The Global Pediatric Nephrology Workforce: A Survey of the International Pediatric Nephrology Association

By

Dorey Glenn MD

A Master's Paper submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Master of Public Health in the Public Health Leadership Program

Chapel Hill

2016
# Table of Contents

Abstract ......................................................................................................................... 3
Introduction .................................................................................................................... 4

**Literature Review**

- Search Strategy ........................................................................................................... 5
- US Pediatric Nephrology Workforce ............................................................................. 5
- Global Pediatric Nephrology Workforce ....................................................................... 6

**Subjects and Methods**

- Survey Development .................................................................................................. 9
- Survey Administration .................................................................................................. 9
- Statistical Analysis ..................................................................................................... 10

**Results**

- Survey Respondents .................................................................................................. 10
- North America ............................................................................................................ 16
- Africa .......................................................................................................................... 16
- Australia / New Zealand .............................................................................................. 16
- Europe ......................................................................................................................... 17
- Latin America ............................................................................................................. 17
- Asia ............................................................................................................................. 18
- Middle East .................................................................................................................. 18

**Training Duration and Research Requirements** .......................................................... 19

**Discussion** ................................................................................................................ 21

**Suggested Interventions to Improve the Pediatric Nephrology Workforce**

- Length of training ........................................................................................................ 23
- Research requirements ................................................................................................. 24
- Increasing Job Opportunities ....................................................................................... 25
- Policy Development, Advocacy Activities, and Collaboration ....................................... 26
- Other Activities ............................................................................................................ 26

**Strengths and Limitations** .......................................................................................... 27

**Future Research** ....................................................................................................... 27

**Conclusions** .............................................................................................................. 28

**References** ................................................................................................................ 30

**Appendix A** ................................................................................................................. 33

**Appendix B** ................................................................................................................ 35
Abstract

**Background:** The global pediatric nephrology workforce is poorly characterized. The objectives of this paper are to review what is known regarding this workforce, assess pediatric nephrologists' perceptions of the adequacy of the pediatric nephrology workforce, and understand regional challenges to fellow recruitment and job acquisition. Perceptions regarding optimal length of training and research requirements will also be explored.

**Methods:** A 17-question web-based survey was designed and distributed to members of the International Pediatric Nephrology Association in the Fall of 2015. Quantitative and thematic analyses were performed.

**Results:** We received 341 responses from 2304 valid e-mail invitations. There was a high degree of overall perceived workforce inadequacy with 67% of all respondents reporting some degree of shortage. Perceived workforce shortage ranged from 20% in Australia / New Zealand to 100% in Africa. Respondents from Africa (25%) and North America (22.4%) reported the greatest difficulty recruiting fellows. Respondents from Australia / New Zealand (53.3%) and Latin America (31.3%) reported the greatest perceived difficulty finding jobs as pediatric nephrologists after training. Low trainee interest, low salary, lack of government or institutional support, and few available jobs in pediatric nephrology were the most frequently reported obstacles to fellow recruitment and job availability.

**Conclusions:** Globally, there is a high level of perceived inadequacy in the pediatric nephrology workforce. Regional variability exists in perceived workforce adequacy, ease of recruitment, and job acquisition. Interventions to improve recruitment targeted to specific regional barriers are suggested.
Introduction

Kidney disease is increasingly recognized as an important contributor to the global burden of disease [5–9]. In 2012 chronic kidney disease was ranked 18th in a report on global burden of death [5]. The demand for pediatric nephrologists (PNs) is likely to further expand as the pattern of non-communicable disease in developing countries continues to change and economic development in those regions is able to support a greater range of health care interventions. [10, 11]. The availability of maintenance dialysis, for example, has increased substantially from 1990 to 2010 [6]. The role of pediatric nephrologists, however, extends far beyond the care of patients with acute and chronic kidney disease. PNs support intensive care units, treat complications from non-renal diseases, and fill important educational and administrative roles [1, 12, 13].

Concern regarding the long term PN workforce within the United States is based on a high number of potential retirees in the field and difficulty recruiting trainees [1]. For example, in 2015 only 37 of 58 available fellowship positions were filled [14]. However, to our knowledge, perceived adequacy of the PN workforce has not been systematically described in a context external to the United States.

Some attention has been directed towards the global nephrology workforce shortage by adult nephrologists [9, 15–17]. Efforts to develop training curricula and expand training opportunities to physicians from resource-limited settings have been made on the part of the International Society of Nephrology and the International Pediatric Nephrology Association (IPNA) for example [15,16]. The objectives of our study are to describe the perceived adequacy of the PN workforce and understand regional challenges to fellow recruitment and job acquisition.
Literature Review

Workforce and training data are important for resource allocation and strategic planning. There is a paucity of published literature describing the adequacy of the pediatric nephrology (PN) workforce on a global scale [1–4].

Search Strategy and Results

A web-based search was conducted to identify publications of any type describing the pediatric nephrology workforce. The search terms *pediatric nephrology* AND *workforce*, resulted in 25 articles. Of these, 11 articles were selected based on relevance and applicability. All articles obtained via this search strategy were descriptive or editorial in nature. Nine of eleven articles referred solely to the US pediatric nephrology workforce. No foreign language articles were found using this search strategy. No articles were found to address the pediatric nephrology workforce from a global perspective.

There is a paucity of published literature describing the adequacy of the pediatric nephrology (PN) workforce on a global scale [1–4]. No studies have been published to describe either the perceived PN workforce, or the actual adequacy of the PN workforce on a global scale. The following literature review will summarize the extant literature in the United States, since it is the region with the most available literature. This will be followed by a review of the available literature describing the pediatric and adult nephrology workforces in regions other than North America.

US Pediatric Nephrology Workforce

In 1997 the American Society of Pediatric Nephrology (ASPN), in association with the American Society of Nephrology, the American Association of Transplant Physicians, the National Kidney Foundation, and the Renal Physicians Association, deployed a survey of both adult and pediatric nephrologists in the United States designed to broadly assess the nephrology
workforce [20]. PN workforce projections, based on growth in the pediatric ESRD population and the need for clinical teaching, estimated that 9-12 trainees would be needed per year to meet clinical and teaching requirements.

The gross underestimation of these projections, intended to apply to the PN workforce of 2010, exemplifies the difficulty of predicating workforce needs over time. Even at the time of these projections in 1997, the American Society of Pediatric Nephrology cast doubt on these projections. The ASPN noted that most PNs hold academic positions, and that workforce projections based solely on clinical and teaching requirements do not account for the myriad of other administrative and research responsibilities held by PNs [12]. A survey of 504 US PNs (response rate 66%) collected in 2013, found that in addition to patient care, 88% of surveyed PNs teach, 80% do administrative work, and 63% participate in research [1]. This survey raised concern regarding the adequacy of the PN workforce within the United States based on a high number of potential retirees in the field and difficulty recruiting trainees [1]. Thirty-seven percent of respondents also reported a desire to spend more time in non-clinical activities.

There has also been concern regarding the number of incoming PNs to the field. In 2015 only 37 of 58 available PN fellowship positions went filled [14]. A 2010 survey of PN fellows found that a lack of interest or exposure to PN, financial constraints, and perceived PN workload were factors that fellows felt dissuaded potential trainees from the field [21]. A 2014 survey of 531 non-nephrology pediatric fellows regarding their perceptions of a PN career found that lack of role models and mentors, difficult subject matter, few procedures, unappealing lifestyle, lack of interest, and patient complexity were reasons that PN was not considered [22]. A survey of Pediatric Nephrology training program directors, by the same authors, described that 60% of respondents found it somewhat to very difficult to recruit trainees. Reasons cited included lack of qualified applicants, low income, and demanding workload.

**Global Pediatric Nephrology Workforce**
A 1997 survey of 15 lead PN programs in Latin America found high variability in the number of PNs per population [23]. Uruguay, Cuba, and Argentina were found to have a more favorable ratio of PNs to population unit of children than the United States. Guatemala was found to have the lowest ratio of PNs to unit population. A significant correlation between GDP and number of PNs was found for the 15 countries studied. The author comments that PN takes a low priority for healthcare managers, and that PNs in Latin American lack the “technological, legal, and advisory local infrastructure in the organization of pediatric nephrology services [23].”

Given the paucity of literature examining the pediatric nephrology workforce outside of the United States, a MEDLINE search was initiated using the search terms nephrology, workforce, global, and international. This strategy was used to find articles describing the adult nephrology workforce. Twenty-four articles were reviewed, of which 5 were selected based on relevance and applicability.

Sharif et al analyze the adult nephrology workforce on a global scale [15]. They describe wide variation in this workforce, ranging from 53 nephrologists per million population in Italy to 0.1 nephrologist per million population in Ghana. They identify multiple factors that might affect the adult nephrology workforce, including, declining trainee interest in the field, rising costs of medical education and subspecialty training, inflexible work schedules, increased incidence and prevalence of chronic and end stage kidney disease, erosion of the scope of practice of nephrologists by other specialties, inadequate training, an aging workforce, and the development of new health care delivery models. Sharif et al also note that country level analysis is needed to optimally understand the interplay of these factors within local health systems. They recommend international cooperation at addressing “effective training programmes at the undergraduate and postgraduate level, adoption of novel recruitment strategies, flexible workforce practices, greater ownership of the traditional nephrology landscape and enhanced opportunities for research”. [15]
The adult nephrology workforce in sub-Saharan Africa is inadequate to meet the nephrology needs of the region [24]. Naicker et al raise the issue of migration of physicians away from areas of greatest need [25]. Indeed, the relocation of physicians away from their home countries may be more of an issue for subspecialties like nephrology. Out of necessity, many physicians are required to seek out-of-country subspecialty training in nephrology, for example, in South Africa, the United Kingdom, or the United States. The demand for these physicians to remain in host countries to fill workforce gaps, and in some cases the desire of these physicians to remain in these countries, further exacerbates workforce shortages in developing regions. The International Pediatric Nephrology Association’s fellowship training program has proved successful at connecting physicians in developing countries with pediatric nephrology training [18]. Data describing whether these physicians return to practice PN in their home countries, however, is lacking.

Initiatives that partner healthcare institutions, such as the International Society of Nephrology’s Sister’s Renal Program [19, 26], and ministries of health, such as a renal-focused collaboration between Uruguay and Bolivia, are additional examples of approaches to addressing the inadequacy of the nephrology workforce [27]. Though outcome data has not yet been published, the collaboration between the relatively well developed renal program in Uruguay, and nephrologists in Bolivia, serves as an example of the potential for intra-regional cooperation, knowledge sharing, and data monitoring. Achievements include the creation of a shared dialysis registry, collaboration with regional nephrology associations, and a training of a renal healthcare team [27].

Field has proposed that selected physicians in resource limited areas be offered a more limited form of training in nephrology [16]. These “emerging” nephrologists would manage basic aspects of chronic kidney disease. A similar approach to addressing workforce gaps in pediatric nephrology is already underway in the United Kingdom [28]. There is no outcome data regarding the effectiveness of such programs.
The above examples of collaboration and innovation have occurred mainly within the adult nephrology field. It should be noted that significant differences exist between the adult and pediatric nephrology workforces. First, the adult nephrology workforce has a substantial community presence, with many adult nephrologists practicing full time clinical medicine. As previously discussed, the majority of pediatric nephrologists practice in large academic medical centers. There are also significant differences in the availability, distribution, and financing of renal services for children, and these differences are likely to be more pronounced in developing economies.

Subjects and Methods

Survey Development

In order to examine the pediatric nephrology workforce in more depth, we developed and administered a survey instrument assessing the global PN workforce. We developed an English language, web-based survey assessing 3 domains: trainee recruitment, job availability, and workforce adequacy. Survey questions were developed with the input of research team members. A draft survey instrument was pre-tested by 5 pediatric nephrologists to assess content validity, interpretability, and length. The draft instrument was updated based on pretesting feedback. The final survey instrument was comprised of 14 close-ended and 3 open-ended questions (Appendix 1). Question response types included dichotomous, multiple choice, Likert scale, and free text responses. The survey was developed and deployed via the Qualtrics platform at the University of North Carolina at Chapel Hill (see supplemental material) [29]. This study was deemed exempt by the Human Research Ethics Committee of the University of North Carolina Chapel Hill.

Survey Administration
Survey invitations were sent through e-mail to non-North American IPNA members with a valid e-mail address in the online IPNA directory in the fall of 2015. One reminder e-mail was sent 2 weeks later. Survey invitations were sent to North American IPNA members in December of 2015. Implied consent was obtained prior to survey participation. Survey participants received no individual remuneration; however, a donation to IPNA was made on their behalf.

Statistical Analysis

Quantitative data were analyzed using STATA version 13 (College Station, TX) and Microsoft Excel 2013 (Redmond, WA). Survey respondent data were reported as counts and proportions for categorical variables, and medians and interquartile ranges for continuous variables. T-tests were performed comparing ratios of workforce shortage, difficulty recruiting fellows, and difficulty finding a PN job for each region compared to all other regions. T-tests were performed with the allowance for unequal variances. Qualitative analyses were performed using ATLAS.ti version 7 (Berlin, Germany). Thematic analysis was independently performed by two research team members to code open-ended questions into 11 themes. Discrepancies between coders were rectified by a third party. All survey responses were collected and analyzed anonymously.

Results

Survey Respondents

We received 341 responses from 2304 valid e-mail invitations, yielding an overall response rate of 15%. Responses were received from 71 countries. Regional response rates ranged from 11.2% in Asia to 31.3% in Australia and New Zealand.
Tables 1 and 2 display region, practice type, involvement in trainee education, and percent time allocated to clinical practice and research for the survey respondents. Of the 341 respondents, 167 (48%) were affiliated with an academic or university based practice and 206 (60%) reported involvement in trainee education. The median time percentage allocated to clinical nephrology and research was 66.7% (IQR 50.0-75.0) and 25.0% (IQR 0-25.0), respectively. Figures 1, 2, and 3 represent the perceived adequacy of the PN workforce, difficulty recruiting trainees, and difficulty finding a PN job after training by region. Figures 4 and 5 display results of qualitative analysis of 456 open-ended responses querying challenges to PN trainee recruitment and job acquisition.

Table 1 Survey respondent and non-respondent characteristics. (a)

<table>
<thead>
<tr>
<th>Region</th>
<th>Survey Respondents</th>
<th>Survey Non-Responders</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>107 (31.4)</td>
<td>566 (28.8)</td>
</tr>
<tr>
<td>Latin America</td>
<td>40 (11.7)</td>
<td>225 (11.5)</td>
</tr>
<tr>
<td>Europe</td>
<td>75 (22.0)</td>
<td>450 (22.9)</td>
</tr>
<tr>
<td>Asia</td>
<td>61 (17.9)</td>
<td>480 (24.5)</td>
</tr>
<tr>
<td>Africa</td>
<td>17 (5.0)</td>
<td>66 (3.4)</td>
</tr>
<tr>
<td>Australia / New Zealand</td>
<td>15 (4.4)</td>
<td>33 (1.7)</td>
</tr>
<tr>
<td>Middle East</td>
<td>26 (7.6)</td>
<td>143 (7.3)</td>
</tr>
<tr>
<td>Total</td>
<td>341</td>
<td>1963</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Practice Type</th>
<th>Survey Respondents</th>
<th>Survey Non-Responders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academia or University Based</td>
<td>167 (49.0)</td>
<td></td>
</tr>
<tr>
<td>Government Affiliated</td>
<td>81 (23.8)</td>
<td></td>
</tr>
<tr>
<td>Multiple Practice Types</td>
<td>65 (19.1)</td>
<td></td>
</tr>
<tr>
<td>Private Practice</td>
<td>17 (5.0)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>9 (2.6)</td>
<td></td>
</tr>
<tr>
<td>Military Affiliated</td>
<td>2 (0.6)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Involved in Trainee Education</th>
<th>Survey Respondents</th>
<th>Survey Non-Responders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>206 (60.4)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>135 (39.6)</td>
<td></td>
</tr>
</tbody>
</table>

(a) Values presented as n (%).
Table 2 Percent time allocated to clinical pediatric nephrology, research, and other activities by region. (a)

<table>
<thead>
<tr>
<th>Region</th>
<th>n</th>
<th>Clinical Pediatric Nephrology</th>
<th>Research</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>107</td>
<td>50.0 (50.0-75.0)</td>
<td>25.0 (0-25.0)</td>
<td>20.0 (0-25.0)</td>
</tr>
<tr>
<td>Latin America</td>
<td>39</td>
<td>66.7 (50.0-75.0)</td>
<td>20.0 (0-28.6)</td>
<td>14.3 (0-25.0)</td>
</tr>
<tr>
<td>Europe</td>
<td>75</td>
<td>75.0 (50.0-75.0)</td>
<td>25.0 (0-25.0)</td>
<td>20.0 (0-25.0)</td>
</tr>
<tr>
<td>Asia</td>
<td>59</td>
<td>50.0 (40.0-75.0)</td>
<td>20.0 (0-25.0)</td>
<td>25.0 (0-25.0)</td>
</tr>
<tr>
<td>Africa</td>
<td>17</td>
<td>50.0 (50.0-75.0)</td>
<td>25.0 (25.0-37.5)</td>
<td>0 (0-25.0)</td>
</tr>
<tr>
<td>Australia / New Zealand</td>
<td>15</td>
<td>75.0 (50.0-100.0)</td>
<td>0 (0-25.0)</td>
<td>0 (0-25.0)</td>
</tr>
<tr>
<td>Middle East</td>
<td>26</td>
<td>75.0 (50.0-75.0)</td>
<td>25.0 (16.7-25.0)</td>
<td>0 (0-25.0)</td>
</tr>
<tr>
<td>Total</td>
<td>338</td>
<td>66.7 (50.0-75.0)</td>
<td>25.0 (0-25.0)</td>
<td>14.3 (0-25.0)</td>
</tr>
</tbody>
</table>

Values presented as median and interquartile range (IQR). b Three respondents who did not report their time breakdown (1 from Latin America and 2 from Asia) were excluded from the analysis.

Figure 1 Perceived adequacy of the PN workforce by region and * indicates a significantly different (p<0.05) ratio of respondents reporting workforce shortage compared to the average of other regions.
Figure 2 Perceived difficulty recruiting trainees by region and * indicates a significantly different (p<0.05) ratio of respondents reporting recruitment difficulty compared to the average of other regions.

Figure 3 Perceived difficulty finding a PN job after training by region and * indicates a significantly different (p<0.05) ratio of respondents reporting a perceived difficulty with job acquisition after training compared to the average of other regions.
Figure 4 Results of qualitative analysis of responses to challenges to PN trainee recruitment
Figure 5 Results of qualitative analysis of responses to challenges to job acquisition after PN training
North America

A total of 107 responses (response rate of 15.9%) were received from North American PNs (100 from the United States, 7 from Canada). Mexico was included in the Latin American region. Seventy-nine percent of North American respondents reported a mild to severe shortage in the PN workforce (figure 1). Of those expressing some degree of shortage, 52% reported a moderate to severe shortage. North American respondents reported the greatest difficulty recruiting trainees with 76% reporting this activity to be somewhat to very difficult (figure 2). Lack of interest (47%), low salary (41%), and hard work / poor work-life balance (35%) were the most frequently reported challenges to trainee recruitment (figure 4). Sixty-three percent of North American respondents reported it to be somewhat easy to very easy to find a PN job after training, but 48% noted that geographic distribution of jobs was a challenge to job acquisition (figures 3 and 5).

Africa

Seventeen responses (response rate 20.7%) were received from nine African countries. All respondents reported some degree of workforce shortage and 71% reported a severe shortage. Of the 8 respondents involved in physician training, there was variation in perceived ease regarding trainee recruitment. Lack of institutional or government support and resources was the most frequently sighted reason for difficulty recruiting trainees in respondents from Africa (60%). The majority (64%) also reported it to be somewhat to very easy to find a job after training. Barriers to job acquisition after training included lack of resources (46%) and lack of PN positions (39%).

Australia / New Zealand

Fifteen responses (response rate 31.3%) were received from Australia and New Zealand. In contrast to North America, 53% of respondents reported a mild to severe surplus of PNs, and
27% thought the workforce was adequate. Relative to all other regions, respondents from Australia and New Zealand reported the greatest ease recruiting fellows, 54% reporting recruitment to be somewhat to very easy. A lack of training positions (40%) and low job availability (30%) were cited as challenges to fellow recruitment. Consistent with the reported relative surplus of PNs, 93% of respondents reported it to be somewhat to very difficult to find a job after training with 90% citing a lack of available PN positions as the major obstacle to job acquisition.

Europe

Seventy-five responses (response rate 14.4%) were received from 26 European countries. Responses from Russia were included as part of the European region. Fifty-eight percent of respondents from Europe felt the PN workforce was adequate or in surplus, which is substantially higher than other regions (with the exception of Australia / NZ). Forty-two percent reported a mild to severe shortage. Of the 67% of European respondents involved in physician training, 41% reported difficulty, 43% reported ease, and 15% were neutral regarding their ability to recruit trainees. More respondents reported difficulty (46%) than ease (25%) with job acquisition following training, and 30% were neutral on this issue. A perceived lack of jobs (71%), lack of resources (20%), and the geographic location of jobs (20%) were the most frequently reported challenges to job acquisition.

Of the 19 respondents from Eastern Europe, 63% reported a perceived workforce shortage. This was significantly different (p=0.038) from respondents in Western Europe (34.6%, n=52). There were no significant differences in the percent of respondents from these two sub-regions reporting difficulty recruiting trainees (p=0.978) or difficulty finding a PN job after training (p=0.127).

Latin America
Forty responses (response rate 15.1%) were received from 13 countries in Latin America. For the purposes of our study, we included Jamaica and Mexico as part of Latin America. Twenty-eight percent of respondents from Latin America felt the PN workforce was adequate in their country, while 72% reported a mild to severe shortage. Of the 63% of respondents involved in physician training, 50% reported difficulty, 20% reported ease, and 30% were neutral regarding their ability to recruit trainees. Lack of institutional or government support and resources (33%) and low salary (29%) were the most frequently reported challenges to trainee recruitment. Two thirds of respondents perceived job acquisition following training to be somewhat to very difficult. The perceived difficulty obtaining a PN job after training in Latin America was significantly higher than the average of other regions. Lack of available PN positions (39%), lack of resources (26%), and geographic location of jobs (22%) were the most frequently reported challenges to job acquisition.

Asia

Sixty-one responses (response rate 11.2%) from 12 Asian countries were received. Countries in the Middle East were excluded from the Asian region and analyzed separately. Seventy-seven percent of respondents from Asia reported a mild to severe shortage in the PN workforce. Of the 57% of Asian respondents involved in physician training, 70% reported difficulty, 15% reported ease, and 15% were neutral regarding their ability to recruit trainees. Lack of institutional or government support and resources (32%) and hard work / poor work-life balance (23%) were the most frequently reported challenges to trainee recruitment. Fifty percent of respondents perceived job acquisition following training to be somewhat to very difficult, and 32% reported it to be somewhat to very easy. Lack of available PN positions (30%), lack of resources (27%), and poor subspecialty recognition / adult nephrologist redundancy (30%) were the most frequently reported challenges to job acquisition after training.

Middle East
Twenty-six responses from 8 countries were received (response rate 15.3%). Turkey was included in the Middle East region rather than Europe or Asia. Seventy-six percent of respondents from the Middle East reported a mild to severe shortage in the PN workforce. Of the 58% respondents from the Middle East involved in physician training, 47% reported difficulty, 20% reported ease, and 33% were neutral regarding their ability to recruit trainees. Lack of institutional or government support and resources (22%) and hard work / poor work-life balance (22%) were the most frequently reported challenges to trainee recruitment. Sixty percent of respondents from the Middle East reported it to be somewhat easy to very easy to find a PN job after training. Lack of available PN positions (39%) and lack of resources (23%) were the most frequently reported challenges to job acquisition after training.

**Training Duration and Research Requirements**

Three years of PN training was perceived as optimal by the majority of respondents in North America, Europe, Asia, Australia / New Zealand, and the Middle East (Figure 6). The majority of respondents from Latin America and Africa reported that two years of PN training is optimal. The percentage of respondents reporting mandatory research requirements in their country varied from 27% in Europe to 96% in North America (Figure 7). In all regions, apart from North America, the percentage of respondents reporting that research or scholarship should be a mandatory part of PN training was greater than the percentage reporting a current research requirement.
Figure 6 Perceived optimal years of pediatric nephrology training by region
Discussion

PNs in most regions of the world perceive that the PN workforce is inadequate, with the exception of Australia / NZ and certain areas of Europe, where the workforce is felt to be adequate or even in surplus. Fift-three percent of respondents from Australia and New Zealand reported a mild to severe surplus of PNs, with an additional 27% reporting the workforce as adequate. Among all regions, respondents from Australia / NZ also reported the greatest difficulty with job acquisition and greatest ease with fellow recruitment. These data suggest an oversupply and/or highly interested pool of potential PN trainees relative to training slots, and a potentially over-saturated or mal-distributed PN job market. Indeed, many PNs from Australia / NZ seek additional advanced degrees after completing PN training [30]. Given the region’s relative surplus of PNs, and apparent oversupply of candidate trainees, future study should be directed to better understand this end of the “adequacy spectrum”. Understanding the relative
importance of factors that modulate trainee interest and trainee apprehension about PN, has the potential to be very helpful for regions with greater difficulty recruiting trainees.

Similarly, though to a lesser extent than Australia / NZ, the majority (58%) of European respondents reported workforce adequacy or surplus. Regional variability regarding workforce adequacy has been noted in the adult nephrology community in Europe.[15]. Sharif et al speculated that this variability might be explained by differences in healthcare delivery models, matching of workforce supply to service demands, and the use of physician extenders [15]. We were unable to verify the applicability of these factors to the PN workforce from our data.

Factors affecting the supply of adult nephrologists may not translate to the PN workforce due to, for example, contrasting distributions in the public-private sectors and differing training requirements. Our findings from Europe and Australia / NZ stand in sharp contrast, however, to North America, Latin America, Asia, the Middle East, and Africa.

Neither the high degree of perceived workforce inadequacy in North America, nor the challenges to trainee recruitment identified by North American respondents, are surprising [1, 12, 22]. Lack of interest, hard work / poor work-life balance, and poor salary were obstacles to fellow recruitment reported by more than a third of North American respondents. These themes echo the results of a 2008 survey of U.S pediatric nephrology fellows that reflected lack of interest, financial constraints, and perceived PN workload as factors dissuading potential trainees from PN [21]. Similar themes have been identified as obstacles in the adult nephrology workforce [15, 17]. In our data, these themes were more frequently reported in North America than in any other region, suggesting that interventions in North America need to be directed toward addressing these obstacles.

Contrasting perceptions between respondents from North America and Europe are particularly noteworthy. Seventy-nine percent of North American respondents reported a perceived workforce inadequacy, compared to 42% of European respondents. Similarly, difficulty recruiting
trainees was reported by 76% of North American respondents, compared to 41% of European respondents. While our data cannot be used to substantiate objective differences in the PN workforce between these two regions, we hypothesize that perceived differences might be related to variation in the use of physician extenders, the referral patterns of primary care providers, and the relative ease of recruiting and utilizing trainees. Additional research is needed to replicate and further explore these findings.

**Suggested Interventions to Improve the Pediatric Nephrology Workforce**

**Length of training**

Length of training and mandatory research requirements are two factors that might be modified to increase the appeal of PN to potential trainees. The Latin American and African regions were the only regions, however, to prefer 2 years of training over 3. Data favoring 3 years of training in North America is consistent with previous research in this region [30]. Recent data, from within the United States, has suggested that there are varying opinions among PNs. In a survey of 766 US pediatric nephrologists, 49% were in favor of a 2 year training option, 34% were opposed, and 17% were unsure [30]. In the same study, among 102 pediatric nephrology program directors, 58% were in favor of a 2 year option, 35% were opposed, and 7% were undecided. Pros and cons of a 2 year training duration, extracted from free-text responses from the aforementioned study, are presented in Figure 8.
<table>
<thead>
<tr>
<th>In favor of two year’s training</th>
<th>Opposed to two year’s training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrated clinical training allowing for more skilled clinicians.</td>
<td>Not enough time to learn all the skills required</td>
</tr>
<tr>
<td>Research opportunities have all but dried up for clinicians</td>
<td>Research training valuable for academic research career and informs and enhances experience as a clinician. Will slow or even halt pediatric research findings.</td>
</tr>
<tr>
<td>Poor financial support for research</td>
<td></td>
</tr>
<tr>
<td>Make the specialty more attractive, since we need more pediatric nephrologists</td>
<td>Pediatric academic status will diminish.</td>
</tr>
<tr>
<td>Two years would be sufficient</td>
<td>Treated as inferior to the three year academic nephrologist.</td>
</tr>
<tr>
<td></td>
<td>Research is essential and third year expands critical thinking and clinical and research tools of the trainee</td>
</tr>
<tr>
<td>Not everyone wants to have an academic research career</td>
<td>Pediatric academic status will diminish. The strength of Pediatric Nephrology lies in its academic focus</td>
</tr>
<tr>
<td>Enter the workforce sooner and less expense to the trainee</td>
<td>Compensation is the issue not the length of training.</td>
</tr>
</tbody>
</table>

A compendium of actual PN training duration across multiple countries and continents has recently been published [30]. (Appendix B Three years of training is the most common duration of PN training, though training duration does vary depending from country to country. Three years is the current minimal recommendation in the United States, Europe, and Australia / New Zealand.

**Research requirements**

If training duration were to be shortened, it is likely that research and scholarship requirements would either be made optional or curtailed. Our data, however, suggest a greater interest in increasing, rather than decreasing, research / scholarship requirements in all regions other than North America. In our data, 75% of North American respondents felt that research or scholarly activity should be mandatory; a notable finding given that research is currently a required component of PN fellowship training in the United States. Some North American respondents
commented that mandatory research requirements might be a barrier to fellow recruitment, and that a two year clinical track might have broader appeal to potential trainees. Nonetheless, the majority (65%) of North American respondents thought the ideal training duration was three years, not two. Given that most pediatric nephrologists work in academic centers, decisions to shorten training must be weighed against the importance of broad clinical exposure and the need to train clinician-scholars to advance the field. These data highlight the importance of tailoring training requirements to regional and country-level needs and expectations, without sacrificing clinical expertise [10].

**Increasing Job Opportunities**

Many respondents from Africa (46%), Asia (27%), Latin America (26%), Australia / NZ (30%), and the Middle East (23%) reported that lack of resources was an obstacle to job acquisition. Lack of resources might signify inadequate, aging, or absent infrastructure, insufficient financial support on the part of institutions or governments, or inadequate number of allotted training slots or PN positions. For example, 30% of Asian respondents reported that redundancy with adult nephrologists or general pediatricians was a concern. Similarly, lack of institutional or government support and resources was frequently mentioned by respondents from Africa (60%), Asia (32%), Latin America (33%), and the Middle East (22%) as an obstacle to trainee recruitment.

Strengthening regional professional associations and their advocacy efforts should be a high priority. In regions with limited resources, providing abbreviated specialization training in PN to pediatricians might be one approach to increasing the “effective” workforce, promoting the field, and setting the stage for future advances in the PN workforce.

Ensuring that critical care and trauma certification programs include dedicated nephrology services as a part of certification, is another way to support the field and reinforce the
importance of the pediatric nephrologist in multidisciplinary care of complex pediatric patients. Such is already the case in the United States for a Level 1 critical care designation and level 1 or level 2 trauma designation [31].

**Policy Development, Advocacy Activities, and Collaboration**

Advocacy at government and ministry levels is also needed to support policy development and resource allocation that are favorable to both established and developing PN communities. We recommend utilizing World Kidney Day as a platform for such advocacy [32]. These interventions must be tailored to the political, social, and institutional environments and will vary by region and country. We also suggest that regional and international PN societies develop resources to assist with this form of advocacy. Interventions to bolster training opportunities and develop long term institution to institution support such as the ISN's Sister Renal Center Program, IPNA's fellowship training grants, and the annual International Pediatric Nephrology Fellows Conference are additional examples of ongoing efforts to support the PN workforce [11, 18, 19, 26, 33].

**Other Activities**

Future assessments of the PN workforce might consider incorporating additional factors such as pediatric population size, rural versus urban disparities, PN training requirements, physician remuneration, and healthcare expenditure. Building a comprehensive and up-to-date database of practicing pediatric nephrologists, physician extenders, nurse practitioners, and dialysis personnel will be of integral to the success of these efforts. Other interventions to support the growth of PN workforce include developing and sharing novel teaching tools, strengthening existing trainee relationships, broadening and facilitating mentorship relationships across institutions, exposing potential trainees to nephrology early in their education, training nurse practitioner and mid-level providers, and engaging potential trainees in national level meetings.
and conferences. Journal editors and guideline committees should be committed to publish research, guidelines, and conference recommendations that are relevant and practical for PNs working in low resource settings. Initiatives to this effect, for example, include the recent KDIGO Implementation Strategies Conference on Understanding Needs in Low and Middle Income Countries [34].

**Strengths and Limitations**

Strengths of our study include its quantitative and qualitative assessments of the PN workforce and broad international reach. Furthermore, the geographic distribution of respondents closely mirrored that of non-respondents (see table 1). These results must be considered in the context of study limitations. A response rate of 15% is modest; however, this response rate is consistent with previous multinational web-based surveys of physicians [35–40]. Second, the survey did not differentiate between active (~1300) and inactive IPNA members, rendering it subject to participation by PNs no longer in active practice. Third, the survey was an English language, internet-based survey, resulting in possible under-coverage and response bias. The survey should be translated into other languages for future, broader evaluations of the PN global workforce. Fourth, selection bias, especially regarding free-text responses, is potentially operative in our data. We speculate the direction of bias to be towards greater workforce inadequacy. Finally, we recognize the high degree of variation likely to be found both across geographic regions and within individual countries. Future surveys should aim for higher response rates to allow for additional sub-regional analyses.

**Future Research**

The survey-based method used in this study to assess workforce adequacy relies on the subjective perceptions and attitudes of individuals. This method was employed primarily
because of its ease, and is suitable as a first attempt at assessing the PN workforce on a broad scale.

Future efforts at assessing the PN workforce, especially at the national level, should employ more rigorous methods based on worker density and distribution. The Theil L measure, Theil T index, and Gini coefficient, for example, are measures that can be used to assess inequalities in health-worker distribution [41]. These measures allow for decomposition of inequality data, which can be useful for meaningful sub-analyses, for example based on rural/urban disparities. Such measures would require an accurate, and up to date, survey of pediatric nephrologists at the country level. Accounting for non-clinical activities of PNs should also be included in these measures, and would be most easily accomplished at the country-level. The support of regional professional societies in facilitating these assessments should be a high priority.

Conclusions

The PN community must make the development of its workforce a prime research and advocacy priority. Such efforts will require the leadership, vision, and effort of the International Pediatric Nephrology Association (IPNA), as well as regional pediatric nephrology associations and individual pediatric nephrologists.

The data presented above provide a broad assessment of perceptions of the global PN workforce, and suggest a high degree of inadequacy in most regions of the world. Efforts to address this perceived inadequacy could include capitalizing on the elegance of our organ system by developing innovative and inspiring teaching tools, re-imagining ways of sharing responsibility and clinical care coverage to improve work-life balance, joining together to advocate for resources and recognition in developing nations, reigniting discussions regarding training duration and research requirements, and strengthening research and training
partnerships across the globe. These goals should be accomplished while combating erosion of scope of practice by other specialties and maintaining full dedication and service to patients and families.

Note: A portion of this masters’ paper has been previously published and can be found at the following citation: Glenn D, Ocegueda S, Nazareth M, et al. The global pediatric nephrology workforce: a survey of the International Pediatric Nephrology Association. BMC Nephrology. 2016;17(1):1-11.
References


29. Qualtrics. Qualtrics, Provo, Utah, USA


Appendix A

Survey Instrument

This 12 question, 5 minute, survey will give us an opportunity to characterize training settings for pediatric nephrology around the world. The questions are for both trainees and fully trained pediatric nephrologists.

Thank you,
Maria Ferris, Mara Medeiros, William Primack, Dorey Glenn and Adam Weinstein

Your participation implies consent. All data is collected anonymously. This study was given exempt status by the Office of Human Research Ethics at the University of North Carolina.

Q27 In what country do you currently practice pediatric nephrology?

Q38 What percentage of your time is devoted to clinical pediatric nephrology and research?

- [ ] Clinical Pediatric Nephrology
- [ ] Research
- [ ] Other

Q5 Your pediatric nephrology program is best described as: (you may choose more than one)

- [ ] private practice
- [ ] Academia or in a university
- [ ] government affiliated hospital
- [ ] military affiliated hospital
- [ ] Other (please specify ____________________)

Q8 Does your current program train pediatric nephrology fellows (sub-specialty residents or registrars)?

- [ ] Yes
- [ ] No

Answer If Does your current program train pediatric nephrology fellows (sub-specialty residents or registrars) Yes Is Selected

Q9 If yes, please answer how easy or difficult it is to:

<table>
<thead>
<tr>
<th></th>
<th>Very easy</th>
<th>Easy</th>
<th>Somewhat Easy</th>
<th>Neutral</th>
<th>Somewhat Difficult</th>
<th>Difficult</th>
<th>Very Difficult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recruit pediatric nephrology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>trainees (fellows or registrars)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Q13 What makes it easy or difficult to recruit nephrology trainees in your country?

Q35 In your opinion, what is the optimal length for pediatric nephrology training?
- 1 year
- 2 years
- 3 years
- 4 years
- more than 4 years

Q10 What is your opinion of the adequacy of the pediatric nephrology workforce in your country?
- Severe shortage
- Moderate shortage
- Mild shortage
- Adequate
- Mild surplus
- Moderate surplus
- Severe surplus

Q15 After fellowship training, how easy or difficult is it to find a job as a pediatric nephrologist in your country?

<table>
<thead>
<tr>
<th></th>
<th>Very easy</th>
<th>Easy</th>
<th>Somewhat easy</th>
<th>Neutral</th>
<th>Somewhat difficult</th>
<th>Difficult</th>
<th>Very difficult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Find a job as a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pediatric nephrologist</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>after training</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q14 What are the challenges or obstacles to finding a nephrology position after training?

Q36 Do you feel that research or scholarship should be a mandatory component of nephrology training?
- Yes
- No

Q36 Please feel free to share any comments you may have regarding length of training below.
Appendix B

Figure 9 Taken from Primack WA, Glenn DA, Meyers KEC Pediatric Nephrology Training Worldwide 2016: Quantum educatus? Kidney Int Rep. doi: 10.1016 [30]

<table>
<thead>
<tr>
<th>Country</th>
<th>Medical School</th>
<th>Pediatric Training</th>
<th>Pediatric Nephrology</th>
<th>Certification</th>
<th># IPNA Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>Yes</td>
<td>720</td>
</tr>
<tr>
<td>Japan</td>
<td>6</td>
<td>5</td>
<td>3</td>
<td>Yes</td>
<td>278</td>
</tr>
<tr>
<td>Brazil</td>
<td>6</td>
<td>3</td>
<td>2 or 3</td>
<td>Yes</td>
<td>124</td>
</tr>
<tr>
<td>India</td>
<td>5</td>
<td>1 rot/3 ped</td>
<td>3m-2yr</td>
<td>Yes¹</td>
<td>102</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>5 or 6</td>
<td>2 or 5</td>
<td>3</td>
<td>No</td>
<td>98</td>
</tr>
<tr>
<td>Germany</td>
<td>6</td>
<td>4 or 5</td>
<td>3</td>
<td>Yes</td>
<td>77</td>
</tr>
<tr>
<td>Turkey³</td>
<td>6³</td>
<td>4</td>
<td>3</td>
<td>Yes</td>
<td>63</td>
</tr>
<tr>
<td>Argentina</td>
<td>6 or 7</td>
<td>4 or 5</td>
<td>3</td>
<td>Yes</td>
<td>57</td>
</tr>
<tr>
<td>Canada</td>
<td>3 or 4</td>
<td>3 or 4</td>
<td>2</td>
<td>Yes</td>
<td>55</td>
</tr>
<tr>
<td>China</td>
<td>5 or 8</td>
<td>3</td>
<td>3</td>
<td>No</td>
<td>53</td>
</tr>
<tr>
<td>Italy</td>
<td>6</td>
<td>5</td>
<td>2 to 3</td>
<td>No</td>
<td>52</td>
</tr>
<tr>
<td>France</td>
<td>7</td>
<td>4</td>
<td>2</td>
<td>No</td>
<td>49</td>
</tr>
<tr>
<td>Australia</td>
<td>6</td>
<td>1-2 rot/3</td>
<td>3</td>
<td>Yes</td>
<td>43</td>
</tr>
<tr>
<td>Netherlands</td>
<td>6</td>
<td>4,5</td>
<td>2.5</td>
<td>Yes</td>
<td>42</td>
</tr>
<tr>
<td>Spain</td>
<td>6</td>
<td>3 or 4</td>
<td>1</td>
<td>No</td>
<td>41</td>
</tr>
<tr>
<td>Saudi</td>
<td>7</td>
<td>1 rot/4 ped</td>
<td>2</td>
<td>Yes</td>
<td>39</td>
</tr>
<tr>
<td>Mexico</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td>Yes</td>
<td>37</td>
</tr>
<tr>
<td>Russia</td>
<td>6</td>
<td>1 to 2</td>
<td>4m-2yr</td>
<td>??</td>
<td>35</td>
</tr>
<tr>
<td>Nigeria</td>
<td>6</td>
<td>5 to 7</td>
<td>Not specified</td>
<td>No</td>
<td>35</td>
</tr>
<tr>
<td>Philippines</td>
<td>4</td>
<td>1 rot/3 ped</td>
<td>2</td>
<td>Yes</td>
<td>30</td>
</tr>
<tr>
<td>Belgium</td>
<td>6</td>
<td>4 to 5</td>
<td>Abroad</td>
<td>No</td>
<td>30</td>
</tr>
<tr>
<td>Egypt</td>
<td>6</td>
<td>1 rot/3 ped</td>
<td>2</td>
<td>Yes</td>
<td>28</td>
</tr>
<tr>
<td>Chile</td>
<td>7</td>
<td>3</td>
<td>2</td>
<td>Yes</td>
<td>27</td>
</tr>
<tr>
<td>Columbia</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td>No</td>
<td>26</td>
</tr>
<tr>
<td>Korea</td>
<td>6</td>
<td>5</td>
<td>1 or 2</td>
<td>Yes</td>
<td>25</td>
</tr>
<tr>
<td>Indonesia</td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td>35</td>
</tr>
<tr>
<td>Switzerland</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>Yes</td>
<td>18</td>
</tr>
<tr>
<td>Israel</td>
<td>5</td>
<td>4.5</td>
<td>2.5</td>
<td>Yes</td>
<td>18</td>
</tr>
<tr>
<td>Norway</td>
<td>6</td>
<td>5</td>
<td>No</td>
<td>No</td>
<td>13</td>
</tr>
<tr>
<td>Hungary</td>
<td>6</td>
<td>5</td>
<td>2</td>
<td>Yes</td>
<td>12</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>5</td>
<td>7</td>
<td>3</td>
<td>No</td>
<td>15</td>
</tr>
</tbody>
</table>