How to Calculate the Risk of Shortage and Surplus of Pediatric Workforce?

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In the first part of this series debating the required pediatric workforce in different European child healthcare systems, the European Paediatric Association (EPA) presented the equations for calculating the need of annual number of newly certified pediatricians in the different European national contexts, and for keeping their national pediatric workforce stable.[1] This article provides further equations for calculating dynamically the risk of shortage and surplus in numbers of pediatricians, and its impact on child healthcare services. We also debate how to develop and to provide sustainable pediatric services for European children by training a nationally tailored pediatric workforce, competent to undertake the child healthcare able to meet the expectations of the families of healthy, sick, or children with disabilities.

Selection of Demographic Factors Influencing the Need for Training Pediatricians

Young pediatricians working in hospitals complained about an inordinately high work load during and after normal working hours and about unsatisfactory working conditions with an increasing administrative burden and decreasing clinical and research pediatric activity.[2] Considering increasing treatment numbers of children in practices and hospitals, because of an increased individual demand for healthcare, the slight increase of pediatric workforce in some European countries may not lead to a reduced work load for individual pediatricians. The median age of primary care pediatricians increased to almost 55 years in some countries like Germany and Italy. Thus, nearly 50% of all pediatricians working in private practices may plan to retire from their practice over the next 5-10 years. Furthermore, an increasing number of employed female pediatricians in different European countries decided against a full-time job because of several factors, including significant cultural, social, and economic constraints for female pediatricians, therefore, emphasizing the likely persistence of sex disparities and unequal opportunities to unrestricted accessibility to work in pediatrics.[3] In 2016, the proportion of pediatricians working part-time ranged from 0% to 15% in a selected group of 10 European countries. Politicians should decisively acknowledge this connection between more part-time work and fewer medical working hours. Therefore, the number of training places in pediatrics must be adequately planned and increased if necessary.

This means that there is an economic question of needs and that it cannot be left solely to a market system of supply and demand. The migration of pediatricians from Eastern European countries across borders to fill the gaps in Western European countries, particularly within the European Union 28 where the circulation of professionals is unrestricted, appears often to be unfair for those countries that have paid for the training of pediatricians. Other factors influencing the calculation of the need for training pediatricians seem to be less critical (eg, the unemployment rate of pediatricians in 2016 was almost 0 in most West European countries). Furthermore, the percentage of pediatricians changing their profession or having no intention to work was insignificant.

Calculating the Adequate Balance of Annually Trained and Retired Pediatricians

The number of practicing pediatricians in the various nations could stay stable throughout the years, providing that the number of annually certified young pediatricians will match exactly the number of annual retirements. Whereas the number of newly certified pediatricians (NewPed) and their median age at certification (CerAge) should easily be available by the national medical associations at the end of each year, it may be more complicated to estimate the number of retiring pediatricians several years in advance because of variable retirement ages (RetAge).

Therefore, we propose to use a model of 2 equations for estimating the number of retiring pediatricians (RetPED) at intervals of 1, 5, and 10 years, which may allow for a prospective planning. National medical associations are able to calculate the median age of all practicing pediatricians (MedAge). This statistical data enables calculating the number of expected RetPED in 2 steps (**Table I**; available at www.jpeds.com). The RetAge in Europe ranges between 60 and 70 years with a lower age for female pediatricians also differing across jurisdictions. The median age of all practicing pediatricians (MedAge) can be annually calculated by National Medical Associations and/ or the National Institutes of Medical Statistics as well as the

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EPA	European Paediatric Association
UNEPSA	Union of National European Paediatric Societies and Associations

median age of newly certified pediatricians (NewAge). For instance, in a simulation case where RetAge is equal to 65 years, MedAge is equal to 55 years and NewAge is equal to 30 years, one- half of all pediatricians will have to work 10-35 more years whereas the other one-half will have to work for another 1-10 years only.

Annually Retiring Pediatricians (Step 1)

Assuming that the numbers of annually certified and retired pediatricians do not change and that the age of all pediatricians above the age of MedAge is uniformly distributed, the number of annually retiring pediatricians (RetPed) can be calculated by equation 1 shown in **Table I**.

Estimated Total Number of All Practicing Pediatricians (Step 2)

The estimated total number of all practicing pediatricians after a specific number (k) of years (PracPedk) is given by equation 2 shown in **Table I**. For instance, using the same figures used in the simulation case of step 1 (**Table I**), if RetPed is equal to 600 and NewPed is equal to 400, the annual deficit of pediatricians will be 200, thus, accumulating to 1000 missing pediatricians after 5 years if the number of trained pediatricians is not adjusted accordingly.

Developing and Providing Sustainable Child Healthcare Services for European Children by Training Nationally Tailored Pediatric Workforces

The number of lifelong working years is defined by the period of full-time work without interruptions between certification as a general pediatrician and the age of retirement. This means that the above algorithm on a stable number of pediatricians will only be realistic if all pediatricians are working full-time without intermittent longer leave of absence such as parental leave, etc. Furthermore, the proportion of immigrants/emigrants of all annually trained pediatricians will have an influence on the number of all practicing pediatricians. In addition, there are other variables, such as career changes, influencing the calculations. These variables, however, will only matter if the new generation of pediatricians is developing new working habits differing from the traditional ones. Moreover, digitalization and other newly developed medical technologies may lessen the number of required pediatricians in the near future. Likewise, expanding solo practices for community care by multidisciplinary teams including nonpediatric care givers such as nurse practitioners will contribute to the above mentioned demand for a nationally tailored replacement of retired pediatricians.

One way of adding the possibly influencing variables identified by the EPA/Union of National European Paediatric Societies and Associations (UNEPSA) (**Table II**; available at www.jpeds.com) to the equation 2 is to calculate the estimated or calculated gradual influence by specific factors, to be multiplied with numbers of PracPed, NewPed, and RetPed. The factor of 1 indicates no influence. A factor of 0.9 will indicate a negative influence of 5% reduction of the future number of any type of pediatrician. Vice versa a factor of 1.1 will indicate a 5% positive influence on the respective numbers of pediatricians.

Part-Time Work: A Confounding Variable Influencing the Equation for Developing and Providing Stable Child Healthcare Services for European Children

Several variable factors (**Table II**) may influence the calculation for the required number of certified pediatricians in different European countries, which should be taken in account when applying the equations proposed to the various local contexts. Among them, the part-time factor plays an important role, which may possibly influence the basic equations 1 and 2 used to calculate the pediatric workforce needed in a given nation. In this case, a model of 3-step corrective equations can be used to minimize the impact of this factor on the final figure.

For instance, using the same example and figures as in steps 1 and 2, and assuming the number of PracPed to be 12 000, RetPed equal to 600, and NewPed equal to 400, in the event that 20% of all NewPed are planning to work half-time during the next 5 years and 100% of RetPed have worked full-time, then equation 2 (**Table I**) must be adapted by a part-time factor (partF). This factor corrects the total number of full-time and half-time pediatricians to a total number of (virtual) full-time pediatricians (**Table III**, equation A, B, and C; available at www.jpeds.com).

Conclusions

The EPA/UNEPSA proposes a functional method for possibly calculating the adequate balance of annually trained and retired pediatricians, aiming at keeping the number of practicing pediatricians stable, yet responding to the needs of pediatric workforce in the different European countries, which are typically characterized by diverse socioeconomic contexts and different healthcare systems. Furthermore, EPA/UNEPSA emphasizes the importance to develop sustainable national child healthcare service systems for European children. One goal could be obtained by training an adequate nationally tailored pediatric workforce. Compatibility and consistency could be determined by the use of selected factors to be applied to the equations proposed. These were satisfactorily tested in different European countries by a recent EPA/UNEPSA internal pilot survey. A further report will describe the application of equations developed in an expanded survey made by the EPA/UNPSA member societies and association. ■

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Table I. Two-step calculation of the balance between annually trained and retired pediatricians

Equation 1 (annually retiring pediatricians):

$$RetPed = \frac{PracPed}{2*(RetAge - MedAge)}.$$

with PracPred representing the number of all practicing pediatricians.

Example: RetAge = 65 y, MedAge = 55 y, and NewAge = 30 y
Considering the numbers above and assuming the number of all practicing pediatricians equals 12 000, the number of annually retiring pediatricians will be:

$$\frac{12\,000}{2*(65-55)} = 600.$$

Equation 2 (practicing pediatricians after k y):

$$PracPedk = PracPed + k*(NewPed - RetPed).$$

Example: if RetPed = 600 and NewPed = 400, when applying the numbers in equation 1 into equation 2, the total number of pediatricians after 5 years will be:

$$12\,000 + 5*(400 - 600) = 11\,000.$$

*Results are based on the simulation case described in **Table III**.

Table II. List of variable factors identified by EPA/UNEPSA to be influencing the equations for calculating the required number of certified pediatricians in European Nations

	Variables	Mathematic terms
(1)	Actual number of all practicing pediatricians working full time	PracPed
(2)	practicing pediatricians after (k) years	PracPedk*
(3)	Number of annually certified pediatricians	NewPed
(4)	Number of required new pediatricians to keep the number of practicing pediatricians stable	NewPed*
(5)	Number of annually retiring pediatricians	RetPed
(6)	Median age of all practicing pediatricians	MedAge
(7)	Median age of newly certified pediatricians	NewAge
(8)	Median age of retiring pediatricians	RetAge
(9)	Part-time working factor	partF
(10)	Percentage of full-time pediatricians	PercFull
(11)	Percentage of half-time pediatricians	PercHalf

*Results are based on the simulation case described in **Table III** and do not represent original data.

Table III. Corrective 3-step equations to minimize the influence of part-time factor on the calculation for developing stable child healthcare services for European children

Step1)
Equation A (part-time factor):

$$partF = \frac{PercFull + 0.5 * PercHalf}{100}$$

with PercFull being the percentage of full-time pediatricians and PercHalf the percentage of half-time pediatrians respectively.

Example: Assuming the number of PracPed = 12 000, RetPed = 600, newly certified pediatricians (NewPed) = 400.
If 20% of all NewPed are planning to work half-time during the next five years and 100% of RetPed have worked full-time, the part-time factor of

$$\frac{80 + 0.5 * 20}{100} = 0.9$$

Step 2)
To determine the number of full-time equivalents of NewPed, the number of NewPed must be multiplied by partF = 0.9. This is applied in the following adapted equation for the practicing pediatricians after *k* years (PracPedk*):
Equation B (equation 2 adapted for part-time working new pediatricians):

$$PracPedk^* = PracPed + k * (partF * NewPed - RetPed)$$

Example: for the simulation case proposed in step 1, the total number of pediatricians after 1 y will be:

$$12\,000 + 1 * (0.9 * 400 - 600) = 11\,760.$$

Step 3)
To obtain the number of annually certified pediatricians necessary to keep the total number pediatricians at the actual height of 12 000, Equation B has to be rearranged to solve for NewPed:
Equation C (equation B adapted to calculate the number of required new pediatricians to keep the number of practicing pediatricians stable):

$$NewPed^* = \frac{1}{partF} * RetPed,$$

Example: in the simulation case of steps 1 and 2, after one year the number of required pediatricians is:

$$\frac{1}{0.9} * 600 \approx 667.$$

Thus, about 667 newly certified pediatricians (20% of them working half-time) are necessary to replace 600 RetPed full-time working .
If, however, 50% instead of 20% of all newly certified pediatricians are planning to work half-time, partF will be 0.75. Then for the example, after 1 y we need a number of:

$$\frac{1}{0.75} * 600 = 800$$

newly certified pediatricians (50% of them working half-time) to replace 600 RetPed full-time working. This means that 400 pediatricians are working full-time and 400 half-time, however, the latter 50% provide only 33.3% of the total care.
If, however, 50% of the total work load should be performed by half-time working pediatricians the required total number of pediatricians would be 900 (300 full-time and 600 half-time). This means that two thirds of all pediatricians would work half-day and do 50% of the total work of pediatricians.

*Results are based on the simulation case described in **Table III** and do not represent original data.

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