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Size, composition and distribution of human resource for health in India: new estimates using National Sample Survey and Registry data

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TITLE PAGE

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ABSTRACT

Objectives: Present study attempts to provide the latest estimates on size, composition and distribution of human resource for health in India and compare with the health workers population ratio as recommended by the World Health Organization. The study also aims to estimate size of non-health workers engaged in health sector and technically qualified health professionals not being part of the health workforce.

Design: Nationally representative cross-section household survey and review of published documents by the Central Bureau of Health Intelligence.

Setting: National

Participants: Head of household/key informant in a sample of 101724 households

Interventions: Not applicable

Primary and secondary outcome measures: Primary outcome-Number and density of health workers; secondary outcome- percentage of health workers technically qualified and percentage technically qualified not in workforce.

Results: Total size of health workforce estimated from National Sample Survey (NSS) is 3.8 million as of January 2016, which is about 1.2 million less than the total number of health professionals registered with different councils and associations. The density of doctors and nurses and midwives per 10,000 population is 20.6 according the NSS and 26.7 on the basis of the registry data. The density in rural India and states in eastern India are lower than the WHO minimum threshold of 22.8 per 10,000 population. More than 80% of doctors and 70% of nurses and mid-wives are employed in private sector. Lastly, as high as approximately 25% of the currently working health professionals do not have required qualifications as laid down by professional councils while 20% of adequately qualified doctors are not in the current workforce.

Conclusions: Distribution and qualification of health professionals are serious problems in India when compared with the overall size of the health workers. Policy should focus on enhancing the quality of health workers and mainstreaming professionally qualified persons into the health workforce.

Strengths and limitations of this study

- Size and composition, density and distribution across states, rural-urban and public private sectors of HRH in India have been estimated as of January 2016.
- The study for the first time estimates non-health workers engaged in the health sector and technically qualified health professionals not being part of current workforce.
- The registry data of the health professionals are inadequately updated and National Sample Survey data provides information on self-reporting basis
- There could be an overlap in the definition and reporting of nurses and midwives in the National Sample Survey data.

Introduction

The size and composition of human resource for health (HRH) in India has significantly changed during the last decade, particularly since the launch of National Rural Health Mission (NRHM) in 2004. Most existing literature on HRH in India, using pre-NRHM data, reported that India is well short of the World Health Organization's (WHO) minimum threshold of 22.8 skilled health professionals per 10,000 population[1–5]. Recently, WHO drawing evidence from the Organisation for Economic Cooperation and Development (OECD) countries revised the minimum need as 44.5 health professionals per 10,000 population[6].The Global Health Workforce Alliance (GHWA) and WHO categorised India among the 57 most severe crisis facing countries in terms of availability of human resource for health HRH[7,8]. However, the recent health sector reforms in India have emphasised on strengthening HRH, particularly in the public sector system[9]. For instance, central and many state governments took proactive steps towards rural posting for public sector doctors. Many states contracted private sector practitioners and non-governmental organisations (NGOs) to bridge the gaps at primary health centre levels in rural and sub-urban areas[9]. On the supply side, the last decade and a half witnessed a rise in the medical colleges, nursing institutions and other technical education institutions in medical and para-medical disciplines[10,11].

Against this background, we assess the current situation of overall availability, composition and distribution of HRH in India. Using data from registration of health professionals with different professional councils and the labour force survey of the National Sample Survey Organisation (NSSO), we estimated the current size and composition of HRH in different categories such as allopathic doctors, indigenous system (Ayurvedic, Unani, Siddha and Homeopathic [AYUSH]) doctors, dentists, nurses and midwives, and technicians and allied

health workers like health assistants, sanitarians, nutritionist, pathological assistants etc. and compared the population heath workers ratio with the minimum threshold of 22.8 health workers per 10,000 population of the WHO [7,8]. One of the main motivations of the present study is to compare the health professional registry data with the workers data from the NSSO and provide range of estimations for different categories of health professionals across the two sources.

Several studies in the past estimated the size and composition of HRH in India [1–8, 12-14, 16]. However almost all of these studies, excepting one [16], are based on dated data, hence present a situational analysis during the pre-reforms period in the health sector in India. For instance, Rao et al. using Census 2001 and NSSO 2004-05 data estimated approximately 2.2 million health workers in India which roughly translates into a density of 20 technical health workers per 10,000 population[3]. The study estimated size of allopathic physician and surgeon ranging between 0.47 million and 0.67 million. All these estimates are far lower to the minimum thresholds of 22.8 health workers per 10,000 population and 10 doctors per 10,000 population. These studies also provided estimates of other health workers such as nurses and midwives, AYUSH doctors, and pharmacists. Other studies have highlighted a lopsided distribution of HRH across Indian states with comparatively poorer states of the north and east which have low density of health workers compared to Delhi and south Indian states [3,5]. Anand et al. in an India-China comparative study estimated 1.9 million health workers on the basis of the Census 2001 data[1]. Density of doctors and nurses taken together reported in the study is 13.6 per 10,000 population[2] which is far lower compared to the estimates in other studies[3,5]. In a recent study, using the NSSO 2011-12 data from NSSO, Rao et al. estimated that, there were 2.5 million health workers (density of 20.9 workers) in India [16]. The study also reported that more than half of the total number of health workers

are unqualified and adjusting for the right qualifications leaves India with a density of 9.1 workers per 10,000 population. Hazarika, however, on the basis of government records reported higher number of doctors (0.76 million) and nurses (1.6 million) for the year 2010 and 2011 respectively[14].A report by Klynveld Peat Marwick Goerdeler (KPMG) and Federation of Indian Chambers of Commerce and Industries (FICCI), using data from Central Bureau of Health Intelligence (CBHI), estimated total size of health workers in India as 4.7 million in the year 2015 consisting of 0.9 million doctors, 0.69 million AYUSH workers and 1.6 million registered nurses[15].

Most of the earlier studies used pre-reforms period data and do not capture recent changes in HRH situation in India. Moreover, only a couple of studies provide situation of HRH gaps at the state levels and rural-urban disaggregation. Also the existing literature does not provide insights on size of allied health professionals and support staff. Our paper aims to fill these gaps in literature by providing latest estimates of HRH as of January 2016 at an all-India and state level; and rural-urban disaggregation. Also, for the first time we estimated the size of non-medical support staff at the country level.

Methods

The present study used data from two sources: (i) web-site of institutions and review of existing reports and literature providing data on registered qualified health professionals and (ii) the 68th round (July 2011-June 2012) NSSO survey on 'Employment and Unemployment Situation in India'.

The first set of information were collected from the published literature and the web-sites of Medical Council of India (MCI), Dental Council of India (DCI), Indian Nursing Council (INC), Pharmacy Council of India, Indian Association of Physiotherapist and Ministry of

Health and Family Welfare (MoFHW). These institutions provide numbers of registered professionals in their respective fields. Most numbers were collated from the respective reports/web-sites for the year 2015. Based on these records, we identified seven different categories of health workers. Categories of workers, their required educational qualifications, sources of data and reference years are presented in –Table 1.

Table 1: Sources of information on registered health professionals

Health workers	Educational qualification	Degree awarding agencies and Source of data	Latest Year available
Allopathic doctors (physician and surgeon)	graduates with a bachelor's or postgraduate specialist diploma	Medical council of India	2015
Dental practitioner	graduates with a bachelor's or postgraduate degree in dentistry	Dental council of India	2014
AYUSH practitioner	graduates with a bachelor's or postgraduate degree in Ayurveda, Unani, Siddha, or Homoeopathy	Department of AYUSH/MoHFW	2015
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	2015
Pharmacist	diploma or bachelor's degree course in pharmacy	Pharmacy council of India	2014
Physiotherapist, diagnostic and others technician	Diploma/certificate in medical allied fields	Indian Association of Physiotherapist and Ministry of health and Family Welfare	2014

The second source of information on health workers is available from household survey on employment and unemployment situation in India conducted by the NSSO every five years[17]. The NSSO is a nationally representative multi-stage stratified cluster sample survey, which collects information on labour market indicators, along with a range of socioeconomic characteristics of households and individuals. The sample size of the 68th round was 101,724 households (59,700 rural and 42,024 urban) covering approximately 457,000 persons spread over approximately 12,000 villages/urban blocks in the country. The survey collected self-reported information on types of work of each individual during a reference period of the last one year of the survey. Along with a large number of labour market indicators, the survey collected information related to nature of occupation of workers categorised by the 3-digit National Classifications of Occupation (NCO) 2004 and 5-digit National Industrial Classification (NIC) 2008.

Workers in the NSSO data are identified by their reported activity status. The survey reports up to two activities of all persons based on major and short time dispensation criteria separately. For instance, an individual may report being primarily a non-worker, but may be pursuing some economic activities for short period of time in a reference year. Similarly, an individual primarily engaged in non-medical activities based on primary status might pursue some medical activities on secondary status basis only for a shorter time-period in the reference year. We considered both activities of each individual and identified health workers either on primary or secondary status basis. NSSO defines this as 'Usual Primary and Subsidiary Status (UPSS) workers[17]. Hence, the total health workforce estimates included two distinct groups of individuals: i) individuals reporting working as health workers according their primary status and ii) health workers according to their secondary status but

not according to their primary status. Accordingly, distribution of these workers by rural-urban, public-private etc. is based on respective work statuses. This helped identifying 'not in workforce' persons as those who did not report as worker either as per their primary or secondary status. Cross-classifying with individuals' educational achievements we identified size of technically qualified persons for health service delivery but are not in the workforce.

NCO 2004 and NIC 2008 codes were used to classify health workforce by broad occupation types such as physician, dental, AYUSH, nurses etc. Since, health workers may be employed within the health sector as well as non-health sector (railways, defence, other non-health enterprises etc.), we considered all sectors of the economy to estimate the HRH size. Further, health sector also employed a large number of non-health workers such as managers, accountants, clerks, drivers and other similar support staff. We estimated size of all those non-health workers employed in the health sector. We used NCO (3-digit) and NIC (5-digit) codes to identify three major categories of workers:

1. Individuals trained in medical, para-medical and related activities working within the health sector of the economy, (health workers in health sector);
2. Individuals trained in medical, para-medical and related activities working in non-health sector of the economy (health workers in non-health sector); and
3. Individuals not trained in medical, para-medical and related activities working within the health sector of the economy only as support staff (non-health workers in health sector).

Here we want to clarify that all untrained and/or unregistered personnel dispensing medical advice and medicines including personnel whose qualifications are incomplete are included in the first two categories. The third category only represents non-medical staff such as managers, clerks, accountants, sanitation workers etc. Types of health workforce identified in the NSSO survey along with the NCO and NIC codes is presented in Appendix, section I.

The existing NCO and NIC codes in the 2011-12 survey could not identify disaggregated numbers of health professionals by physician, AYUSH and dentist in the non-health sector, although the same were identified within the health sector (first category). Since the previous NSSO surveys used NCO 1968 code, the same disaggregation in non-health sector was available in the 2004 survey. We used the ratio of physician, dentist and AYUSH in total health professional to segregate the numbers of physician, dentist and AYUSH only in the non-health sector. We reported segregated numbers for the three categories of the HRH (physician, dentist and AYUSH) only at the national level. Also, within the AYUSH workers, the latest NSSO data does not support reliable estimates on different components such as Ayurveda, Unani, Siddha, Naturopathy and Homoeopathy.

The two sources (registry and NSSO data) mostly identify comparable categories of health professionals. However, there were two categories where we could not generate comparable estimates. One of these is the group categorised as 'health associate professionals' in the NSSO consisting of health assistant, sanitarian, dietician and nutritionist, optometrists and opticians, dental assistants, physiotherapy associates, pharmacist assistant etc. We did not find comparable estimates on these workers from other sources. Similarly, number of Auxiliary nurse and midwives (ANM) is available from the records of MoHFW but the same could not be identified in the NSSO because of the overlap of NCO codes [3].

NSSO data contains information on education levels completed by each individual. We ascertained educational qualification of workers by comparing educational achievements of health workers (reported in the NSSO data) with the required qualifications as recommended

by the agencies such as MCI for doctors and surgeon and INC for nurses and auxiliary nurses.

Although, NSSO data does not provide information on rural-urban break-up of work place of workers, we used information on rural-urban place of residence of workers to compare the proportional distribution of all population and health workforce across rural and urban settings. In general, the rural-urban place of residence of health workers can proxy the availability of HRH in the respective areas.

In order to estimate total number of health workforce as of January 2016 we applied the worker participation rate (WPR) estimated from NSSO 2011-12 to the projected population as of 1st January 2016 using cumulative annual growth rate of population between 2001 and 2011 censuses. The projections were done at disaggregated levels – male and female living in rural and urban areas separately in all states. The final estimates of HRH was arrived at using the formulae in equation (1).

$$HW_{ha} = popl_{ijk}2016 * WPR_{ha} \quad \ldots\ldots (1)$$

Where 'HW_{ha}' represents health workers from categories 'a' (representing doctors, dental, AYUSH, nurses etc.); $popl_{ijk}2016$ is projected population as of January 2016 and WPR_{ha} is worker participation rate for each category in the year 2011-12. Estimation of WPR in each category of workers is arrived at using equation (2).

$$WPR_{ha} = N/popl_{ijk}2011-12 \quad \ldots\ldots (2)$$

Where; N is number of workers in each category.(see Appendix, section – II for the details on the methods of projection)

We assumed the WPR of health workers in the year 2016 to be the same as estimated from the NSSO 2011-12 data. Although WPR has declined over the years between 2009-10 and

2011-12 the decline has been less than 1%, most of the decline has been realised in rural areas and among females. We assumed that WPR among health professionals did not decline significantly since 2011-12.

Patient and Public Involvement

Patient and/or public were not involved in this study.

Results

Size and composition

Total size of health workforce estimated from NSSO is approximately 3.8 million as of January 2016 (Table 2).

Table 2: Total number of health workers by broad categories as on January 1, 2016

Health worker category	Estimates based on NSSO as of January 1, 2016	Registered, 2015*	Source of registered numbers
Allopathic physician	7,70,277	9,36,488	MCI
Dental practice	95,959	1,54,436	MCI
AYUSH	5,30,919	7,44,563	MCI
Physiotherapy, diagnostic and others	86,508	60,000	MoHFW
Nursing and midwife	13,17,669	16,73,338	INC
Pharmacist	2,14,744	6,64,176	Pharmacist Association
Health associate professional**	8,11,744	NA	
ANM	NA	7,89,740	MoHFW
All	3,827,820	5,022,741	

Notes: * registered with MCI/NCI, Association and MoHFW records; **includes health assistant, sanitarian, dietician and nutritionist, optometrists and opticians, dental assistants, physiotherapy associates, pharmacist assistant etc.

Sources: Column 2 – Authors' estimates using unit level data of the NSSO 2011-12; Column 3 – Central Bureau of Health Intelligence 2017[17)

This excludes approximately 1.2 million non-health workers engaged in the health sector. The NSSO estimates are about 1.2 million lower to the total number of health professionals registered with different councils and associations. Total number of registered physicians and

nurses with MCI and INC respectively were 0.94 million and 1.67 million respectively in the year 2015 as against 0.77 million physician and 1.32 million nurses and midwives estimated from NSSO for the year 2016. In addition, health associate professionals as reported in the NSSO data is estimated at 0.8 million. Total number of ANM, available only from MoHFW, is approximately 0.79 million.

In addition, the NSSO estimates include approximately 1.25 million non-health workers (other support staff) employed in the health sector (Table 3).

Table 3: Number of other support workers in health sector estimated from NSSO as on January 1, 2016

Types of workers	% distribution	Total number	Per 10,000 population
Clerks, cashiers, tellers etc.	21.0	261,048	1.98
Personal care, housekeeping etc.	17.1	212,499	1.62
Garbage Collectors and Related Labourers	13.0	161,923	1.23
Life science professionals	7.0	87,108	0.66
Directors and chief executives & managers	6.4	79,545	0.60
Motor drivers	5.2	64,216	0.49
Other workers in health sector	4.7	58,871	0.45
Messengers, Porters, Door Keepers and related	4.2	52,854	0.40
Physical and engineering science technicians	4.1	50,884	0.39
Chemical products and machine operators	2.9	36,211	0.28
Precision workers in metal and related materials	2.7	33,954	0.26
Mathematician, statistician, computer professionals	2.7	33,365	0.25
Architects, engineers and related	2.0	25,265	0.19
General and department managers	2.0	24,634	0.19
Mechanics, fitters, finishers etc.	1.6	19,805	0.15
Business professionals	1.6	19,545	0.15
Teaching professional and associate	1.5	18,308	0.14
Physicist, chemist & related	0.5	5,844	0.04
Total	100	**1,245,878**	9.47

Source: Authors' estimates using unit level data of NSSO 2011-12.

More than one-fifth (0.26 million) provide administrative support staff such as clerks, cashiers, teller etc. Personal care staff such as housekeeping and restaurant service workers, personal care, protective service etc. constituted 17% (0.21 million) of all non-health workers. The third major category of workers is garbage collectors and related sanitation workers constituting up to 13% of all non-health workers within the health sector. Motor drivers constituted more than 5% of all non-health workers in the health sector.

Density

Estimates from NSSO translates to approximately 29 health workers per 10,000 population if all HRH are taken into consideration (Figure 1). Nurses and midwifes had the largest share (density being 10 and 12.7 per 10,000 population on the basis of NSSO and INC respectively) in the total health workforce.

Considering only doctors (including AYUSH) and nurses & midwives, the density of health workers is 20.6 per 10,000 population according the NSSO estimates; and 26.7 per 10,000 population according to registry data. Estimates from NSSO are marginally below and the registry data are considerably above the WHO's minimum threshold of 22.8 workers per 10,000 population. However, if we consider ANM as part of the trained health workers the density turns out to be close to 30 per 10,000 population. NSSO numbers indicate that there are 10 nurses and midwifes per 10,000 population. This translates to 1.7 nurses and midwives per allopathic doctors as against the High Level Expert Group (HLEG) recommendation of two nurses and one ANM per allopathic doctor[18]. The registered numbers too reflect almost the same ratio between nurses and midwives and allopathic physicians.

When the estimates on total health workers from NSSO are adjusted for qualification, the density is reduced from 29 to 16 per 10,000 population (Table 4).

Table 4: Percentage of health professionals without requisite qualifications and the adjusted estimates of health workers -- total number and per 10,000 population

Health worker category	% health professional not with requisite qualifications**	Total number of HRH after adjusting for education	Density of HRH per 10,000 population after adjusting for education
Allopathic physician	24	5,85,411	4.5
Dental practice	8	88,282	0.7
AYUSH	21	4,19,426	3.2
Physiotherapy, diagnostic and others	45	47,579	0.4
Nursing and midwife	58	5,53,421	4.2
Health associate professional*	62	3,08,463	2.3
Pharmacist	62	81,603	0.6
Total	54	20,84,185	15.8

Notes: * includes health assistant, sanitarian, dietician and nutritionist, optometrists and opticians, dental assistants, physiotherapy associates, pharmacist assistant etc.; ** levels of required qualifications considered for doctors (allopathic, dental and AYUSH) was graduate/post graduate in medicine, for nurse and midwife higher secondary with technical education in medicine or related field, for others higher secondary with technical education in para-medical related fields[15].

Source: Authors' estimates using unit level data of NSSO 2011-12.

For physicians, 24% had inadequate or no medical training. Adjusting for this proportion, the allopathic physician density in India reduced from 5.9 to 4.5 per 10,000 population. Similarly, the proportion of nurses and midwives per 10,000 population drops down to 4.2 when adjusted with required level of education and training.

Distribution across states, rural-urban and public private

Most of the central and eastern Indian states have low density of health workers ranging from approximately 23 per 10,000 population in Bihar and North-East states other than Assam to as low as 7 per 10,000 population in Jharkhand. The only south Indian states reflecting lower density than the all India average (29) is Andhra Pradesh (25) and only eastern Indian state

having higher density than the all India average is West Bengal (36). Highest concentration of health workers is in Delhi (67) followed by Kerala (66), Punjab (52) and Haryana (44) (Figure 2a). Considering only doctor, nurse and midwife density per 10,000 population, Delhi and Kerala numbers are far higher compared to other states with Bihar along with Jharkhand occupying the lowest position (Figure 2b).

Density of physician and surgeons (including AYUSH and dental) per 10,000 population is as low as 1.8 in Assam and 1.9 in Himachal Pradesh (Table 5).

Table 5: Health worker density (Per 10 000 population) in states in India.

State	Physician and surgeon*	Health associates**	Nurse and midwife	All
Andhra Pradesh	5.9	11.5	7.9	25.4
Assam	1.8	1.0	8.0	11.3
Other NE states$	6.7	7.8	10.6	25.1
Bihar	3.3	17.5	2.0	22.9
Chhattisgarh	18.3	3.5	10.7	32.4
Delhi	34.4	13.4	19.5	67.3
Goa	11.3	4.8	6.5	22.7
Gujarat	5.8	7.4	26.5	39.8
Haryana	16.8	18.3	9.0	44.1
Himachal Pradesh	1.9	7.9	6.0	15.9
Jammu & Kashmir	14.7	15.7	11.0	41.8
Jharkhand	3.0	0.3	3.3	6.7
Karnataka	17.1	8.0	10.0	35.1
Kerala	14.5	13.4	38.2	66.0
Madhya Pradesh	6.3	2.5	3.5	12.3
Maharashtra	19.7	6.7	9.6	36.0
Odisha	7.4	10.3	2.1	19.9
Punjab	17.8	21.3	12.5	51.7
Rajasthan	4.5	1.4	14.3	20.4
Tamilnadu	8.6	8.7	15.2	32.6
Uttar Pradesh	13.8	4.0	3.9	22.1
Uttarakhand	11.6	6.9	18.7	37.2
West Bengal	16.9	12.5	6.7	36.1
Union Territories$$	12.3	21.8	27.6	61.7
All India	11.3	8.4	9.4	29.1

Notes: * includes AYUSH and dental practitioners; **includes health assistant, sanitarian, dietician and nutritionist, optometrists and opticians, dental assistants, physiotherapy associates, pharmacist and pharmaceutical assistants; $ includes six north east Indian states Arunachal Pradesh, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura; $$ includes Andaman and Nicobar Islands, Dadar and Nagar Haveli and Lakshadweep.

Source: Authors' estimates using unit level data of NSSO 2011-12.

Density of physician and surgeon is also lower than five in states of Bihar, Jharkhand and Rajasthan. Delhi has the highest density of physician and surgeon (34) but the density of nurses and midwives is the highest (38) in Kerala. The HLEG recommendation for the doctor-nurse ratio in India is 1:3. Other states with acute adverse ratio (less than 1:1) of nurse to doctor are Bihar, Chhattisgarh, Goa, Haryana, Jammu and Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Punjab, Uttar Pradesh and West Bengal.

The uneven distribution of health workers is also reflected across rural-urban settings. Although rural India constituted approximately 71% of the total population in 2016, only 36% of all health workers are in the rural areas (Figure3). This proportion is little lower for health associates and assistants and pharmacist. The proportion of physician and nurses in rural areas are 34% and 33% respectively.

Further, bulk of the total health workforce is employed in private sector (Figure 4). The proportion employed in private sector is far higher for doctors compared to nurse and midwife and other health workers. In case of AYUSH and dental practitioner, share of public sector is less than 10%. However, approximately 45% of nurse and midwife are employed in public sector institutions (Figure 4). Further, private health sector in India consists of wide range of service providers ranging from 'for-profit' hospitals, 'not-for-profit' (NGO, charitable institutions, trusts, etc.) institutions and private individual practitioners[12,20]. Distribution of all health workers by types of institutions reflect that overwhelming majority (53%) of these workers are self-employed in sole proprietorship or partnership entity. Only 6% of all health workers are employed in big corporate companies with public or private limited status (Figure 5).

Lastly, our analysis reflect that a sizeable proportion of technically qualified individuals are not in the existing workforce (Table 6).

Table 6: Percentage individuals (age 15 years and above) with different levels of education not in workforce

Level of education	Persons	Male	Female
Graduate in medicine	19.2	16.3	25.7
Graduate in other	37.5	16.6	69.2
Diploma/Certificate in medicine	30.9	16.3	45.5
Diploma/Certificate in other	29.6	21.8	54.2
Vocational training in health and paramedical services	9.9	37.9	26.3
Other Technical degree	23.3	17.3	39.6
No Technical degree	45.7	20.8	70.0
Total	44.7	20.4	69.7

Source: Authors' estimates using unit level data of NSSO 2011-12.

In general, 45% individuals with some educational qualification are not in the workforce. This proportion is slightly lower for the individuals with medical or related degrees. However, approximately 19% individuals with degree in medicine and 31% individuals with diploma /certificate in medicine are not in the current workforce. These proportions are 26% and 46% respectively in case of female. In case of vocational training in health and paramedical services, however, higher proportion of male (38%) compared to female (26%) are out of workforce.

Discussion

The study presents updated estimates of HRH in India as of January 2016. For the first time, we estimated size and composition of non-health workers employed within the health sector. Two major sources of data, employment and unemployment survey of NSSO 2011-12 and registration of health professionals with institutions till 2015, largely reflect similar results excepting a couple of additional categories of health workers reported across the two sources.

Data from the two sources are not strictly comparable. The methods and points of data collection across the two sources are different. In general, estimates from NSSO are lower in comparison with those from the registry data. There are several possible reasons which include: (i) Many registered professionals are unemployed and are looking for suitable jobs, (ii) many of the registered professionals have migrated out of country, (iii) they may be simply out of labour force and not looking for any employment (mostly old age and women), and (iv) many of these registered professionals may not be alive any more.

Density of total health workers is estimated to be 29 per 10,000 population based on NSSO and 38 per 10,000 population based on the registration data. If only doctors, nurses and midwives are considered, the density of health workers is close to WHO's minimum required threshold of 22.8 health workers per 10,000 population.

Our estimates from NSSO are higher compared to a similar study using the NSSO data[16] mainly because we considered all health workers employed either as their principal or subsidiary activity status. Combining principal and subsidiary statuses together provides larger estimates compared to only principal status workers as reported in Rao et al. using the same data source [15]. The largest difference we find is for AYUSH workers: an overwhelmingly large proportion of them report as health workers only in subsidiary status capacity. Considering only principal activity of health workers highly underestimates size of AYUSH professionals as reported in the NSSO data.

We for the first time presented two additional categories of workers directly or indirectly engaged in the activities related to human health. These two categories of workers are: (i) health assistants and associates and (ii) other support staff engaged in administrative,

managerial and other support activities. Health associates and assistants directly support other health workers involved in service delivery. This group includes health assistants, sanitarians, dieticians and nutritionists, optometrists and opticians, dental assistants, physiotherapy associates, pharmacist assistants etc. We estimated total size of such workers at 0.81 million as of January 2016. The second group (1.25 million) included clerks, cashiers, tellers, housekeeping and restaurant service workers, personal care, protective service staff, garbage collectors, other sanitation workers etc. These support staff perform crucial roles which are imbedded in overall health service delivery.

Our findings from NSSO clearly show the dominance of the private sector in total HRH. This dominance is most evident in the number of dentists. In general, little over 50% of all doctors are produced from government medical colleges, more than 80% of them are employed in private institutions or work as private practitioner[19,20]. Although it cannot be argued that all those who study in public institutions should only work in public sector, it may not be out of order to expect that professionals passing out from public institutions must be sufficiently sensitive to public health issues and may extend their services at least in some proportion to public sector facilities. In recent years, Government of India and a few state governments have been recommending for a few years of rural posting for newly passed out health professionals. Also, governments both at the central and state levels have come out with strategies to utilise the services of private health professionals in the public sector facilities.

In general, we find that although the overall size of health workers in India is lower than many developed countries, these numbers are close to the WHO lowest threshold of 22.8 doctors and nurses per 10,000 population. Adding the workers from health associate professionals and ANM leads to a density of approximately 30 per 10 000 population in

India. Recently WHO has revised the minimum threshold to 44.5 per 10 000 population. This higher threshold is based on the experiences of developed countries and India can certainly aspire to achieve this in near future. However, there are serious problems related to the distribution of HRH across Indian states and rural-urban settings. Bulk of the doctors and nurses are located in major cities leaving a significant gap in rural areas and in poorer states. Moreover, there are also significant problems related to educational qualifications of a large proportion of health workers. Approximately one-fourth of physicians and approximately half of total number of nurses reported inadequate qualification. Adjusting the total number of health workers with adequate educational qualification obviously leaves a significant gap in the availability of quality health workers. In contrast, a sizeable proportion of technically qualified individuals are not in the workforce. A large proportion of them are women. Government has taken up several initiatives, including enhanced retirement age and suitable working conditions of women workers, in recent years to mainstream these technically qualified persons.

Our research has a few obvious limitations. Apart from the fact that the registry data of the health professionals are inadequately updated, NSSO data provides information on self-reporting basis. However, both the sources taken together may provide a range of availability of health workers in India. We have used WPR of 2011-12 from the NSSO data to estimate health workers as of January 2016. NSSO data is not available so far after 2011-12. If WPR of health workers declines after 2011-12, our estimates from NSSO are likely to be upwardly biased. Another limitation of the study is overlap in the definition and reporting of nurses and midwives in the NSSO data. Further, many health professionals may work in the public and private sectors and rural and urban areas simultaneously. The data and methods used in our study is not capable to capture this phenomenon fully.

Conclusion

Distribution and qualification of health professionals are serious problems in India when compared with the overall size of the health workers. In contrast, a large proportion of technically qualified health professionals are not in the current workforce. Any HRH policy needs to consider these points while considering changes/reform in the existing policy. Policy should focus on enhancing the quality of health workers and mainstreaming professionally qualified persons into the health workforce.

Declarations:

Authors' contribution: AK, HN and SZ conceptualised the study. AK, AS, HN, RN, RT conducted data analysis and review of literature. AK, HN and SZ prepared the first draft. All authors contributed to review and revision in the first draft and approved the final version.

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Data sharing statement: The data set used in the study are publicly available from National Sample Survey Organisation and Medical and Nursing Council of India. Anyone can access these data set either by paying the requisite fee or by making request for free access.

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Figure legends

Figure 1: Health worker density - All India number of (health workers per 10 000 population).

Figure 2a: Total health worker density – Major states (Per 10 000 population).

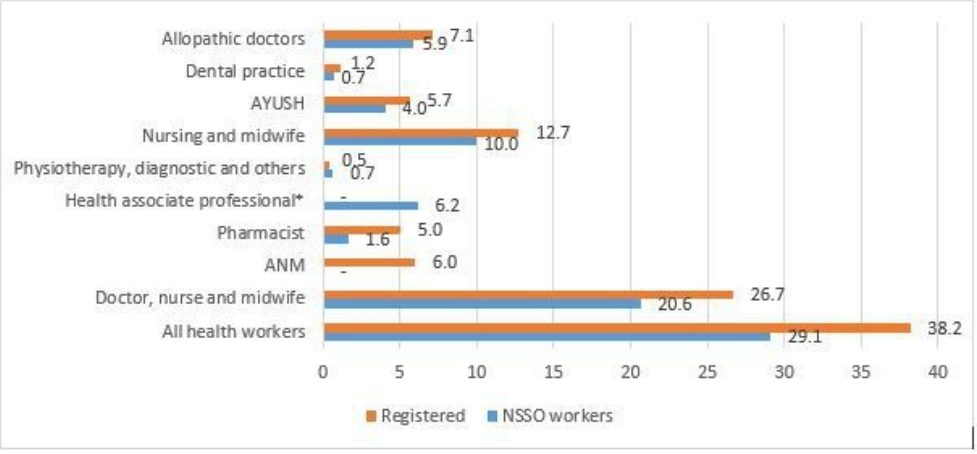
Figure 2b: Physician, surgeon and nurse density – Major states (Per 10 000 population).

Figure 3: Rural-urban distribution (% share) of health workers.

Figure 4: Public-private distribution (% share) of health workers.

Figure 5: Percentage distribution of health workers by types of enterprise they are employed with.

Figure 1: Health worker density - All India number of (health workers per 10 000 population).



Note: * includes health assistant, sanitarian, dietician and nutritionist, optometrists and opticians, dental assistants, physiotherapy associates, pharmacist assistant etc.

Source: Authors' estimates using unit level data of the NSSO 2011-12 **and Registry data**

52x33mm (300 x 300 DPI)

Figure 2a: Total health worker density – Major states (Per 10 000 population).

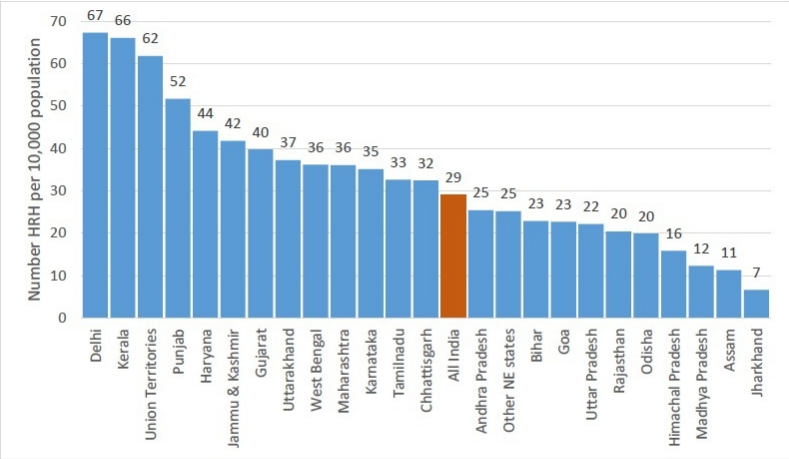
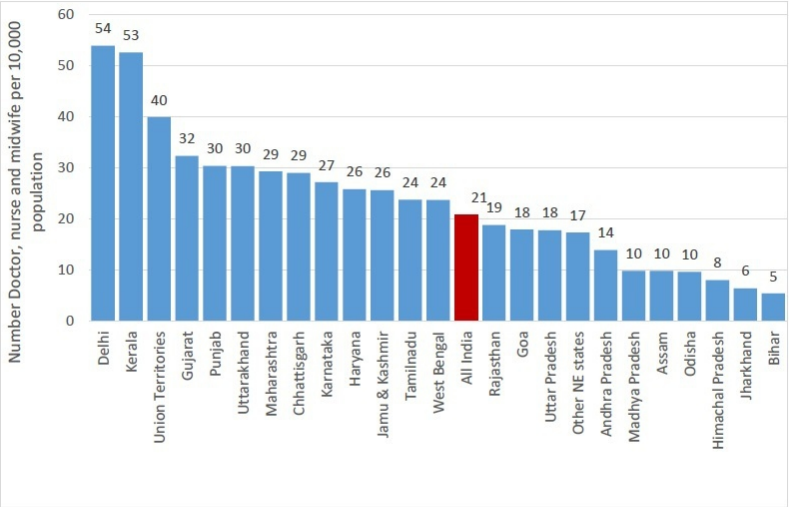


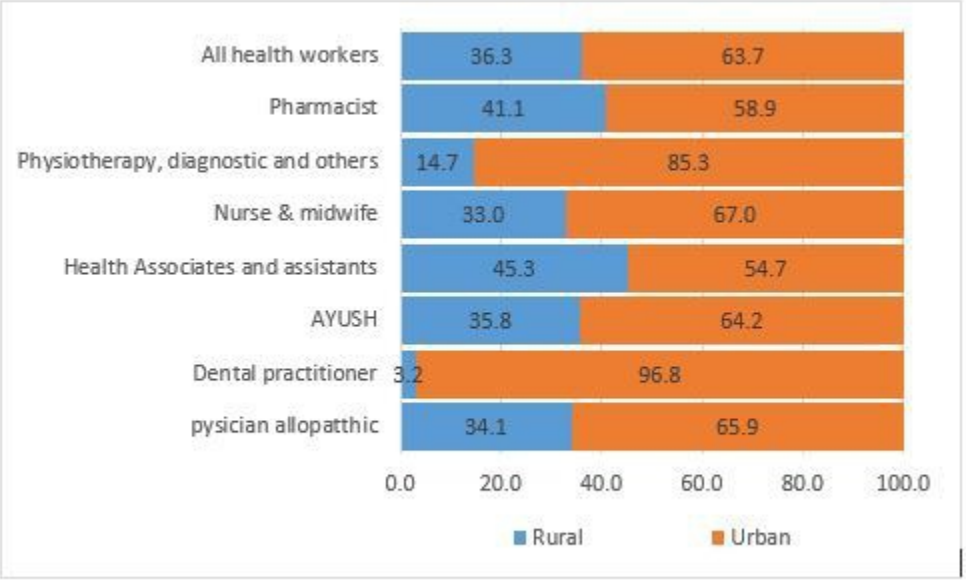
Figure 2b: Physician, surgeon and nurse density – Major states (Per 10 000 population).



Source: Authors' estimates using unit level data of the NSSO 2011-12

69x101mm (300 x 300 DPI)

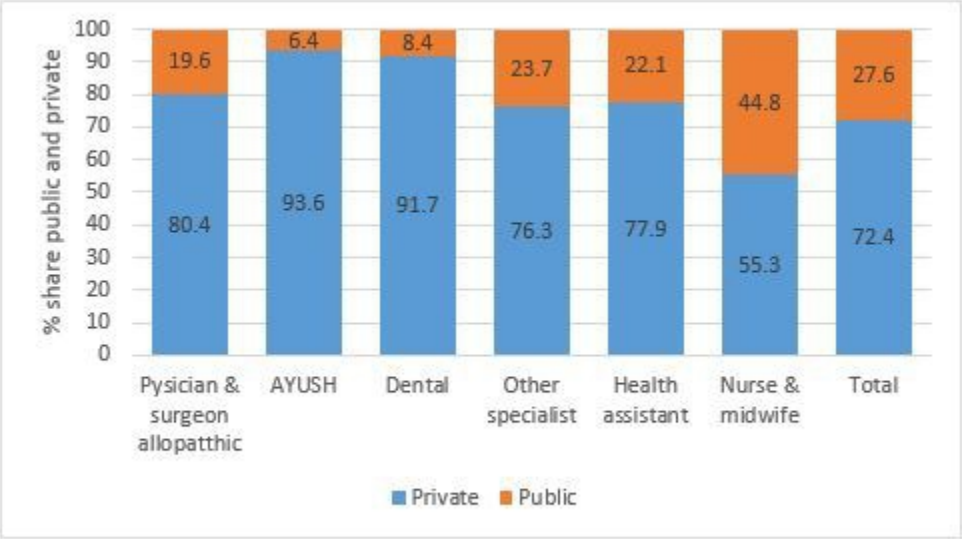
Figure 3: Rural-urban distribution (% share) of health workers



Source: Authors' estimates using unit level data of the NSSO 2011-12

42x30mm (300 x 300 DPI)

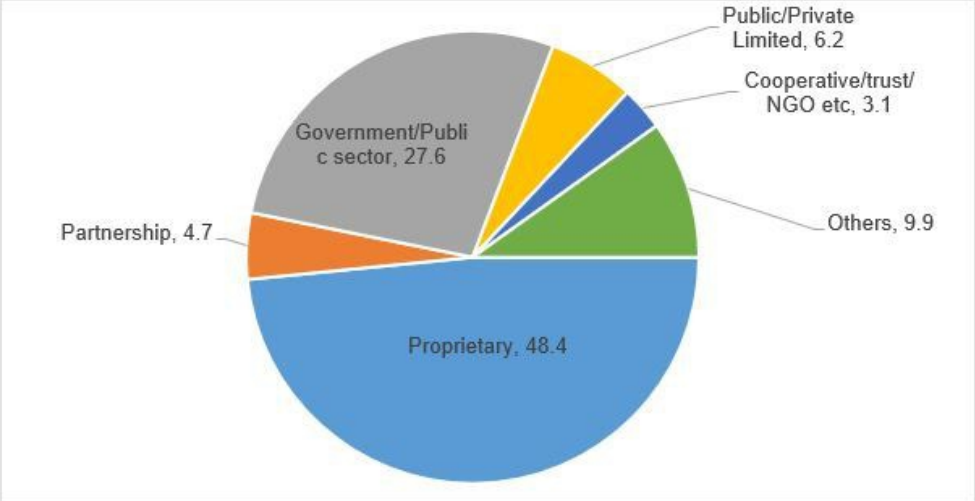
Figure 4: Public-private distribution (% share) of health workers



Source: Authors' estimates using unit level data of the NSSO 2011-12

42x29mm (300 x 300 DPI)

Figure 5: Percentage distribution of health workers by types of enterprise they are employed with



Source: Authors' estimates using unit level data of the NSSO 2011-12

52x32mm (300 x 300 DPI)

Appendix

I: Types of workforce directly and indirectly engaged in improving human health identified in the NSSO survey

Classification of workforce	**NCO code 2004**	**NIC code 2008**	**Types of workers identified**
Health workers in health sector	222, 223, 322, 323, 324	86100 to 86909	Physician, AYUSH, Dentist, Nurse and midwives, health associates, physiotherapist, traditional medical practitioners
Health workers in non-health sector	222, 223, 322, 323, 324	All other NIC codes	Health professionals (including physician, AYUSH and Dentist) , Nurse and midwives, health associates,
Non-health workers in health sector	All other NCO codes	86100 to 86909	Other support staff such as Managers, Engineers, Clerks, cashiers, personal care, garbage collectors, drivers etc.

II. Methods of projection for health workers

To project the size of HRH at January1, 2016, first we projected total population using the following equation (1)

$$popl_{ijk}2016 = popl_{ijk}2011 * (1 + r_{ijk} \div 100)^{4.75} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

Where; $popl_{ijk}2016$ is projected population as of January 1, 2016; $popl_{ijk}2011$ is population on March, 1 2011; Number of years between March 1, 2011 and January 1, 2016 is represented by 4,75; and subscript ijk represents group of population of gender i (male or female) living in area j (rural or urban) in state k.

r_{ijk} is cumulative annual growth rates (%) of population ijk between 2001 and 2011 estimated using the formulae: $r_{ijk} = \sqrt[10]{((popl_{ijk}2011 \div popl_{ijk}2001) - 1)} * 100$ ………. (2)

From NSSO, we estimated worker population ratio (WPR) for different categories of health workers as given by: $WPR_{ha} = N \div popl2011-12$ …….. (3)

Where; WPR_{ha} is WPR of any particular category of health workers such as doctors, dental, AYUSH, nurse and midwife etc., N is number of workers in each category and popl2011-12 is total population, all of these parameters have been estimated from NSSO 2011-12 survey.

Finally, we estimate total number of health workers and disaggregated by categories by multiplying category wise WPR with the projected population i.e. by multiplying equation (3) with equation (1) as follows:

$HW_{ha=} popl_{ijk} 2016 * WPR_{ha}$ ……(4)

Where 'HW' represents health workers from categories 'a' (representing doctors, dental, AYUSH, nurses etc.)

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Size, composition and distribution of human resource for health in India: new estimates using National Sample Survey and Registry data

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TITLE PAGE

Title of the article: Size, composition and distribution of human resource for health in India: new estimates using National Sample Survey and Registry data

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ABSTRACT

Objectives: We provide new estimates on size, composition and distribution of human resource for health in India and compare with the health workers population ratio as recommended by the World Health Organization. .We also estimate size of non-health workers engaged in health sector and the size of technically qualified health professionals who are not a part of the health workforce.

Design: Nationally representative cross-section household survey and review of published documents by the Central Bureau of Health Intelligence.

Setting: National

Participants: Head of household/key informant in a sample of 101,724 households

Interventions: Not applicable

Primary and secondary outcome measures: Primary outcome-Number and density of health workers; secondary outcome- percentage of health workers who are technically qualified and percentage individuals technically qualified not in workforce.

Results: Total size of health workforce estimated from National Sample Survey (NSS) data is 3.8 million as of January 2016, which is about 1.2 million less than the total number of health professionals registered with different councils and associations. The density of doctors and nurses and midwives per 10,000 population is 20.6 according the NSS and 26.7 on the basis of the registry data. Health workforce density in rural India, and states in eastern India are lower than the WHO minimum threshold of 22.8 per 10,000 population. More than 80% of doctors, and 70% of nurses and mid-wives are employed in the private sector. Approximately 25% of the currently working health professionals do not have required qualifications as laid down by professional councils while 20% of adequately qualified doctors are not in the current workforce.

Conclusions: Distribution and qualification of health professionals are serious problems in India when compared with the overall size of the health workers. Policy should focus on enhancing the quality of health workers and mainstreaming professionally qualified persons into the health workforce.

Strengths and limitations of this study

- Size and composition, density and distribution across states, rural-urban and public private sectors of HRH in India have been estimated as of January 2016.
- The study for the first time estimates non-health workers engaged in the health sector and technically qualified health professionals not being part of current workforce.
- The registry data of the health professionals in India are inadequately updated and National Sample Survey data provides information on self-reporting basis
- There could be an overlap in the definition and reporting of nurses and midwives in the National Sample Survey data

Introduction

The size and composition of human resource for health (HRH) in India has significantly changed during the last decade. Most existing literature on HRH in India reports that the country is well short of the World Health Organization's (WHO) recommendation of the minimum threshold of 22.8 skilled health professionals per 10,000 population[1–5]. Recently, WHO drawing evidence from the Organisation for Economic Cooperation and Development (OECD) countries revised the minimum need as 44.5 health professionals per 10,000 population[6].The Global Health Workforce Alliance (GHWA) and WHO categorised India among the 57 most severe crisis facing countries in terms of availability of human resource for health HRH[7,8].

The recent health sector reforms in India, particularly since the launch of National Rural Health Mission (NRHM), have emphasised on strengthening HRH in the public sector system[9]. For instance, the central and many state governments took proactive steps towards rural posting for public sector doctors. Several states contracted private sector practitioners and non-governmental organisations (NGOs) to bridge the manpower gaps at primary health centre levels in rural and sub-urban areas[9]. On the supply side, the last one decade and a half witnessed a rise in the medical colleges, nursing institutions and other technical education institutions in medical and para-medical disciplines[10,11].

Healthcare services in India are offered by a varied range of professionals trained in different specialties of medicine and healthcare. The entire health workforce includes many informal medical practitioners, such as registered medical practitioners (including traditional birth attendants, faith healers, snake-bite curers, bone setters etc.) with or without any formal

education or skill-training. Registered medical practitioners are often the first point of contact for treatment for a large proportion of population living in rural and remote areas.

Among the formal healthcare providers, allopathic doctors, which include physician, surgeon, specialist and medical graduates with a bachelor‘s or postgraduate specialist diploma or degree and are registered with the Medical Council of India (MCI) and dentists holds a similar degree and are registered with Dental Council of India (DCI). AYUSH (an indigenous Indian system of medicine comprising of Ayurvedic, Yoga, Unani, Siddha and Homeopathic) doctors are bachelor’s or postgraduate degree holders in AYUSH. Their registering institutions are Central Council for Indian Medicine or the Central Council for Homoeopathy and are authorized to dispense medicines and conduct surgery using their respective fields of specialization. AYUSH doctors are integral part of HRH in India as their professions are recognised by a Parliament Act[3,4,5].

Another group of health workforce include subordinate staff which includes, nurses, auxiliaries nurses and midwives, physiotherapists, diagnostic and other technicians. Nurses have a diploma in general nursing and midwifery or a bachelor’s degree or a postgraduate degree registered with the Indian Nursing Council (INC). Auxiliary nurse midwives (ANM), who mainly work as subordinates to main nurse have a diploma in auxiliary nurse midwifery. In addition there are also community health workers having a 10 years of formal education and having undergone a short training course. Physiotherapist, diagnostic and others technicians with varied level diploma and certificate also perform crucial activities as healthcare workers[5].

Several studies in the past have estimated the size and composition of HRH in India [1–8, 12-15]. However almost all these studies, excepting one [15], are based on dated data, representing the pre-reforms time period in the health sector. For instance, Rao et al. using Census 2001 and NSSO 2004-05 data estimated approximately 2.2 million health workers in India which roughly translates into a density of 20 technical health workers per 10,000 population[3]. The study estimated size of allopathic physician and surgeon ranging between 0.47 million and 0.67 million. All these estimates are far lower to the minimum thresholds of 22.8 health workers per 10,000 population and 10 doctors per 10,000 population. These studies also provided estimates of other health workers such as nurses and midwives, AYUSH doctors, and pharmacists. Other studies have highlighted a lop-sided distribution of HRH across Indian states with comparatively poorer states of the north and east which have low density of health workers compared to Delhi and south Indian states [3,5]. Anand et al. in an India-China comparative study estimated 1.9 million health workers on the basis of the Census 2001 data[1]. Density of doctors and nurses taken together reported in the study is 13.6 per 10,000 population[2] which is far lower compared to the estimates in other studies[3,5]. In a recent study, using the NSSO 2011-12 data from NSSO, Rao et al. estimated that, there were 2.5 million health workers (density of 20.9 workers) in India [16]. The study also reported that more than half of the total number of health workers are unqualified and adjusting for the right qualifications leaves India with a density of 9.1 workers per 10,000 population. Hazarika, however, on the basis of government records reported higher number of doctors (0.76 million) and nurses (1.6 million) for the year 2010 and 2011 respectively[14]. A report by Klynveld Peat Marwick Goerdeler (KPMG) and Federation of Indian Chambers of Commerce and Industries (FICCI), using data from Central Bureau of Health Intelligence (CBHI), estimated total size of health workers in India as 4.7 million in the year 2015 consisting of 0.9 million doctors, 0.69 million AYUSH doctors and 1.6 million registered nurses[16].

Earlier studies using pre-reforms period data do not capture recent changes in the HRH situation. Moreover, only a couple of studies provide situation of HRH gaps at the state levels and rural-urban disaggregation. The existing literature does not provide insights on size of allied health professionals and support staff. Our paper aims to fill these gaps in literature by providing latest estimates of HRH as of January 2016 at the all-India and state levels; and its rural-urban disaggregation. In addition, for the first time we report estimates of the size of non-medical support staff at the country level.

Methods

The present study used data from two sources: (i) web-site of institutions and review of existing reports and literature providing data on registered qualified health professionals[17] and (ii) the 68th round (July 2011-June 2012) National Sample Survey Organisation (NSSO) data on 'Employment and Unemployment Situation in India'[18].

Registered qualified health professionals: The first set of information were collected from the published literature and the web-sites of MCI, DC), INC, Pharmacy Council of India, Indian Association of Physiotherapists and Ministry of Health and Family Welfare (MoHFW). These institutions provide numbers of registered professionals in the respective fields. However, since the professional councils do not maintain live registers, the information available from them fails to account for health workers leaving the workforce because of death, migration, and retirement; or double counting of workers because they have registered in more than one state. We collated this data for different categories of professionals for the year 2015.

NSSO data: The second source of information on health workers is available from household survey on employment and unemployment situation in India conducted by the NSSO every

five years. The NSSO is a nationally representative multi-stage stratified cluster sample survey, which collects information on labour market indicators, along with a range of socioeconomic characteristics of households and individuals. The sample size of the 68th round NSSO was 101,724 households (59,700 rural and 42,024 urban) covering approximately 457,000 persons spread over approximately 12,000 villages/urban blocks in the country. The survey collected self-reported information on types of work of each individual during a reference period of the last one year of the survey. Along with a large number of labour market indicators, the survey collected information related to nature of occupation of workers, categorised by the 3-digit National Classifications of Occupation (NCO) 2004 and 5-digit National Industrial Classification (NIC) 2008, which help identify nationally as well as state-level representative sectoral composition of workers, including workforce engaged in human health activities. However, since NSSO collects working status of individuals on self-reporting basis it is possible that many individuals may report themselves as health workers even if they do not possess requisite qualifications as specified by MCI, INC and other similar agencies..

Based on these records, we identified seven different categories of health workers, their required educational qualifications, and registering institutions (Table 1).

Table 1: Sources of information on registered health professionals

Health workers	Educational qualification	Registering institution	
Allopathic doctors (physician and surgeon)	graduates with a bachelor‘s or postgraduate specialist 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,	Department of AYUSH/MoHFW	

	Siddha, or Homoeopathy		
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	

The NSSO survey reports up to two self-reported activities of all persons based on major and short time dispensation criteria separately. For instance, an individual may report being primarily a non-worker, but may be pursuing some economic activities for short period of time in a reference year. Similarly, an individual primarily engaged in non-medical activities based on primary status might pursue some medical/health activities on secondary status basis only for a shorter time-period in the reference year. We considered both activities of each individual and identified health workers with primary and secondary statuses taken together. NSSO defines this as 'Usual Primary and Subsidiary Status (UPSS) workers[18]. Hence, the total health workforce estimates included two distinct groups of individuals: i) individuals reporting working as health workers according their primary status and ii) health workers according to their secondary status but not according to their primary status. Accordingly, distribution of these workers by rural-urban, public-private etc. is based on respective work statuses. This helped identifying 'not in workforce' persons as those who did not report as worker either as

per their primary or secondary status. Cross-classifying with individuals' educational achievements we identified size of technically qualified persons for health service delivery but are not in the workforce.

We used NCO 2004 and NIC 2008 codes to classify health workforce by broad occupation types. Since, health workers may be employed within the health sector as well as non-health sector (railways, defence, other non-health enterprises etc.), we considered all sectors of the economy to estimate the HRH size. Further, health sector also employed a large number of non-health workers such as managers, accountants, clerks, drivers and other similar support staff. We estimated size of all those non-health workers employed in the health sector. We used NCO (3-digit) and NIC (5-digit) codes to identify three major categories of workers:

1. Individuals trained in medical, para-medical and related activities working within the health sector of the economy, (health workers in health sector);
2. Individuals trained in medical, para-medical and related activities working in non-health sector of the economy (health workers in non-health sector); and
3. Individuals not trained in medical, para-medical and related activities working within the health sector of the economy only as support staff (non-health workers in health sector).

Here we want to clarify that all unregistered personnel dispensing medical advice and medicines including personnel whose qualifications are incomplete are included in the first two categories. However, we also present the estimates by excluding those who are inadequately qualified. The third category represents non-medical staff such as managers, clerks, accountants, sanitation workers etc. Types of health workforce identified in the NSSO survey along with the NCO and NIC codes is presented in Appendix, section I.

The existing NCO and NIC codes in the 2011-12 survey could not identify disaggregated numbers of health professionals by allopathic doctor, AYUSH doctor and dentist in the non-health sector, although the same were identified within the health sector (first category). Since the previous NSSO surveys used NCO 1968 code, the same disaggregation in non-health sector was available in the 2004 survey. We used the ratio of allopathic doctor, dentist and AYUSH doctor in total health professional to segregate the numbers of allopathic doctor, dentist and AYUSH doctor only in the non-health sector. We reported segregated numbers for the three categories of the HRH (allopathic doctor, dentist and AYUSH doctor) only at the national level. Also, within the AYUSH, the latest NSSO data does not support reliable estimates on different components such as Ayurveda, Unani, Siddha, Naturopathy and Homoeopathy.

The two sources (registry and NSSO data) identify comparable categories of health professionals except for the two categories where comparable estimates were not available. One of these is the group categorised as 'health associate professionals' in the NSSO consisting of health assistant, sanitarian, dietician and nutritionist, optometrists and opticians, dental assistants, physiotherapy associates, pharmacist assistant etc. We did not find comparable estimates on these workers from other sources. Similarly, number of Auxiliary nurse and midwives (ANM) is available from the records of MoHFW but could not be identified in the NSSO because of the overlap of NCO codes [3].

NSSO data contains self-reported information on education levels completed by each individual. We compared educational achievements of health workers (reported in the NSSO data) with the required qualifications as recommended by the agencies such as MCI for doctors and INC for nurses and auxiliary nurses.

Although, NSSO data does not provide information on rural-urban break-up of work place of workers, we used information on rural-urban place of residence of workers to compare the proportional distribution of all population and health workforce across rural and urban settings. In general, the rural-urban place of residence of health workers can proxy the availability of HRH in the respective areas.

In order to estimate total number of health workforce as of January 2016 we applied the worker participation rate (WPR) estimated from NSSO 2011-12 to the projected population as of 1st January 2016 using cumulative annual growth rate of population between 2001 and 2011 population censuses. The projections were done at disaggregated levels – male and female living in rural and urban areas separately in all states. The final estimates of HRH were arrived using the formula in equation (1).

$$HW_{ha} = popl_{ijk}2016 * WPR_{ha} \quad \ldots\ldots (1)$$

Where 'HW_{ha}' represents health workers from categories 'a' (representing doctors, dental, AYUSH, nurses etc.); $popl_{ijk}2016$ is projected population as of January 2016 and WPR_{ha} is worker participation rate for each category in the year 2011-12. Estimation of WPR in each category of workers is arrived at using equation (2).

$$WPR_{ha} = N/popl_{ijk}2011 - 12 \quad \ldots\ldots (2)$$

Where; N is number of workers in each category.(see Appendix, section – II for the details on the methods of projection)

We assumed the WPR of health workers in the year 2016 to be the same as estimated from the NSSO 2011-12 data. Although WPR has declined over the years between 2009-10 and 2011-12 the decline has been less than 1%, most of the decline has been realised in rural areas and

among females. We assumed that WPR among health professionals did not decline significantly since 2011-12.

Patient and Public Involvement

The two data sources (NSSO and registry institutions) collected information from individuals through sample survey and registration process respectively. However, the present study only accessed anonymised data available in public domain and does not involve patient and/or public in research design, outcome measures, data analysis and interpretation of results..

Results

To start with we present a brief demographic and employment status of health workers estimated from NSSO data (Appendix Table AI). More than 58% of all health workers are male. The proportion of male is higher in the allopathic, AYUSH and dental categories and lower in the nurse and midwife category. Approximately 80% of all health workers is in 25-60 year age group. Approximately 30% of all health workers, 15% among allopathic doctor, reported their education level below higher secondary level. Most of the all health workers reported employed as regular wage earners (57%). However, as high as 63% of allopathic and 88% of AYUSH doctors reported themselves as self-employed.

Size and composition

Total size of health workforce estimated from NSSO is approximately 3.8 million as of January 2016 (Table 2).

Table 2: Total number of health workers by broad categories as on January 1, 2016

Health worker category	Estimates based on NSSO as of January 1, 2016	Registered, 2015*	% of estimated to registered

Allopathic doctor	770,277	936,488	82.25
Dental practice	95,959	154,436	62.14
AYUSH	530,919	744,563	71.31
Physiotherapy, diagnostic and others	86,508	60,000	144.18
Nursing and midwife	1,317,669	1,673,338	78.74
Pharmacist	214,744	664,176	32.33
Health associate professional**	811,744	NA	NA
ANM	NA	789,740	NA
All	3,827,820	5,022,741	76.21

Notes: * registered with MCI/NCI, Association and MoHFW records; **includes health assistant, sanitarian, dietician and nutritionist, optometrists and opticians, dental assistants, physiotherapy associates, pharmacist assistant etc.

Sources: Column 2 – Authors' estimates using unit level data of the NSSO 2011-12; Column 3 – CBHI 2017[18]

The NSSO estimates are about 1.2 million lower to the total number of health professionals registered with different councils and associations. Total number of registered doctors and nurses with MCI and INC respectively were 0.94 million and 1.67 million respectively in the year 2015 as against 0.77 million doctors and 1.32 million nurses and midwives estimated from NSSO for the year 2016. In addition, health associate professionals as reported in the NSSO data is estimated at 0.8 million. Total number of ANM, available only from MoHFW is approximately 0.79 million.

In addition, the NSSO estimates include approximately 1.25 million non-health workers (other support staff) employed in the health sector (Table 3).

Table 3: Number, percentage distribution and per 10,000 population of other support workers in health sector estimated from NSSO as on January 1, 2016

Types of workers	Total number of support workers in health sector	% distribution of all support workers	Support workers in health sector per 10,000 population
Clerks, cashiers, tellers etc.	261,048	21.0	1.98
Personal care, housekeeping etc.	212,499	17.1	1.62

Garbage Collectors and Related Labourers	161,923	13.0	1.23
Life science professionals	87,108	7.0	0.66
Directors and chief executives & managers	79,545	6.4	0.60
Motor drivers	64,216	5.2	0.49
Other workers in health sector	58,871	4.7	0.45
Messengers, Porters, Door Keepers and related	52,854	4.2	0.40
Physical and engineering science technicians	50,884	4.1	0.39
Chemical products and machine operators	36,211	2.9	0.28
Precision workers in metal and related materials	33,954	2.7	0.26
Mathematician, statistician, computer professionals	33,365	2.7	0.25
Architects, engineers and related	25,265	2.0	0.19
General and department managers	24,634	2.0	0.19
Mechanics, fitters, finishers etc.	19,805	1.6	0.15
Business professionals	19,545	1.6	0.15
Teaching professional and associate	18,308	1.5	0.14
Physicist, chemist & related	5,844	0.5	0.04
Total	1,245,878	100	9.47

Source: Authors' estimates using unit level data of NSSO 2011-12.

More than one-fifth (0.26 million) of all non-health workers engaged in health sector are administrative support staff such as clerks, cashiers, teller etc. Personal care staff such as housekeeping and restaurant service workers, personal care, protective service etc. constituted 17% (0.21 million) and garbage collectors and related sanitation workers constituted 13% of all non-health workers within the health sector. Motor drivers constituted more than 5% of all non-health workers in the health sector.

Density

Estimates from NSSO translates to approximately 29 health workers per 10,000 population if all HRH are taken into consideration (Figure 1). Nurses and midwifes had the largest share (density being 10 and 12.7 per 10,000 population on the basis of NSSO and INC respectively) in the total health workforce.

Considering only doctors (including AYUSH) and nurses & midwives, the density of health workers is 20.6 per 10,000 population according the NSSO estimates; and 26.7 per 10,000 population according to the registry data. Estimates from NSSO are marginally below and the registry data are considerably above the WHO's minimum threshold of 22.8 workers per 10,000 population. However, if we consider ANM as part of the trained health workers the density turns out to be close to 30 per 10,000 population. NSSO numbers indicate that there are 10 nurses and midwifes per 10,000 population. This translates to 1.7 nurses and midwives per allopathic doctors as against the High Level Expert Group (HLEG) recommendation of two nurses and one ANM per allopathic doctor[19]. The registered numbers too reflect almost the same ratio between nurses and midwives and allopathic doctors.

When the estimates on total health workers from NSSO are adjusted for qualification, the density is reduced from 29 to 16 per 10,000 population (Table 4). For allopathic doctors, 24% had inadequate or no medical training. Adjusting for this proportion, the ensity of allopathic doctors at the country level declines from 5.9 to 4.5 per 10,000 population. Similarly, the proportion of nurses and midwives per 10,000 population drops down to 4.2 when adjusted with required level of education and training.

Table 4: Percentage of health professionals without requisite qualifications and the adjusted estimates of health workers -- total number and per 10,000 population

Health worker category	% health professional not with requisite qualifications**	Total number of HRH after adjusting for education	Density of HRH per 10,000 population after adjusting for education
Allopathic physician	24	585,411	4.5
Dental practice	8	88,282	0.7
AYUSH	21	419,426	3.2
Physiotherapy, diagnostic and others	45	47,579	0.4
Nursing and midwife	58	553,421	4.2

Health associate professional*	62	308,463	2.3
Pharmacist	62	81,603	0.6
Total	54	2,084,185	15.8

Notes: * includes health assistant, sanitarian, dietician and nutritionist, optometrists and opticians, dental assistants, physiotherapy associates, pharmacist assistant etc.; ** levels of required qualifications considered for doctors (allopathic, dental and AYUSH) was graduate/post graduate in medicine, for nurse and midwife higher secondary with technical education in medicine or related field, for others higher secondary with technical education in para-medical related fields[15].

Source: Authors' estimates using unit level data of NSSO 2011-12.

Distribution across states, rural-urban and public private

Most of the central and eastern Indian states have low density of health workers ranging from approximately 23 per 10,000 population in Bihar and North-East states other than Assam to as low as 7 per 10,000 population in Jharkhand. The only south Indian states reflecting lower density than the all India average (29) is Andhra Pradesh (25) and only eastern Indian state having higher density than the all India average is West Bengal (36). Highest concentration of health workers is in Delhi (67) followed by Kerala (66), Punjab (52) and Haryana (44) (Figure 2a). Considering only doctor, nurse and midwife density per 10,000 population, Delhi and Kerala numbers are far higher compared to other states with Bihar along with Jharkhand occupying the lowest position (Figure 2b).

Density of physician and surgeons (including AYUSH and dental) per 10,000 population is as low as 1.8 in Assam and 1.9 in Himachal Pradesh (Table 5).

Table 5: Health worker density (Per 10 000 population) in states in India.

State	Doctors*	Health associates**	Nurse midwife	All
Andhra Pradesh	5.9	11.5	7.9	25.4
Assam	1.8	1.0	8.0	11.3
Other NE states$	6.7	7.8	10.6	25.1
Bihar	3.3	17.5	2.0	22.9

Chhattisgarh	18.3	3.5	10.7	32.4
Delhi	34.4	13.4	19.5	67.3
Goa	11.3	4.8	6.5	22.7
Gujarat	5.8	7.4	26.5	39.8
Haryana	16.8	18.3	9.0	44.1
Himachal Pradesh	1.9	7.9	6.0	15.9
Jammu & Kashmir	14.7	15.7	11.0	41.8
Jharkhand	3.0	0.3	3.3	6.7
Karnataka	17.1	8.0	10.0	35.1
Kerala	14.5	13.4	38.2	66.0
Madhya Pradesh	6.3	2.5	3.5	12.3
Maharashtra	19.7	6.7	9.6	36.0
Odisha	7.4	10.3	2.1	19.9
Punjab	17.8	21.3	12.5	51.7
Rajasthan	4.5	1.4	14.3	20.4
Tamilnadu	8.6	8.7	15.2	32.6
Uttar Pradesh	13.8	4.0	3.9	22.1
Uttarakhand	11.6	6.9	18.7	37.2
West Bengal	16.9	12.5	6.7	36.1
Union Territories$$	12.3	21.8	27.6	61.7
All India	11.3	8.4	9.4	29.1

Notes: * includes allopathic, AYUSH and dental practitioners; **includes health assistant, sanitarian, dietician and nutritionist, optometrists and opticians, dental assistants, physiotherapy associates, pharmacist and pharmaceutical assistants; $ includes six north east Indian states Arunachal Pradesh, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura; $$ includes Andaman and Nicobar Islands, Dadar and Nagar Haveli and Lakshadweep.
Source: Authors' estimates using unit level data of NSSO 2011-12.

Density of allopathic doctors is also lower than five in states of Bihar, Jharkhand and Rajasthan. Delhi has the highest density of doctors (34) but the density of nurse and midwife is the highest (38) in Kerala. The HLEG recommendation for the doctor-nurse ratio in India is 1:3[19]. The states with acute adverse ratio (less than 1:1) of nurse to doctor are Bihar, Chhattisgarh, Goa, Haryana, Jammu and Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Punjab, Uttar Pradesh and West Bengal.

The uneven distribution of health workers is also reflected across rural-urban settings. Although rural India constituted approximately 71% of the total population in 2016, only 36% of all health workers are in rural areas (Figure3). This proportion is little lower for health

associates and assistants and pharmacist. The proportion of doctor and nurses in rural areas are 34% and 33% respectively.

Further, bulk of the total health workforce is employed in private sector (Figure 4). The proportion employed in private sector is far higher for doctors compared to nurse and midwife and other health workers. In case of AYUSH and dental practitioner, share of public sector is less than 10%. However, approximately 45% of nurse and midwife are employed in public sector institutions (Figure 4). Further, private health sector in India consists of wide range of service providers ranging from 'for-profit' hospitals, 'not-for-profit' (NGO, charitable institutions, trusts, etc.) institutions and private individual practitioners[12,20]. Distribution of all health workers by types of institutions reflect that overwhelming majority (53%) of these workers are self-employed in sole proprietorship or partnership entity. Only 6% of all health workers are employed in big corporate companies with public or private limited status (Figure 5).

Lastly, our analysis reveals that a sizeable proportion of technically qualified individuals are not in the existing health workforce. We estimated percentage of all adults (age 15 years and above) with education in medical related and other fields who are currently not in workforce (Table 6).

Table 6: Percentage of all adult (age 15 years and above) individuals with different levels of education not in workforce

Level of education	Persons	Male	Female
Graduate in medicine	19.2	16.3	25.7
Graduate in other	37.5	16.6	69.2
Diploma/Certificate in medicine	30.9	16.3	45.5
Diploma/Certificate in other	29.6	21.8	54.2
Vocational training in health and paramedical services	9.9	37.9	26.3
Other Technical degree	23.3	17.3	39.6

No Technical degree*	45.7	20.8	70.0
Total	44.7	20.4	69.7

Note: * including illiterate
Source: Authors' estimates using unit level data of NSSO 2011-12.

In general, 45% of all adult individuals are not in the workforce. The proportion of individuals with medical or related degrees but not in existing workforce is 19% for 'graduate in medicine' and 31% for 'Diploma/Certificate in medicine'. These proportions are 26% and 46% respectively for females. In case of vocational training in health and paramedical services, however, higher proportion of male (38%) compared to female (26%) are out of workforce.

Discussion

The study presents updated estimates of HRH in India as of January 2016. In addition to health workers directly involved in service delivery, for the first time, we estimated size and composition of support health workers and non-health workers employed within the health sector. Two major sources of data, employment and unemployment survey of NSSO 2011-12 and registration of health professionals with institutions till 2015, largely reflect similar results excepting a couple of additional categories of health workers reported across the two sources. In general, estimates from NSSO are lower in comparison with those from the registry data. There are several possible explanations which include: (i) many registered professionals are unemployed and are looking for suitable jobs, (ii) many registered professionals have migrated out of the country, (iii) they may be out of labour force by choice and not looking for any employment (mostly old age and women), and (iv) many of these registered professionals may not be alive any more. This calls for a need of a regular updating and maintaining live register of health professionals so that adequate information on size of HRH could be available on a real time basis.

Our estimates from NSSO are higher compared to a similar study using the NSSO data[15] mainly because we considered all health workers employed either as their principal or subsidiary activity status. Combining principal and subsidiary statuses together provides larger estimates compared to only principal status workers as reported in Rao et al. using the same data source [15]. The largest difference we find is for AYUSH workers: an overwhelmingly large proportion of them report as health workers in subsidiary status capacity only..

Density of total health workers is estimated to be 29 per 10,000 population based on NSSO and 38 per 10,000 population based on the registration data. Even by only considering service delivery workers, the density estimates in this study are close to WHO's minimum threshold of 22.8 health workers per 10,000 population. However, our estimates also reveal an alarmingly large presence of unqualified health professionals in the workforce. Adjusting for adequate qualifications of health workers reduced the density from 29 to 16 health workers per 10,000 population. Presence of unqualified health professional in health system is not unique in India. Many developing countries, particularly in China and Africa report large presence such professionals[21]. Unqualified health professionals are usually first point of contact for rural and poor population in case of any ailment. Quacks, traditional healers, bone-setters etc. fall in this category.

Apart from India 'quacks' exist in other countries as well. In South Africa, bogus doctors or quacks are increasingly seeping into the health system [21]. Several cases have been noted for where people had impersonated as doctors and pharmacists[21]. With increasing cases of fake doctors in United Kingdom, checks are regularly conducted on foreign doctors [22].

Similar problem of quacks persists in countries like Bangladesh [23], China [24], Uganda [25] and Australia [26].

A few countries have attempted to mainstream these health professional by bringing them in the fold of registered medical practitioners (RMP). One such category in India is *Dai* (female birth attendant) who may be also be registered with government and are allowed to deliver service. Another example of mainstreaming these workers is registering them as para-medical persons by a few state governments. However, so far there is no clear policy India related to these workers and many of these health workers continue working without any formal system in place.

We for the first time presented two additional categories of workers directly or indirectly engaged in the activities related to human health. These two categories of workers are: (i) health assistants and associates and (ii) other support staff engaged in administrative, managerial and other support activities. Health associates and assistants directly support other health workers involved in service delivery. This group (0.81 million as of January 2016) included health assistants, sanitarians, dieticians and nutritionists, optometrists and opticians, dental assistants, physiotherapy associates, pharmacist assistants etc. The second group (1.25 million) included clerks, cashiers, tellers, housekeeping and restaurant service workers, personal care, protective service staff, garbage collectors, other sanitation workers etc. These support staff perform crucial roles which are imbedded in overall health service delivery.

Our findings from NSSO clearly show the dominance of the private sector in total HRH. In general, little over 50% of all doctors in India are produced from government medical colleges, more than 80% of them are employed in private institutions or work as private

practitioner[20,27]. Although it cannot be argued that all those who studied in public institutions should only work in public sector, it may not be out of order to expect that professionals passing out from public institutions must be sufficiently sensitive to public health issues and may extend their services at least in some proportion to public sector facilities. In recent years, Government of India and a few state governments have been recommending for a few years of rural posting for newly passed out health professionals. Also, governments both at the central and state levels have come out with strategies to utilise the services of private health professionals in the public sector facilities.

In general, we find that although the overall size of health workers in India is lower than many developed countries, these numbers are close to the WHO minimum threshold of 22.8 doctors and nurses per 10,000 population. Recently WHO has revised the minimum threshold to 44.5 per 10 000 population. This higher threshold is based on the experiences of developed countries and India should certainly aspire to achieve this in near future.

However, there are serious problems related to the distribution of HRH across Indian states and rural-urban settings. Bulk of the doctors and nurses are located in major cities leaving a significant gap in rural areas and in poorer states.

Further, a sizeable proportion of technically qualified individuals are not in the workforce. A large proportion of them are women. Government has taken up several initiatives, including enhanced retirement age and suitable working conditions for women workers, in recent years to mainstream these technically qualified persons.

Our analysis has a few obvious limitations. Apart from the fact that the registry data of the health professionals are inadequately updated, NSSO data provides information on self-

reporting basis. However, both the sources taken together may provide a range of availability of health workers in India. We have used WPR of 2011-12 from the NSSO data to estimate health workers as of January 2016. NSSO data is not available so far after 2011-12. If WPR of health workers declines after 2011-12, our estimates from NSSO are likely to be upwardly biased. Another limitation of the study is overlap in the definition and reporting of nurses and midwives in the NSSO data. Further, many health professionals may work in the public and private sectors and rural and urban areas simultaneously. The data and methods used in our study is not capable to capture this phenomenon fully.

Conclusion

Distribution and qualification of health professionals are serious problems in India when compared with the overall size of the health workers. In contrast, a large proportion of technically qualified health professionals are not in the current workforce. Any HRH policy needs to consider these points while considering changes/reform in the existing policy. Policy should focus on enhancing the quality of health workers and mainstreaming professionally qualified persons into the health workforce.

Declarations:

Authors' contribution: AK, HN and SZ conceptualised the study. AK, AS, HN, RN, RT conducted data analysis and review of literature. AK, HN and SZ prepared the first draft. All authors contributed to review and revision in the first draft and approved the final version.

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Data sharing statement: The data set used in the study are publicly available from National Sample Survey Organisation and Medical and Nursing Council of India. Anyone can access these data set either by paying the requisite fee or by making request for free access.

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Figure legends

Figure 1: Health worker density - All India number of (health workers per 10 000 population).

Figure 2a: Total health worker density – Major states (Per 10 000 population).

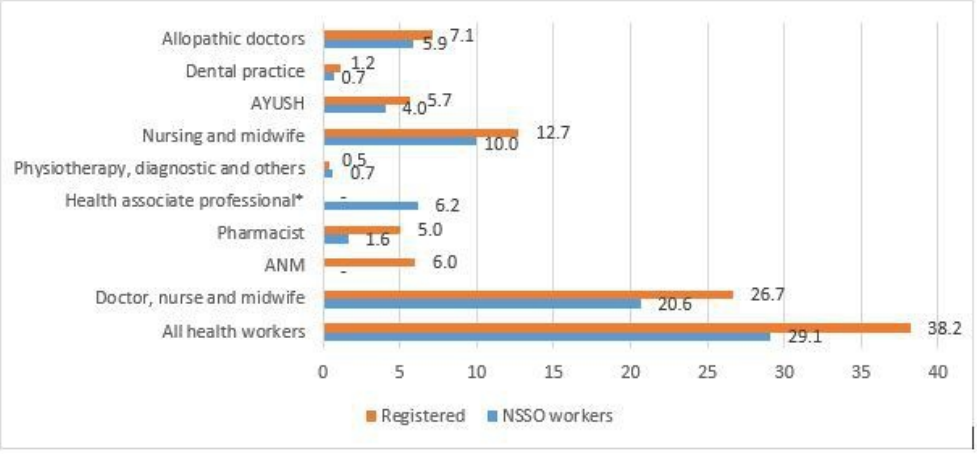
Figure 2b: Physician, surgeon and nurse density – Major states (Per 10 000 population).

Figure 3: Rural-urban distribution (% share) of health workers.

Figure 4: Public-private distribution (% share) of health workers.

Figure 5: Percentage distribution of health workers by types of enterprise they are employed with.

Figure 1: Health worker density - All India number of (health workers per 10 000 population).



Note: * includes health assistant, sanitarian, dietician and nutritionist, optometrists and opticians, dental assistants, physiotherapy associates, pharmacist assistant etc.

Source: Authors' estimates using unit level data of the NSSO 2011-12 **and Registry data**

52x33mm (300 x 300 DPI)

Figure 2a: Total health worker density – Major states (Per 10 000 population).

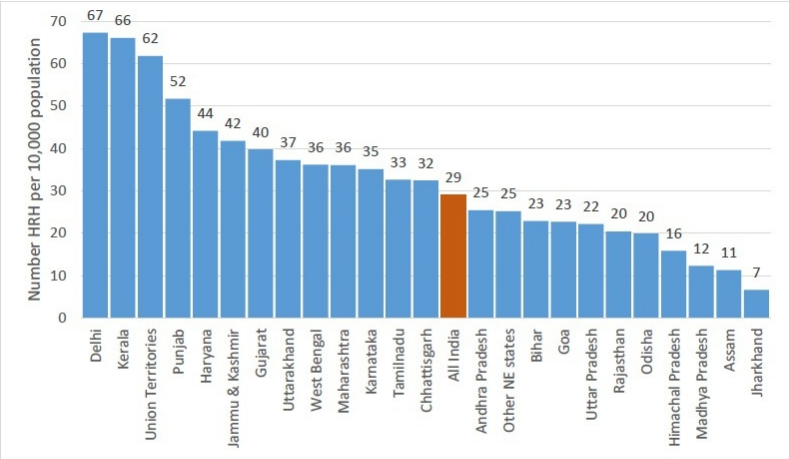
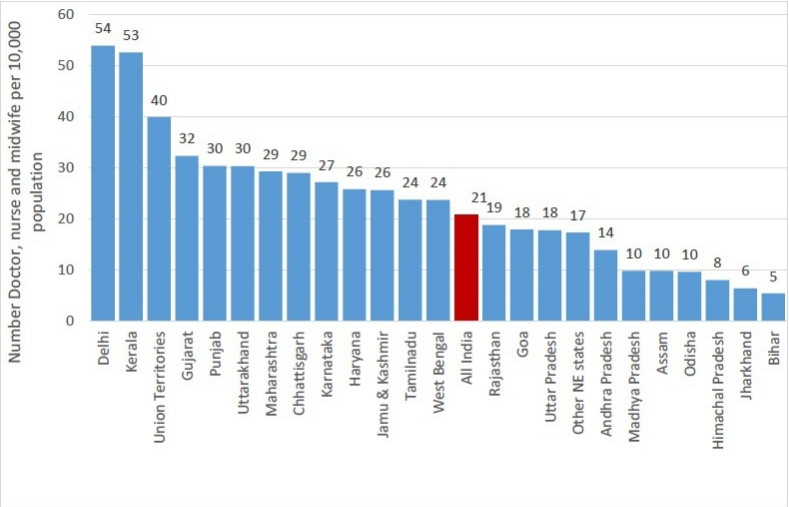


Figure 2b: Physician, surgeon and nurse density – Major states (Per 10 000 population).



Source: Authors' estimates using unit level data of the NSSO 2011-12

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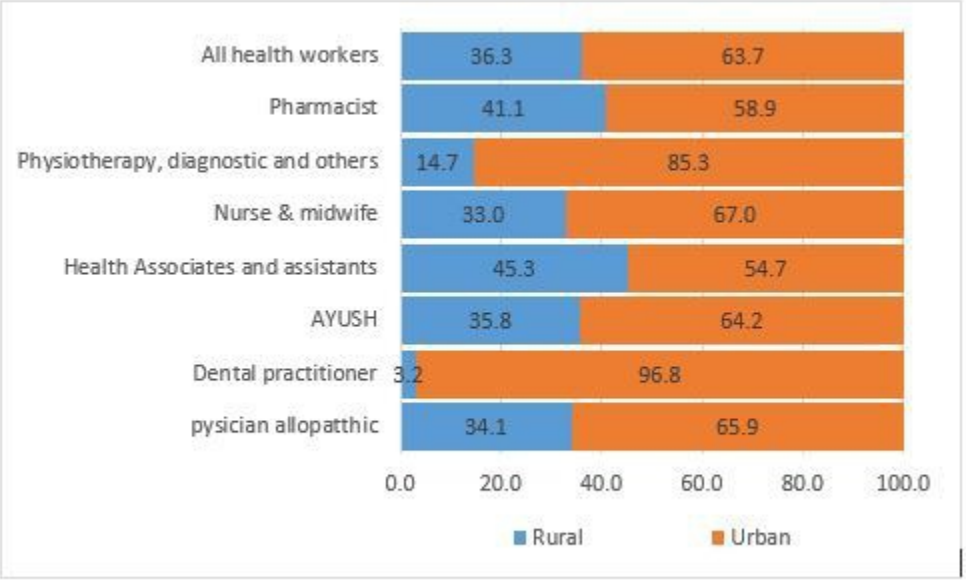
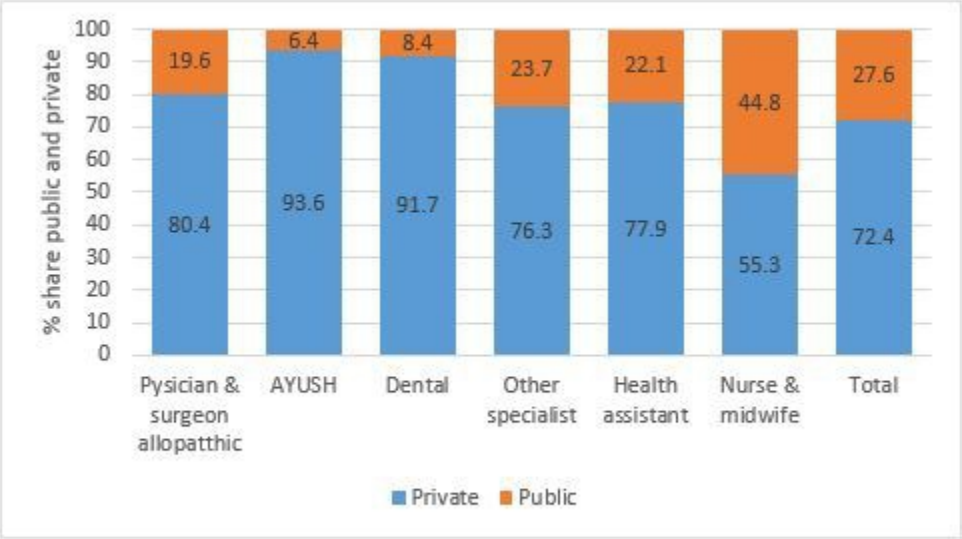
Figure 3: Rural-urban distribution (% share) of health workers



Source: Authors' estimates using unit level data of the NSSO 2011-12

42x30mm (300 x 300 DPI)

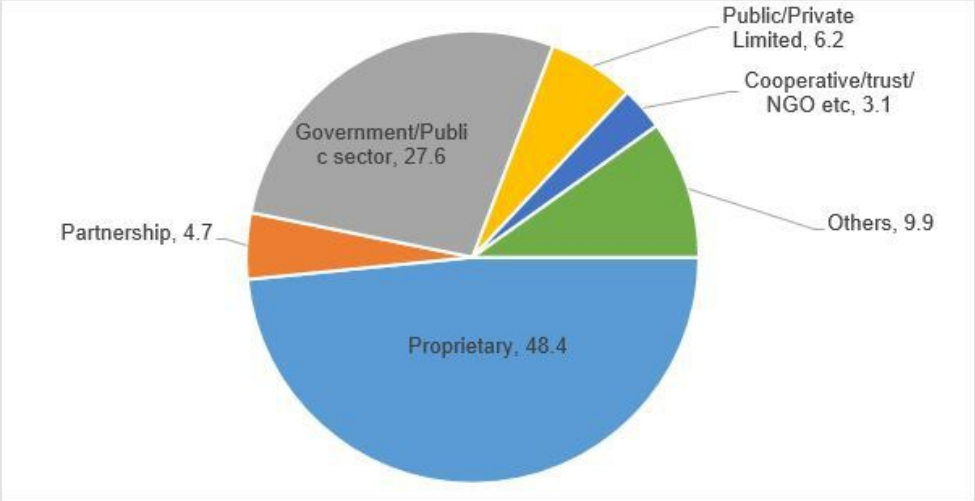
Figure 4: Public-private distribution (% share) of health workers



Source: Authors' estimates using unit level data of the NSSO 2011-12

42x29mm (300 x 300 DPI)

Figure 5: Percentage distribution of health workers by types of enterprise they are employed with



Source: Authors' estimates using unit level data of the NSSO 2011-12

52x32mm (300 x 300 DPI)

Appendix

Section I: Types of workforce directly and indirectly engaged in improving human health identified in the NSSO survey

Classification of workforce	NCO code 2004	NIC code 2008	Types of workers identified
Health workers in health sector	222, 223, 322, 323, 324	86100 to 86909	Physician, AYUSH, Dentist, Nurse and midwives, health associates, physiotherapist, traditional medical practitioners
Health workers in non-health sector	222, 223, 322, 323, 324	All other NIC codes	Health professionals (including physician, AYUSH and Dentist) , Nurse and midwives, health associates,
Non-health workers in health sector	All other NCO codes	86100 to 86909	Other support staff such as Managers, Engineers, Clerks, cashiers, personal care, garbage collectors, drivers etc.

Section II. Methods of projection for health workers

To project the size of HRH at January1, 2016, first we projected total population using the following equation (1)

$$popl_{ijk}2016 = popl_{ijk}2011*(1+r_{ijk} \div 100)^{4.75} \quad \ldots\ldots (1)$$

Where; $popl_{ijk}2016$ is projected population as of January 1, 2016; $popl_{ijk}2011$ is population on March, 1 2011; Number of years between March 1, 2011 and January 1, 2016 is represented by 4,75; and subscript ijk represents group of population of gender i (male or female) living in area j (rural or urban) in state k.

r_{ijk} is cumulative annual growth rates (%) of population ijk between 2001 and 2011 estimated using the formulae: $r_{ijk} = \sqrt[10]{((popl_{ijk}2011 \div popl_{ijk}2001)} - 1)*100$ .... (2)

From NSSO, we estimated worker population ratio (WPR) for different categories of health workers as given by: $WPR_{ha} = N \div popl2011-12$ ..... (3)

Where; WPR_{ha} is WPR of any particular category of health workers such as doctors, dental, AYUSH, nurse and midwife etc., N is number of workers in each category and popl2011-12 is total population, all of these parameters have been estimated from NSSO 2011-12 survey.

Finally, we estimate total number of health workers and disaggregated by categories by multiplying category wise WPR with the projected population i.e. by multiplying equation (3) with equation (1) as follows:

$HW_{ha=} popl_{ijk}2016 * WPR_{ha}$ .....(4)

Where 'HW' represents health workers from categories 'a' (representing doctors, dental, AYUSH, nurses etc.)

Section III. Appendix Table

Appendix Table A I: Gender, age, education and employment status of health workers

Attributes	Allopathic doctor	AYUSH	Dental	Diagnostics	Health associates	Nurse & midwife	All
Gender							
Male	78.09	86.46	70.15	93.58	70.7	21.2	58.01
Female	21.91	13.54	29.85	6.42	29.3	78.8	41.99
Age (in years)							
below 25	3.52	8.45	1.51	1.34	16.73	27.09	15.16
26-35	34.12	26	50.07	55.74	33.82	31.13	33.1
36-49	37.53	37.68	42.23	32.1	30.72	27.71	32.4
50-60	16.94	16.04	6.19	10.82	14.75	13.51	14.99
60-70	5.36	10.54	0	0	3.67	0.51	3.42
70 & above	2.54	1.29	0	0	0.31	0.05	0.94
Education							
Below higher secondary	14.33	15.38	3.08	5.36	46.31	34.64	29.89
Higher Secondary	14.74	9.7	13.05	39.97	22.73	41.24	25.74
Graduate & above	70.93	74.92	83.86	54.67	30.97	24.12	44.37
Employment status							
Self-employed	62.94	88.06	77.73	76.08	36.19	6.9	38.83
Regular wage earner	36.17	11.94	22.27	23.92	56.18	88.52	57.22
Casual Wage earner	0.89	0	0	0	7.63	4.58	3.95
Total	100	100	100	100	100	100	100