Human Resources in Healthcare and Health Outcomes in India

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I Introduction

Human resources for health (HRH) comprising of health professionals and skilled health workers (ranging from doctors, nurses to all other paramedics) are crucial in shaping health outcomes across the countries on the globe (see WHO, 2006 & 2016a&b). Adequate availability of such human resource is a necessary pre-requisite for desirable health outcomes (see WHO, 2006 & 2016a&b; Anand and Barnighasen, 2013; Hazarika, 2013; Motkuri and Naik, 2004). But the shortage of human resources in healthcare services is a reality and hence it has been a cause of concern particularly in developing countries like India (see WHO, 2016a; Motkuri *et al.*, 2017; Rao *et al.*, 2009&2016; Rao *et al.*, 2011; Hazarika, 2013). It is not merely the shortage but also the composition (by various cadres) and its distribution across geographical entities that make matters worse (see Dussault, 1999; Motkuri and Naik, 2010; Rao *et al.*, 2013). Therefore, the concerned international organizations, global community and policy makers of respective countries are seriously considering to address challenges related to shortages and distributional aspects of human resources in the healthcare sector.

As the World Health Organisation (WHO) has observed in its recent report, the estimated needs-based shortage of HRH is to the tune of 17.4 million healthcare workers globally (WHO, 2016a). The composition of this shortage is in terms of 2.6 million doctors and over 9 million nurses and midwives (see WHO, 2016a). It is also observed that the largest needs-based *shortages* are in countries of South East Asia and African regions. Undoubtedly, one can imagine the contribution of India in the pool of global level estimated shortage of human resources in healthcare services. Despite such inadequacy in HRH, India has made a considerable progress in respect of health inputs and outcomes since independence. But the country's progress is still falls short of desirable health outcomes. Some of the critical input domains where the country is struggling with are: health infrastructure, finance and human resources. The health policies of country since independence in general and the recent National Health Policy (NHP) of 2017 in particular have been emphasizing on the significance of these aspects particularly that of human resource in the healthcare system of the country.

The education and training of skilled technical manpower remains the mainstay of provisioning the required capacity of such health workers. The educational infrastructure therefore has to be in tune of the rising demand for qualified health professionals and the other skilled health workers. The overall education system in general and medical education in particular has far reaching implications in respect of supplying the required number of health workers. In this regard, the WHO report rightly observes that the chronic under-investment in education and training of health workers and the mismatch between education strategies in relation to health systems and population needs results in persistent shortages of human resources for healthcare (WHO, 2016).

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In India efforts have been made to have an effective policy in this regard since independence. The Bhore Committee (1946) on the eve of independence made certain recommendations on medical education for the production and supplying of qualified health professionals. Post-independence, the Government of India enacted the Medical Council Act, 1956 and established Indian Medical Council as a professional body and an authority for setting up standards, and regulating the medical education, training and practices of the health professionals / personnel. The Expert Committees[1] at different points of time since 1960 have made certain recommendations towards improving the system (Thomas, 2017). One probable reason behind the failure to attain the desired goals in health outcomes could very well be the inadequacy of HRH and its compositional and distributional abnormalities. A large proportion of population in India especially the poor are still finding it difficult to access and avail modern health care services owing to its either its absence or inability to afford the same. Recently, Government of India in an attempt to revive the system for effective functioning has proposed a new, but yet to be enacted, National Medical Commission replacing / repealing the old Medical Council. How far it succeeds in revitalizing the healthcare system of the country remains to be seen.

It is universally acknowledged that inadequate availability and inequitable distribution of suitably trained, motivated and supported health workers serves as a handicap in achieving the goal of universal health coverage (Hazarika, 2013). In addition evidence suggests that there is acute shortage of health personnel in some regions particularly the rural ones which remain under-served as doctors mostly prefer to be in urban areas. This is supported by the observed inequalities in the distribution of health workers particularly of doctors and dentists which have a significant bearing on health outcomes (*ibid*).

With this backdrop, the present exercise is a situation analysis of size, composition and distribution of human resources available in the entire system of health care services sector in India. The present study contributes to the existing system of knowledge in terms of trend analysis of the overall workforce engaged in healthcare services sector of India. It also explores the relationship between educational development and health workers availability alongside the association between density of health workers and health outcomes across states of India.

II Method and Source

The focus of the present study is to assess the overall human resources engaged in healthcare sector in terms of its cadres like healthcare professionals and skilled health workers. The entire workforce in health care sector consists of a range of health professionals such as doctors (physicians and surgeons) of allopath and dental and other specialists, practitioners of AYUSH (Ayurveda, Unani, Sidda, Homeopathy) nurses and auxiliary nurse midwives (ANMs), pharmacists and diagnostics technicians with medical or pharmacy degree or diplomas to those largely holding non-medical educational qualifications: health assistants, community health workers (CHWs) and accredited social health activists (ASHAs) along with unlicensed private medical practitioners (PMP) and traditional healers (see Box A1 & A2 in the Appendix for details). Also, there is a non-medical cadre of health management and supporting workers

[1] Such as *Mudaliar Committee* in 1962, *Shrivastav Committee* in 1975, *Bajaj Committee* in 1986, and the very recent *High Level Expert Group on Universal Health Coverage* in 2011 all have examined the challenges of medical education and suggested measures for improvement (Thomas, 2017).

ranging from managerial and financial professionals along with other administrative, accounting personnel to clerical staff engaged in the sector. Broadly the health workers may be categorized as medical health professional including paramedical personnel and non-medical workers in healthcare sector in India. The latter consists of various types of non-medical workers[2]. As they are working in the healthcare institution they are categorized workers in the healthcare sector.

The sources of information on health workforce in India are as follows. The count of registrations made with professional bodies and respective authorities such as national and state level Medical Councils or the similar bodies and that are published in Government of India reports on health information or health statistics such as Health Information of India or Rural Health Statistics. In the absence of live-register consisting of actively working health professional, Government India's reported information based on such enduring registrations with professional bodies and authorities is considered to be inflated one about the number of health professionals actively working in India (see Motkuri and Naik, 2010; Rao *et al.*, 2016; Motkuri *et al.*, 2017). The issues concerned with such data are: multiplicity and duplication of registrations, no mechanism of delisting those who are not active in serving and those who are not available for providing their services in India owing to such factors – migration, disability, aging and death (Motkuri *et al.*, 2017). Migration of health professionals and other skilled workers trained in India and working abroad is not uncommon for India[3] (see Ravi, 2017; Sinha, 2007; Percot, 2006). Some of the other factors are eventual and common.

Alternatively, there are two other main sources: the Census of India and the National Sample Survey Office (NSSO) sample surveys particularly that of quinquennial Employment and Unemployment Surveys (EUSs). Unlike the registration based accumulated numbers reported by Government of India in its health statistics reports, these two sources provide the information on number of health workers actively serving in any part of country. Both the Census and NSSO sample survey classify the workforce by the industry and occupation that they engaged in. For the purpose of workers' classification these sources adopt the National Industrial Classification (NIC) and National Classification of Occupations (NCO). They are timely updated and harmonized with the World or International systems of such classifications[4]. The 1991 Census classification of workers is based on NIC of 1987, that of 2001 Census is NIC of 1998 and that of recent 2011 Census is NIC of 2009. The Division 93 of NIC-87, 85 of NIC-98 and 86 of NIC-2009 represent the workforce engaged in healthcare activities. The Census operations from 1971 to 2001 have adopted NCO of 1968 for the classification of workers by their occupation and the recent Census 2011 adopted NCO-2004.

The present analysis is based on information sourced from Census of India. We have three Census (1991, 2001 and 2011) data to elicit changes during the last two decades in respect of the workforce in the health care sector. As the Census for the year 1991 was not conducted in the state of Jammu and Kashmir, some adjustment for the national level aggregate of population and

[2] For instance, as one of the private health care institution in India claims, their "Non-medical departments range from cafeteria, gift shop and switchboard personnel to patient escorts and social workers, accounting, housekeeping, maintenance, physical plant, information technology, human resources/recruiting, risk managers and laundry personnel", see at: https://www.fmri.in/overview-non-medical-staff

[3] As it is observed, India is the largest source of physicians in the USA and the UK, and the second and third largest in Australia and Canada (Ravi, 2017).

[4] The first national industrial classification in India was made in 1962 followed by 1970, 1987, 1998, 2004 and 2008 that modified in 2009. The first classification of occupation in India was made in 1946 followed by 1958, 1968 and then after a long time in 2004 and recently in 2015.

health workers is made. The analysis is largely based on the workforce classified as those engaged in healthcare sector based on NIC system. Hence it covers all cadres of workforce including the non-medical administrative staff engaged in the health sector. Besides, the analysis of NCO-based classification of workers of Census for the year 2001 is carried out and corroborated with previous studies. As the Census 2011 data on the NCO-based workers is yet to be released, we refer to the recent study that made estimations based on NSSO survey in 2011-12 for the updated analysis in this respect.

As the total number, change and growth of workforce engaged in healthcare activities is not revealing much in terms of its availability and adequacy with reference to the population in need of their services. The standardization of health workers to population ratio indicating density serves towards eligible comparison in this regard. Herein, we have considered density of health workers as number of health workers available per thousand population (HW/1000P) as a standardized measure. For the density measure while the numerators (i.e. health workers) and denominator (population) remains the same the multiplying constant varies from 1000 to lakh to avoid fraction (decimal) values in density indicator. For the present exercise density is per 1000 population.

For a long time there has not been any referential minimum requirement in terms of health workers per 1000 population. The research and the policy is concerned with variation in the availability of health workers on standardized measure across geographical entities i.e. countries and regions and sub-region within countries. Recently, the World Health Organisation has come up with referential minimum requirement of 4.45 health workers per 1000 population to achieve certain basic health outcomes (see WHO, 2016). Some estimated shortage of health workforce is derived referring to WHO's such benchmark (minimum) requirement of health professionals and skilled workers.

III Workforce in Healthcare Sector in India: Availability and Shortfalls

3.1 The Workforce engaged in Health Activities

In this section, we examine the total workforce engaged in healthcare activities. It consists of the health as well managerial and financial professionals along with other skilled workers in the health care sector. As mentioned above it is based on the industrial classification (NIC) of workers for the years 1991, 2001 and 2011.

Growth of Workforce in Healthcare

The total workforce engaged in healthcare sector of India in 1991 was 1.9 million that has risen to 2.35 million in 2001 and further to 4.6 million in 2011 (see Table 1). The addition (increment) of workforce in health during 1991-2001 was merely 0.45 million but it was a phenomenal addition / increment of 2.25 million that almost doubled the total workforce in healthcare during the decade of 2001-11. The comparison of the rate of growth in population and health workforce across states indicate that while rate of growth in population decelerated during the two decades period between 1991 and 2011, the rate of growth in health workforce accelerated (see Table 1). The rate of growth in healthcare workforce in India is almost similar to that of its population during 1990s but it was four times higher than that of the population during 2001-11.

Health Workers per 1000 Population: Density as a Measure of Availability and Adequacy

The density when standardized as number of health workers available per 1000 population, it is revealing that for three Census years (1991, 2001 and 2011) the density is recorded as 2.25 and 2.28 and 3.80 health workers respectively. This trend informs of a marginal improvement on this standardized measure during 1990s which is quite remarkable during the last decade. This could be due to the rising health workforce along with a decline on population growth rates during the decade 2001-11.

Disproportionate Urban Concentration of Health Workers

The density of health workers in rural areas has been lower when compared with that of urban areas. In fact, the health workers density in urban areas showed a marginal decline during 1991-2001 due to the fact that the rate of growth in urban health workers was not keeping the pace with that of urban population during this period. Again, there was a remarkable improvement in terms of growth in rural health workers and its density during 2001-11. But it could not alter the rural disadvantage in terms of having lower density. A large of proportion of workforce engaged in healthcare sector in India is disproportionately concentrated in its urban space. Urban areas sharing less than one third of total population have more than half of the workforce engaged in healthcare (see Table 1). Conversely, rural areas with more than two-thirds of total population of the country have less than half of the workforce engaged in healthcare services. This is not denying a certain improvement in rural areas during the last decade. The rate of growth in health workforce in rural India (8.95%) between 2001 and 2011 is almost eight times higher than that of its rural population (1.64%). In urban areas, the growth of health workforce (5.54%) is merely two times higher than that of its population (2.45%). In the previous decade there has not been much difference between rate of growth of health workers and population either in rural or urban areas of the country. The rate of growth in rural health workers between 1991 and 2001 was two-thirds of what the urban health workers witnessed during the period. Such pattern is reversed during 2001-11 wherein the rate of growth in urban health workers was 60 per cent to that of the rural.

Table 1: Workforce in Healthcare Sector in India

	Population			**Health Workers**			Health Workers per 1000 Population (HW/1000P)		
Location	1991	2001	2011	1991	2001	2011	1991	2001	2011
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***
	(in Millions)						(in Nos)		
All	846.3	1028.6	1210.9	1.90	2.35	4.60	2.25	2.28	3.80
Rural	628.7	742.5	833.7	0.76	0.90	2.11	1.21	1.21	2.53
Urban	217.6	286.1	377.1	1.14	1.45	2.49	5.24	5.08	6.60
Urban to Rural Ratio									
	0.346	0.385	0.452	1.498	1.621	1.178	4.327	4.207	2.604
Percent of Rural to All									
	74.3	72.2	68.9	40.0	38.2	45.9			
Rate of Growth (CAGR) in %									
All		1.97	1.64		2.13	6.95			
Rural		1.68	1.17		1.64	8.95			
Urban		2.77	2.80		2.45	5.53			

Notes: **1. CAGR** – Compound Annual Growth Rate (in %); **2.** All India figures for the year 1991 were adjusted to account for Jammu and Kashmir for which Census was not conducted in this year.

Source: Authors' Calculations based on Census of India.

When examined the decadal change in terms of absolute addition / increment (i.e. number of people / workers added from the base to reference years), the urban areas contributed little above one-third of the total population added between 1991 and 2001, and around half of it between 2001 and 2011. In case of the health workers, more than two-thirds (70%) of health workers that added to total workforce engaged in health activities during 1990s was concentrated in urban areas but such a urban concentration appeared to be little lower during 2000s wherein the urban share was little less than half (46%) of the total increment. The ratio of increment in the decade 2001-11 to the previous decade (1991-2001) is 0.8 in case of absolute increment of population but the increment of health workers in 2001-11 was 9 times higher than that of the increment in the previous decade (1991-2001). In urban areas such ratio between the last and the previous decade is 1.3 times in case of population and 3.3 times in respect of health workforce.

On the whole, the growth of workforce engaged in the health care sector is impressive during the last decade (2001-11) when compared with previous decade. But still, the rural disadvantage in this regard persists. The urban space is having an explicit relative advantage in this regard where it's share of health work force outweighs its share of population which stands to exceed the minimum need-based requirement. Therefore there is a need for geographical redistribution or redeployment of health workers between rural and urban areas.

Reference with Minimum Requirement: Shortage

As the WHO observed a minimum requirement is 4.45 health workers of skilled nature. Given the size of population in the country and WHO's threshold (of 4.45 health workers per 1000 population), it could have required nearly 3.73, 4.58, and 5.39 million skilled workforce for its health care services in India respectively for the years 1991, 2001 and 2011. The obvious ***shortage of skilled health professional and workers in 1991 was 1.85 million, it was 2.23 million in 2001 and it was 0.79 million in 2011***.

Such a minimum requirement when qualified independently between rural and urban areas, urban areas will far exceed the minimum requirement leaving the rural space falling far short of it. Visibly such shortage is quite severe in the rural areas when contrasted against the shortage depicted at the national level. Therefore, apart from making up for the shortage in health workforce, there needs to be an emphasis on its redistribution or redeployment.

Surge in Health Workforce during 2001-11 explained: ASHAs or growth of Private Sector?

The surge in terms of doubling of the workforce engaged in health sector could be due to growth private sector in healthcare services or induction of ASHAs or otherwise. In fact, engaging accredited social health activist (ASHAs), at least one per a village, is one of important component of the Government of India's National Rural Health Mission (NRHM) launched in 2005. In order to implement NRHM in rural India, a large number of ASHA workers since then are inducted and made part of the rural healthcare system. The countryside consists of more than 6 lakh villages and the count would be much more if the number of hamlets taken into account.

As per the Government of India's report the total number of ASHAs engaged by States / UTs increased from 7.06 lakh in 2009 to 8.90 lakh in 2013 (GOI, 2013). If we take an approximate of 8 lakh ASHAs for the year 2011, they account for little above one-third of the total health

workers added (increment) between 2001 and 2011. In rural areas, around two-thirds of increment in health workforce during the same period (2001-11) is accounted for by these ASHAs.

The economic reforms introduced in 1991 facilitated growth of private sector in most of the industry and services sectors including the healthcare services. Although the Government of India has since mid-1980s actively encouraged the formal private healthcare sector through direct and indirect incentives and policy measure, it took a shape during the post-reform period (see Chakravarthi *et al.*, 2017). In terms of the growth in private healthcare industry the 1990s was just a beginning but its impact got multifold since the turn of 21 Century. The private healthcare system in India is a heterogeneous mix ranging from individual practitioners to small and medium hospital and the corporate commercial hospital sector (*ibid*). As it is observed, the trend in healthcare industry during 2000s indicates that large-scale enterprises in this regard are growing faster than those of small and medium ones (see Hooda, 2015). For instance, one of the giant corporate healthcare institutions Apollo began their service since 1980s and expanding multifold geographically within and outside India. Apollo Hospitals' recent annual report claims that it has patients from 120 countries around the globe (see Apollo, 2016). The growing demand and healthcare industry and market, multinational companies as well began entering into Indian market and begin their operations (see Chakravarthi *et al.*, 2017).

Therefore, the remarkable growth of workforce engaged in healthcare activities observed for the decade 2001-11 is partly due to expanding private healthcare industry in India. Giant corporate bodies are engaging huge number of health care professionals and the other skilled health workers along with non-medical workers. There has not been much effort in assessing the size and strength of the private health care system especially in respect of its human resources. The Apollo Hospitals' recent annual report claims that it has more than 9 thousands beds capacity and nearly 60,000 dedicated health care providing staff (including doctors and other paramedics) in its group of hospitals across cities in the country (see Apollo, 2016). There are many such corporate and non-corporate multi-specialty hospitals in India along with clinics and nursing homes. Most of these private health care institutions are largely concentrated in urban areas.

It is interesting to note that there is a spatial difference in accounting for these two important factors in surge witnessed in the growth of healthcare workforce in rural and urban areas. While the induction of ASHA workers accounted for the large portion of increment in the rural health workforce during the last decade (2001-11), it is the growth of private sector in healthcare that contributed largely for the growth of urban health workforce during this period.

Regional Variations: Across Major States

Going beyond verification of the national aggregate, regional variation in this perspective is quite large with a huge variation across states in India in terms of the rate of growth of population and health workers along with the number of health workers available per 1000 population (see Table 2).

Similar to the national scene, it is true for states as well as regards the contrast between growth in population and health workforce. While the population growth rate decelerates, growth of health workforce accelerates during the two decades period between 1991 and 2011 (see Table 2). Moreover, unlike the situation observed for the period 1990s, the rate of growth in health

workforce during 2001-11 is considerably higher than that of population and it is true for most of the states. The rate of growth in health workforce during 1990s across states was less than four per cent. It is even lower among most of the states except Kerala and New Delhi. But, during 2001-11 some of the states viz., Assam, Himachal Pradesh, Jammu and Kashmir, and Odisha have witnessed a double digit rate of growth in their healthcare workforce. Except the state of Chhattisgarh, all the remaining states have registered a rate of growth in their health workforce in the range of 5 to 8 per cent. Reading the ratio of rate of growth in health workers to that of population returns a national average of 4.2. States which stands above the national average are: Kerala (13.7), Odisha (8.8), Himachal Pradesh (8.7), Assam (6.7) united Andhra Pradesh (6.5), Karnataka (5.1), Jammu and Kashmir (5.1), Tamil Nadu (4.9), West Bengal (4.8), Punjab (4.7) and Gujarat (4.5) which could be considered as states with advantage in capacity of health workforce. The rest of the states may be counted as disadvantaged in this regard.

Table 2: Density of Health Workers (per 1000 Population) and Growth of Population and Health Workers between 1991 and 2011: Majors States in India

Sno	State	1991-2001		2001-11		HW per 1000 Population		
		Pop	HW	Pop	HW	1991	2001	2011
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***
1	Andhra Pradesh (United)	1.37	2.30	1.05	6.80	2.1	2.3	4.0
1a	Andhra Pradesh (Residual)	-	-	0.92	7.22	-	2.0	3.8
1b	Telangana	-	-	1.23	5.12	-	2.7	4.2
2	Assam	1.75	1.27	1.59	10.71	1.8	1.8	4.2
3	Bihar	1.86	0.90	2.29	7.16	1.4	1.1	1.8
4	Chhattisgarh	-	-	2.06	4.22	-	1.8	2.3
5	Gujarat	2.06	1.89	1.78	7.97	2.3	2.2	4.1
6	Haryana	2.53	1.93	1.83	6.49	2.6	2.4	3.8
7	Himachal Pradesh	1.63	(-)1.20	1.22	10.62	3.1	2.4	5.7
8	Jammu & Kashmir	2.77	-	2.14	10.90	-	2.2	5.0
9	Jharkhand	-	-	2.04	7.59	-	1.4	2.4
10	Karnataka	1.63	1.91	1.46	7.45	2.3	2.4	4.3
11	Kerala	0.90	3.33	0.48	6.59	3.7	4.7	8.5
12	Madhya Pradesh	2.81	2.95	1.87	7.43	1.7	1.9	3.2
13	Maharashtra	2.07	2.90	1.49	5.52	3.3	3.6	5.3
14	Odisha	1.52	0.17	1.32	11.60	1.8	1.6	4.2
15	Punjab	1.85	1.86	1.31	6.11	3.0	3.0	4.7
16	Rajasthan	2.53	1.80	1.95	7.45	1.9	1.8	3.0
17	Tamil Nadu	1.11	1.36	1.46	7.22	2.4	2.5	4.3
18	Uttarakhand	-	-	1.74	6.77	-	2.5	4.1
19	Uttar Pradesh	2.30	1.93	1.86	6.67	1.6	1.5	2.3
20	West Bengal	1.65	2.14	1.31	6.25	2.6	2.7	4.4
21	NCT of Delhi	3.93	3.92	1.94	3.62	6.6	6.6	7.8
All India		***1.97***	***2.13***	***1.64***	***6.95***	***2.2***	***2.3***	***3.8***
C V (Major States excl. Delhi)						***26.7***	***36.3***	***35.9***

Notes: **1.** Figure represent rural and urban combined; **2.** For the state of Jammu and Kashmir in fact there was no Census conducted in 1991 but the estimated population figures are available with RGI and so we made a rough estimation based on that; **3.** The United Andhra Pradesh was bifurcated in the year 2014 into residual state of Andhra Pradesh and Telangana State. The separate state level averages for these two states for the years 2001 and 2011 were based on their district level information; 4. CV – Coefficient of Variation (%).

Source: Authors' Calculations based on Census Data.

While contrasting the population growth rates with that of growth rates of health work force, the decade of 1991-2001 exhibited small and marginal difference across states and a similar pattern was seen as regard the progress made in density of health workforce (available per 1000 population) during this (see Table 2). Due to considerably high rate of growth in health

workforce over and above that of population during 2001-11 the density of health workers across states shot up substantially ranging from 1.5 to 2.5 times higher by the year 2011 over the base (i.e. 2001). It is true for most of the states in India, although the rate of improvement varies. As observed above the surge in healthcare workforce is partly due to the induction of ASHA workers while implementing the NRHM since 2005 and partly the growth of private healthcare industry. As is the case of variation in rate of improvement across states, the contribution of ASHA workers and growth in private sectors varies from state to state.

The variation (as measured by CV) in density across states increased between 1991 and 2001 but has marginally reduced thereafter by 2011. However, the distance between the lowest density to that of the highest has increased throughout the two decades. The highest density observed among major states was three times that of the lowest one in 1991; it was 4 times in 2001 and 5 times in 2011.

3.2 Health Professional and Skilled Health Workers: NCO-based Workforce

Here in we examine the healthcare work force by differentiating health professionals and other skilled health workers. As mentioned above it is based on the classification of occupation (NCO) of workers for the year 2001 and information for the year 2011 of Census is yet to be released. It needs to be clarified that the totals of NIC based workforce that engaged in healthcare industry may not get exactly matching total from NCO based workforce engaged in this sector. The difference is due to non-medical staff engaged in the healthcare sector are not classified as health workers in the NCO.

In an illuminating in-depth study by Anand and Fan (2016) based on occupational classification (NCO) data of Census 2001, that carried out a state as well as the district level analysis observed that in India there were 2.1 million health workers of which 0.82 million (or 39.6%) were doctors, 0.63 million (or 30.5%) were nurses and midwives, and 0.024 million (or 1.2%) were dentists. Of all doctors, 77.2 per cent were allopathic and 22.8 per cent were of AYUSH (ayurvedic, homeopathic, unani or sidda) category. Other categories of health workers were pharmacists, ancillary health professionals, and traditional and faith healers, who comprised 28.8 per cent of the total health workforce. This study observed the density of health workers at the level was 79.7 doctors per lakh population, 61.3 nurses and midwives per lakh population, and dentists were just 2.4 per lakh population (Anand and Fan, 2016). The urban–rural ratio was 1.45 as 59.2 per cent of total health workers were located in urban areas, where 27.8 per cent of the population resides. The study further observed that the ratio of urban density to rural density for doctors was 3.8, for nurses and midwives 4.0, and for dentists 9.9 (*ibid*).

The study brought out inter-state differences as follows. There was a six-fold interstate differential between the highest and lowest density of all health workers (see Anand and Fan, 2016). Certain categories of health workers are highly concentrated in particular states. For instance, West Bengal had 30.6 per cent of all homeopathic doctors, Uttar Pradesh had 37.5 per cent of all unani doctors and Maharashtra had 23.0 per cent ayurvedic doctors. Kerala had 38.4 per cent of all the medically qualified nurses available in the country. In some states the fraction of AYUSH doctors was much higher wherein it was 41.7 per cent in Tripura, 40.5 per cent in Orissa and 38.1 per cent in Kerala (*ibid*). Anand and Fan (2016) study observed a suggestive

substitution between nurses and doctors within states wherein it found a negative correlation[5] between the percentage of nurses in the health workforce of a state and the percentage of doctors. Further, the study found that the density of all health workers in a state was positively but imperfectly correlated with the per capita income of the state[6]. The study infers that better-off states seem to afford more doctors plus nurses per capita[7] and more dentists per capita[8].

Further, more interestingly, the study observed that less than half (48.6%) of the health workers in India had secondary schooling and above educational qualifications and less a quarter (23.3%) of them only had qualifications of any medical degree or diploma (see Anand and Fan, 2016). It indicates that Indian healthcare system consists of such a large proportion of unqualified workforce.

However, due to brevity and limited purpose of present exercise and avoid repeating the analysis of Anand and Fan (2016), a brief description of the situation is described above. Unlike in the Anand and Fan (2016) study where the density of health workers is measured for lakh population, the present study computed health workers per 1000 population to maintain consistency with the analysis already conducted above based on NIC based classification of workers. Our focus herein is to present state level density of NCO based health workers of all cadres together (All) along with that of doctors and nurses (D&N), of allopathic doctors (AD), and of nurses including midwives (Nurses) per 1000 population (see Table 3).

The density in terms of all cadres of NCO-based health workforce available per 1000 population varied across states and the variation is almost five-fold from the lowest of 1.3 in Uttar Pradesh to the highest of 4.7 in New Delhi (see Table 3). The density of only allopathic doctors is very low across states; it is less than one except Punjab and Delhi. Similarly, the density of Nurses is less than one excepting in Kerala and Delhi.

As the Census 2011 data in this respect (NCO-based workers data) is yet to be released, we present here the updated situation in India a study based on NSSO survey of 2011-12 although it is strictly not comparable for the trends analysis of temporal change with Census 2001. A recent study by Rao *et al.*, (2016) based on NSSO 68th round Employment and Unemployment Survey (EUS) in 2011-12, taking into account of occupational classification of workers (NCO), estimated the density of health professional and skilled health workers. This study has considered only those health workers who are qualified while matching the occupation and educational qualification of the workers covered under the survey. This study has measured the density per 10000 populations. It is very well discernible from the estimates offered by this study, that density of all cadres of qualified health professionals and health workers together appeared to be lower than that observed for the year 2001. In fact, the estimates based on two different sources (Census and NSSO) and methods being strictly not comparable a trend comparison becomes unreliable. The state level data of Census 2001 presented combines both qualified and unqualified health professionals and other health workers whereas the Rao *et al.* (2016) study based on NSSO's survey of 2011-12 presents their estimates of qualified health professionals.

[5] i.e. of Pearson correlation coefficient across states of (-)0.60 (see Anand and Fan, 2016).
[6] Found a correlation coefficient of 0.76 (see Anand and Fan, 2016).
[7] Having a correlation coefficient of 0.92 (see Anand and Fan, 2016).
[8] Having correlation coefficient of 0.93 (see Anand and Fan, 2016).

Table 3: Density of Health Workers (NCO-based Cadres) across Majors States in India

- HW per 1000 Population for Census 2001 and per 10000 for NSSO (2011-12)

Sno	State	Census 2001 (Density per 1000 Population)				NSSO 2011-12 (Density per 10000 Population)		
		All	D&N	AD	Nurses	All	AD	Nurses
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***
1	Andhra Pradesh	2.1	1.5	0.75	0.53	8.3	2.3	1.9
2	Assam	1.4	1.0	0.28	0.54	2.2	2.0	-
3	Bihar	1.0	0.7	0.40	0.18	1.5	0.3	0.4
4	Chhattisgarh	1.6	1.1	0.40	0.47	9.8	3.6	2.3
5	Gujarat	1.7	1.2	0.43	0.49	16.6	1.4	13.1
6	Haryana	2.0	1.5	0.82	0.35	17.1	3.3	5.1
7	Himachal Pradesh	2.6	1.6	0.58	0.67	2.2	0.1	1.1
8	Jammu & Kashmir	2.2	1.4	0.71	0.54	9.1	1.8	2.3
9	Jharkhand	1.4	1.0	0.39	0.48	2.3	0.7	1.6
10	Karnataka	2.0	1.5	0.70	0.61	9.2	5.2	1.3
11	Kerala	3.7	2.8	0.60	1.71	31.6	3.2	18.5
12	Madhya Pradesh	1.6	1.1	0.50	0.42	5.1	0.3	1.7
13	Maharashtra	2.8	2.2	0.77	0.99	16.8	8.7	4.2
14	Odisha	1.9	1.5	0.26	1.02	3.1	1.3	1.0
15	Punjab	2.6	2.0	1.10	0.60	12.6	2.2	6.8
16	Rajasthan	1.4	1.0	0.40	0.47	3.4	0.4	2.6
17	Tamil Nadu	2.2	1.6	0.57	0.80	12.5	1.6	6.3
18	Uttarakhand	2.1	1.6	0.73	0.56	15.2	6.8	5.2
19	Uttar Pradesh	1.3	1.0	0.61	0.22	7.8	6.2	0.5
20	West Bengal	2.3	1.6	0.69	0.58	5.4	3.5	0.8
21	NCT of Delhi	4.7	3.6	1.60	1.43	17.9	7.5	1.4
All India		***1.9***	***1.4***	***0.60***	***0.58***	***9.1***	***3.4***	***3.2***

Notes: **1.** It is based on National Classification of Occupation (NCO); **2. D&N** – Doctors (Physicians and Surgeons) of all categories and Nurses including the Auxiliary Nurse Mid-Wives (ANMs); **AD** – Allopath Doctors; **Nurse**s including the Auxiliary Nurse Mid-Wives (ANMs).

Source: **1.** Authors' Calculations based on Census Data; **2.** For NSSO (2011-12) information Rao *et al.* (2016).

According to the study (Rao *et al.*, 2016) there were 1.4 million unqualified health workers in India representing 56.4 per cent of its total health workforce estimated for the year 2011-12. The percent of unqualified ones in various cadres of health professionals are as follows: 42.3 per cent of allopathic doctors, 58.4 per cent of nurses and midwives, 27.5 per cent of dentists, 56.1 of AYUSH practitioners and 69.2 per cent health associates (see Rao *et al.*, 2016). Moreover, presence of such unqualified health professionals is quite large in rural areas (71.2 per cent) which surprisingly are to the tune of (48.8%) in urban area as well (*ibid*). Indeed, prevalence of unqualified and largely unlicensed private medical practitioners (PMPs) attending to certain basic healthcare services is not a rare phenomenon in rural India and there are lakhs of such unqualified doctors in many cases at least one per village (see Narayana, 2004, Narayana, 2006).

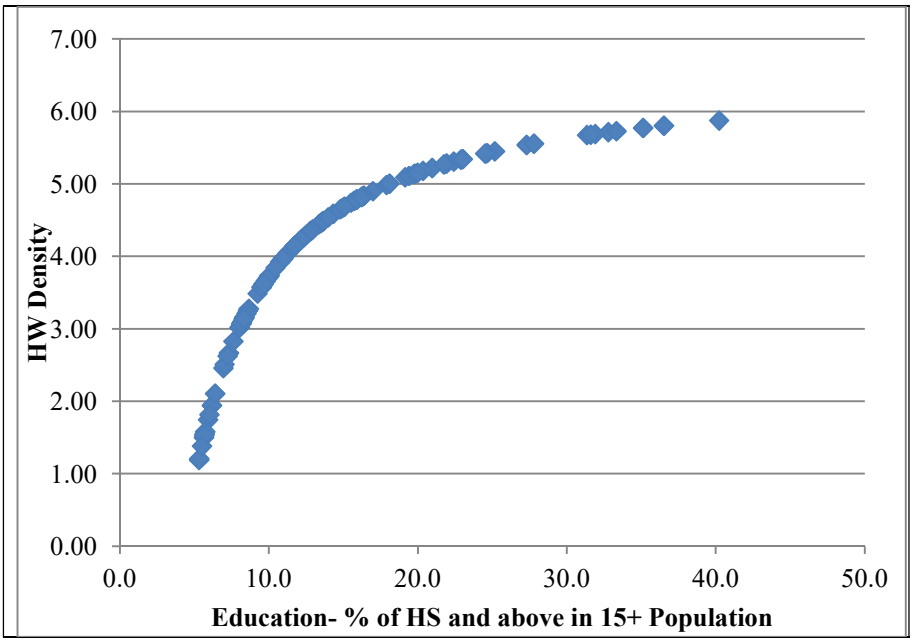
As regard the composition of the health workforce, there seems to be ideal ratio of nurses to doctors which should not be less than one meaning there needs to be more than one nurse per doctor (Rao *et al.*, 2016). But in India, this ratio varies widely across the states. Some of the states for instance, Uttar Pradesh, Karnataka, West Bengal and Delhi having density of nurses less than that of doctors indicate such an undesirable ratio of nurses to doctors below one (see

Table 3). States like Kerala and Gujarat have shown very high densities of nurses when compared to that of doctors.

3.3 Educational Levels and Health Workers Density

The aforesaid description spells out the deficiency in quantum and composition of the health workforce which largely depend on its generation form within the system. Such generation could possibly be linked with overall educational development of the region that ensures supply of qualified and trained health professionals. Therefore, we verify the association between educational development and density of health workers across states in India. As the training and production of qualified health professionals and the other skilled health workers depends on the education system and the development, the latter is critical in supplying such health workers. The variable constructed for representing the educational development is the percentage of adult (15 years and above age) population with educational level of higher secondary (HS) and above. It would have been ideal if state-wise enrolment or number of seats available for degree and diploma courses and training related to medical, clinical or any healthcare related subjects were considered for this purpose. In the absence of a readily available indicator of the kind, proxy for the same is considered for the purpose of present analysis.

Figure 1: Educational Development and Health Workers Density across states and UTs in India



Note: Observations are of all states and UTs for the years 1991, 2001 and 2011.

Source: Authors' estimation based on Census of India information.

An exploratory linear bivariate regression of health worker density (dependent variable) against the educational development (independent variable) indicates that there is a significantly positive association between the two (see Figure 1). It shows a non-linear monotonic relationship consisting of an asymptote of health workers density after a certain threshold level of educational development. Therefore, one could argue that for complying with an ideal health

worker density, there is a need for a threshold of educational development that would ensure generation and supply of health work force.

IV Availability of Workforce in Healthcare Services and Health Outcomes

Given the deficient state of heath workforce, it becomes pertinent to verify the kind of bearing this has in explaining the disparity on health outcomes across the states. . The input and outcome variables considered are respectively health workers per 1000 population and the infant mortality rate (IMR). As a beginning a bi-variate analysis is attempted here in this present exercise without controlling for any other independent variables. It is to be noted that in the previous section, state level analysis presented only for major states in India, but for the regression analysis observations of all the states including union territories (together 35 entities) are considered. The analysis of five separate bi-variate regression equations with the same dependent variable (i.e. IMR) on five different independent variables is presented (See table 4).

Table 4: Bi-Variate Regression Results - state level association between availability of health workers and health outcomes (i.e. IMR)

Dependent Variable: ***Infant Mortality Rate (IMR)***

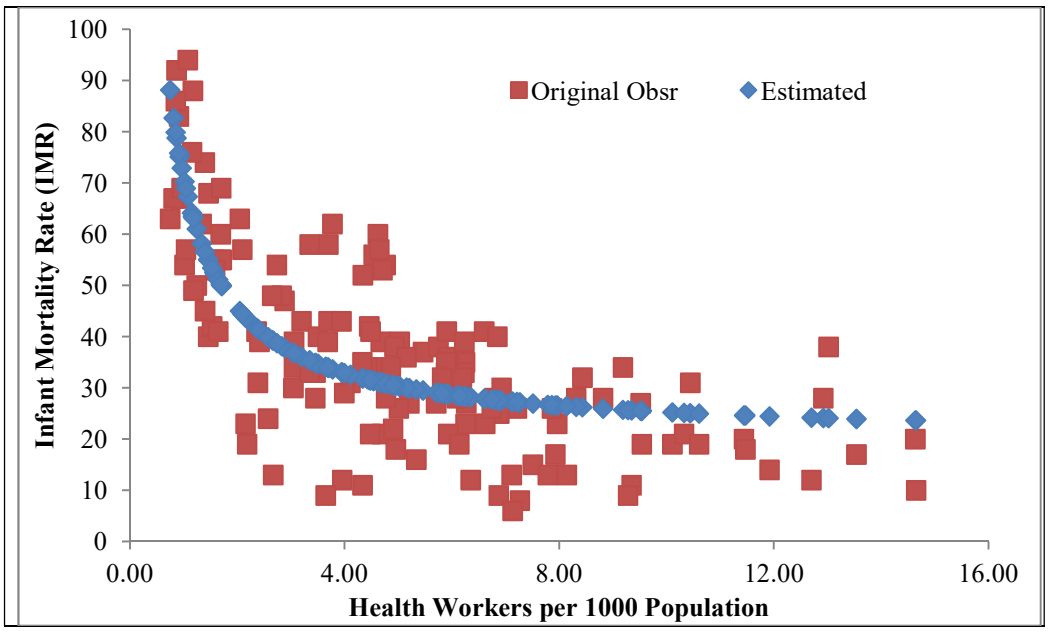
Eq.No.	Independent Variables	Constant	B	P	R^2	df	Obsr
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***
1	NIC based HW/1000P - All	20.20 (1.61)	50.72 (3.71)	0.00	0.58	139	140
2	NCO based HW/1000P – All	23.26 (2.95)	38.92 (4.55)	0.00	0.51	69	70
3	NCO based HW/1000P – Doctors & Nurses	24.55 (3.10)	24.90 (3.25)	0.00	0.45	69	70
4	NCO based HW/1000P – Allopath Doctors	36.18 (3.28)	2.59 (0.82)	0.00	0.13	69	70
5	NCO based HW/1000P – Nurses (incl. ANMs)	29.36 (2.68)	7.45 (1.0)	0.00	0.44	69	70

Notes: 1. Figures in Parenthesis are values of Standard Errors (SE); 2. Observations are - separate rural and urban values of all the 35 Indian States and Union Territories; 3. ANMs – Auxiliary Nurse-Midwives; NIC – National Industrial Classification; NCO – National Classification of Occupations.

Source: Authors' estimation based on Census and SRS data.

A reciprocal form of regression equation is considered for the present bi-variate analysis of relationship between the density of health workers and the selected health outcome, i.e. IMR. If it is to speak in the terms of econometrics, the equation with reciprocal term of density (as the independent variable) is fitting better and indicating monotonic non-linear relationship than that of its linear counterpart. Indeed, the diagnosis of residuals distribution checking the randomness is not favourable for linear equation but for reciprocal form of regression equation.

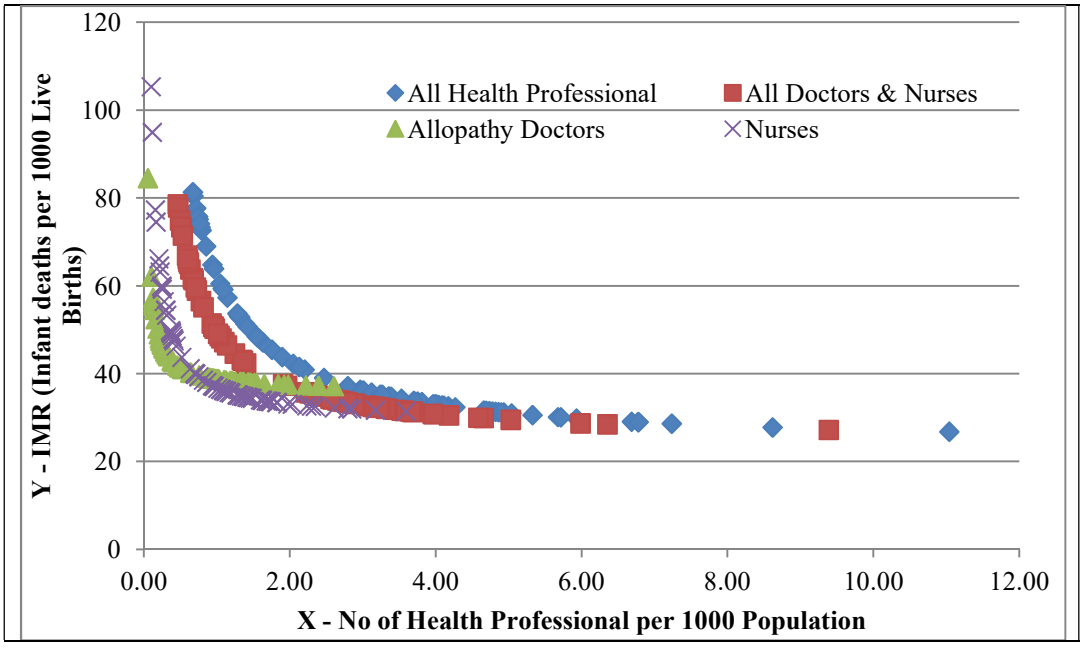
Figure 2: Health Workers and Infant Mortality Rate (IMR) across states and UTs in India for the years 2001 and 2011



Note: Observations are state level rural and urban values separately for the years 2001 and 2011.

Source: Authors' estimation based on Census and SRS data.

Figure 3: Health Workers and Infant Mortality Rate (IMR) across states and UTs in India for the year 2001



Notes: Observations are state level rural and urban values separately for the year 2001.

Source: Authors' estimation based on Census and SRS data.

The bi-variate regression analysis five separate equations conducted in this exercise informs us the significantly strong and positive relationship / association between density of health workers and the health outcome. Otherwise a negative relationship observed between IMR and density of health workers indicates a positive relationship between such density of workforce and health

outcomes because IMR is a negative outcome indicator that to be minimized (lesser the IMR better the health outcome in terms of higher infant survival rate). The explanatory power of the independent variable varied from 0.58 that of density of NIC based health workforce of all cadres to 0.21 of NCO based health workforce of only allopathic doctors.

V Conclusion

The paper examined the growth and adequacy of the workforce engaged in health care sector in India for two decades based on Census data along with the association between health workers density and educational development and then selected health outcome (i.e. IMR). The analysis informs that there is an improvement as regard density of health workers in India and across states between 1991 and 2011 particularly in the last decade (2001-11). Interestingly health workers in rural areas registered faster growth when compared with their urban counterparts. Despite this growth in rural areas, the density of health workers in rural area is one-third of that in urban areas. It is apparent that the improvement in rural health workers density is largely accounted for induction of ASHA workers since 2005 with the implementation of NRHM and that of urban for the growth of healthcare in private sector. Again, despite the remarkable improvement in health workers density particularly during 2001-11, the country is falling short of the WHO's need-based minimum requirement (4.45 health workers per 1000 population) of health workers.

The exploratory verification asserts that there is a significantly positive association between density of health workforce and educational development. It shows a non-linear monotonic relationship consisting of an asymptote of health workers density after a certain threshold level of educational development. Further, there is a significant and strong positive relationship / association between the density of health workers and health outcomes. Given the deficit in health workforce, there is a need to generate more of them and focus on its redistribution as well to address the regional differences.

* * *

Appendix

Box A1: WHO Classification of Health Workers

Health Workforce: Aggregated Level

In the aggregated data set, the health workforce is classified according to the following 9 broad categories:

Physicians - Includes generalist medical practitioners and specialist medical practitioners.

Nursing and midwifery personnel - Includes nursing professionals, midwifery professionals, nursing associate professionals and midwifery associate professionals. Traditional midwives are not classified here, but as community/traditional health workers (see below).

Dentistry personnel - Includes dentists, dental assistants, dental technicians and related occupations.

Pharmaceutical personnel - Includes pharmacists, pharmaceutical assistants, pharmaceutical technicians and related occupations.

Laboratory health workers - Includes laboratory scientists, laboratory assistants, laboratory technicians, radiographers and related occupations.

Environment and public health workers - Includes environmental and public health officers, environmental and

public health technicians, sanitarians, hygienists, district health officers, public health inspectors, food sanitation and safety inspectors and related occupations.

Community and traditional health workers - Includes community health officers, community health-education workers, family health workers, traditional and complementary medicine practitioners, traditional midwives and related occupations.

Other health workers - Includes a large range of other cadres of health service providers such as medical assistants, dieticians, nutritionists, occupational therapists, medical imaging and therapeutic equipment technicians, optometrists, ophthalmic opticians, physiotherapists, personal care workers, speech pathologists and medical trainees.

Health management and support workers - Includes other categories of health systems personnel, such as managers of health and personal-care services, health economists, health statisticians, health policy lawyers, medical records technicians, health information technicians, ambulance drivers, building maintenance staff, and other general management and support staff.

Health Workforce: Disaggregated Level

In the disaggregated data set, the health workforce is classified according to the following 18 categories:

Physicians* - Includes generalist medical practitioners and specialist medical practitioners.

Nursing personnel - Includes nursing professionals and nursing associate professionals.

Midwifery personnel - Includes , midwifery professionals and midwifery associate professionals *(Note: that for some countries, nurses with midwifery training are counted under nursing personnel.)*

Dentists - Includes dentists.

Dental technicians/assistants - Includes dental technicians, dental assistants and related occupations.

Pharmacists - Includes pharmacists.

Pharmaceutical technicians/assistants - Includes pharmaceutical technicians, pharmaceutical assistants and related occupations.

Laboratory scientists - Includes laboratory scientists.

Laboratory technicians/assistants - Includes laboratory assistants, laboratory technicians and related occupations.

Radiographers - Includes radiographers and related occupations.

Environmental and public health workers* - Includes environmental and public health officers, environmental and public health technicians, sanitarians, hygienists, district health officers, public health inspectors, food sanitation and safety inspectors and related occupations.

Community health workers - Includes community health officers, community health-education workers, family health workers and related occupations. Does not include traditional midwives.

Traditional medicine practitioners - Includes traditional and complementary medicine practitioners and associates.

Traditional birth attendants - Includes traditional midwives.

Medical assistants - Includes medical assistants, clinical officers and related occupations.

Personal care workers - Includes institution-based personal care workers, home-based personal care workers, health care assistants and other categories of care attendants in health services.

Other health workers - Includes a large range of other cadres of health service providers such as dieticians, nutritionists, occupational therapists, medical imaging and therapeutic equipment technicians, optometrists, ophthalmic opticians, physiotherapists, speech pathologists and medical trainees.

Health management and support workers* - Includes other categories of health systems personnel, such as managers of health and personal-care services, health economists, health statisticians, health policy lawyers, medical records technicians, health information technicians, ambulance drivers, building maintenance staff, and other general management and support staff

Source: WHO Technical Note.

Box A2: Cadres of Health workers and Education in India

Doctors (allopathic): medical graduates who hold either an MBBS (Bachelors degree in Medicine and Surgery) degree alone or an MBBS degree with a specialist degree or diploma. Education is imparted in Medical Colleges. The Medical Council of India is acknowledged as the regulatory body for institutions granting these degrees.

Dentists: The basic bachelors degree (BDS) which may be followed by post-graduate training in the form of a Masters degree (MDS). The regulatory body is the Dental Council of India.

Practitioners of Ayurveda, Homeopathy, Unani, Sidha: this group collectively known as AYUSH doctors hold bachelors or post graduate degrees in one of the above systems of traditional medicine. The regulatory body is the Central Council for Indian Medicine or the Central Council for Homeopathy.

Nurses: Nursing qualifications include a three and a half year diploma in General Nursing and Midwifery (GNM) or a four year bachelors degree (B.Sc) which may be followed by a two to three year post graduate degree (M.Sc) registered with the Nursing Council of India.

Auxiliary Nurses and Midwives: This group receives a two year diploma in auxiliary nursing and midwifery.

Pharmacists: with a bachelors or masters degree in pharmacy.

Laboratory and Diagnostics Technicians: Trade / occupation specific degree or diploma.

Medical Assistants: Trade / occupation specific degree or diploma.

Community Health Workers (CHWs): This group consists of individuals who have undergone at least ten years of formal education. They receive 23 days of training to perform this function. The broad group of Community Health Workers includes cadres such as Health Assistants and Health Educators.

Accredited Social Health Activists (ASHAs): this is a cadre of health volunteers set up under the NRHM. They are resident in the village that they work in, have a minimum of eight years of formal education and are usually women in the age range of 25-45 years.

Registered (Private) Medical Practitioners (RMP / PMP): This group consists of unlicensed practitioners who mainly practice allopathic medicine. They are found both in rural and urban areas and have little to no formal medical training.

Traditional Healers: this heterogeneous group includes those who use spells, chants and talismans to treat illnesses.

Health Management and Supporting Workers: Non-medical degrees or Diplomas

Source: Adopted from Rao *et al.* (2011) with a marginal addition based on WHO's technical note.

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