

1 **Title page**

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

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## ABSTRACT

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

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

RESULTS: The study estimated (from NHWA 2018) a total stock of 5.76 million health workers which included allopathic doctors (1.16 million), nurses/midwives (2.34 million), pharmacist (1.20 million), dentists (0.27 million), and traditional medical practitioner (AYUSH 0.79 million). However, the active health workforce size estimated (from NSSO2017-18) is much lower (3.12 million) with allopathic doctors and nurses/midwives estimated as 0.80 million and 1.40 million respectively. Stock density of doctor and nurses/mid-wives are 8.8 and 17.7 respectively per 10,000 persons as per NHWA. However, active health workers' density (estimated from NSSO) of doctor and nurses/mid-wives are estimated to be 6.1 and 10.6 respectively. The numbers further drop to 5.0 and 6.0 respectively after accounting for the adequate qualifications. All these estimates are well below the WHO threshold of 44.5 doctor, nurses and midwives per 10,000 population. The results reflected highly skewed distribution of health workforce across states, rural-urban and public-private sectors. A substantial proportion of active health worker

61 were found not adequately qualified on the one hand and on the other more than 20% of  
62 qualified health professionals are not active in labour markets.

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

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

71 **INTRODUCTION**

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

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

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

90 The investment case for HRH in India is exemplified by the fact that India has a very low density  
91 of health workers per 10,000 population and the distribution of health workforce across the  
92 Indian states is highly skewed [10,11]. A recent WHO report mentions that India needs at least

93 1.8 million doctors, nurses and midwives to achieve the minimum threshold of 44.5 health  
94 workers per 10,000 population in 2030 [12]. Also, India's National Health Policy (NHP) 2017  
95 recommended strengthening existing medical education system and the development of a cadre  
96 of mid-level care providers [13]. Similarly, the *NITI Aayog's* Strategy for "New India@75" aims at  
97 generating 1.5 million jobs in the public health sector by 2022-23 [14]. The current COVID-19  
98 pandemic has further exposed the acute shortage of health workers in India's health system. In  
99 addition, OECD countries have benefited by the presence of Indian origin and Indian trained  
100 doctors and nurses [7], whilst during the COVID-19 situation the health system in India is  
101 struggling with low numbers of trained health personnel.

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

111 Recent research [12, 15-18] has identified several areas of concern related to Indian health  
112 workforce. Studies have highlighted that there has been acute shortages of doctors and nurses  
113 along with low levels of skill-mix. A lack of adequate number of institutions providing training in  
114 nursing, and international migration of nurses from India are the two most prominent reasons

115 for the shortage of trained nurses in India [19-22]. Moreover, studies have also highlighted low  
116 quality of a large share of total number of nurses in India [23]. The National Health Policy (NHP)  
117 2017 in this regard recommends to improve regulation and quality management of nursing  
118 education India [13].

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

124

#### 125 *Structure of health workforce in India*

126 Healthcare services in India are offered by a varied range of professionals trained in different  
127 specialties of medicine and healthcare. The supply side information (Central Bureau of Health  
128 Intelligence [24]) on the availability of health professionals indicate that these health  
129 professionals have varied levels of educational qualifications and are registered with different  
130 councils/agencies [10,11]. Table 1 presents categories of health professionals directly engaged in  
131 services delivery along with their levels of educational qualification and their registering agencies.  
132 In addition to the health professionals as presented in Table 1, there are also community health  
133 workers with 10 years of formal education and a short training course. The health workforce at  
134 the ground level also includes many informal medical practitioners, such as registered medical  
135 practitioners (RMPs) (including traditional birth attendants, faith healers, snakebite curers,  
136 bonesetters etc.) with or without any formal education or skills/training. RMPs are often the first

137 point of contact for treatment for a large proportion of population living in rural and remote  
138 areas and they may be dispensing either allopathic or traditional drugs or both as the need arises  
139 [10-11].

140

## 141 **METHODS**

142 The present study used data from two main sources: (1) National Health Workforce Accounts  
143 (NHWA) on India -2018 [25] and (2) Periodic Labour Force Survey (PLFS) conducted during July  
144 2017 – June 2018 by the National Sample Survey Office (NSSO 2017-18) [26]. In addition,  
145 information was also collected from Central Bureau of Health Intelligence (CBHI) 2019, Rural  
146 Health Statistics (2019) and population projection from the Census of India (2019) [27].

### 147 *NHWA data*

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

### 153 *NSSO data*

154 The sample size of PLFS 2017-18 [26] is 102,113 households (56,108 rural and 46,005 urban)  
155 covering 433,339 individuals (246,809 rural and 186,503 urban). The survey collected information  
156 related to the nature of occupation of workers using National Classifications of Occupation (NCO)  
157 2004 and the National Industrial Classification (NIC) 2008. NSSO data also provide information on  
158 detailed activity status such as worker, unemployed and out of labour force, location of workers

159 by state and rural and urban, general educational and technical educational qualifications, place  
160 of working by public and private sectors.

161 *Methods of estimation of health workforce*

162 Total stock of health professionals by types of health professionals (doctors, nurses and  
163 midwives, pharmacists and traditional medicine practitioners) is directly reported in the NHWA  
164 database. We estimated size of comparable categories of health workforce from the NSSO 2017-  
165 18, using the worker population ratio (WPR) and projected population as of January 2018. We  
166 applied the WPR at the disaggregated occupational levels estimated from NSSO 2017-2018 to the  
167 projected population as of 1 January 2018 using population projection [27] at disaggregated  
168 levels: male and female living in rural and urban areas separately in each state. The estimates of  
169 HRH were arrived at using equation (1).

170  $HW_{aijk} = pop_{ijk} * WPR_{aijk} \dots \dots \dots (1)$

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

176  $WPR_a = workers_a / pop \dots \dots \dots (2)$

177 The NSSO survey reports up to two self-reported activities of all persons based on major and  
178 short time dispensation criteria separately. We considered both activities of each individual and  
179 identified health workers on the basis of either primary or secondary status. Information on

180 activity status and educational background of each individual were used for identifying  
181 'unemployed' and 'not in labour force' statuses of persons with medical qualifications.

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

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

195

#### 196 *Supply side estimation*

197 We estimated the supply of health professionals in future years up to 2030 using estimated  
198 number of seats in different medical colleges/institutions. Institutions offering health programs  
199 in 2019 were identified through Google search engine using keywords such as "health programs",  
200 "nursing courses", "AYUSH", "MBBS", "BPharma" and "allied health programs". The search was  
201 limited to programs offered in India. Additionally, the websites of the All India Council of

202 Technical Education, University Grants Commission, universities and institutions were also  
203 searched, and education supplements of newspapers and commercial web-sites were searched.  
204 The number of seats in various health professional programs was forecasted for the period till  
205 2030. We assumed a seat occupancy rate of 95% for medical doctors for the forecast time period.  
206 For generating the workforce estimates for each year, we added the new supply for each year to  
207 the workforce numbers in the preceding year and subtracted assumed exits from the workforce  
208 to account for mortality, retirement and migration by assuming an overall annual attrition rate  
209 of 7% every year.  
210 Finally, we modelled scenarios according to different levels of policy intervention which was  
211 similar to that adopted by Ridoutt et al. [28].

212

## 213 **RESULTS**

### 214 **Size and Composition of Health Workforce**

215 Table 2 presents estimates of HRH, categorized by doctors, dentists, nurses/mid-wives and  
216 pharmacist, at the all India level using the two main sources of data. Since workers self-reported  
217 occupations in the NSSO survey and health workers may or may not have adequate qualifications,  
218 we present estimates on health workforce from NSSO with and without adequate qualifications.  
219 NHWA reports a total stock of approximately 1.16 million allopathic doctors, 2.34 million  
220 nurses/midwives (including ANM), 1.20 million pharmacists, 0.27 million dentists, and traditional  
221 medicine professionals 0.79 million. Both the estimates (with and without adequate  
222 qualifications) from NSSO are invariably lower compared with the NHWA estimates for all the  
223 reported categories. According to NSSO, the numbers of allopathic doctors and nurses/mid-

224 wives, even before adjusting for the right qualifications, are 0.80 million and 1.4 million  
225 respectively. Estimates on pharmacist, dentist, and traditional medical practitioners from NSSO  
226 are also significantly lower as compared with those recorded in the NHWA.

227 The difference in the estimates from the two sources are the highest for nurses/midwives and  
228 pharmacists. For nurses/midwives categories, ANM is not recorded separately in the NSSO and  
229 may be clubbed partly with nurses/midwives and partly with health associates. For pharmacists,  
230 only pharmacists engaged in the retail trade were identifiable in the NSSO data and pharmacist  
231 assistants are clubbed in the health associate category. The NSSO based estimates after adjusting  
232 for the mandated qualifications are further lower as 18% of health workers who self-reported as  
233 allopathic doctors and 44% of health workers engaged as nurses/midwives had no adequate  
234 qualification.

235 State-wise dis-aggregation of allopathic doctors and nurses reflect that as per the NHWA data,  
236 approximately 39% of allopathic doctors are concentrated in the three states of Maharashtra  
237 (16%), Tamil Nadu (12%) and Karnataka (11%) (Table 3). These are followed by Andhra Pradesh  
238 (9%), Uttar Pradesh (7%), West Bengal (6.5%) and Kerala (5%). These states taken together  
239 constitutes up to approximately 70% of the total stock of allopathic doctors.

240 However, in terms of active workforce, estimated from NSSO, Uttar Pradesh shares the largest  
241 proportion (14%) of all allopathic doctors followed by West Bengal (11%) and Kerala (11%). Uttar  
242 Pradesh and Tamil Nadu also share highest proportion of all nursing workers 10-11% each,  
243 followed by Maharashtra (8.8%) and Andhra Pradesh (6.6%). State-wise dis-aggregation of all  
244 health professionals is presented in Appendix Table A-II.

245

## 246 **Density of Doctors and Nurses and Skill-mix**

247 At the all India level, stock density of doctor and nurses/mid-wives are 8.8 and 17.7 respectively  
248 per 10,000 persons (Figure 1). If we add total stock of dentists and traditional medicine  
249 practitioners, total stock density in India is estimated as 34.6 per 10.000 persons. However,  
250 density of active workers (as estimated from the NSSO) of doctor and nurses/mid-wives (without  
251 adjusting for adequate qualification) are estimated to be 6.1 and 10.6 respectively. The density  
252 further drops to 5.0 and 6.0 respectively after adjusting for the adequate qualifications. Total  
253 active worker density is estimated to be 26.5 and 16.7 respectively before after adjusting for  
254 qualifications.

255 Among the states, Kerala reported the highest density of active doctor workforce (25.4) whereas  
256 Delhi had the highest density of active nurse/midwives workforce estimated from NSSO.  
257 Considering doctor and nurse workforce together, Kerala, Delhi and Tamil Nadu are on the top  
258 of the list with the density of doctors and nurses taken together being 49, 38, and 28 per 10,000  
259 persons respectively. Towards the bottom of the list are the states of Bihar, Jharkhand and Odisha  
260 with doctor-nurse density being as low as 7, 9 and 9.7 per 10,000 persons respectively (Figure 2).  
261 (see Appendix Table A-III for details).

262 As far as the skill-mix ratio is concerned, the stock data of NHWA suggests nurse to doctor ratio  
263 as to be 2.02:1 at the all India level, with large scale variations across states varying from 10.7:1  
264 in Himachal Pradesh and 9.9:1 in Haryana on the higher side to as low as 0.4:1 in Bihar and 0.6:1  
265 in Uttarakhand. The nurse to doctor ratio on the basis of the NSSO data, however, is estimated  
266 to be 1.7:1 at the all India level with Punjab (7.1:1) and Delhi (4.8:1) on the higher side and states

267 of Bihar, Jammu & Kashmir and Madhya Pradesh having less than 1 nurse per doctor on the lower  
268 side (Table 4).

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

278

### 279 **Estimated Skilled Health Workforce Size by 2030**

280 Table 5 depicts the estimated number of skilled health workers (doctors/ nurses and midwives)  
281 for 2019 through 2030. The base line number for 2019 has been taken from the education  
282 adjusted estimates of health workforce from the NSSO 2017-18 (Table 2). The projected skilled  
283 health workforce numbers will rise from current estimates of 1.77 million to 2.65 million in 2030.  
284 However, even this will not result in a rise of the skilled health workforce density as the density  
285 will be approximately 17.5 per 10,000 population in 2030. There will be a shortfall of  
286 approximately 1.13 million skilled health workers to reach 22.8 skilled health workers per 10,000  
287 population. However, if there is a scale-up of nursing supply to approximately 200% growth by  
288 2030, the resultant number of nurses will be 2.02 million in 2030 and the total skilled health

289 workforce number will be 3.45 million in 2030 (22.76 skilled health professionals per 10,000  
290 population).

291  
292 If the NSSO reported data for health professionals without any adjustment for educational  
293 qualifications is considered as the baseline, the projected estimates of skilled health workforce  
294 numbers would be 3.03 million and density will be approximately 20.03 per 10,000 population in  
295 2030 at current growth rates. There will be a shortfall of approximately 0.7 million skilled health  
296 workers to reach 25 skilled health workers per 10,000 population. The forecasted supply side  
297 scenario from 2020 to 2030 is presented in Appendix xx.

298  
299 **Distribution of Health workforce by Gender and Age**

300 The gender and age distribution of health workforce (Figure 4 and Figure 5 respectively) reveals  
301 that there is a clear numerical dominance of males in doctors, dental and AYUSH categories  
302 whereas females outnumber male in the nurse's category. Approximately two-thirds of all health  
303 workforce are below age 40 years while more than 25% being in the young age group of below  
304 30 years. Nurses and dentists reflect higher concentration, 38% 30% respectively, in the younger  
305 age group (15-29 years) as compared with doctors (23%) and other health workers. Accordingly,  
306 doctors have higher concentration in the older age group of 50 years and above (18%) as against  
307 3% dentists and 5.5% nurses in the same age group.

308  
309 **Distribution across Rural–Urban and Public–Private**

310 The uneven distribution of health workers is also reflected across rural–urban and public-private  
311 settings (Appendix Figure-A-I and Figure A-II). Although rural India constituted approximately  
312 66% of the total population in 2018, only 33% of all health workers are in rural areas. This  
313 proportion is a quite lower for dental work force. The proportions of doctor and nurses in rural  
314 areas are 27% and 36%, respectively. Further, the bulk of the total health workforce is employed  
315 in the private sector. NSSO Report on health and morbidity in India [34] reflect that  
316 approximately 60% of inpatient care and 70% of outpatient care in India is provided by private  
317 sector. The proportions employed in the private sector: doctors (65%), dentists (89%), AYUSH  
318 (93%) and other health workers (67%) are also to a great extent commensurate to the proportion  
319 of service delivery.

320

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

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

328 We also examined the gender and age profile of the persons who have technical education in  
329 medicine but are ‘out of labour force’ and noted that female shares an overwhelming proportion  
330 (31%) of persons with technical education in medicine but are out of labour force. Proportions of  
331 persons with technical education in medicine but out of labour force is higher in the younger and

332 elderly age groups. However, approximately 20% female who are not in the labour force and  
333 have technical education in medicine are in the age group of 30-40 years (Appendix Figure A-III).  
334 An overwhelming proportion of these women reported themselves engaged in household work  
335 as against joining labour market.

336

## 337 **DISCUSSIONS AND POLCY IMPLICATIONS**

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

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

350

351 The minor deviations in the two studies are attributed to the use of population projection  
352 numbers as we used the Census of India projections as against the UN population projections  
353 used in the WHO study. However, NHWA and NSSO based estimates in the present study reflect

354 widely varied estimates on the size of health workforce with the NHWA based estimates  
355 significantly higher to the NSSO based estimates.

356 Several reasons have been highlighted explaining the difference between the estimates of health  
357 professionals from the NHWA data and health workers as reported in the NSSO data [11,15].

358 Most of these reasons are related to the fact that a large proportion of the health professionals  
359 registered with different councils and associations are not part of the current health workforce  
360 in India. One widely discussed reason is the migration of qualified health professionals from India  
361 to other developed countries [7,10,29,30].

362 In addition, there are reasons related to the veracity and updating of the NHWA data. For  
363 instance, the NHWA data is collated from different professional councils, which do not maintain  
364 a live register and do not require renewing the registration. The information they provide is  
365 fraught with non-adjustment of health professionals leaving the workforce because of death,  
366 retirement and double counting of workers because they have registered in more than one state  
367 [11,15].

368 However, one of the most important reasons of this differential estimate is that the NHWA  
369 provides total stock of health professionals but not all of them are active in labour markets. Using  
370 NSSO, we reported in this paper that a substantial proportion of medically qualified individuals,  
371 overwhelmingly women, is currently not a part of workforce, either because they are currently  
372 unemployed but available for work or they do not want to join labour markets. This is particularly  
373 amplified for nurses/midwives, for whom the difference between the registered and active  
374 workers is the highest. If we apply this proportions (% employed) over the NHWA stock data, we  
375 come to pretty close estimates from the two sources.

376 Density of health workforce with respect to population is an important indicator of availability of  
377 health workforce. Density of allopathic doctors and nurses who are active in labour market are  
378 as low as 6.1 and 10.6 respectively per 10,000 persons (16.7 in total), which is well below the  
379 WHO threshold of 44.5 doctors, nurses and midwives per 10,000 population. If we add dentists  
380 and AYUSH professionals, the total active health workforce density comes to be approximately  
381 22 per 10,000 persons. The present study clearly reveals that new investment for improving the  
382 size of active health workforce is the most important area which needs policy attention in India.  
383 In addition, we also find a sub-optimal skill-mix between doctor and nurse and doctor and allied  
384 health professional. Size of traditional medicine practitioners (including AYUSH) in India is quite  
385 sizeable. Total number of active AYUSH practitioners is almost 70% of the total number of active  
386 allopathic doctors.

387 However, the number of nurses per doctor is less than 2. This number is lower to 1 if we consider  
388 BSc Nursing qualifications. In most OECD countries there are 3-4 nurses per doctors [7]. We find  
389 that although total stock of nurses in the country is approximately 3 times number of doctors, a  
390 large proportion of nurses are not actually active in labour market. In order to increase nurses'  
391 participation in active health workforce, creating a smooth employment environment for nurses  
392 may be another area of policy intervention. A few states Delhi, Punjab, Himachal Pradesh, and  
393 Chhattisgarh have high nurse doctor ratio but in these states density of doctor per 10,000 persons  
394 are very low. There is a need to make balance between densities of doctor and nurse both for a  
395 better availability of health professionals and skill-mix. Similarly, doctor/allied health  
396 professionals' ratio is also very poor which needs attention. The Global Strategy report [4] and

397 other similar studies [31] also emphasized creation of enough allied health professionals through  
398 improved training and educational infrastructure.

399 Skewed distribution of health workforce across states and rural-urban setting is yet another area  
400 which needs policy attention. Nearly two-thirds of all health workforce in India is concentrated  
401 in urban areas leaving rural population either in extreme unmet need of health workers or to  
402 avail their services by travelling in urban areas or both. The lopsided distribution of health  
403 workforce is also pronounced across Indian states. Most of the less developed states such as  
404 Bihar, Jharkhand, Odisha, Rajasthan, Uttar Pradesh etc. reflect the acute shortage of health  
405 workforce.

406 As far as public-private division of health workforce is concerned, the bulk of doctors'  
407 employment is in private sector while nurses are almost equally distributed across public and  
408 private sector. Public sector seems to be sole employer of traditional medical practitioners. These  
409 lop-sided distribution of health workers not only create shortage of trained health workforce in  
410 many states and rural areas but also leads to unequal skill-mix across different types of health  
411 workers in different settings. These findings are in conformity with earlier studies [11,17].

412 The public sector is also challenged by a high rate of vacancy of sanctioned positions [32]. While  
413 the shortage is most pronounced for specialists at Community Health Centres, the shortages are  
414 prominently witnessed across the states for various positions. The existing vacancies are  
415 attributed to diverse reasons that range from barriers in recruitment, litigations against  
416 recruitment processes and premature exits from the system, especially in contractual positions.  
417 Filling up existing vacancies in government sector requires urgent policy attention.

418 An analysis of the health workforce projections suggests that the estimated density of skilled  
419 health professionals (doctors, nurses & midwives) per 10,000 population is unlikely to alter from  
420 current levels by 2030 if the current rates of growth are sustained. While we are to witness an  
421 absolute rise in numbers by 2030, the density of the health workforce is unlikely to change by  
422 2030. AYUSH represents Indian systems of medicine which are predominantly accessed by  
423 people of Indian origin, and their inclusion might introduce difficulty in creating comparisons with  
424 other countries. Nonetheless, we feel that since there is a significant government emphasis and  
425 investment in their training and deployment, as well as them sharing a large clientele in the  
426 population, they merit an inclusion in the overall workforce numbers. We have presented the  
427 AYUSH numbers as distinct from doctors, but we have included them in the calculation of the  
428 overall skilled health worker density.

429 At the present level of the growth in the supply side, the skill-mix ratio of doctor: nurse is unlikely  
430 to alter by 2030. A near 200% growth in the supply side for nurses will improve the doctor: nurse  
431 ratio to 1:1.5 by 2030. This will require a further rapid scale-up of nursing programs. The High  
432 Level Expert Group report for the Planning Commission in 2012 [33] had suggested a ratio of  
433 1:2:1 for doctor: nurse: ANM for India. For achieving this number of nurses by 2030, simultaneous  
434 efforts will have to be undertaken on the demand side of the market as well. The roles for nurses  
435 and the functions that are performed by them will need closer attention.

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

437 **Expanding the supply side of the health workforce:** The expansion of medical educational  
438 institutions (medicine, nursing, dentistry etc.) should be prioritized across geographical regions  
439 with a shortage of health workforce and the passed out from these institutions should be

440 encouraged to work in local areas. Thailand represents a good example of effective  
441 implementation of rural retention policies for medical doctors [35]

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

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

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

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

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

460 **Up-skilling programs for less qualified care providers:** There is a section of the health workforce  
461 which has lower than desirable qualification as reported in the NSSO data. This issue needs

462 deliberation within the Councils and the Ministry of Health at the national level to identify the  
463 mechanisms to address the issue. While we do not recommend their formalization in the  
464 workforce in the present form, the government can consider up-skilling programs to improve the  
465 quality of services and engage them in a range of care giving and non-medical health services.

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

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

474

475

#### 476 LIST OF ABBREVIATIONS

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

484 Medical Practitioner; SDG's – Sustainable Development Goals; UN – United Nations; WHO – World  
485 Health Organisation; WPR – Worker Population Ratio.

486

487 DECLARATIONS

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

490 Consent to participate – Not applicable.

491

492 CONSENT FOR PUBLICATION: Not applicable

493 AVAILABILITY OF DATA AND MATERIALS: Data for this study was used from secondary sources. Micro data  
494 from the NSSO is available for free in public domain from the official website

495 (<http://www.mospi.gov.in/unit-level-data-report-nss-75th-round-july-2017-june-2018-schedule->

496 [250social-consumption-health](#)) of the National Sample Survey Office, Ministry of Statistics and  
497 Programme Implementation, Government of India.

498

499 COMPETING INTERESTS: No competing interest

500

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503

504 AUTHOR'S CONTRIBUTIONS

505 AK, DM, HN, JB, SZ and TZ jointly conceptualised the idea. AK, DM, JB, HN and TZ developed early analytical  
506 framework. AK, HN, SH and TZ analysed the data. AK, HN and SH prepared the first draft. DM, HG, JB, SZ

507 and TZ provided extensive comments to the first draft and contributed to developing the final draft. AK,

508 DM, HG, HN, JB, SH, SZ and TZ all reviewed the final draft and consented to the final manuscript.

509

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517 [eng.pdf;jsessionid=E7906442B2EC6417EBE3C5F7D45715FC?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/250040/9789241511285-eng.pdf;jsessionid=E7906442B2EC6417EBE3C5F7D45715FC?sequence=1) (Accessed 20 April  
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**FIGURES**

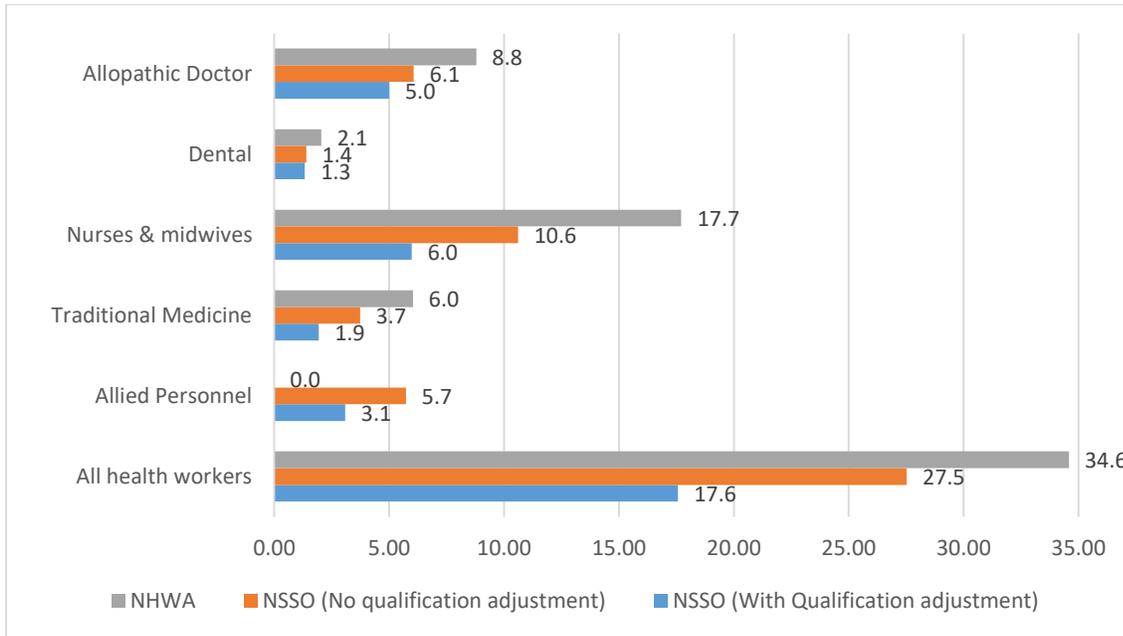


Figure 1: Number of health professionals/workers per 10,000 persons, 2018

Sources: Estimates from NHWA 2018 and NSSO 2017-18

Note: using population projection as of 1<sup>st</sup> January 2018 from Census of India 2011

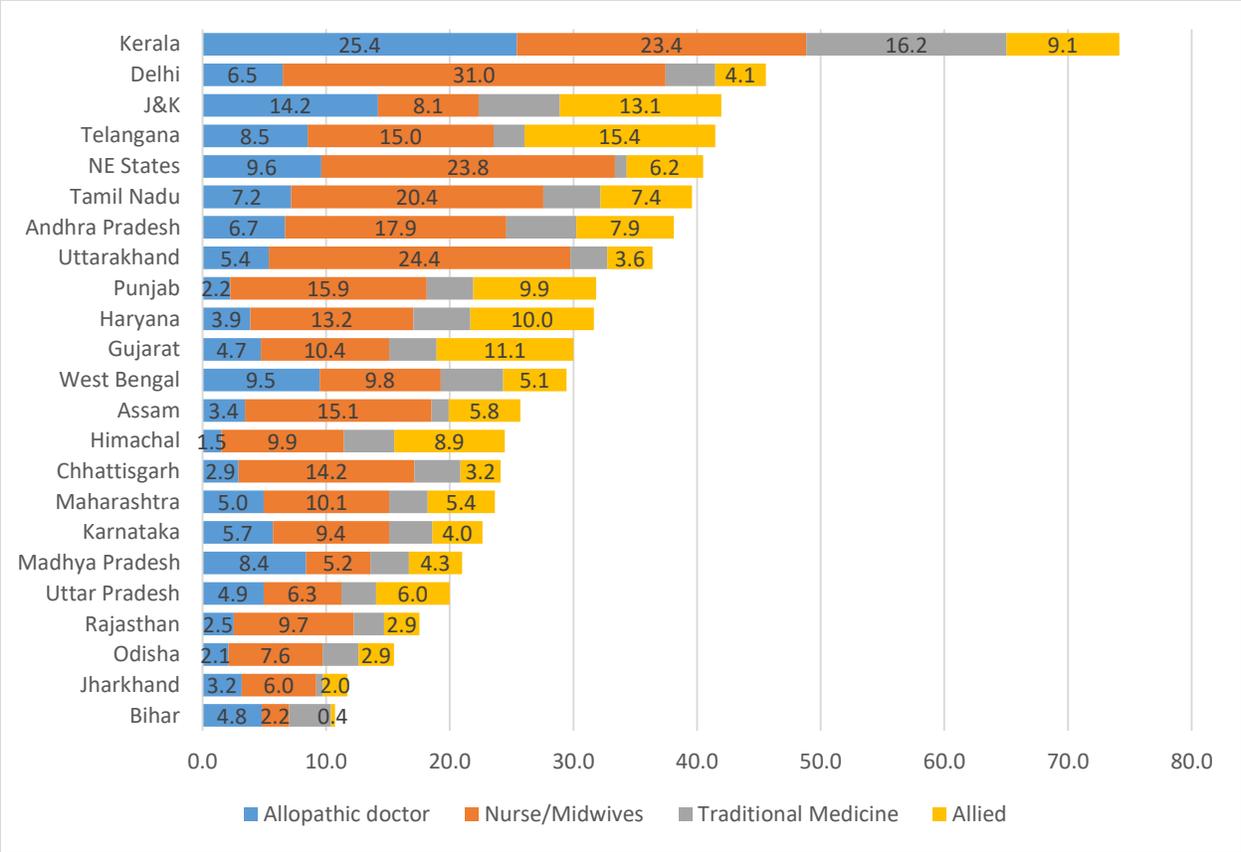


Figure 2. Density of health workers/professionals in states, 2018

Sources: Estimates from NSSO 2017-18

Note: using population projection as of 1<sup>st</sup> January 2018 from Census of India 2011

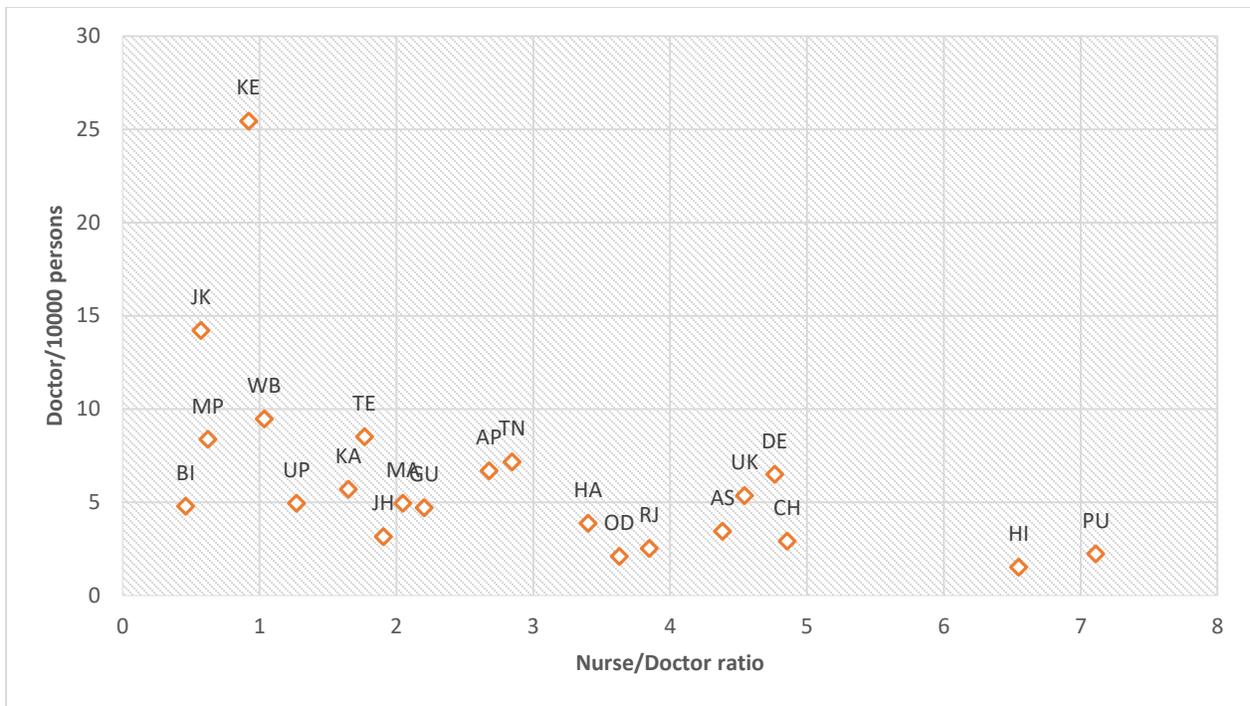


Figure 3: States with varied density of doctors and nurse/doctor ratio

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

Note: using population projection as of 1<sup>st</sup> January 2018 from Census of India 2011

DE Delhi	HA Haryana	HI Himachal Pradesh	JK Jammu and Kashmir	PU Punjab	RJ Rajasthan	UK Uttarakhand	AS Assam
CH Chhattisgarh	MP Madhya Pradesh	UP Uttar Pradesh	BI Bihar	JH Jharkhand	WB West Bengal	OD Odisha	MA Maharashtra
GU Gujarat	AP Andhra Pradesh	KA Karnataka	KE Kerala	TN Tamil Nadu	TE Telangana		

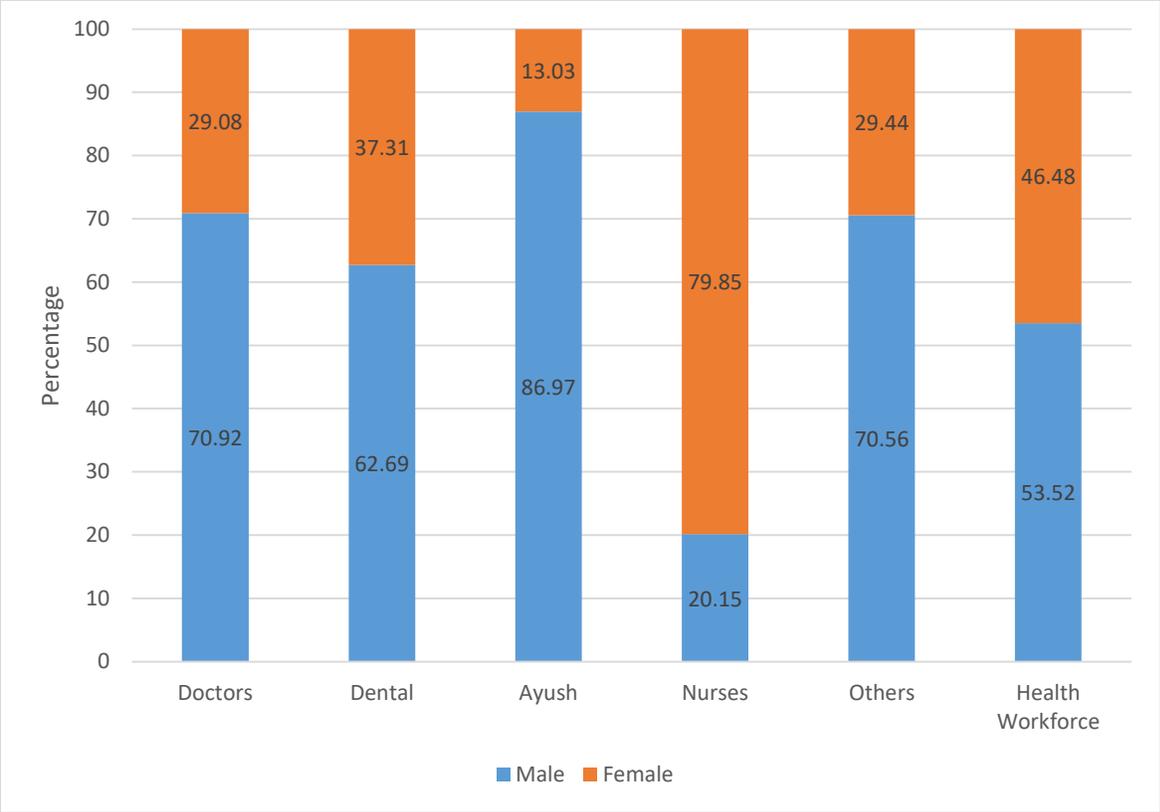


Figure 4. Gender distribution of HRH in India-2018

Source: Estimates from NSSO 2017-18

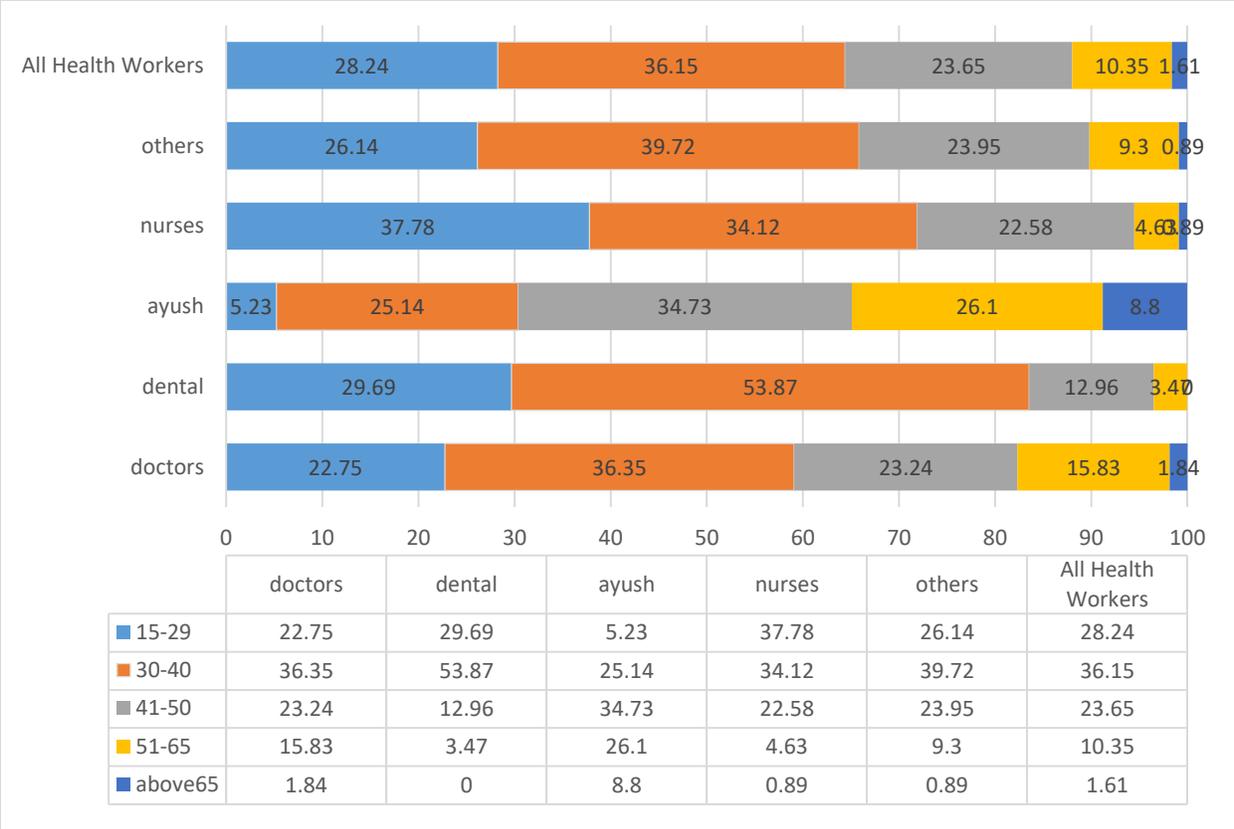


Figure 5. Age distribution of health workforce in India-2018

Source: Estimates from NSSO 2017-18

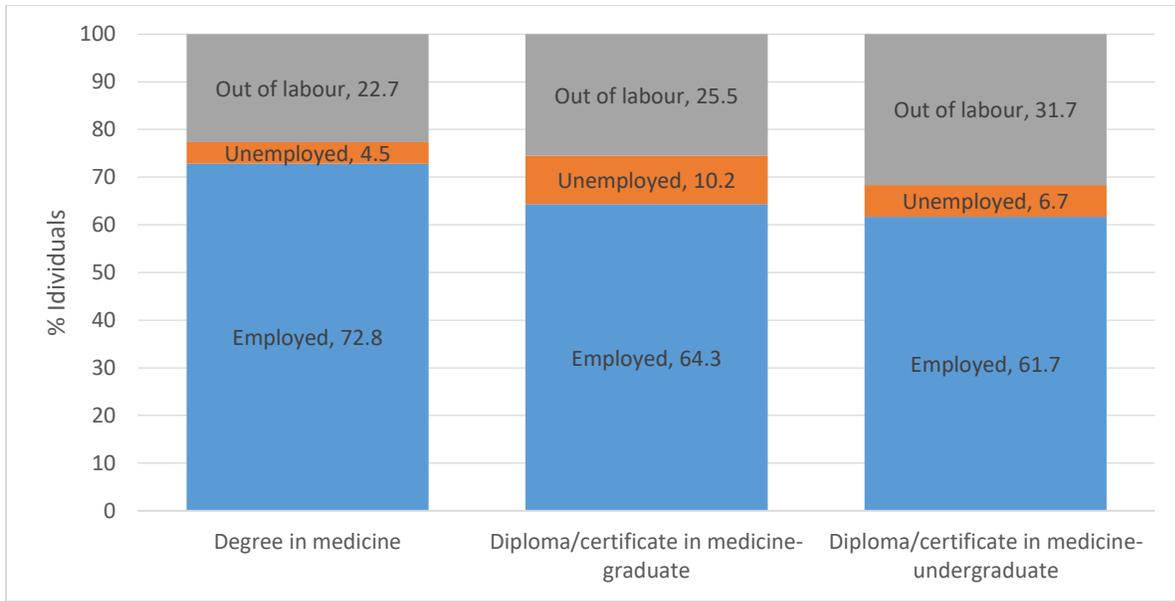


Figure 6: Percentage distribution of individuals with various levels of technical education in medicine as employed, unemployed and out of labour force, 2018  
 Source: Estimates from NSSO 2017-18

Table 1: Types of health professionals, their educational qualification and registering agencies

Health workers	Educational qualification	Registering agencies
Allopathic doctors (physician and surgeon)	graduates with a bachelor's degree in medicine/surgery or postgraduate diploma	Medical council of India
Dental practitioner	graduates with a bachelor's or postgraduate degree in dentistry	Dental council of India
AYUSH practitioner	graduates with a bachelor's or postgraduate degree in Ayurveda, Unani, Siddha, or Homoeopathy	Department of AYUSH/ MoHFW
Nurse	diploma in General Nursing and Midwifery (3.5 year course) or a 4-year bachelor's degree or a 2–3-year postgraduate degree	Indian Nursing Council
Auxiliary nurse and midwife	a diploma in auxiliary nurse midwifery (2-year course).	Ministry of health and Family Welfare
Pharmacist	diploma or bachelor's degree course in pharmacy	Pharmacy council of India
Physiotherapist, diagnostic and others technician	diploma/certificate in medical allied fields	Indian Association of Physiotherapist and Ministry of health and Family Welfare

Sources: using information from CBHI 2019 and Councils of health professionals

Table 2. Size and composition of HRH in India as of 2018

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

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

Note: \* includes health assistants, sanitarians, dietitians and nutritionists, optometrists and opticians, dental assistants, physiotherapy associates, pharmacist assistants, occupational therapist chiropodist, masseur etc.

Table 3. Number and percentage distribution of allopathic doctors and nurse in states, 2018

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

Note: \* includes north-east states of Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura

Sources: NHWA 2018 and NSSO 2017-18

Table 4: Skill-mix of health workers in different states, 2018

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

Sources: NHWA 2018 and NSSO 2017-18

Table 5: Projected skilled health workforce (2019 to 2030)

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

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

\*From NSSO estimates