)	<0.001*
by age 18 years, no. (%)	98 (82)	23 (100)	7 (88)	15 (83)	8 (67)	15 (100)	2 (67)	29 (71)	<0.001*
by age 21 years, no. (%)	118 (98)	23 (100)	8 (100)	18 (100)	11 (92)	15 (100)	2 (67)	41 (100)	0.01*
Countries reporting regular pediatric promotive and preventive care received, no. (%)	110 (91)	19 (83)	7 (88)	19 (100)	11 (92)	10 (67)	3 (100)	41 (100)	0.002*
Percentage of primary care provided by non-physician, median (IQR)	28 (9-58)	81 (53-85)	50 (35-68)	32 (17-61)	11 (5-27)	9 (17-26)	30 (12-32)	13 (3-33)	<0.001**
Percentage of primary care provided by general physician, family doctor, or medical officer, median (IQR)	20 (11-36)	17 (12-25)	17 (11-38)	18 (12-28)	36 (15-46)	21 (14-24)	17 (17-17)	22 (9-49)	0.83**
Percentage of primary care provided by pediatrician, median (IQR)	33 (13-59)	3 (2-16)	27 (20-33)	26 (23-55)	50 (46-71)	59 (47-69)	51 (51-51)	48 (26-71)	<0.001**
Number of physicians per 100,000 population,[3] (median, IQR)	158.1 (43.4-290.0)	12.0 (5.5-37.2)	39.2 (23.6-64.7)	117.9 (81.7-116.5)	175 (114.5-257.5)	154.6 (85.4-196.4)	247.7 (207.1-255.4)	331.1 (277.7-403.5)	<0.001**

[1] World Bank list of economies (2017) [Internet]. World Bank. Available from: http://databank.worldbank.org/data/download/site-content/CLASS.xls

[2] The State of the World's Children 2016 Statistical Tables. (2016, June 27). Retrieved October 31, 2017, from https://data.unicef.org/resources/state-worlds-children-2016-statistical-tables/

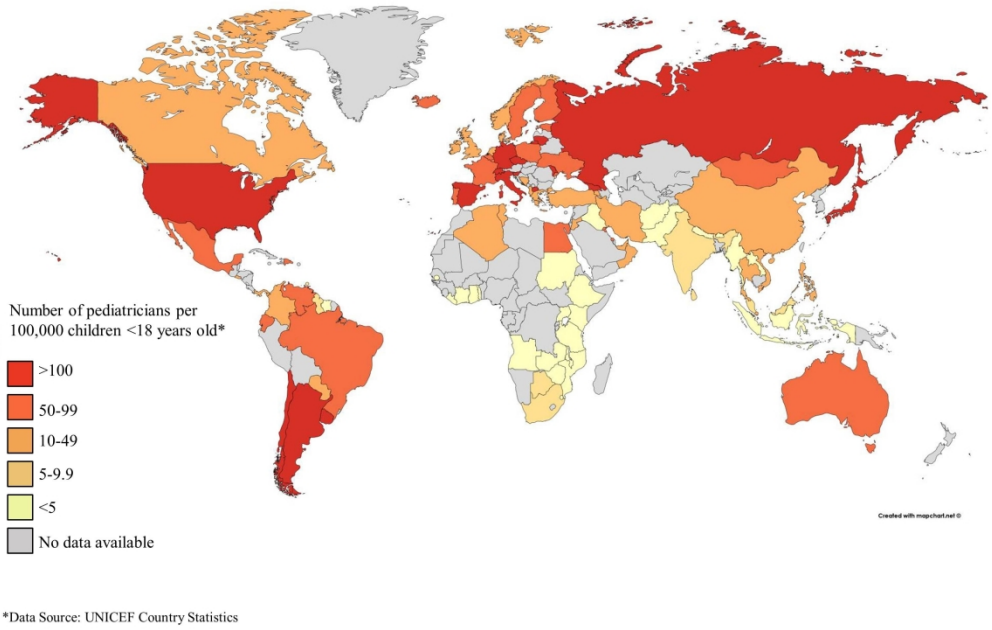
[3] The 2016 update, Global Health Workforce Statistics, World Health Organization, Geneva (http://www.who.int/hrh/statistics/hwfstats/).

* *P* values were calculated using Fisher's exact tests for categorical variables

**P* values were calculated using Kruskal-Wallis tests for continuous variables (based on chi-square statistics with 6 degrees of freedom).

† Age of transition from pediatric care not reported by one country in the South and Central America region.

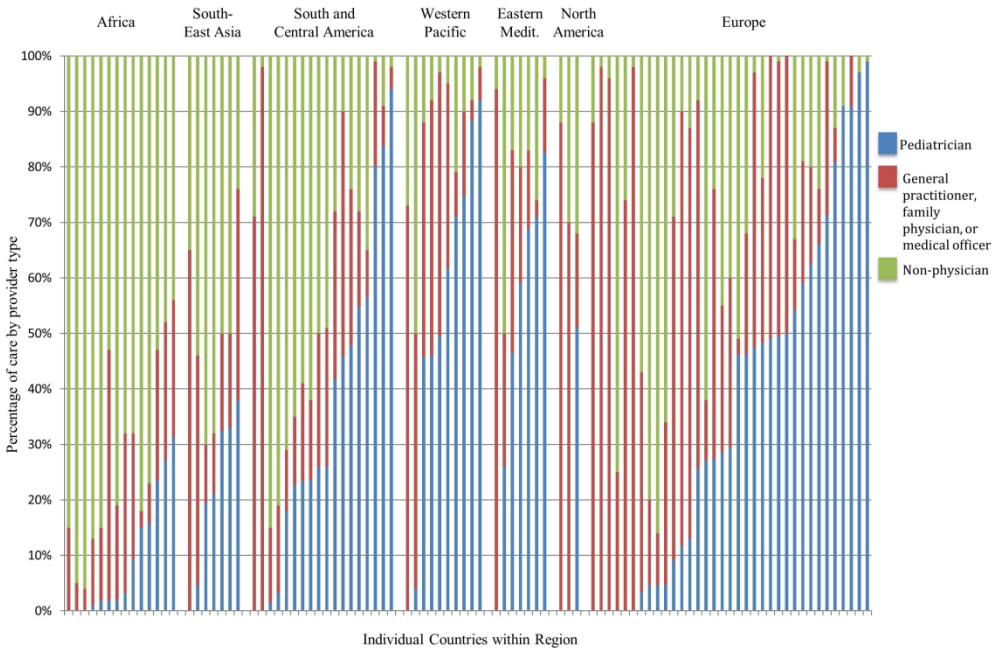
Figure 1: Pediatrician density per 100,000 children <18 years old*



*Data Source: UNICEF Country Statistics

254x190mm (300 x 300 DPI)

Figure 2: Type of provider seen for Primary Care



254x190mm (300 x 300 DPI)

International Pediatrics Survey

Please complete the survey below.

Thank you!

This survey is designed to learn more about how many pediatricians are practicing, who provides medical care for children, and how pediatricians are trained in your country.

Some of the questions ask for specific numbers and may be difficult for you to answer. Please answer to the best of your knowledge. If there is someone who would be better able to answer a question in your country, please tell us their contact information by emailing beth.harper@childrens.harvard.edu or in the comment box at the end of the survey. Thankyou!

What language do you prefer for this survey? ◯ English

Country Name _____

Your email address _____

General Practice Information

In [country], is there specific clinical care for children, separate from care for adults?

◯ Yes
◯ No

At approximately what age do children in [country] transition out of specific pediatric care to adult care?

◯ < 10 years
◯ 10-12 years
◯ 13-15 years
◯ 16-18 years
◯ 19-21 years
◯ >21 years
(Years)

Do children in [country] receive regular preventative and promotive care throughout childhood (well-child checks, growth monitoring, nutrition assessment, parenting advice, anticipatory guidance, immunization) by either a physician or non-physician health care provider?

◯ Yes
◯ No

If a child is receiving regular preventative and promotive care in [country], what type of provider will he or she see?

Non-physician provider 100% of the time | Non-physician provider and Physician equally | Physician 100% of the time

(Place a mark on the scale above)

If a child is seeing a PHYSICIAN for regular preventative or promotive care in [country], what type of physician will he or she most often see?

General physician, Family physician, or Medical officer 100% of the time | General physician, Family physician, Medical officer OR Pediatrician equally | Pediatrician 100% of the time

(Place a mark on the scale above)

In [country], if you visited the following types of institutions, how likely is it that a Pediatrician would be working there?

General or primary care clinic	○	○	○	○
Public or Government-run hospital	○	○	○	○
Faith-based hospital	○	○	○	○
Private hospital	○	○	○	○
Academic/referral center	○	○	○	○

Pediatrics Workforce

Approximately how many pediatricians (including pediatricians and pediatric sub-specialists) are currently working in [country]?

_____

(If unable to estimate, please leave blank. Please estimate number of persons, even if part-time.)

Please check all of the types of pediatric subspecialty care that are currently available in [country].

- ☐ Adolescent Medicine
- ☐ Pediatric Allergist
- ☐ Pediatric Anesthesiologist
- ☐ Pediatric Cardiologist
- ☐ Child Development/Developmental Medicine
- ☐ Pediatric Dermatologist
- ☐ Pediatric Ear, Nose, and Throat surgeon
- ☐ Pediatric Endocrinologist
- ☐ Pediatric Gastroenterologist
- ☐ Geneticist
- ☐ Pediatric Hematologist Pediatric
- ☐ Immunologist Pediatric
- ☐ Infectious Disease Pediatric
- ☐ Intensivist (PICU) Metabolic
- ☐ Disease Specialist Pediatric
- ☐ Nephrologist / Renal
- ☐ Neonatologist (NICU) Pediatric
- ☐ Neurologist Pediatric Oncologist
- ☐ Pediatric Ophthalmologist
- ☐ Pediatric Orthopedist
- ☐ Pediatric Pulmonologist
- ☐ Pediatric Psychiatrist
- ☐ Pediatric Rheumatologist
- ☐ Pediatric Surgeon Pediatric
- ☐ Urologist
- ☐ (Please select all that apply)

What percentage of pediatricians working in [country] work in the following areas?

	None	< 5%	5-25%	25-50%	50-75%	75-95%	>95%	100%
Public Sector only	◯	◯	◯	◯	◯	◯	◯	◯
Private Sector only	◯	◯	◯	◯	◯	◯	◯	◯
Both in the Public and Private Sector	◯	◯	◯	◯	◯	◯	◯	◯

Approximately how many NEW pediatricians are entering the workforce in [country] each year? _____
(If unable to estimate, please leave blank)

Based upon the number of NEW and RETIRING pediatricians each year in [country], what are workforce expectations over the next 10 years?

◯ Increase
◯ Decrease
◯ Stable

Education and Training in Pediatrics

Are there post-graduate training programs in Pediatrics in [country]?
◯ Yes
◯ No

How many post-graduate training programs in pediatrics are there in [country]?
_____

Is there a published directory or list of these programs?
◯ Yes
◯ No

Is this directory or list available on the internet?
◯ Yes No
◯

Please list the website or provide a link:
_____

Is there someone we may contact to obtain the directory or list?
◯ Yes
◯ No

Please include the name and contact information below:
_____

Please list as many of the programs as possible, along with contact information if available.
_____

Is there a national or regional accreditation organization that accredits programs in [country]?
◯ Yes
◯ No

What is the name of the accrediting organization or organizations?
_____

Are any of the programs in [country] accredited?
◯ Yes - all Yes -
◯ some No
◯

The following questions aim to understand how many years of training it takes to become a pediatrician in [country].

Is a university degree required prior to beginning medical school?
◯ Yes
◯ No

How many years of medical school, at a minimum, are required? _____

How many years of general medicine training or internship that is not specific to pediatrics? _____

How many years of post-graduate training specific to pediatrics? _____

Is additional supervised time in practice required to register as a specialist?
◯ Yes
◯ No

How many years of additional supervised practice is required to register as a specialist? _____

In [country], are there national standardized guidelines/requirements for postgraduate pediatric training?
◯ Yes
◯ No

Is there a standardized curriculum (i.e., national curriculum) in place for pediatric post-graduate training programs?
◯ Yes
◯ No

What body is in charge of the standardized (i.e. national) curriculum? _____

Is there a published resource of post-graduate training program requirements?
◯ Yes
◯ No

Please include a link to the website for this resource or contact information _____

Are there pediatric sub-specialty training opportunities in your country?
◯ Yes
◯ No
(We define sub-specialty training as training within a particular field of pediatrics, for example pediatric endocrinology or pediatric cardiology)

Please check all of the pediatric sub-specialties for which there are training programs in [country].

- ☐ Adolescent Medicine
- ☐ Pediatric Allergist Pediatric
- ☐ Anesthesiologist Pediatric
- ☐ Cardiologist
- ☐ Child Development/Developmental Medicine
- ☐ Pediatric Dermatologist
- ☐ Pediatric Ear, Nose, and Throat surgeon
- ☐ Pediatric Endocrinologist
- ☐ Pediatric Gastroenterologist
- ☐ Geneticist
- ☐ Pediatric Hematologist Pediatric
- ☐ Immunologist Pediatric
- ☐ Infectious Disease Pediatric
- ☐ Intensivist (PICU) Metabolic
- ☐ Disease Specialist Pediatric
- ☐ Nephrologist / Renal
- ☐ Neonatologist (NICU) Pediatric
- ☐ Neurologist Pediatric Oncologist
- ☐ Pediatric Ophthalmologist
- ☐ Pediatric Orthopedist
- ☐ Pediatric Pulmonologist
- ☐ Pediatric Psychiatrist
- ☐ Pediatric Rheumatologist
- ☐ Pediatric Surgeon Pediatric
- ☐ Urologist
- ☐ (Select all that apply)

We greatly appreciate any additional information, clarifications, or comments you may have! Please tell us about them here.

THANK YOU for your participation! You will receive a copy of the report when available. If you have additional questions or concerns, please enter them below or email us at beth.harper@childrens.harvard.edu

Supplemental File - List of Country Respondents by Region[1]

Africa		
Responder	*Non-responder*	*No Contact Identified*
Algeria	Benin	Cabo Verde
Angola	Burkina Faso	Central African Republic
Botswana	Burundi	Comoros
Congo, Dem. Rep.	Cameroon	Equatorial Guinea
Côte d'Ivoire	Chad	Guinea
Ethiopia	Congo, Rep.	São Tomé and Principe
Gambia, The	Eritrea	South Sudan
Ghana	Gabon	
Kenya	Guinea-Bissau	
Liberia	Lesotho	
Malawi	Madagascar	
Mozambique	Mali	
Namibia	Mauritania	
Nigeria	Mauritius	
Rwanda	Niger	
Seychelles	Senegal	
South Africa	Sierra Leone	
Swaziland		
Tanzania		
Togo		
Uganda		
Zambia		
Zimbabwe		

[1] Regions defined using World Health Organization regional groupings with North America separated from Central and South America. Further information about WHO regional groupings can be found at: https://www.who.int/healthinfo/global_burden_disease/definition_regions/en/ (Accessed December 2018).

Eastern Mediterranean		
Responder	*Non-responder*	*No Contact Identified*
Afghanistan	Djibouti	
Bahrain	Lebanon	
Egypt, Arab Rep.	Morocco	
Iran, Islamic Rep.	Saudi Arabia	
Iraq	Somalia	
Jordan	Yemen, Rep.	
Kuwait		
Libya		
Oman		
Pakistan		
Qatar		
Sudan		
Syrian Arab Republic		
Tunisia		
United Arab Emirates		

Europe		
Responder	*Non-responder*	*No Contact Identified*
Albania	Croatia	Andorra
Armenia	Cyprus	Azerbaijan
Austria	Kazakhstan	Kosovo
Belarus	Kyrgyz Republic	Montenegro
Belgium	Malta	San Marino
Bosnia and Herzegovina	Netherlands	Turkmenistan
Bulgaria	Tajikistan	
Czech Republic	Uzbekistan	
Denmark		
Estonia		
Finland		
France		
Georgia		
Germany		
Greece		
Hungary		
Iceland		
Ireland		
Israel		
Italy		
Latvia		
Liechtenstein		
Lithuania		
Luxembourg		
Macedonia, FYR		
Moldova		
Norway		
Palestine		
Poland		
Portugal		
Romania		
Russian Federation		
Serbia		
Slovak Republic		
Slovenia		
Spain		
Sweden		
Switzerland		
Turkey		
Ukraine		
United Kingdom		

North America		
Responder	*Non-responder*	*No Contact Identified*
Canada Mexico United States	Puerto Rico	

South and Central America		
Responder	*Non-responder*	*No Contact Identified*
Argentina	Bahamas, The	Antigua and Barbuda
Bolivia	Belize	Barbados
Brazil	Costa Rica	St. Kitts and Nevis
Chile	Cuba	St. Lucia
Colombia	Dominica	St. Vincent and the Grenadines
Dominican Republic	Honduras	
Ecuador	Jamaica	
El Salvador	Uruguay	
Grenada		
Guatemala		
Guyana		
Haiti		
Nicaragua		
Panama		
Paraguay		
Peru		
Suriname		
Trinidad and Tobago		
Venezuela, RB		

South-East Asia		
Responder	*Non-responder*	*No Contact Identified*
Bangladesh Bhutan India Indonesia Myanmar Nepal Sri Lanka Thailand	Maldives	Timor-Leste

Western Pacific		
Responder	*Non-responder*	*No Contact Identified*
Australia	Korea, Rep.	Brunei Darussalam
Cambodia	Macao SAR, China	Fiji
China	Malaysia	Kiribati
Hong Kong SAR, China	Papua New Guinea	Korea, Dem. People's Rep.
Japan		Marshall Islands
Lao PDR		Micronesia, Fed. Sts.
Mongolia		Nauru
New Zealand		Palau
Philippines		Samoa
Singapore		Solomon Islands
Taiwan, China		Tonga
Vietnam		Tuvalu
		Vanuatu

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Where are the Paediatricians? An International Survey to Understand the Global Paediatric Workforce

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Abbreviations:

Sustainable Development Goals – SDGs
Gross Domestic Product – GDP
Interquartile Range – IQR
International Pediatric Association - IPA

Contributors' Statement Page

Dr. Harper and Dr. Russ conceptualized and designed the study, designed the data collection instruments, coordinated and supervised data collection, drafted the initial manuscript, and reviewed and revised the manuscript.

Dr. Nganga, Dr. Armstrong, Dr. Forsyth coordinated data collection, reviewed and revised the manuscript.

Dr. Ham assisted with design of the data collection instrument including piloting, and reviewed and revised the manuscript.

Dr. Keenan advised the international approach, aided with data collection, reviewed and revised the manuscript.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Abstract

Objective: Our primary objective was to examine the global paediatric workforce and to better understand geographic differences in the number of paediatricians globally. Secondary objectives were to describe paediatric workforce expectations, who provides children with preventative care, and when children transition out of paediatric care.

Design: Survey of identified paediatric leaders in each country.

Setting: Paediatric association leaders worldwide

Main outcome measures: Paediatrician numbers, provision of primary care for children, age of transition to adult care.

Results: Responses were obtained from 121 countries (73% of countries approached). The number of paediatricians per 100,000 children ranged from a median of 0.5 (IQR 0.3-1.4) in low income countries to 72 (IQR 4-118) in high income countries. Africa and South-East Asia reported the lowest pediatrician density (median of 0.8 paediatricians per 100,000 children, IQR 0.4-2.6 and median of 4, IQR 3-9, respectively), and fewest paediatricians entering the workforce. 82% of countries reported transition to adult care by age 18 and 39% by age 15. Most countries (91%) but only 64% of low income countries reported provision of paediatric preventative care ($p<0.001$, Cochran-Armitage trend test). Systems of primary care provision varied widely. A majority of countries (63%) anticipated increases in their paediatric workforce in the next decade.

Conclusions: Paediatrician density mirrors known inequities in health provider distribution. Fewer paediatricians are entering the workforce in areas with already low paediatrician density, which may exacerbate disparities in child health outcomes. In some regions, children transition to adult care during adolescence, with implications for health care training and delivery. Paediatrician roles are heterogeneous worldwide, and country-specific strategies should be utilized to address inequity in child health provision.

What is Known about This Subject:

Significant discrepancy between burden of disease and distribution of health professionals has been documented.

Various structures are in place for paediatric care across the globe.

The global distribution of pediatricians, their role in providing care to children and the structure for child health systems in various countries are not known.

What This Study Adds:

There are inequities in both paediatrician distribution and numbers of new paediatricians entering the workforce in areas with high child mortality.

Most countries provide some regular primary care for children, but the systems to provide that care are highly variable.

In many areas, children transition from paediatric care in early adolescence, with implications for training and care delivery.

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Introduction

The discrepancy between the global burden of disease and the distribution of health professionals has been well-described.(1-9) Areas with the highest disease burden have the lowest percentage of health professionals, exacerbating the impact of the health workforce deficit. The World Health Organization has identified an index of 4.45 health workers (physicians, nurses, and midwives) per 1000 population necessary to meet the Sustainable Development Goals (SDGs) by 2030.(6) Countries are called on to set specific targets for numbers of health workers including physicians and health specialists depending upon their needs and health services structure.

Child health was a focal point in the Millennium Development Goals and continues to be important in the SDGs. Epidemiologic shifts towards non-communicable diseases, a renewed focus on optimizing child development, the unique health needs of adolescents, and emphasis on reducing morbidity not just mortality, all require renewed deliberation about how health care for children is delivered and advanced.(10-12) Differing health system designs lead to wide variability in the roles that paediatricians and other child health providers fill in supporting the health of a country's children. Understanding those roles is vital to providing equitable and quality health care and to developing appropriate training competencies for all child health professionals.

Some regional efforts have been undertaken to understand where paediatricians are working and what roles they play, but the paediatric workforce worldwide has not been previously described.(6, 13-15) Similarly, while health systems have been described on country and sometimes regional levels, a global understanding of health care systems for children and their variation can provide valuable information for potential reforms at country level.

The goal of this study was to examine the global status of the paediatric workforce and to better understand geographic differences in the types of work that paediatricians undertake in the provision of child health care. Our objectives were to identify the number of paediatricians globally, examine paediatric workforce expectations, understand who provides children with regular promotive and preventative care, and to learn when children transition out of paediatric care to adult care.

Methods

Survey development

An online survey was developed using REDCap, an electronic survey tool.(16) The survey queried the number of paediatricians per country, expected workforce changes, primary care provision for children, and age of transition to adult care. (Supplement 1) Faculty at Boston Children's Hospital initially piloted the survey with cognitive interviewing to improve question clarity. The refined survey was further piloted and edited with paediatric leaders within the Global Paediatric Education Consortium representing Europe, Asia, Africa, and the Middle East.(17) As the internationally agreed upon languages for communication between paediatric societies in the International Paediatric Association (IPA) are English, French and Spanish, the final survey was translated into French and Spanish by DR Interpreting, Inc. Translated surveys were sent to native French and Spanish speakers to confirm accuracy of the translation.

Patient and public involvement

Patients and the public were not directly involved in the design of this study.

Study Sample

The survey was distributed to identified paediatric leaders with a goal of attaining one response per country or economy. Countries and economies for inclusion were defined as the 193 UN member countries plus the 5 World Bank Economies (Hong Kong, Macau, Palestine, Puerto Rico and Taiwan) with populations of over 500,000 people, for a total of 198 countries and economies. The survey was initially distributed in May 2015 via email to the lead delegates from the 121 countries with active membership in the IPA at that time. Regional and subspecialty societies that did not function at the country level were excluded. The survey was sent to non-respondents each week for three consecutive weeks. In a second phase, contact was made with paediatric leaders within the non-responding countries, as well as an additional 45 countries in which paediatric leadership was identified through contacts known to the author group, networks from the Global Paediatric Education Consortium, International Paediatric Academic Leaders Association, Harvard University, the American Academy of Paediatrics Section of International Child Health, or through contacts with country Ministries of Health. Paediatric leaders from non-responding countries who were in attendance at the International Paediatric Congress in August 2016 were also identified and approached.

A majority of countries (73) had a single response. Of those countries with duplicate responses to the survey, 30 had only one complete response and 17 required further review by the authors (BH and CR). Of those, seven countries had identical duplicate responses, or the response that was most complete was selected. Ten countries were contacted to clarify duplicate responses, and 9 clarified. One country had two responses with some variation, and the respondents could not be reached for clarification; for that country the response from the president of the country's paediatric association was used.

Country statistics for populations under age 18 were obtained from publically available UNICEF country statistics.(18) Income and GDP classifications were based on 2016 World Bank groupings.

Statistical Analysis

Paediatric workforce characteristics were described using frequencies, medians and interquartile ranges where appropriate. Comparisons between regions were calculated using Kruskal-Wallis tests and Fisher's exact tests, while comparisons between GDP categories were calculated using Cuzick's non-parametric tests for trend and Cochran-Armitage trend tests. Data was analyzed using Stata (StataCorp. 2015. *Stata Statistical Software: Release 14*. College Station, TX: StataCorp LP).

The study protocol was reviewed by the Institutional Review Board at Boston Children's Hospital and deemed not human subjects research.

Results

Responses were received from 95 (79%) of the 121 countries with IPA membership, and 121 (73%) of the 166 total countries and economies for which a contact was identified. (Supplement 2). In total, this represented 61% of the global 198 countries and economies. Eight countries responded in French, ten in Spanish, and the remainder in English.

There were 32 countries for whom no contact was identified and therefore no survey sent, and 45 countries that did not respond to the survey (Table 1). No contact identified and non-responder countries did not vary significantly from responder countries by GDP (p=0.18, Fisher's exact test), but did vary by region (p=0.002, Fisher's exact test), with more no contact

identified countries located in the Western Pacific, and more non-responders in Africa. Countries with no contact identified had significantly smaller populations than those targeted, with a median population of 274,000 as compared with a median population of 10 million in responder countries ($p<0.001$, Kruskal-Wallis test).

The number of paediatricians reported was normalized against the population of children under 18 years old in each country to obtain a paediatrician density ratio (Figure 1). Paediatrician density varied significantly by GDP, ranging from a median of 0.5 paediatricians per 100,000 children in low income countries to a median of 72 paediatricians per 100,000 children in high income countries ($p<0.001$, Nonparametric trend test, Table 2). In addition, significant variability was seen by region ($p<0.001$, Kruskal-Wallis test, Table 3). The lowest density was seen in Africa (median of 0.8 paediatricians per 100,000 children, interquartile range (IQR) 0.4-2.6) and South-East Asia (median of 4 paediatricians per 100,000 children, IQR 3-9) as compared with a global median of 32 paediatricians per 100,000 children (IQR 5-74 and 59 and 87 per 100,000 children (IQR 38 109, and 49-135) in North America and Europe, respectively.

The number of new paediatricians entering the workforce also varied by GDP classification ($p=0.01$, Nonparametric trend test) and by region ($p<0.001$, Kruskal-Wallis test). In low income countries, the paediatric workforce gained a median of 10 new paediatricians per year, or 0.08 per 100,000 children, while in high income countries the median was 60 new paediatricians per year, or 3 per 100,000 children (Table 2). In Africa, countries anticipated a median of 5 new paediatricians (0.08 per 100,000 children) per year as compared to a global median of 30 (1.44 paediatricians per 100,000 children) (Table 3).

Age of transition out of paediatric care did not vary by gross domestic product (GDP, Table 2) but did vary by region ($p<0.001$, Fisher's exact test, Table 3). Notably, in South-East Asia, Africa, and the Eastern Mediterranean, over 65% of countries reported that children transitioned from paediatric care by age 15 years, whereas less than 45% of countries reported transition by age 15 in South and Central America and less than 15% in Europe, North America, and the Western Pacific.

Most countries (91%) responded affirmatively when asked "*do children in your country receive regular preventative and promotive care throughout childhood (well-child checks, growth monitoring, nutrition assessment, parenting advice, anticipatory guidance, immunization) by either a physician or non-physician health care provider?"* This rate was considerably lower in low-income countries, where only 64% of countries reported regular primary care ($p<0.001$, Cochran-Armitage trend test, Table 2). The type of provider seen for primary paediatric care varied (Figure 2). Worldwide, children see non-physicians as the primary care provider a median of 28% of the time (Table 2, Table 3, IQR 9-59%). If children saw a physician, that person was a paediatrician (rather than general physician, family physician or medical officer) a median of 33% of the time.

Discussion

This international survey of paediatricians is the first, to our knowledge, to report data on paediatrician density and the roles that paediatricians play in provision of care for children on a global scale. This study identified wide variability in paediatrician density, consistent with health workforce findings of physicians as a whole.(5, 8, 19) Areas with the highest burden of paediatric mortality and morbidity had the lowest paediatrician density, and paediatricians are

joining the workforce at lower rates in those same regions, which may exacerbate inequities in child health. One reason for this inequity may be the existence of a training capacity gap, with fewer avenues to train paediatricians or fewer opportunities for employment in areas with an already low workforce. Some high-income countries have already undertaken more detailed analysis of their paediatric workforce, and used this to inform investment and education policy.(14, 20-24)

Another explanation could be the impact of internal or external migration on access to paediatric care. Both have multiple drivers, including job satisfaction, healthy work environment, adequate supplies, feeling of support, and appropriate recognition.(2, 25, 26) Within countries, there is often a significant misdistribution of health care professionals towards large, wealthy urban areas.(1, 2, 25, 27) More detailed data on intra-national distribution of paediatricians would be valuable in understanding and seeking to address these disparities of access. Migration between countries has also been well documented.(1, 2, 8, 26) While there are no clear data on the impact of this 'brain drain' in paediatrics, in both the United States and UK, it is estimated that one-third of the paediatrician workforce are international medical graduates.(28, 29) Specific efforts to reverse these trends include a focus on providing access to medical training to students from low resource settings, as exemplified by the Latin American School of Medicine (ELAM) in Cuba, and efforts to develop pediatric residency programs in low and middle income countries.(30, 31) Additional efforts to improve salaries, work environments and career opportunities may also be effective means of decreasing external migration and encouraging a trend towards a more equitable distribution of paediatricians globally.(32-34)

This study identified that many children transition from paediatric care to adult care by age 15, relatively early in adolescence. Age of transition varied by region but not by country

income, suggesting that it may be more associated with cultural or professional norms around transition to adulthood rather than workforce planning. Improved understanding of the systems of care for adolescents is critical among UN, WHO and Lancet Commission calls for increased focus, expertise and research on adolescent-specific care.(10-12) With early transition to adult care, advancing the adolescent health agenda may require a defined framework for adolescent services and multisectoral approach that engages youth within their communities.

Our study demonstrated that while most countries offered some form of broadly defined preventive care to children, this primary care role is often filled by non-physicians or generalists. In both high and low income countries, task shifting and task sharing have been important and often successful methods for improving access to care and addressing health costs while retaining quality of care.(35-39) Most countries continue to explore the appropriate skills mix for providing care, particularly in community settings. Optimizing this skills mix will require inter-professional collaboration and training to promote successful multidisciplinary primary care. System planning needs to account for and support the primary role of family and the informal care structures that may exist in communities. A thoughtful country-level approach is required to balance development of preventive and community interventions, alongside secondary and tertiary level services with appropriate referral structures.

Workforce studies, including this one, may not capture all of the specific roles that health professionals play, including leadership in health care systems, policy, and government; educators and researchers in universities; and community advocates. A robust national workforce strategy needs to account for these roles, and country-level human resources for health planning should establish a target density for the paediatrician workforce in relation to their expected roles

within the system. For example, the role of a paediatrician in even high density, high-income countries such as the US, UK and Australia is by design quite different, with paediatricians providing primary care in the former, and secondary and tertiary care in the latter. Clear understanding and designation of tasks such as provision of primary care and age of transition to adult care would need to be considered in order to appropriately define paediatric workforce requirements. Analysis of skills mix needs should also incorporate anticipated epidemiologic changes including a reduction in infectious causes of under-5 mortality, an increase in the proportion of neonatal mortality, and a shift towards chronic diseases in children.(12, 40) As countries work to scale-up their health care workforce these baseline data can help inform development strategies.(41, 42)

This study has several limitations. We found no validated tool that would appropriately meet our study objective, therefore developed the survey de novo. Despite piloting the survey among multiple countries, cultures, and languages, it is possible that some terms, while commonly used, may have been interpreted differently in different settings, particularly among respondents for whom French, English or Spanish was not their native language. All data were collected as survey responses, usually from a single representative in each country. While we targeted experts at the national paediatric association level who would have knowledge of the state of paediatrics and child health in that nation, responses could vary among individuals particularly for more subjective questions. While we achieved a high level of response globally, there were regional gaps, with particular low responses from West Africa and the Western Pacific. Countries with low physician density and population were similarly underrepresented in this sample. These challenges may have been due to language or internet access difficulties, absence of or less active national paediatric organization or simply limited paediatric presence in

those countries. This study was focused on paediatricians, a small component in any country of the human workforce related to child health and health systems. However, paediatricians are important resources for countries, with substantial understanding of child health needs who can also help support country development of child health services and provide guidance for the continuum of care for children and families.

Conclusion

As the global community seeks universal health coverage and works to address the known shortage in healthcare workers, care should be taken to meet the health workforce needs of the world's children and adolescents. Clarification of paediatrician roles and accompanying skill mix is important in developing health workforce capacity to meet those needs. This study described the state of the paediatric workforce worldwide with notable variability in paediatrician density and roles in different countries. A training capacity gap in countries with high disease burdens may exacerbate the problem of a small workforce relative to healthcare needs. These findings highlight the need for country specific child health workforce strategies, assisted by the development of standardized tools to monitor health care capacity and outcomes as countries focus on meeting the SDGs for child health.

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Table 1: Characteristics of responder, non-responder, and no contact identified groups

	Responder	Non-responder	No contact identified	*P* value
Countries, no. (%)	121 (61)	45 (23)	32 (16)	
GDP classification[1]				0.18*
Low income, no. (%)	14 (12)	12 (27)	5 (16)	
Lower middle income, no. (%)	30 (25)	12 (27)	8 (25)	
Upper middle income, no. (%)	34 (28)	12 (27)	12 (38)	
High income, no. (%)	43 (36)	9 (20)	7 (22)	
Region[2]				0.002*
Africa, no. (%)	23 (19)	17 (38)	7 (21)	
South-East Asia, no. (%)	8 (7)	1 (2)	1 (3)	
South and Central America, no. (%)	19 (16)	8 (18)	5 (16)	
Western Pacific, no. (%)	12 (10)	4 (9)	13 (41)	
Eastern Mediterranean, no. (%)	15 (12)	6 (13)	0	
North America, no. (%)	3 (2)	1 (2)	0	
Europe, no. (%)	41 (34)	8 (18)	6 (19)	
Country population,[3] median in thousands (IQR)	10,824 (4,503-43,417)	7,237 (2,175-17,468)	274 (98-1,208)	<0.001**
Country population <18 years,[4] median in thousands (IQR)	3,744 (1,081-14,144)	3,248 (798-9,500)	113 (27-581)	0.08**
Number of physicians per 100,000 population,[6] median (IQR)	158 (43-290)	62 (8-241)	46 (19-147)	0.002**

World Bank list of economies (2017) [Internet]. World Bank. Available from: http://databank.worldbank.org/data/download/site-content/CLASS.xls

[2] Region classification based on "WHO regional offices." World Health Organization, World Health Organization, 2017, www.who.int/about/regions/en/.

[3] Population, total. (2017, September 18). Retrieved October 09, 2017, from https://data.worldbank.org/indicator/SP.POP.TOTL

[4] The State of the World's Children 2016 Statistical Tables. (2016, June 27). Retrieved October 31, 2017, from https://data.unicef.org/resources/state-worlds-children-2016-statistical-tables/

[6] The 2016 update, Global Health Workforce Statistics, World Health Organization, Geneva (http://www.who.int/hrh/statistics/hwfstats/).

* *P* values were calculated using Fisher's exact tests for categorical variables

** *P* values were calculated using Kruskal-Wallis tests for continuous variables (based on chi-square statistics with 2 degrees of freedom.)

Table 2: Results by GDP Classification

	World (N=121)	Low Income (N=14)	Lower Middle Income (N=30)	Upper Middle Income (N=34)	High Income (N=43)	*P* value
Number of pediatricians per country, median (IQR)	650 (180-3,500)	70 (25-200)	600 (250-5,000)	1,700 (256-6,000)	1,400 (500-3,500)	<0.001**
Number of pediatricians per 100,000 children <18 years[1], median (IQR)	32 (5-74)	0.5 (0.3-1.4)	6 (3-32)	30 (15-60)	72 (44-118)	<0.001**
Number of new pediatricians entering the workforce each year per 100,000 children <18 years in country[1], median (IQR)	1.44 (0.42-3.07)	0.08 (0.03-0.18)	0.45 (0.02-0.93)	1.36 (0.57-2.09)	3.10 (2.05-4.06)	0.01**
Number of countries reporting transition from pediatric care†						
by age 12 years, no. (%)	3 (3)	0	3 (10)	0	0	0.13*
by age 15 years, no. (%)	47 (39)	9 (64)	15 (50)	13 (39)	10 (23)	0.002*
by age 18 years, no. (%)	98 (82)	14 (100)	27 (90)	26 (79)	31 (72)	0.01*
by age 21 years, no. (%)	118 (98)	14 (100)	30 (100)	33 (100)	41 (95)	0.18*
Countries reporting regular pediatric promotive and preventive care received, no. (%)	110 (91)	9 (64)	26 (87)	33 (97)	42 (98)	<0.001*
Percentage of primary care provided by non-physician, median (IQR)	28 (9-58)	82 (70-85)	34 (11-61)	28.5 (2-51)	24 (9-45)	0.01**
Percentage of primary care provided by general physician, family doctor, or medical officer, median (IQR)	21 (11-36)	12 (7-16)	24 (14-42)	18 (10-27)	23 (10-36)	0.76**
Percentage of primary care provided by pediatrician, median (IQR)	33 (13-57)	17 (8-22)	30 (12-49)	44 (23-56)	46 (7-73)	0.04**
Number of physicians per 100,000 population,[2] median (IQR)	158.1 (43.4-290.0)	6.6 (3.0-12.0)	76.6 (20.1-154.6)	158.1 (85.4-246.3)	299 (196.4-379.1)	<0.001**

[1] The State of the World's Children 2016 Statistical Tables. (2016, June 27). Retrieved October 31, 2017, from https://data.unicef.org/resources/state-worlds-children-2016-statistical-tables/

[2] The 2016 update, Global Health Workforce Statistics, World Health Organization, Geneva (http://www.who.int/hrh/statistics/hwfstats/).

**P* values were calculated using Cuzick's nonparametric tests for trend for continuous variables (based on Z statistics with 1 degree of freedom).

***P* values were calculated using Cochran-Armitage trend tests for categorical variables (based on chi-square statistics with 1 degree of freedom).

† Age of transition from pediatric care not reported by one country in the upper middle income group.

Table 3: Results by Region

	World (N=121)	Africa (N=23)	South-East Asia (N=8)	South and Central America (N=19)	Western Pacific (N=12)	Eastern Mediterranean (N=15)	North America (N=3)	Europe (N=41)	*P* value
GDP classification[1]									<0.001*
Low income, no. (%)	14 (12)	11 (48)	1 (13)	1 (5)	0	1 (7)	0	0	
Lower middle income, no. (%)	30 (25)	6 (26)	6 (75)	4 (21)	5 (42)	5 (33)	0	4 (10)	
Upper middle income, no. (%)	34 (28)	5 (22)	1 (13)	12 (63)	1 (8)	4 (27)	1 (33)	10 (24)	
High income, no. (%)	43 (36)	1 (4)	0	2 (11)	6 (50)	5 (33)	2 (67)	27 (66)	
Number of pediatricians per country, median (IQR)	650 (180-3,500)	70 (23-167)	500 (320-3,700)	1,200 (30-5,500)	2,900 (600-5,600)	650 (425-3000)	25,000 (2,667-80,000)	1,545 (500-4,500)	<0.001**
Number of pediatricians per 100,000 children <18 years,[2] median (IQR)	32 (5-74)	0.8 (0.4-2.6)	4 (3-9)	47 (9-64)	32 (17-64)	25 (5-49)	59 (38-109)	87 (49-135)	<0.001**
Number of new pediatricians entering the workforce each year per 100,000 children <18 years in country,[2] median (IQR)	1.44 (0.42-3.07)	0.08 (0.04-0.14)	0.42 (0.35-0.79)	1.47 (1.05-2.67)	1.44 (0.60-3.06)	0.80 (0.37-2.19)	5.61 (1.66-9.57)	3.08 (1.86-4.05)	<0.001**
Transition from pediatric care†									
by age 12 years, no. (%)	3 (3)	1 (4)	0	2 (11)	0	0	0	0	0.25*
by age 15 years, no. (%)	47 (39)	16 (70)	6 (75)	8 (44)	1 (8)	11 (73)	0	5 (12)	<0.001*
by age 18 years, no. (%)	98 (82)	23 (100)	7 (88)	15 (83)	8 (67)	15 (100)	2 (67)	29 (71)	<0.001*
by age 21 years, no. (%)	118 (98)	23 (100)	8 (100)	18 (100)	11 (92)	15 (100)	2 (67)	41 (100)	0.01*
Countries reporting regular pediatric promotive and preventive care received, no. (%)	110 (91)	19 (83)	7 (88)	19 (100)	11 (92)	10 (67)	3 (100)	41 (100)	0.002*
Percentage of primary care provided by non-physician, median (IQR)	28 (9-58)	81 (53-85)	50 (35-68)	32 (17-61)	11 (5-27)	9 (17-26)	30 (12-32)	13 (3-33)	<0.001**
Percentage of primary care provided by general physician, family doctor, or medical officer, median (IQR)	20 (11-36)	17 (12-25)	17 (11-38)	18 (12-28)	36 (15-46)	21 (14-24)	17 (17-17)	22 (9-49)	0.83**
Percentage of primary care provided by pediatrician, median (IQR)	33 (13-59)	3 (2-16)	27 (20-33)	26 (23-55)	50 (46-71)	59 (47-69)	51 (51-51)	48 (26-71)	<0.001**
Number of physicians per 100,000 population,[3] (median, IQR)	158.1 (43.4-290.0)	12.0 (5.5-37.2)	39.2 (23.6-64.7)	117.9 (81.7-116.5)	175 (114.5-257.5)	154.6 (85.4-196.4)	247.7 (207.1-255.4)	331.1 (277.7-403.5)	<0.001**

[1] World Bank list of economies (2017) [Internet]. World Bank. Available from: http://databank.worldbank.org/data/download/site-content/CLASS.xls

[2] The State of the World's Children 2016 Statistical Tables. (2016, June 27). Retrieved October 31, 2017, from https://data.unicef.org/resources/state-worlds-children-2016-statistical-tables/

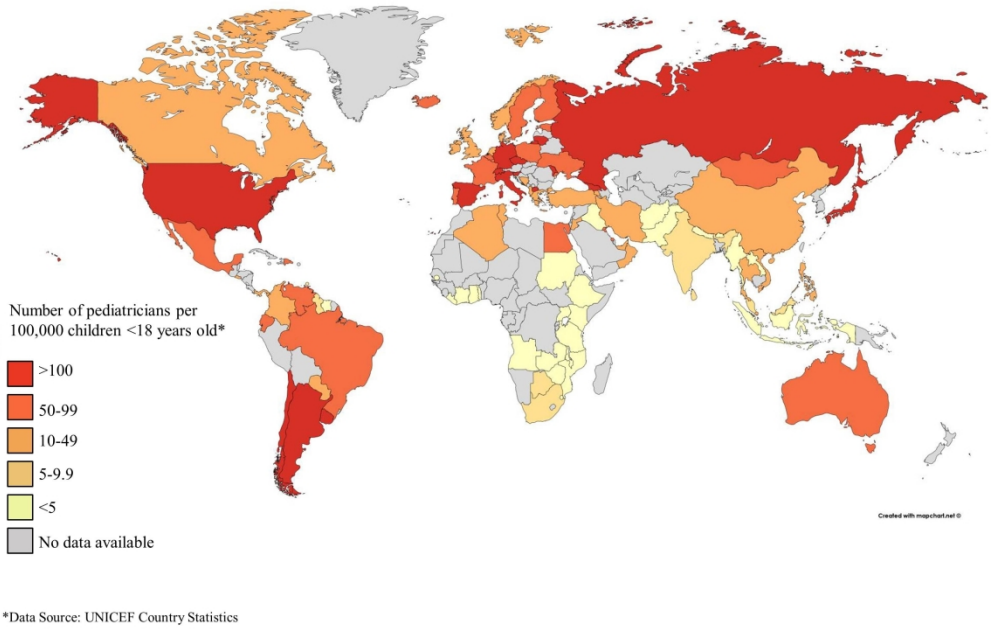
[3] The 2016 update, Global Health Workforce Statistics, World Health Organization, Geneva (http://www.who.int/hrh/statistics/hwfstats/).

* *P* values were calculated using Fisher's exact tests for categorical variables

**P* values were calculated using Kruskal-Wallis tests for continuous variables (based on chi-square statistics with 6 degrees of freedom).

† Age of transition from pediatric care not reported by one country in the South and Central America region.

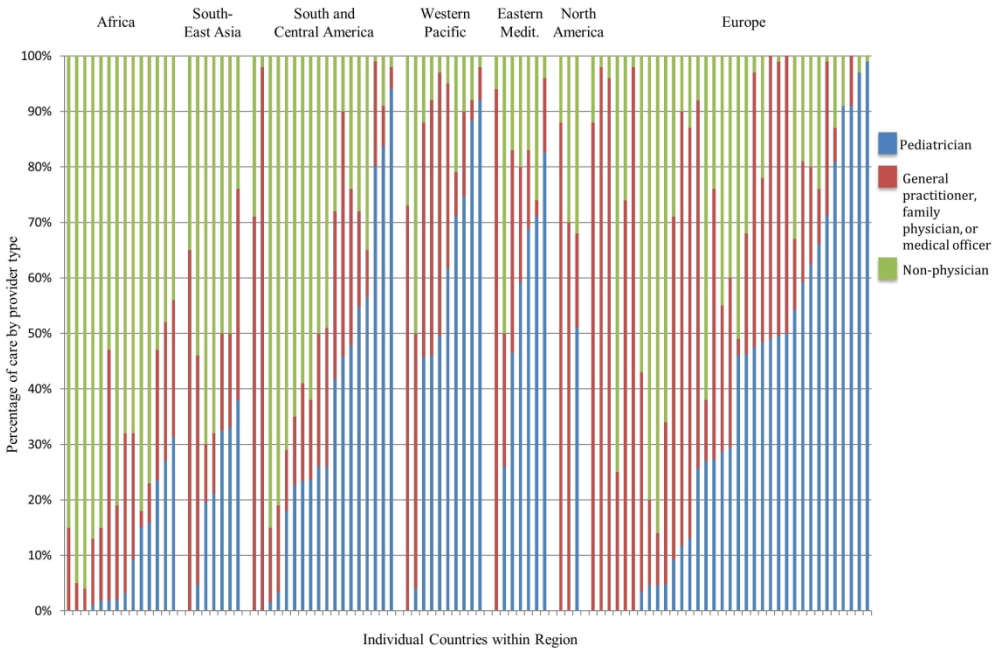
Figure 1: Pediatrician density per 100,000 children <18 years old*



*Data Source: UNICEF Country Statistics

254x190mm (300 x 300 DPI)

Figure 2: Type of provider seen for Primary Care



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International Pediatrics Survey

Please complete the survey below.

Thank you!

This survey is designed to learn more about how many pediatricians are practicing, who provides medical care for children, and how pediatricians are trained in your country.

Some of the questions ask for specific numbers and may be difficult for you to answer. Please answer to the best of your knowledge. If there is someone who would be better able to answer a question in your country, please tell us their contact information by emailing beth.harper@childrens.harvard.edu or in the comment box at the end of the survey. Thankyou!

What language do you prefer for this survey? ◯ English

Country Name _____

Your email address _____

General Practice Information

In [country], is there specific clinical care for children, separate from care for adults?

◯ Yes
◯ No

At approximately what age do children in [country] transition out of specific pediatric care to adult care?

◯ < 10 years
◯ 10-12 years
◯ 13-15 years
◯ 16-18 years
◯ 19-21 years
◯ >21 years
(Years)

Do children in [country] receive regular preventative and promotive care throughout childhood (well-child checks, growth monitoring, nutrition assessment, parenting advice, anticipatory guidance, immunization) by either a physician or non-physician health care provider?

◯ Yes
◯ No

If a child is receiving regular preventative and promotive care in [country], what type of provider will he or she see?

Non-physician provider 100% of the time | Non-physician provider and Physician equally | Physician 100% of the time

(Place a mark on the scale above)

If a child is seeing a PHYSICIAN for regular preventative or promotive care in [country], what type of physician will he or she most often see?

General physician, Family physician, or Medical officer 100% of the time | General physician, Family physician, Medical officer OR Pediatrician equally | Pediatrician 100% of the time

(Place a mark on the scale above)

In [country], if you visited the following types of institutions, how likely is it that a Pediatrician would be working there?

General or primary care clinic	○	○	○	○
Public or Government-run hospital	○	○	○	○
Faith-based hospital	○	○	○	○
Private hospital	○	○	○	○
Academic/referral center	○	○	○	○

Pediatrics Workforce

Approximately how many pediatricians (including pediatricians and pediatric sub-specialists) are currently working in [country]?

_____

(If unable to estimate, please leave blank. Please estimate number of persons, even if part-time.)

Please check all of the types of pediatric subspecialty care that are currently available in [country].

- ☐ Adolescent Medicine
- ☐ Pediatric Allergist
- ☐ Pediatric Anesthesiologist
- ☐ Pediatric Cardiologist
- ☐ Child Development/Developmental Medicine
- ☐ Pediatric Dermatologist
- ☐ Pediatric Ear, Nose, and Throat surgeon
- ☐ Pediatric Endocrinologist
- ☐ Pediatric Gastroenterologist
- ☐ Geneticist
- ☐ Pediatric Hematologist Pediatric
- ☐ Immunologist Pediatric
- ☐ Infectious Disease Pediatric
- ☐ Intensivist (PICU) Metabolic
- ☐ Disease Specialist Pediatric
- ☐ Nephrologist / Renal
- ☐ Neonatologist (NICU) Pediatric
- ☐ Neurologist Pediatric Oncologist
- ☐ Pediatric Ophthalmologist
- ☐ Pediatric Orthopedist
- ☐ Pediatric Pulmonologist
- ☐ Pediatric Psychiatrist
- ☐ Pediatric Rheumatologist
- ☐ Pediatric Surgeon Pediatric
- ☐ Urologist
- ☐ (Please select all that apply)

What percentage of pediatricians working in [country] work in the following areas?

	None	< 5%	5-25%	25-50%	50-75%	75-95%	>95%	100%
Public Sector only	◯	◯	◯	◯	◯	◯	◯	◯
Private Sector only	◯	◯	◯	◯	◯	◯	◯	◯
Both in the Public and Private Sector	◯	◯	◯	◯	◯	◯	◯	◯

Approximately how many NEW pediatricians are entering the workforce in [country] each year? _____
(If unable to estimate, please leave blank)

Based upon the number of NEW and RETIRING pediatricians each year in [country], what are workforce expectations over the next 10 years?

◯ Increase
◯ Decrease
◯ Stable

Education and Training in Pediatrics

Are there post-graduate training programs in Pediatrics in [country]?
◯ Yes
◯ No

How many post-graduate training programs in pediatrics are there in [country]?
_____

Is there a published directory or list of these programs?
◯ Yes
◯ No

Is this directory or list available on the internet?
◯ Yes No
◯

Please list the website or provide a link:
_____

Is there someone we may contact to obtain the directory or list?
◯ Yes
◯ No

Please include the name and contact information below:
_____

Please list as many of the programs as possible, along with contact information if available.
_____

Is there a national or regional accreditation organization that accredits programs in [country]?
◯ Yes
◯ No

What is the name of the accrediting organization or organizations?
_____

Are any of the programs in [country] accredited?
◯ Yes - all Yes -
◯ some No
◯

The following questions aim to understand how many years of training it takes to become a pediatrician in [country].

Is a university degree required prior to beginning medical school?
◯ Yes
◯ No

How many years of medical school, at a minimum, are required? _____

How many years of general medicine training or internship that is not specific to pediatrics? _____

How many years of post-graduate training specific to pediatrics? _____

Is additional supervised time in practice required to register as a specialist?
◯ Yes
◯ No

How many years of additional supervised practice is required to register as a specialist? _____

In [country], are there national standardized guidelines/requirements for postgraduate pediatric training?
◯ Yes
◯ No

Is there a standardized curriculum (i.e., national curriculum) in place for pediatric post-graduate training programs?
◯ Yes
◯ No

What body is in charge of the standardized (i.e. national) curriculum? _____

Is there a published resource of post-graduate training program requirements?
◯ Yes
◯ No

Please include a link to the website for this resource or contact information _____

Are there pediatric sub-specialty training opportunities in your country?
◯ Yes
◯ No
(We define sub-specialty training as training within a particular field of pediatrics, for example pediatric endocrinology or pediatric cardiology)

Please check all of the pediatric sub-specialties for which there are training programs in [country].

- ☐ Adolescent Medicine
- ☐ Pediatric Allergist Pediatric
- ☐ Anesthesiologist Pediatric
- ☐ Cardiologist
- ☐ Child Development/Developmental Medicine
- ☐ Pediatric Dermatologist
- ☐ Pediatric Ear, Nose, and Throat surgeon
- ☐ Pediatric Endocrinologist
- ☐ Pediatric Gastroenterologist
- ☐ Geneticist
- ☐ Pediatric Hematologist Pediatric
- ☐ Immunologist Pediatric
- ☐ Infectious Disease Pediatric
- ☐ Intensivist (PICU) Metabolic
- ☐ Disease Specialist Pediatric
- ☐ Nephrologist / Renal
- ☐ Neonatologist (NICU) Pediatric
- ☐ Neurologist Pediatric Oncologist
- ☐ Pediatric Ophthalmologist
- ☐ Pediatric Orthopedist
- ☐ Pediatric Pulmonologist
- ☐ Pediatric Psychiatrist
- ☐ Pediatric Rheumatologist
- ☐ Pediatric Surgeon Pediatric
- ☐ Urologist
- ☐ (Select all that apply)

We greatly appreciate any additional information, clarifications, or comments you may have! Please tell us about them here.

THANK YOU for your participation! You will receive a copy of the report when available. If you have additional questions or concerns, please enter them below or email us at beth.harper@childrens.harvard.edu

Supplemental File - List of Country Respondents by Region[1]

Africa		
Responder	*Non-responder*	*No Contact Identified*
Algeria	Benin	Cabo Verde
Angola	Burkina Faso	Central African Republic
Botswana	Burundi	Comoros
Congo, Dem. Rep.	Cameroon	Equatorial Guinea
Côte d'Ivoire	Chad	Guinea
Ethiopia	Congo, Rep.	São Tomé and Principe
Gambia, The	Eritrea	South Sudan
Ghana	Gabon	
Kenya	Guinea-Bissau	
Liberia	Lesotho	
Malawi	Madagascar	
Mozambique	Mali	
Namibia	Mauritania	
Nigeria	Mauritius	
Rwanda	Niger	
Seychelles	Senegal	
South Africa	Sierra Leone	
Swaziland		
Tanzania		
Togo		
Uganda		
Zambia		
Zimbabwe		

[1] Regions defined using World Health Organization regional groupings with North America separated from Central and South America. Further information about WHO regional groupings can be found at: https://www.who.int/healthinfo/global_burden_disease/definition_regions/en/ (Accessed December 2018).

Eastern Mediterranean		
Responder	*Non-responder*	*No Contact Identified*
Afghanistan	Djibouti	
Bahrain	Lebanon	
Egypt, Arab Rep.	Morocco	
Iran, Islamic Rep.	Saudi Arabia	
Iraq	Somalia	
Jordan	Yemen, Rep.	
Kuwait		
Libya		
Oman		
Pakistan		
Qatar		
Sudan		
Syrian Arab Republic		
Tunisia		
United Arab Emirates		

Europe		
Responder	*Non-responder*	*No Contact Identified*
Albania	Croatia	Andorra
Armenia	Cyprus	Azerbaijan
Austria	Kazakhstan	Kosovo
Belarus	Kyrgyz Republic	Montenegro
Belgium	Malta	San Marino
Bosnia and Herzegovina	Netherlands	Turkmenistan
Bulgaria	Tajikistan	
Czech Republic	Uzbekistan	
Denmark		
Estonia		
Finland		
France		
Georgia		
Germany		
Greece		
Hungary		
Iceland		
Ireland		
Israel		
Italy		
Latvia		
Liechtenstein		
Lithuania		
Luxembourg		
Macedonia, FYR		
Moldova		
Norway		
Palestine		
Poland		
Portugal		
Romania		
Russian Federation		
Serbia		
Slovak Republic		
Slovenia		
Spain		
Sweden		
Switzerland		
Turkey		
Ukraine		
United Kingdom		

North America		
Responder	*Non-responder*	*No Contact Identified*
Canada Mexico United States	Puerto Rico	

South and Central America		
Responder	*Non-responder*	*No Contact Identified*
Argentina	Bahamas, The	Antigua and Barbuda
Bolivia	Belize	Barbados
Brazil	Costa Rica	St. Kitts and Nevis
Chile	Cuba	St. Lucia
Colombia	Dominica	St. Vincent and the Grenadines
Dominican Republic	Honduras	
Ecuador	Jamaica	
El Salvador	Uruguay	
Grenada		
Guatemala		
Guyana		
Haiti		
Nicaragua		
Panama		
Paraguay		
Peru		
Suriname		
Trinidad and Tobago		
Venezuela, RB		

South-East Asia		
Responder	*Non-responder*	*No Contact Identified*
Bangladesh Bhutan India Indonesia Myanmar Nepal Sri Lanka Thailand	Maldives	Timor-Leste

Western Pacific		
Responder	*Non-responder*	*No Contact Identified*
Australia	Korea, Rep.	Brunei Darussalam
Cambodia	Macao SAR, China	Fiji
China	Malaysia	Kiribati
Hong Kong SAR, China	Papua New Guinea	Korea, Dem. People's Rep.
Japan		Marshall Islands
Lao PDR		Micronesia, Fed. Sts.
Mongolia		Nauru
New Zealand		Palau
Philippines		Samoa
Singapore		Solomon Islands
Taiwan, China		Tonga
Vietnam		Tuvalu
		Vanuatu