Title: Size, composition and distribution of health workforce in India: why, and where to invest?

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Word count
Abstract: 352
Manuscript: 5,126
BACKGROUND: Investment in human resources for health not only strengthen the health system but also generates employment and contributes to economic growth. India can gain from enhanced investment in health workforce in multiple ways. This study in addition to presenting updated estimates on size and composition of health workforce, identifies areas of investment in health workforce in India.

METHODS: We analyzed two sources of data: i) National Health Workforce Account (NHWA) 2018 and ii) Periodic Labour Force Survey 2017-18 of the National Sample Survey Office (NSSO). Using the two sources we collated comparable estimates of different categories of health workers in India, density of health workforce and skill-mix at the all India and state levels.

RESULTS: The study estimated (from NHWA 2018) a total stock of 5.76 million health workers which included allopathic doctors (1.16 million), nurses/midwives (2.34 million), pharmacist (1.20 million), dentists (0.27 million), and traditional medical practitioner (AYUSH 0.79 million). However, the active health workforce size estimated (from NSSO2017-18) is much lower (3.12 million) with allopathic doctors and nurses/midwives estimated as 0.80 million and 1.40 million respectively. Stock density of doctor and nurses/mid-wives are 8.8 and 17.7 respectively per 10,000 persons as per NHWA. However, active health workers’ density (estimated from NSSO) of doctor and nurses/mid-wives are estimated to be 6.1 and 10.6 respectively. The numbers further drop to 5.0 and 6.0 respectively after accounting for the adequate qualifications. All these estimates are well below the WHO threshold of 44.5 doctor, nurses and midwives per 10,000 population. The results reflected highly skewed distribution of health workforce across states, rural-urban and public-private sectors. A substantial proportion of active health worker
were found not adequately qualified on the one hand and on the other more than 20% of qualified health professionals are not active in labour markets.

CONCLUSION: India needs to invest in HRH for increasing the number of active health workers and also improve the skill-mix which requires investment in professional colleges and technical education. India also needs encouraging qualified health professionals to join the labour markets and additional trainings and skill building for already working but inadequately qualified health workers.

Key Words: Health workforce, Investment in health, India
INTRODUCTION

Human resources for health (HRH) are a core building block of health systems [1]. The High-Level Commission on Health Employment and Economic Growth (ComHEEG), [2] emphasized that a targeted investment in health workforce promotes economic growth through range of pathways such as enhanced productivity and output, social protection and cohesion, social justice, innovation and health security. Investment in health workforce is a driver of progress towards several Sustainable Development Goals (SDGs) [2-4]. This aligns with the Global Strategy on Human resources for Health: Workforce 2030 Report, which notes that adequate investment in health workforce along with availability, accessibility, acceptability and coverage leads to overall social & economic development along with improvements in population health [4].

Despite this increased recognition of a central role of health workforce in attaining health outcomes and enhanced economic growth, the investment in health workforce, particularly in lower and middle income countries is lower than desired levels for education and training for health workers and ensuring health worker accessibility. [4,5]. This present paper aims to identify the current challenges of HRH and the areas of investment in HRH in India.

There is also an increasing interest in evidence about the value and contributions of different staff-mixes to patient, personnel, and organizational outcomes [4,6,7], with some recent research suggesting that investment in more diverse staff and skill mix can result in improved quality of care, quality of life, and job satisfaction [8,9].

The investment case for HRH in India is exemplified by the fact that India has a very low density of health workers per 10,000 population and the distribution of health workforce across the Indian states is highly skewed [10,11]. A recent WHO report mentions that India needs at least
1.8 million doctors, nurses and midwives to achieve the minimum threshold of 44.5 health workers per 10,000 population in 2030 [12]. Also, India’s National Health Policy (NHP) 2017 recommended strengthening existing medical education system and the development of a cadre of mid-level care providers [13]. Similarly, the NITI Aayog’s Strategy for “New India@75” aims at generating 1.5 million jobs in the public health sector by 2022-23 [14]. The current COVID-19 pandemic has further exposed the acute shortage of health workers in India's health system. In addition, OECD countries have benefited by the presence of Indian origin and Indian trained doctors and nurses [7], whilst during the COVID-19 situation the health system in India is struggling with low numbers of trained health personnel.

An enhanced investment in health workforce in India has the potential of not only strengthening the health system and improving the accessibility to health workers but also generating employment not only for doctors and nurses but also for a large number of allied health professionals, associate health workers and subordinate/support staff. Such investments in India also have potential to increase employment and female labour force participation. The share of formal employment in the health sector is significantly higher (more than 60%) in India as compared with other sectors (less than 20%). Also, new employment opportunities in HRH has the potential to improve the labour force participation among women. Female workers comprise approximately 50% of the total health sector workforce in India [12].

Recent research [12, 15-18] has identified several areas of concern related to Indian health workforce. Studies have highlighted that there has been acute shortages of doctors and nurses along with low levels of skill-mix. A lack of adequate number of institutions providing training in nursing, and international migration of nurses from India are the two most prominent reasons
for the shortage of trained nurses in India [19-22]. Moreover, studies have also highlighted low quality of a large share of total number of nurses in India [23]. The National Health Policy (NHP) 2017 in this regard recommends to improve regulation and quality management of nursing education India [13].

Very few studies have highlighted the need of skill-mix and task shifting and the required investment in this area. The present study is an attempt to identify such needs of improvement in availability and skill-mix of health workforce. The paper also presents an updated information on size and composition of health workforce in India and projections for 2030. Our paper attempts to identify the current HRH challenges and the areas of investment in HRH in India.

Structure of health workforce in India

Healthcare services in India are offered by a varied range of professionals trained in different specialties of medicine and healthcare. The supply side information (Central Bureau of Health Intelligence [24]) on the availability of health professionals indicate that these health professionals have varied levels of educational qualifications and are registered with different councils/agencies [10,11]. Table 1 presents categories of health professionals directly engaged in services delivery along with their levels of educational qualification and their registering agencies.

In addition to the health professionals as presented in Table 1, there are also community health workers with 10 years of formal education and a short training course. The health workforce at the ground level also includes many informal medical practitioners, such as registered medical practitioners (RMPs) (including traditional birth attendants, faith healers, snakebite curers, bonesetters etc.) with or without any formal education or skills/training. RMPs are often the first
point of contact for treatment for a large proportion of population living in rural and remote areas and they may be dispensing either allopathic or traditional drugs or both as the need arises [10-11].

METHODS

The present study used data from two main sources: (1) National Health Workforce Accounts (NHWA) on India -2018 [25] and (2) Periodic Labour Force Survey (PLFS) conducted during July 2017 – June 2018 by the National Sample Survey Office (NSSO 2017-18) [26]. In addition, information was also collected from Central Bureau of Health Intelligence (CBHI) 2019, Rural Health Statistics (2019) and population projection from the Census of India (2019) [27].

NHWA data

The NHWA for India provides information on different categories of stock of health workers at national and sub-national (state) levels. The latest information available is for the year 2018. We extracted number of health professionals from NHWA for four different categories (Medical doctors, Dentist, Nurses/midwives/Auxiliary nurse and midwives (ANM),and Pharmacist) at the all India and state levels for the year 2018 [25].

NSSO data

The sample size of PLFS 2017-18 [26] is 102,113 households (56,108 rural and 46,005 urban) covering 433,339 individuals (246,809 rural and 186,503 urban). The survey collected information related to the nature of occupation of workers using National Classifications of Occupation (NCO) 2004 and the National Industrial Classification (NIC) 2008. NSSO data also provide information on detailed activity status such as worker, unemployed and out of labour force, location of workers
by state and rural and urban, general educational and technical educational qualifications, place of working by public and private sectors.

Methods of estimation of health workforce

Total stock of health professionals by types of health professionals (doctors, nurses and midwives, pharmacists and traditional medicine practitioners) is directly reported in the NHWA database. We estimated size of comparable categories of health workforce from the NSSO 2017-18, using the worker population ratio (WPR) and projected population as of January 2018. We applied the WPR at the disaggregated occupational levels estimated from NSSO 2017-2018 to the projected population as of 1 January 2018 using population projection [27] at disaggregated levels: male and female living in rural and urban areas separately in each state. The estimates of HRH were arrived at using equation (1).

\[ HW_{aijk} = pop_{ijk} \times WPR_{aijk} \] ……………………………………… (1)

where ‘\( HW_a \)’ represents health workers from categories ‘a’ (representing doctors, dentists, AYUSH, nurses and so on); ‘pop’ is the projected population as of January 2018 and ‘\( WPR_a \)’ is worker participation ratio for each category in years 2017–2018. The subscripts i, j and k represents gender, rural-urban and states. WPR in each category of workers was estimated using equation (2).

\[ WPR_a = \frac{workers_a}{pop} \] ……………………………………………………… (2)

The NSSO survey reports up to two self-reported activities of all persons based on major and short time dispensation criteria separately. We considered both activities of each individual and identified health workers on the basis of either primary or secondary status. Information on
activity status and educational background of each individual were used for identifying ‘unemployed’ and ‘not in labour force’ statuses of persons with medical qualifications.

The existing NCO 2004 and NIC 2008 codes used in the 2017-2018 survey could not identify disaggregated numbers of health professionals by allopathic doctors, AYUSH doctors and dentists employed in hospital settings, although the same were identified outside the hospital setting. We applied the ratio of different health professionals outside the hospital sector on the hospital sector to arrive at the total estimate of different categories of health workers. The cross classification of NCO 2004 and NIC 2008 for identifying different categories of workers is presented in Appendix Table A-I.

The two sources (NHWA and NSSO data) identify comparable categories of health professionals. However, NSSO data base does not provide NCO code for identifying ANM and pharmacists comparable to the NHWA. It is possible that a part of the total ANM number in the NSSO data may be clubbed in another category coded as ‘health associate professionals’. The pharmacist number presented in this report on the basis of NSSO data only refers to pharmacists engaged in retail trade.

Supply side estimation

We estimated the supply of health professionals in future years up to 2030 using estimated number of seats in different medical colleges/institutions. Institutions offering health programs in 2019 were identified through Google search engine using keywords such as “health programs”, “nursing courses”, “AYUSH”, “MBBS”, “BPharma” and “allied health programs”. The search was limited to programs offered in India. Additionally, the websites of the All India Council of
Technical Education, University Grants Commission, universities and institutions were also searched, and education supplements of newspapers and commercial web-sites were searched. The number of seats in various health professional programs was forecasted for the period till 2030. We assumed a seat occupancy rate of 95% for medical doctors for the forecast time period. For generating the workforce estimates for each year, we added the new supply for each year to the workforce numbers in the preceding year and subtracted assumed exits from the workforce to account for mortality, retirement and migration by assuming an overall annual attrition rate of 7% every year. Finally, we modelled scenarios according to different levels of policy intervention which was similar to that adopted by Ridoutt et al. [28].

RESULTS

Size and Composition of Health Workforce

Table 2 presents estimates of HRH, categorized by doctors, dentists, nurses/mid-wives and pharmacist, at the all India level using the two main sources of data. Since workers self-reported occupations in the NSSO survey and health workers may or may not have adequate qualifications, we present estimates on health workforce from NSSO with and without adequate qualifications. NHWA reports a total stock of approximately 1.16 million allopathic doctors, 2.34 million nurses/midwives (including ANM), 1.20 million pharmacists, 0.27 million dentists, and traditional medicine professionals 0.79 million. Both the estimates (with and without adequate qualifications) from NSSO are invariably lower compared with the NHWA estimates for all the reported categories. According to NSSO, the numbers of allopathic doctors and nurses/mid-
wives, even before adjusting for the right qualifications, are 0.80 million and 1.4 million respectively. Estimates on pharmacist, dentist, and traditional medical practitioners from NSSO are also significantly lower as compared with those recorded in the NHWA. The difference in the estimates from the two sources are the highest for nurses/midwives and pharmacists. For nurses/midwives categories, ANM is not recorded separately in the NSSO and may be clubbed partly with nurses/midwives and partly with health associates. For pharmacists, only pharmacists engaged in the retail trade were identifiable in the NSSO data and pharmacist assistants are clubbed in the health associate category. The NSSO based estimates after adjusting for the mandated qualifications are further lower as 18% of health workers who self-reported as allopathic doctors and 44% of health workers engaged as nurses/midwives had no adequate qualification.

State-wise dis-aggregation of allopathic doctors and nurses reflect that as per the NHWA data, approximately 39% of allopathic doctors are concentrated in the three states of Maharashtra (16%), Tamil Nadu (12%) and Karnataka (11%) (Table 3). These are followed by Andhra Pradesh (9%), Uttar Pradesh (7%), West Bengal (6.5%) and Kerala (5%). These states taken together constitutes up to approximately 70% of the total stock of allopathic doctors. However, in terms of active workforce, estimated from NSSO, Uttar Pradesh shares the largest proportion (14%) of all allopathic doctors followed by West Bengal (11%) and Kerala (11%). Uttar Pradesh and Tamil Nadu also share highest proportion of all nursing workers 10-11% each, followed by Maharashtra (8.8%) and Andhra Pradesh (6.6%). State-wise dis-aggregation of all health professionals is presented in Appendix Table A-II.
Density of Doctors and Nurses and Skill-mix

At the all India level, stock density of doctor and nurses/midwives are 8.8 and 17.7 respectively per 10,000 persons (Figure 1). If we add total stock of dentists and traditional medicine practitioners, total stock density in India is estimated as 34.6 per 10,000 persons. However, density of active workers (as estimated from the NSSO) of doctor and nurses/midwives (without adjusting for adequate qualification) are estimated to be 6.1 and 10.6 respectively. The density further drops to 5.0 and 6.0 respectively after adjusting for the adequate qualifications. Total active worker density is estimated to be 26.5 and 16.7 respectively before after adjusting for qualifications.

Among the states, Kerala reported the highest density of active doctor workforce (25.4) whereas Delhi had the highest density of active nurse/midwives workforce estimated from NSSO.

Considering doctor and nurse workforce together, Kerala, Delhi and Tamil Nadu are on the top of the list with the density of doctors and nurses taken together being 49, 38, and 28 per 10,000 persons respectively. Towards the bottom of the list are the states of Bihar, Jharkhand and Odisha with doctor-nurse density being as low as 7, 9 and 9.7 per 10,000 persons respectively (Figure 2). (see Appendix Table A-III for details).

As far as the skill-mix ratio is concerned, the stock data of NHWA suggests nurse to doctor ratio as to be 2.02:1 at the all India level, with large scale variations across states varying from 10.7:1 in Himachal Pradesh and 9.9:1 in Haryana on the higher side to as low as 0.4:1 in Bihar and 0.6:1 in Uttarakhand. The nurse to doctor ratio on the basis of the NSSO data, however, is estimated to be 1.7:1 at the all India level with Punjab (7.1:1) and Delhi (4.8:1) on the higher side and states
of Bihar, Jammu & Kashmir and Madhya Pradesh having less than 1 nurse per doctor on the lower side (Table 4).

Contrasting the skill mix ratio with the density of doctors at the state levels reflect that in the states of Bihar and Uttar Pradesh density of doctor and nurse/doctor ratio both are very low (Figure 3). In Karnataka and Jharkhand nurse/doctor ratio is slightly better to that in Bihar and Uttar Pradesh but density of doctors is very low. In Madhya Pradesh and West Bengal, density of doctors is fairly high but the nurse/doctor ratio is very low. In these two states improving the nurse/doctor ratio will lead to a better skill-mix situation. There are also states at the extreme ends, i.e. very high doctor density but very low nurse/doctor ratio (Kerala, Jammu & Kashmir) and very high nurse/doctor ratio but very low density of doctor (Punjab, Himachal Pradesh, Chhattisgarh, Delhi and Uttarakhand).

**Estimated Skilled Health Workforce Size by 2030**

Table 5 depicts the estimated number of skilled health workers (doctors/nurses and midwives) for 2019 through 2030. The base line number for 2019 has been taken from the education adjusted estimates of health workforce from the NSSO 2017-18 (Table 2). The projected skilled health workforce numbers will rise from current estimates of 1.77 million to 2.65 million in 2030. However, even this will not result in a rise of the skilled health workforce density as the density will be approximately 17.5 per 10,000 population in 2030. There will be a shortfall of approximately 1.13 million skilled health workers to reach 22.8 skilled health workers per 10,000 population. However, if there is a scale-up of nursing supply to approximately 200% growth by 2030, the resultant number of nurses will be 2.02 million in 2030 and the total skilled health
workforce number will be 3.45 million in 2030 (22.76 skilled health professionals per 10,000 population).

If the NSSO reported data for health professionals without any adjustment for educational qualifications is considered as the baseline, the projected estimates of skilled health workforce numbers would be 3.03 million and density will be approximately 20.03 per 10,000 population in 2030 at current growth rates. There will be a shortfall of approximately 0.7 million skilled health workers to reach 25 skilled health workers per 10,000 population. The forecasted supply side scenario from 2020 to 2030 is presented in Appendix xx.

**Distribution of Health workforce by Gender and Age**

The gender and age distribution of health workforce (Figure 4 and Figure 5 respectively) reveals that there is a clear numerical dominance of males in doctors, dental and AYUSH categories whereas females outnumber male in the nurse’s category. Approximately two-thirds of all health workforce are below age 40 years while more than 25% being in the young age group of below 30 years. Nurses and dentists reflect higher concentration, 38% 30% respectively, in the younger age group (15-29 years) as compared with doctors (23%) and other health workers. Accordingly, doctors have higher concentration in the older age group of 50 years and above (18%) as against 3% dentists and 5.5% nurses in the same age group.

**Distribution across Rural–Urban and Public–Private**
The uneven distribution of health workers is also reflected across rural–urban and public-private settings (Appendix Figure A-I and Figure A-II). Although rural India constituted approximately 66% of the total population in 2018, only 33% of all health workers are in rural areas. This proportion is a quite lower for dental work force. The proportions of doctor and nurses in rural areas are 27% and 36%, respectively. Further, the bulk of the total health workforce is employed in the private sector. NSSO Report on health and morbidity in India [34] reflect that approximately 60% of inpatient care and 70% of outpatient care in India is provided by private sector. The proportions employed in the private sector: doctors (65%), dentists (89%), AYUSH (93%) and other health workers (67%) are also to a great extent commensurate to the proportion of service delivery.

**Person with Medical Education but Out of Labour Force**

Further, NSSO data also indicates that a substantial proportion of medically qualified persons are not the part of current health workforce. The estimates from the NSSO indicate that among the individuals with a qualification of degree in medicine (graduate and above), 27% are not active in labour market as doctors while approximately 4% are currently unemployed and looking for jobs (Figure 6). Similarly, among the diploma holders, above or below graduate levels, only 63% reported currently employed.

We also examined the gender and age profile of the persons who have technical education in medicine but are ‘out of labour force’ and noted that female shares an overwhelming proportion (31%) of persons with technical education in medicine but are out of labour force. Proportions of persons with technical education in medicine but out of labour force is higher in the younger and
elderly age groups. However, approximately 20% female who are not in the labour force and have technical education in medicine are in the age group of 30-40 years (Appendix Figure A-III).

An overwhelming proportion of these women reported themselves engaged in household work as against joining labour market.

**DISCUSSIONS AND POLICY IMPLICATIONS**

Investment in HRH to improve availability of health workforce has gained increased attention in recent years [2,5]. In India such investments also have potential to enhance female labour force participation and formalization of labour market [12]. These discussions on enhancing the investment and policy attention to health workforce related issues has assumed centrality in the presence of the COVID-19 pandemic.

In the present report we presented different dimensions of HRH in India, along with existing and emerging challenges which needs to be addressed for improved availability of health workforce in the country as a whole and at the state levels. We used two nationally representative data sources on health workforce: i) stock of health workforce from the NHWA 2018 and ii) National sample survey data (NSSO) 2017-18 on labour force to identify HRH challenges and areas of investment in HRH in India. Our estimates from the NHWA data are almost similar to the results as reported in a recent WHO report [12].

The minor deviations in the two studies are attributed to the use of population projection numbers as we used the Census of India projections as against the UN population projections used in the WHO study. However, NHWA and NSSO based estimates in the present study reflect
widely varied estimates on the size of health workforce with the NHWA based estimates significantly higher to the NSSO based estimates.

Several reasons have been highlighted explaining the difference between the estimates of health professionals from the NHWA data and health workers as reported in the NSSO data [11,15]. Most of these reasons are related to the fact that a large proportion of the health professionals registered with different councils and associations are not part of the current health workforce in India. One widely discussed reason is the migration of qualified health professionals from India to other developed countries [7,10,29,30].

In addition, there are reasons related to the veracity and updating of the NHWA data. For instance, the NHWA data is collated from different professional councils, which do not maintain a live register and do not require renewing the registration. The information they provide is fraught with non-adjustment of health professionals leaving the workforce because of death, retirement and double counting of workers because they have registered in more than one state [11,15].

However, one of the most important reasons of this differential estimate is that the NHWA provides total stock of health professionals but not all of them are active in labour markets. Using NSSO, we reported in this paper that a substantial proportion of medically qualified individuals, overwhelmingly women, is currently not a part of workforce, either because they are currently unemployed but available for work or they do not want to join labour markets. This is particularly amplified for nurses/midwives, for whom the difference between the registered and active workers is the highest. If we apply this proportions (% employed) over the NHWA stock data, we come to pretty close estimates from the two sources.
Density of health workforce with respect to population is an important indicator of availability of health workforce. Density of allopathic doctors and nurses who are active in labour market are as low as 6.1 and 10.6 respectively per 10,000 persons (16.7 in total), which is well below the WHO threshold of 44.5 doctors, nurses and midwives per 10,000 population. If we add dentists and AYUSH professionals, the total active health workforce density comes to be approximately 22 per 10,000 persons. The present study clearly reveals that new investment for improving the size of active health workforce is the most important area which needs policy attention in India. In addition, we also find a sub-optimal skill-mix between doctor and nurse and doctor and allied health professional. Size of traditional medicine practitioners (including AYUSH) in India is quite sizeable. Total number of active AYUSH practitioners is almost 70% of the total number of active allopathic doctors. However, the number of nurses per doctor is less than 2. This number is lower to 1 if we consider BSc Nursing qualifications. In most OECD countries there are 3-4 nurses per doctors [7]. We find that although total stock of nurses in the country is approximately 3 times number of doctors, a large proportion of nurses are not actually active in labour market. In order to increase nurses’ participation in active health workforce, creating a smooth employment environment for nurses may be another area of policy intervention. A few states Delhi, Punjab, Himachal Pradesh, and Chhattisgarh have high nurse doctor ratio but in these states density of doctor per 10,000 persons are very low. There is a need to make balance between densities of doctor and nurse both for a better availability of health professionals and skill-mix. Similarly, doctor/allied health professionals’ ratio is also very poor which needs attention. The Global Strategy report [4] and
other similar studies [31] also emphasized creation of enough allied health professionals through improved training and educational infrastructure. Skewed distribution of health workforce across states and rural-urban setting is yet another area which needs policy attention. Nearly two-thirds of all health workforce in India is concentrated in urban areas leaving rural population either in extreme unmet need of health workers or to avail their services by travelling in urban areas or both. The lopsided distribution of health workforce is also pronounced across Indian states. Most of the less developed states such as Bihar, Jharkhand, Odisha, Rajasthan, Uttar Pradesh etc. reflect the acute shortage of health workforce. As far as public-private division of health workforce is concerned, the bulk of doctors’ employment is in private sector while nurses are almost equally distributed across public and private sector. Public sector seems to be sole employer of traditional medical practitioners. These lop-sided distribution of health workers not only create shortage of trained health workforce in many states and rural areas but also leads to unequal skill-mix across different types of health workers in different settings. These findings are in conformity with earlier studies [11,17]. The public sector is also challenged by a high rate of vacancy of sanctioned positions [32]. While the shortage is most pronounced for specialists at Community Health Centres, the shortages are prominently witnessed across the states for various positions. The existing vacancies are attributed to diverse reasons that range from barriers in recruitment, litigations against recruitment processes and premature exits from the system, especially in contractual positions. Filling up existing vacancies in government sector requires urgent policy attention.
An analysis of the health workforce projections suggests that the estimated density of skilled health professionals (doctors, nurses & midwives) per 10,000 population is unlikely to alter from current levels by 2030 if the current rates of growth are sustained. While we are to witness an absolute rise in numbers by 2030, the density of the health workforce is unlikely to change by 2030. AYUSH represents Indian systems of medicine which are predominantly accessed by people of Indian origin, and their inclusion might introduce difficulty in creating comparisons with other countries. Nonetheless, we feel that since there is a significant government emphasis and investment in their training and deployment, as well as them sharing a large clientele in the population, they merit an inclusion in the overall workforce numbers. We have presented the AYUSH numbers as distinct from doctors, but we have included them in the calculation of the overall skilled health worker density.

At the present level of the growth in the supply side, the skill-mix ratio of doctor: nurse is unlikely to alter by 2030. A near 200% growth in the supply side for nurses will improve the doctor: nurse ratio to 1:1.5 by 2030. This will require a further rapid scale-up of nursing programs. The High Level Expert Group report for the Planning Commission in 2012 [33] had suggested a ratio of 1:2:1 for doctor: nurse: ANM for India. For achieving this number of nurses by 2030, simultaneous efforts will have to be undertaken on the demand side of the market as well. The roles for nurses and the functions that are performed by them will need closer attention.

The analysis in this study throws several points for policy interests as follows:

**Expanding the supply side of the health workforce:** The expansion of medical educational institutions (medicine, nursing, dentistry etc.) should be prioritized across geographical regions with a shortage of health workforce and the passed out from these institutions should be
encouraged to work in local areas. Thailand represents a good example of effective implementation of rural retention policies for medical doctors [35]

**Growth in the number of nurses in the workforce needs priority attention:** The creation of new infrastructure/institutions for nursing may be a medium to long term intervention. Also, efforts should be taken to expand the capacity and quality of existing institutions to train the nurses.

**Increasing participation of trained personnel in the workforce:** A significant proportion of the trained manpower, especially women, is not present in the workforce. Strategies for re-skilling these graduates and attract them in labour markets should be worked out.

**Balancing the skill-mix:** The existing skill-mix is doctor-centric with a lower number of nurses. An emphasis on significantly increasing nursing supply and retaining the nurses in the workforce needs to be evolved at the national level. The specific role of task-shifting and its impact on patient-care and well-being will need greater attention.

**Fast-Tracking recruitment and deployment for public health facilities:** Improve effectiveness of recruitment processes by walk-in interviews or contractual/flexible norms of engagements to reduce the existing human resource gaps in public sector institutions, particularly at the primary levels.

**Harnessing technology:** Covid-19 has highlighted the potential to make more effective use of new and emerging technology to improve the delivery of care, to enable rapid and effective communications, and to improve access to care via e-health and m-health interventions. This is an area where investment in technology and in training the workforce can have dividends.

**Up-skilling programs for less qualified care providers:** There is a section of the health workforce which has lower than desirable qualification as reported in the NSSO data. This issue needs
deliberation within the Councils and the Ministry of Health at the national level to identify the mechanisms to address the issue. While we do not recommend their formalization in the workforce in the present form, the government can consider up-skilling programs to improve the quality of services and engage them in a range of care giving and non-medical health services.

**Improving HWF information:** A significant overhaul and improvement of data on registration of health professionals with live registers of health professionals at the country level is required, with a regular/periodic update and adjustment of the data base. The presence of live registers will replace the reliance on estimates from surveys and give a clearer picture for prompt decision-making and workforce planning for the future, as well as contributing to ongoing quality assurance of the registered professionals.

Implementing the above recommendations will require substantive increase on investment in the health workforce, which will contribute to inclusive economic growth in India.

LIST OF ABBREVIATIONS

- ANM – Auxiliary Nurse Midwife; AYUSH – Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy; CBHI – Central Bureau of Health Intelligence; ComHEEG – High-Level Commission on Health Employment and Economic Growth; HRH – Human Resources for Health; MoHFW – Ministry of Health and Family Welfare; NCO – National Classification of Occupations; NHP – National Health Policy; NHWA – National Health Workforce Account; NIC – National Industrial Classification; NITI Aayog – National Institution for Transforming India; NSSO – National Sample Survey Office; OECD – Organisation for Economic Cooperation and Development; PLFS – Periodic Labour Force Survey; RMP – Registered
DECLARATIONS

ETHICS APPROVAL: Ethical clearance for this study was obtained from the Institutional Ethics Committee (IEC) of the Indian Institute of Public Health Delhi under ‘Expedited Review’.

Consent to participate – Not applicable.

CONSENT FOR PUBLICATION: Not applicable

AVAILABILITY OF DATA AND MATERIALS: Data for this study was used from secondary sources. Micro data from the NSSO is available for free in public domain from the official website (http://www.mospi.gov.in/unit-level-data-report-nss-75th-round-july-2017-june-2018-schedule-250social-consumption-health) of the National Sample Survey Office, Ministry of Statistics and Programme Implementation, Government of India.

COMPETING INTERESTS: No competing interest

FUNDING: This article is part of a research project funded by WHO (grant number WHO Registration 2020/996952-0; Purchase Order 202512192) to the Public Health Foundation of India.

AUTHOR’S CONTRIBUTIONS

AK, DM, HN, JB, SZ and TZ jointly conceptualised the idea. AK, DM, JB, HN and TZ developed early analytical framework. AK, HN, SH and TZ analysed the data. AK, HN and SH prepared the first draft. DM, HG, JB, SZ
and TZ provided extensive comments to the first draft and contributed to developing the final draft. AK, DM, HG, HN, JB, SH, SZ and TZ all reviewed the final draft and consented to the final manuscript.

ACKNOWLEDGEMENT – None
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Figure 1: Number of health professionals/workers per 10,000 persons, 2018

Sources: Estimates from NHWA 2018 and NSSO 2017-18

Note: using population projection as of 1st January 2018 from Census of India 2011
Figure 2. Density of health workers/professionals in states, 2018

Sources: Estimates from NSSO 2017-18

Note: using population projection as of 1st January 2018 from Census of India 2011
Figure 3: States with varied density of doctors and nurse/doctor ratio

Source: Sources: Estimates from NSSO 2017-18 and Census of India 2011.

Note: using population projection as of 1st January 2018 from Census of India 2011
Figure 4. Gender distribution of HRH in India-2018

Source: Estimates from NSSO 2017-18
Figure 5. Age distribution of health workforce in India-2018

Source: Estimates from NSSO 2017-18
Figure 6: Percentage distribution of individuals with various levels of technical education in medicine as employed, unemployed and out of labour force, 2018
Source: Estimates from NSSO 2017-18
| Health workers                  | Educational qualification                                                                 | Registering agencies                                      |
|---------------------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Allopathic doctors              | graduates with a bachelor’s degree in medicine/surgery or postgraduate diploma             | Medical council of India                                   |
| Dental practitioner             | graduates with a bachelor’s or postgraduate degree in dentistry                           | Dental council of India                                    |
| AYUSH practitioner              | graduates with a bachelor’s or postgraduate degree in Ayurveda, Unani, Siddha, or Homoeopathy | Department of AYUSH/MoHFW                                  |
| Nurse                           | diploma in General Nursing and Midwifery (3.5 year course) or a 4-year bachelor’s degree or a 2–3-year postgraduate degree | Indian Nursing Council                                     |
| Auxiliary nurse and midwife     | a diploma in auxiliary nurse midwifery (2-year course).                                   | Ministry of health and Family Welfare                      |
| Pharmacist                      | diploma or bachelor’s degree course in pharmacy                                           | Pharmacy council of India                                   |
| Physiotherapist, diagnostic and others technician | diploma/certificate in medical allied fields                                           | Indian Association of Physiotherapist and Ministry of health and Family Welfare |

Sources: using information from CBHI 2019 and Councils of health professionals
Table 2. Size and composition of HRH in India as of 2018

| HWF                      | NHWA (millions) | NSSO (millions) | NSSO estimate as % of NHWA |
|--------------------------|-----------------|-----------------|----------------------------|
|                          | Total | Adequately | Total | Adequately |
|                          | reported | qualified | reported | qualified |
| Allopathic doctor        | 1.16  | 0.80       | 0.66   | 72.7       | 60.0       |
| Nurse/mid-wives          | 2.34  | 1.40       | 0.79   | 60.9       | 34.3       |
| Pharmacist               | 1.19  | 0.25       | 0.21   | 21.0       | 17.6       |
| Dentist                  | 0.27  | 0.18       | 0.17   | 66.7       | 63.0       |
| Traditional medicine     | 0.79  | 0.49       | 0.25   | 62.0       | 31.6       |
| professional/AYUSH       | N.A   | 0.75       | 0.40   | N.A        | N.A        |
| Health Associates/Allied*|       |            |        |            |            |
| overall                  | 5.76  | 3.87       | 2.48   | 67.2       | 43.1       |

Sources: NHWA 2018; NSSO 2017-18 and Census of India 2011.

Note: * includes health assistants, sanitarins, dietitians and nutritionists, optometrists and opticians, dental assistants, physiotherapy associates, pharmacist assistants, occupational therapist chiropodist, masseur etc.
Table 3. Number and percentage distribution of allopathic doctors and nurse in states, 2018

| State                | NHWA Doctors | NHWA Nurses | NSSO Estimates Doctors | NSSO Estimates Nurses |
|----------------------|--------------|-------------|------------------------|-----------------------|
| Andhra Pradesh       | 9.09         | 12.38       | 4.33                   | 6.64                  |
| Assam                | 2.16         | 1.68        | 1.46                   | 3.66                  |
| Bihar                | 3.67         | 0.6         | 7.04                   | 1.86                  |
| Chhattisgarh         | 0.79         | 0.88        | 1.04                   | 2.88                  |
| Delhi                | 1.93         | 2.4         | 1.58                   | 4.30                  |
| Gujarat              | 6.05         | 5.73        | 3.94                   | 4.97                  |
| Haryana              | 0.52         | 1.9         | 1.37                   | 2.66                  |
| Himachal             | 0.28         | 1.09        | 0.14                   | 0.51                  |
| Jammu and Kashmir    | 1.36         | 0           | 2.38                   | 0.78                  |
| Jharkhand            | 0.53         | 0.27        | 1.46                   | 1.59                  |
| Karnataka            | 11.1         | 9.53        | 4.65                   | 4.39                  |
| Kerala               | 5.36         | 10.22       | 11.10                  | 5.85                  |
| Madhya Pradesh       | 3.45         | 5.28        | 8.48                   | 3.02                  |
| Maharashtra          | 15.67        | 7.02        | 7.49                   | 8.78                  |
| NE States*           | 0.39         | 1.34        | 1.88                   | 2.66                  |
| Odisha               | 2.04         | 4.6         | 1.14                   | 2.37                  |
| Punjab               | 4.37         | 3.33        | 0.83                   | 3.37                  |
| Rajasthan            | 3.92         | 10.31       | 2.41                   | 5.30                  |
| Tamil Nadu           | 12.24        | 11.73       | 6.74                   | 10.99                 |
| Telangana            | 0.45         | 0.51        | 3.93                   | 3.97                  |
| Uttar Pradesh        | 7.01         | 4.51        | 13.72                  | 9.97                  |
| Uttarakhand          | 0.78         | 0.17        | 0.74                   | 1.92                  |
| West Bengal          | 6.51         | 4.54        | 11.39                  | 6.75                  |
| Union Territories    | 0            | 0           | 0.78                   | 0.81                  |

Note: * includes north-east states of Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura
Sources: NHWA 2018 and NSSO 2017-18
Table 4: Skill-mix of health workers in different states, 2018

| State                      | Nurse/Doctor | Traditional including AYUSH / doctor | Medicine doctor | Allied Professional / doctor |
|----------------------------|--------------|--------------------------------------|-----------------|------------------------------|
|                            | NSSO | NHWA | NSSO | NHWA | NSSO | NHWA | NSSO | NHWA | NSSO | NHWA | NSSO |
| Andhra Pradesh             | 2.7  | 3.7  | 0.8  | 0.2  | 1.2  |      |      |      |      |      |      |
| Assam                      | 4.4  | 2.1  | 0.4  | 0.1  | 1.7  |      |      |      |      |      |      |
| Bihar                      | 0.5  | 0.4  | 0.7  | 3.4  | 0.1  |      |      |      |      |      |      |
| Chhattisgarh               | 4.9  | 3    | 1.3  | 0.6  | 1.1  |      |      |      |      |      |      |
| Delhi                      | 4.8  | 3.4  | 0.6  | 0.6  | 0.6  |      |      |      |      |      |      |
| Gujarat                    | 2.2  | 2.6  | 0.8  | 0.7  | 2.4  |      |      |      |      |      |      |
| Haryana                    | 3.4  | 9.9  | 1.2  | 2.5  | 2.6  |      |      |      |      |      |      |
| Himachal Pradesh           | 6.5  | 10.7 | 2.7  | 3.8  | 5.9  |      |      |      |      |      |      |
| Jammu and Kashmir          | 0.6  | 0    | 0.5  | 0.4  | 0.9  |      |      |      |      |      |      |
| Jharkhand                  | 1.9  | 1.4  | 0.2  | 0.1  | 0.6  |      |      |      |      |      |      |
| Karnataka                  | 1.7  | 2.3  | 0.6  | 0.4  | 0.7  |      |      |      |      |      |      |
| Kerala                     | 0.9  | 5.2  | 0.6  | 0.7  | 0.4  |      |      |      |      |      |      |
| Madhya Pradesh             | 0.6  | 4.1  | 0.4  | 1.8  | 0.5  |      |      |      |      |      |      |
| Maharashtra                | 2.0  | 1.2  | 0.6  | 0.9  | 1.1  |      |      |      |      |      |      |
| Odisha                     | 3.6  | 6.1  | 1.4  | 0.6  | 1.4  |      |      |      |      |      |      |
| Punjab                     | 7.1  | 2.1  | 1.7  | 0.3  | 4.4  |      |      |      |      |      |      |
| Rajasthan                  | 3.8  | 7.1  | 1.0  | 0.4  | 1.1  |      |      |      |      |      |      |
| Tamil Nadu                 | 2.8  | 2.6  | 0.6  | 0.1  | 1.0  |      |      |      |      |      |      |
| Telangana                  | 1.8  | 3.1  | 0.3  | 4.2  | 1.8  |      |      |      |      |      |      |
| Uttar Pradesh              | 1.3  | 1.7  | 0.6  | 1.1  | 1.2  |      |      |      |      |      |      |
| Uttarakhand                | 4.5  | 0.6  | 0.6  | 0.5  | 0.7  |      |      |      |      |      |      |
| West Bengal                | 1.0  | 1.9  | 0.5  | 0.6  | 0.5  |      |      |      |      |      |      |
| India                      | 1.7  | 2.1  | 0.6  | 0.7  | 0.9  |      |      |      |      |      |      |

Sources: NHWA 2018 and NSSO 2017-18
Table 5: Projected skilled health workforce (2019 to 2030)

| Year/ Forecast point | Population in billion (India) | Doctors (in million) | AYUSH (in million) | Nurses (in million) | Projected skilled health workforce (in million) | Skilled health workforce needed to reach 25/10,000 (in million) | Gap (in million) |
|----------------------|-------------------------------|----------------------|------------------|---------------------|-----------------------------------------------|-------------------------------------------------|-----------------|
| 2019/ Baseline*      | 1.369                         | 0.65                 | 0.32             | 0.80                | 1.77                                          | 3.42                                           | 1.65            |
| 2025/ Forecast mid-point | 1.452                        | 0.76                 | 0.42             | 1.04                | 2.23                                          | 3.62                                           | 1.40            |
| 2030/ Forecast end-point | 1.513                        | 0.93                 | 0.50             | 1.22                | 2.65                                          | 3.78                                           | 1.13            |

Note: These figures consider adjusted NSSO numbers (workforce numbers adjusted for education qualifications)

*From NSSO estimates