

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

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1 **Title page**

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ABSTRACT

39

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

45 METHODS: We analyzed two sources of data: i) National Health Workforce Account (NHWA)
46 2018 and ii) Periodic Labour Force Survey 2017-18 of the National Sample Survey Office (NSSO).
47 Using the two sources we collated comparable estimates of different categories of health
48 workers in India, density of health workforce and skill-mix at the all India and state levels.

49 RESULTS: The study estimated (from NHWA 2018) a total stock of 5.76 million health workers
50 which included allopathic doctors (1.16 million), nurses/midwives (2.34 million), pharmacist
51 (1.20 million), dentists (0.27 million), and traditional medical practitioner (AYUSH 0.79 million).
52 However, the active health workforce size estimated (NSSO2017-18) is much lower (3.12
53 million) with allopathic doctors and nurses/midwives estimated as 0.80 million and 1.40 million
54 respectively. Stock density of doctor and nurses/mid-wives are 8.8 and 17.7 respectively per
55 10,000 persons as per NHWA. However, active health workers' density (estimated from NSSO)
56 of doctor and nurses/mid-wives are estimated to be 6.1 and 10.6 respectively. The numbers
57 further drop to 5.0 and 6.0 respectively after accounting for the adequate qualifications. All
58 these estimates are well below the WHO threshold of 44.5 doctor, nurses and midwives per
59 10,000 population. The results reflected highly skewed distribution of health workforce across
60 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, Human resource for health, 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 (LMICs) is lower than desired levels for education and training
84 for health workers and ensuring health worker accessibility [4,5]. This present paper aims to
85 identify the current challenges of HRH and the areas of investment in HRH in India.

86 An enhanced investment in HRH has multiple benefits with the potential for a positive impact
87 going far beyond the health sector. Further, the impact of such investments can be maximized
88 by improving the efficiency of HRH spending in a country [2, 4]. This requires a comprehensive
89 analysis of health workforce situation in a country and identifying the areas of investments in
90 health workforce. Improved health workforce information base, mapping geographical regions
91 of workforce shortage, identifying work-load and staff distribution pattern, mapping of skill-mix
92 and training and capacity building of health workforce are of crucial importance for investment

93 decisions at the policy levels in most LMICs [5, 6]. For instance, recent research suggesting that
94 investment in more diverse staff and skill mix can result in improved quality of care, quality of
95 life, and job satisfaction [7-10]. Women constitutes a significant proportion of health workforce
96 globally. However, concentration of women in low profile jobs within the health sector and the
97 related gender inequality has been a serious concern particularly in (LMICs) including India
98 [11,12]. Profiling of health workers by age and gender helps understanding the gender issues of
99 health workforce and women health professionals not participating in the labour markets.

100

101 The investment case for HRH in India is exemplified by the fact that India has a very low density
102 of health workers per 10,000 population and the distribution of health workforce across the
103 Indian states is highly skewed [13,14]. A recent WHO report mentions that India needs at least
104 1.8 million doctors, nurses and midwives to achieve the minimum threshold of 44.5 health
105 workers per 10,000 population in 2030 [15]. Also, India's National Health Policy (NHP) 2017
106 recommended strengthening existing medical education system and the development of a cadre
107 of mid-level care providers [16]. Similarly, the *NITI Aayog's* Strategy for "New India@75" aims at
108 generating 1.5 million jobs in the public health sector by 2022-23 [17]. The current COVID-19
109 pandemic has further exposed the acute shortage of health workers in India's health system. In
110 addition, OECD countries have benefited by the presence of Indian origin and Indian trained
111 doctors and nurses [8], whilst during the COVID-19 situation the health system in India is
112 struggling with low numbers of trained health personnel.

113 An enhanced investment in health workforce in India has the potential of not only strengthening
114 the health system and improving the accessibility to health workers but also generating

115 employment for health professionals, associate health workers and subordinate/support staff,
116 enhancing female labour force participation and share of formal employment in total
117 employment [15].

118 Recent research [13-, 18-21] has identified several areas of concern related to Indian health
119 workforce. Studies have highlighted that there has been acute shortages of doctors and nurses
120 along with low levels of skill-mix. A lack of adequate number of institutions providing training in
121 nursing, and international migration of nurses from India are the two most prominent reasons
122 for the shortage of trained nurses in India [22-25]. Moreover, studies have also highlighted low
123 quality of a large share of total number of nurses in India [16, 26]..

124 Against this background, the main research question in the present study is: what are the
125 dimensions of HRH in India which are crucial for policy attention and enhanced investment. While
126 doing so, the study presents an updated estimate of health workforce at disaggregated
127 geographical regions and identify issues related to difference between health workforce
128 estimates and the stock of health professionals registered with different councils. In addition, the
129 study also estimates level of skill-mix at the all India and state levels. To address the gender
130 dimension of the health workforce, the study estimated level of women participation in health
131 workforce and presents age and gender profile of health professionals who are not active in
132 labour market.

133

134 *HRH policy and structure of health workforce in India*

135 Indian healthcare system is characterized by a pattern of mixed ownership (public and private)
136 and systems of medicine (Allopathic and indigenous including Homoeopathy, *Ayurvedic*, *Yoga*,

137 *Unani, Siddha etc.* [16]. India's HRH policy is shaped by recommendations by various expert
138 committees during the past seven decades. Taking note of acute shortages and uneven
139 distribution of health workforce in India, most of these committees recommended to
140 significantly increase production, maintain an adequate skill-mix of health workers and
141 maintaining minimum level of physical infrastructure at population levels [27]. However,
142 despite these recommendations, India continued to struggle with shortages and uneven
143 distribution of HRH. Also, sustained under-investment in public health system led private sector
144 to overtake public in service delivery and employment of health workforce [28]. Recent health
145 sector reforms, particularly since the launch of the National Rural Health Mission (NRHM) in
146 2005, focused on strengthening public health system and emphasized on improving health
147 worker population ratio. More recently in 2019 government of India announced three
148 strategies to enhance supply of HRH: i) establishing new institutions to produce health workers;
149 ii) expand the intake capacity of the existing medical institutions and iii) upgrade existing
150 district hospitals to medical college level [29]. Simultaneously, government also relaxed the
151 norms of establishing medical colleges and nursing institutions in the private sector. All these
152 are likely to significantly increase supply of health workers in the near future.

153 Healthcare services in India are offered by a varied range of professionals trained in different
154 specialties of medicine and healthcare. The supply side information [30] on the availability of
155 health professionals indicate that these health professionals have varied levels of educational
156 qualifications and are registered with different councils/agencies [13-14]. Table 1 presents
157 categories of health professionals directly engaged in services delivery along with their levels of
158 educational qualification and their registering agencies.

159 AYUSH (an indigenous Indian system of medicine comprising of Ayurvedic, Yoga, Unani, Siddha
160 and Homeopathic) doctors are bachelor's or postgraduate degree holders in AYUSH. Their
161 registering institutions are Central Council for Indian Medicine or the Central Council for
162 Homoeopathy and are authorized to dispense medicines and conduct surgery using their respective
163 fields of specialization. AYUSH doctors are integral part of HRH in India as their professions are
164 recognized by a Parliament Act [13-14]. There are also community health workers with 10 years
165 of formal education and a short training course. The health workforce at the ground level also
166 includes many informal medical practitioners, such as registered medical practitioners (RMPs)
167 (including traditional birth attendants, faith healers, snakebite curers, bonesetters etc.) with or
168 without any formal education or skills/training. RMPs are often the first point of contact for
169 treatment for a large proportion of population living in rural and remote areas and they may be
170 dispensing either allopathic or traditional drugs or both as the need arises [13-14].

171

172 **METHODS**

173 The present study used data from two main sources: (1) National Health Workforce Accounts
174 (NHWA) on India -2018 [31] and (2) Periodic Labour Force Survey (PLFS) conducted during July
175 2017 – June 2018 by the National Sample Survey Office (NSSO 2017-18) [32]. In addition,
176 information was also collected from Central Bureau of Health Intelligence (CBHI) 2019, Rural
177 Health Statistics (2019) and population projection from the Census of India (2019) [33].

178 *NHWA data*

179 The NHWA for India provides information on different categories of stock of health workers at
180 national and state levels. The latest information available is for the year 2018. We extracted

181 number of health professionals from NHWA for four different categories (Medical doctors,
182 Dentist, Nurses/midwives/Auxiliary nurse and midwives (ANM), and Pharmacist) at the all India
183 and state levels for the year 2018.

184 *NSSO data*

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

192 *Methods of estimation of health workforce*

193 Total stock of health professionals by types of health professionals (doctors, nurses and
194 midwives, pharmacists and traditional medicine practitioners) is directly reported in the NHWA
195 database. We estimated size of comparable categories of health workforce from the NSSO 2017-
196 18, using the worker population ratio (WPR) and projected population as of January 2018. We
197 applied the WPR at the disaggregated occupational levels estimated from NSSO 2017-2018 to the
198 projected population as of 1 January 2018 using population projection at disaggregated levels:
199 male and female living in rural and urban areas separately in each state. The estimates of HRH
200 were arrived at using equation (1).

201 $HW_{aijk} = pop_{ijk} * WPR_{aijk} \dots \dots \dots (1)$

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

207
$$WPR_a = \frac{workers_a}{pop} \dots \dots \dots (2)$$

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

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

220 The two sources (NHWA and NSSO data) identify comparable categories of health professionals.
221 However, NSSO data base does not provide NCO code for identifying ANM and pharmacists
222 comparable to the NHWA. It is possible that a part of the total ANM number in the NSSO data
223 may be clubbed in another category coded as 'health associate professionals'. The pharmacist

224 number presented in this report on the basis of NSSO data only refers to pharmacists engaged in
225 retail trade.

226

227 *Supply side estimation*

228 We estimated the supply of health professionals in future years up to 2030 using estimated
229 number of seats in different medical colleges/institutions. Institutions offering health programs
230 in 2019 were identified through Google search engine using keywords such as “health programs”,
231 “nursing courses”, “AYUSH”, “MBBS”, “BPharma” and “allied health programs”. The search was
232 limited to programs offered in India. Additionally, the websites of the All India Council of
233 Technical Education, University Grants Commission, universities and institutions were also
234 searched, and education supplements of newspapers and commercial web-sites were searched.
235 The number of seats in various health professional programs was forecasted for the period till
236 2030. We assumed a seat occupancy rate of 95% for medical doctors for the forecast time period.
237 For generating the workforce estimates for each year, we added the new supply for each year to
238 the workforce numbers in the preceding year and subtracted assumed exits from the workforce
239 to account for mortality, retirement and migration by assuming an overall annual attrition rate
240 of 7% every year.
241 Finally, we modelled scenarios according to different levels of policy intervention which was
242 similar to that adopted by Ridoutt et al. [34].

243

244 **RESULTS**

245 **Size and Composition of Health Workforce**

246 Table 2 presents estimates of HRH, categorized by doctors, dentists, nurses/mid-wives and
247 pharmacist, at the all India level using the two main sources of data. Since workers self-reported
248 occupations in the NSSO survey and health workers may or may not have adequate qualifications,
249 we present estimates on health workforce from NSSO with and without adequate qualifications.
250 NHWA reports a total stock of approximately 1.16 million allopathic doctors, 2.34 million
251 nurses/midwives (including ANM), 1.20 million pharmacists, 0.27 million dentists, and traditional
252 medicine professionals 0.79 million. Both the estimates (with and without adequate
253 qualifications) from NSSO are invariably lower compared with the NHWA estimates for all the
254 reported categories. According to NSSO, the numbers of allopathic doctors and nurses/mid-
255 wives, even before adjusting for the right qualifications, are 0.80 million and 1.4 million
256 respectively. Estimates on pharmacist, dentist, and traditional medical practitioners from NSSO
257 are also significantly lower as compared with those recorded in the NHWA.

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

266 State-wise dis-aggregation of allopathic doctors and nurses reflect large concentration of stock
267 of health professionals in a few states like Maharashtra, Tamil Nadu and Karnataka (Table 3) and
268 active health workforce in states of Uttar Pradesh, West Bengal and Kerala (Appendix Table A-II).

269

270 **Density of Doctors and Nurses and Skill-mix**

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

279 Among the states, Kerala reported the highest density of active doctor workforce (25.4) whereas
280 Delhi had the highest density of active nurse/midwives workforce estimated from NSSO.
281 Considering doctor and nurse workforce together, Kerala, Delhi and Tamil Nadu are on the top
282 of the list with a great deal of variations across states (Figure 2). (see Appendix Table A-III for
283 details).

284 As far as the skill-mix ratio is concerned, the stock data of NHWA suggests nurse to doctor ratio
285 as to be 2.02:1 at the all India level, with large scale variations across states varying from 10.7:1
286 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
287 in Uttarakhand. The nurse to doctor ratio on the basis of the NSSO data, however, is estimated

288 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
289 of Bihar, Jammu & Kashmir and Madhya Pradesh having less than 1 nurse per doctor on the lower
290 side (Table 4). Figure 3 presents skill-mix ratio as against density of doctors at the state levels.

291

292

293 **Estimated Skilled Health Workforce Size by 2030**

294 Table 5 depicts the estimated number of skilled health workers (doctors/ nurses and midwives)
295 for 2019 through 2030. The base line number for 2019 has been taken from the education
296 adjusted estimates of health workforce from the NSSO 2017-18 (Table 2). The projected skilled
297 health workforce numbers will rise from current estimates of 1.77 million to 2.65 million in 2030.
298 However, even this will not result in a rise of the skilled health workforce density as the density
299 will be approximately 17.5 per 10,000 population in 2030. There will be a shortfall of
300 approximately 1.13 million skilled health workers to reach 22.8 skilled health workers per 10,000
301 population. However, if there is a scale-up of nursing supply to approximately 200% growth by
302 2030, the resultant number of nurses will be 2.02 million in 2030 and the total skilled health
303 workforce number will be 3.45 million in 2030 (22.76 skilled health professionals per 10,000
304 population).

305

306 If the NSSO reported data for health professionals without any adjustment for educational
307 qualifications is considered as the baseline, the projected estimates of skilled health workforce
308 numbers would be 3.03 million and density will be approximately 20.03 per 10,000 population in
309 2030 at current growth rates. There will be a shortfall of approximately 0.7 million skilled health

310 workers to reach 25 skilled health workers per 10,000 population. The forecasted supply side
311 scenario from 2020 to 2030 is presented in Appendix Table A-IV.

312

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

314 The gender and age distribution of health workforce (Figure 4 and Figure 5 respectively) reveals
315 that there is a clear numerical dominance of males in doctors, dental and AYUSH categories
316 whereas females outnumber male in the nurse's category. Approximately two-thirds of all health
317 workforce are below age 40 years while more than 25% being in the young age group of below
318 30 years. Nurses and dentists reflect higher concentration, 38% 30% respectively, in the younger
319 age group (15-29 years) as compared with doctors (23%) and other health workers. Accordingly,
320 doctors have higher concentration in the older age group of 50 years and above (18%) as against
321 3% dentists and 5.5% nurses in the same age group.

322

323 **Distribution across Rural–Urban and Public–Private**

324 The uneven distribution of health workers is also reflected across rural–urban and public-private
325 settings (Appendix Figure-A-I and Figure A-II). Although rural India constituted approximately
326 66% of the total population in 2018, only 33% of all health workers are in rural areas. This
327 proportion is a quite lower for dental work force. The proportions of doctor and nurses in rural
328 areas are 27% and 36%, respectively. Further, the bulk of the total health workforce is employed
329 in the private sector. Approximately 60% of inpatient care and 70% of outpatient care in India is
330 provided by private sector [34]. The proportions employed in the private sector: doctors (65%),

331 dentists (89%), AYUSH (93%) and other health workers (67%) are also to a great extent
332 commensurate to the proportion of service delivery.

333

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

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

340 We also examined the gender and age profile of the persons who have technical education in
341 medicine but are 'out of labour force' and noted that female shares an overwhelming proportion
342 (31%) of persons with technical education in medicine but are out of labour force. Proportions of
343 persons with technical education in medicine but out of labour force is higher in the younger and
344 elderly age groups. However, approximately 20% female who are not in the labour force and
345 have technical education in medicine are in the age group of 30-40 years (Appendix Figure A-III).
346 An overwhelming proportion of these women reported themselves engaged in household work
347 as against joining labour markets.

348

349 **DISCUSSIONS AND POLCY IMPLICATIONS**

350 Investment in HRH to improve availability of health workforce has gained increased attention in
351 recent years [2,5]. In India such investments also have potential to enhance female labour force
352 participation and formalization of labour market [15]. These discussions on enhancing the

353 investment and policy attention to health workforce related issues has assumed centrality in the
354 presence of the COVID-19 pandemic.

355 In the present report we presented different dimensions of HRH in India, along with existing and
356 emerging challenges which needs to be addressed for improved availability of health workforce
357 in the country as a whole and at the state levels. We used two nationally representative data
358 sources on health workforce: i) stock of health workforce from the NHWA 2018 and ii) National
359 sample survey data (NSSO) 2017-18 on labour force to identify HRH challenges and areas of
360 investment in HRH in India. Our estimates from the NHWA data are almost similar to the results
361 as reported in a recent WHO report [15]. However, NHWA and NSSO based estimates in the
362 present study reflect widely varied estimates on the size of health workforce with the NHWA
363 based estimates significantly higher to the NSSO based estimates.

364 Several reasons have been highlighted explaining the difference between the estimates of health
365 professionals from the NHWA data and health workers as reported in the NSSO data [14,18].

366 Most of these reasons are related to the fact that a large proportion of the health professionals
367 registered with different councils and associations are not part of the current health workforce
368 in India. One widely discussed reason is the migration of qualified health professionals from India
369 to other developed countries [8,13,35,36].

370 In addition, there are reasons related to the veracity and updating of the NHWA data. For
371 instance, the NHWA data is collated from different professional councils, which do not maintain
372 a live register and do not require renewing the registration. The information they provide is
373 fraught with non-adjustment of health professionals leaving the workforce because of death,

374 retirement and double counting of workers because they have registered in more than one state
375 [14,18].

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

384 Despite the differences in estimates of health workforce across the two main sources of
385 information, both the sources indisputably reflect skewed distribution of health workforce across
386 states and inadequate skill-mix ratio.

387 AYUSH practitioners are recognised health professionals by government of India and they use
388 indigenous system of healthcare. Use of indigenous knowledge in health system is not unique in
389 India. Such system exist in many developing countries including Bangladesh, China and South
390 Africa [37-39] and the Traditional Chinese Medicine was also used as a safeguard against SARS
391 and COVID-19 in China [40]. In India a large section of population has significant belief in AYUSH
392 system and for many chronic conditions AYUSH is often preferred over modern healthcare by a
393 large proportion of population [41, 42]

394 Density of health workforce with respect to population is an important indicator of availability of
395 health workforce. Density of allopathic doctors and nurses who are active in labour market are

396 as low as 6.1 and 10.6 respectively per 10,000 persons (16.7 in total), which is well below the
397 WHO threshold of 44.5 doctors, nurses and midwives per 10,000 population. If we add dentists
398 and AYUSH professionals, the total active health workforce density comes to be approximately
399 22 per 10,000 persons. The present study clearly reveals that new investment for improving the
400 size of active health workforce is the most important area which needs policy attention in India.
401 In addition, we also find a sub-optimal skill-mix between doctor and nurse and doctor and allied
402 health professional. Size of traditional medicine practitioners (including AYUSH) in India is quite
403 sizeable. Total number of active AYUSH practitioners is almost 70% of the total number of active
404 allopathic doctors.

405 However, the number of nurses per doctor is less than 2. This number is lower to 1 if we consider
406 BSc Nursing qualifications. In most OECD countries there are 3-4 nurses per doctors [8]. We find
407 that although total stock of nurses in the country is approximately 3 times number of doctors, a
408 large proportion of nurses are not actually active in labour market. In order to increase nurses'
409 participation in active health workforce, creating a smooth employment environment for nurses
410 may be another area of policy intervention. There is a need to make balance between densities
411 of doctor and nurse both for a better availability of health professionals and skill-mix. Similarly,
412 doctor/allied health professionals' ratio is also very poor which needs attention. The Global
413 Strategy report [4] and other similar studies [43] also emphasized creation of enough allied health
414 professionals through improved training and educational infrastructure.

415 Skewed distribution of health workforce across states and rural-urban setting is yet another area
416 which needs policy attention. Nearly two-thirds of all health workforce in India is concentrated
417 in urban areas leaving rural population either in extreme unmet need of health workers or to

418 avail their services by travelling in urban areas or both. The lopsided distribution of health
419 workforce is also pronounced across Indian states. Most of the less developed states such as
420 Bihar, Jharkhand, Odisha, Rajasthan, Uttar Pradesh etc. reflect the acute shortage of health
421 workforce. To understand the reasons of such skewed distribution across states and to
422 understand regional level complexities a more detailed and deeper study is required.

423 As far as public-private division of health workforce is concerned, the bulk of doctors'
424 employment is in private sector while nurses are almost equally distributed across public and
425 private sector. Public sector seems to be sole employer of traditional medical practitioners. These
426 lop-sided distribution of health workers not only create shortage of trained health workforce in
427 many states and rural areas but also leads to unequal skill-mix across different types of health
428 workers in different settings. These findings are in conformity with earlier studies [14,20].

429 The public sector is also challenged by a high rate of vacancy of sanctioned positions [44]. While
430 the shortage is most pronounced for specialists at Community Health Centres, the shortages are
431 prominently witnessed across the states for various positions. The existing vacancies are
432 attributed to diverse reasons that range from barriers in recruitment, litigations against
433 recruitment processes and premature exits from the system, especially in contractual positions.
434 Filling up existing vacancies in government sector requires urgent policy attention.

435 An analysis of the health workforce projections suggests that the estimated density of skilled
436 health professionals (doctors, nurses & midwives) per 10,000 population is unlikely to alter from
437 current levels by 2030 if the current rates of growth are sustained. While we are to witness an
438 absolute rise in numbers by 2030, the density of the health workforce is unlikely to change by
439 2030. AYUSH represents Indian systems of medicine which are predominantly accessed by

440 people of Indian origin, and their inclusion might introduce difficulty in creating comparisons with
441 other countries. Nonetheless, we feel that since there is a significant government emphasis and
442 investment in their training and deployment, as well as them sharing a large clientele in the
443 population, they merit an inclusion in the overall workforce numbers. We have presented the
444 AYUSH numbers as distinct from doctors, but we have included them in the calculation of the
445 overall skilled health worker density.

446 At the present level of the growth in the supply side, the skill-mix ratio of doctor: nurse is unlikely
447 to alter by 2030. A near 200% growth in the supply side for nurses will improve the doctor: nurse
448 ratio to 1:1.5 by 2030. This will require a further rapid scale-up of nursing programs. The High
449 Level Expert Group report for the Planning Commission in 2012 [45] had suggested a ratio of
450 1:2:1 for doctor: nurse: ANM for India. For achieving this number of nurses by 2030, simultaneous
451 efforts will have to be undertaken on the demand side of the market as well. The roles for nurses
452 and the functions that are performed by them will need closer attention.

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

454 **Expanding the supply side of the health workforce:** The expansion of medical educational
455 institutions (medicine, nursing, dentistry etc.) should be prioritized across geographical regions
456 with a shortage of health workforce and the passed out from these institutions should be
457 encouraged to work in local areas. Thailand represents a good example of effective
458 implementation of rural retention policies for medical doctors [46]

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

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

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

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

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

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

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

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

491

492

493 LIST OF ABBREVIATIONS

494 ANM – Auxiliary Nurse Midwife; AYUSH – Ayurveda, Yoga and Naturopathy, Unani, Siddha and
495 Homeopathy; CBHI – Central Bureau of Health Intelligence; ComHEEG – High-Level Commission on
496 Health Employment and Economic Growth; HRH – Human Resources for Health; LMICs – Lower and
497 Middle Income Countries; MoHFW – Ministry of Health and Family Welfare; NCO – National
498 Classification of Occupations; NHP – National Health Policy; NHWA – National Health Workforce
499 Account; NIC – National Industrial Classification; NITI Aayog – National Institution for Transforming India;
500 NSSO – National Sample Survey Office; OECD – Organisation for Economic Cooperation and
501 Development; PLFS – Periodic Labour Force Survey; RMP – Registered Medical Practitioner; SDG’s –
502 Sustainable Development Goals; UN – United Nations; WHO – World Health Organisation; WPR –
503 Worker Population Ratio.

504

505 DECLARATIONS

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

508 Consent to participate – Not applicable.

509

510 CONSENT FOR PUBLICATION: Not applicable

511 AVAILABILITY OF DATA AND MATERIALS: Data for this study was used from secondary sources. Micro data
512 from the NSSO is available for free in public domain from the official website
513 ([http://www.mospi.gov.in/unit-level-data-report-nss-75th-round-july-2017-june-2018-schedule-](http://www.mospi.gov.in/unit-level-data-report-nss-75th-round-july-2017-june-2018-schedule-250social-consumption-health)

514 [250social-consumption-health](http://www.mospi.gov.in/unit-level-data-report-nss-75th-round-july-2017-june-2018-schedule-250social-consumption-health)) of the National Sample Survey Office, Ministry of Statistics and
515 Programme Implementation, Government of India.

516

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518

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521

522 AUTHOR'S CONTRIBUTIONS

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

527

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535 [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

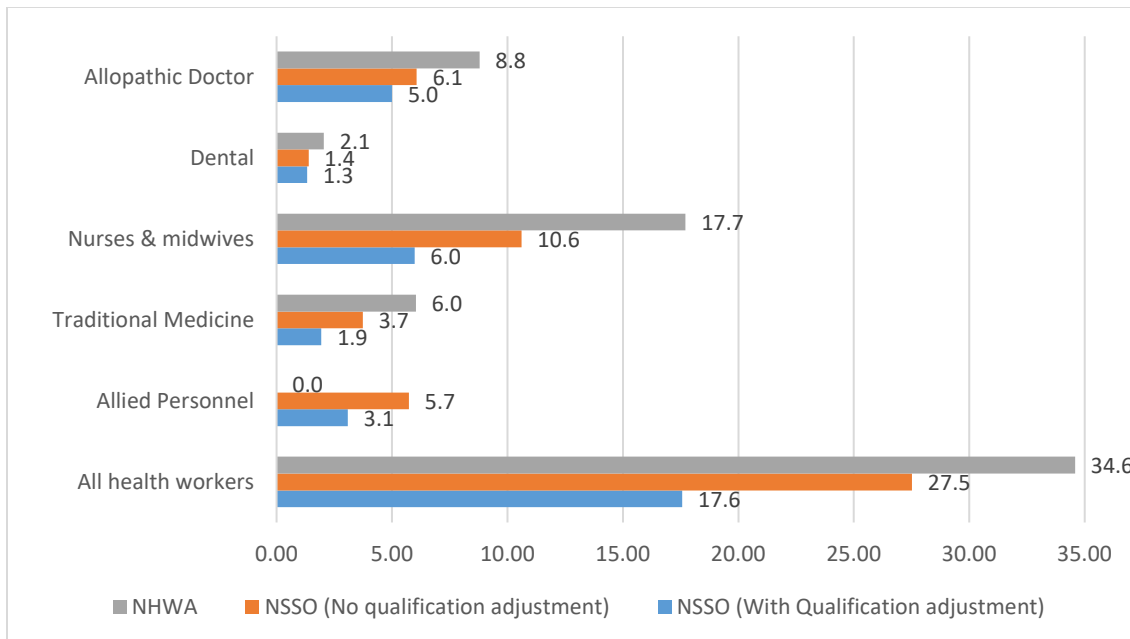


Figure 1: Number of health professionals/workers per 10,000 persons, 2018

Sources: Estimates from NHWA 2018 and NSSO 2017-18

Note: using population projection as of 1st January 2018 from Census of India 2011

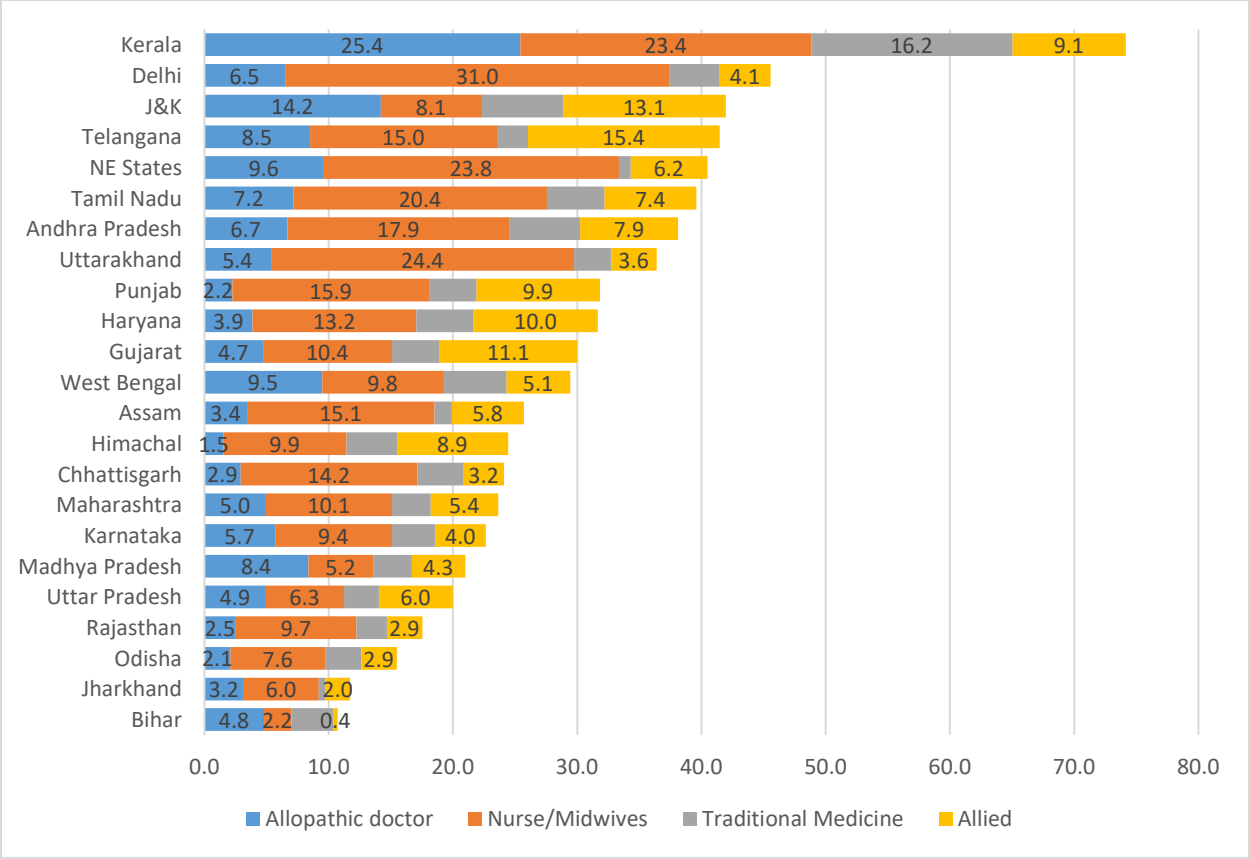


Figure 2. Density of health workers/professionals in states, 2018

Sources: Estimates from NSSO 2017-18

Note: using population projection as of 1st January 2018 from Census of India 2011

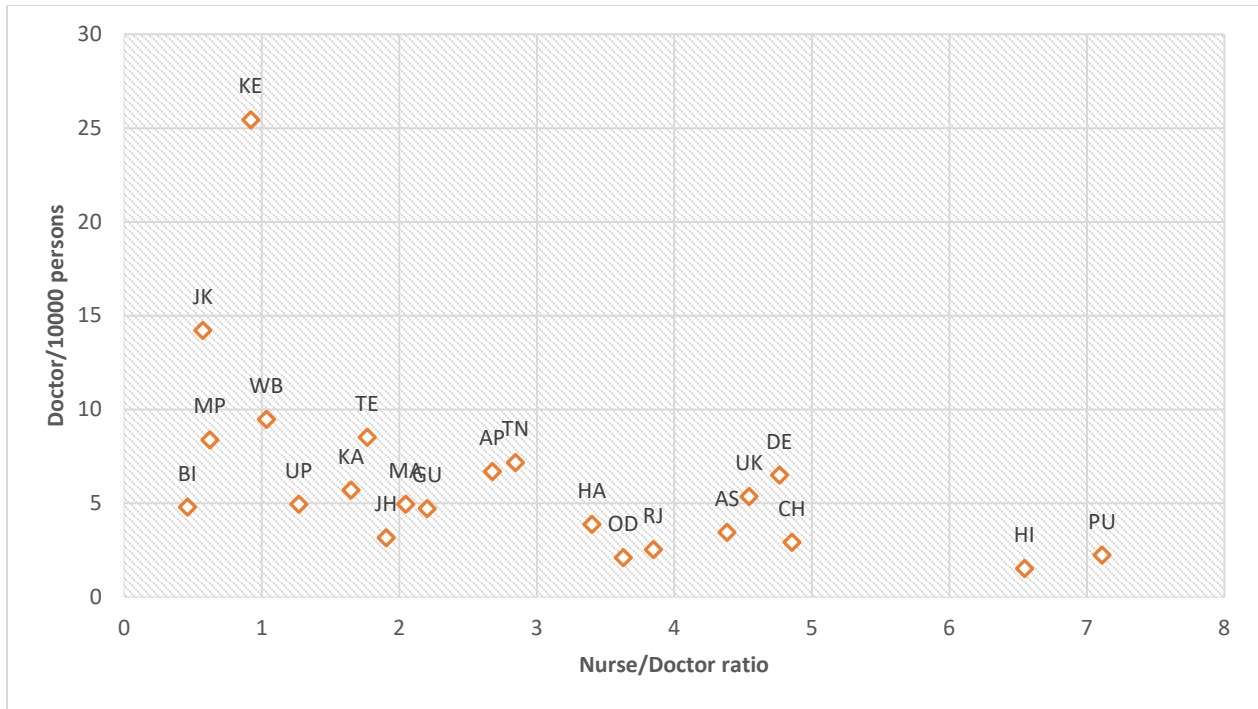


Figure 3: States with varied density of doctors and nurse/doctor ratio

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

Note: using population projection as of 1st January 2018 from Census of India 2011

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		

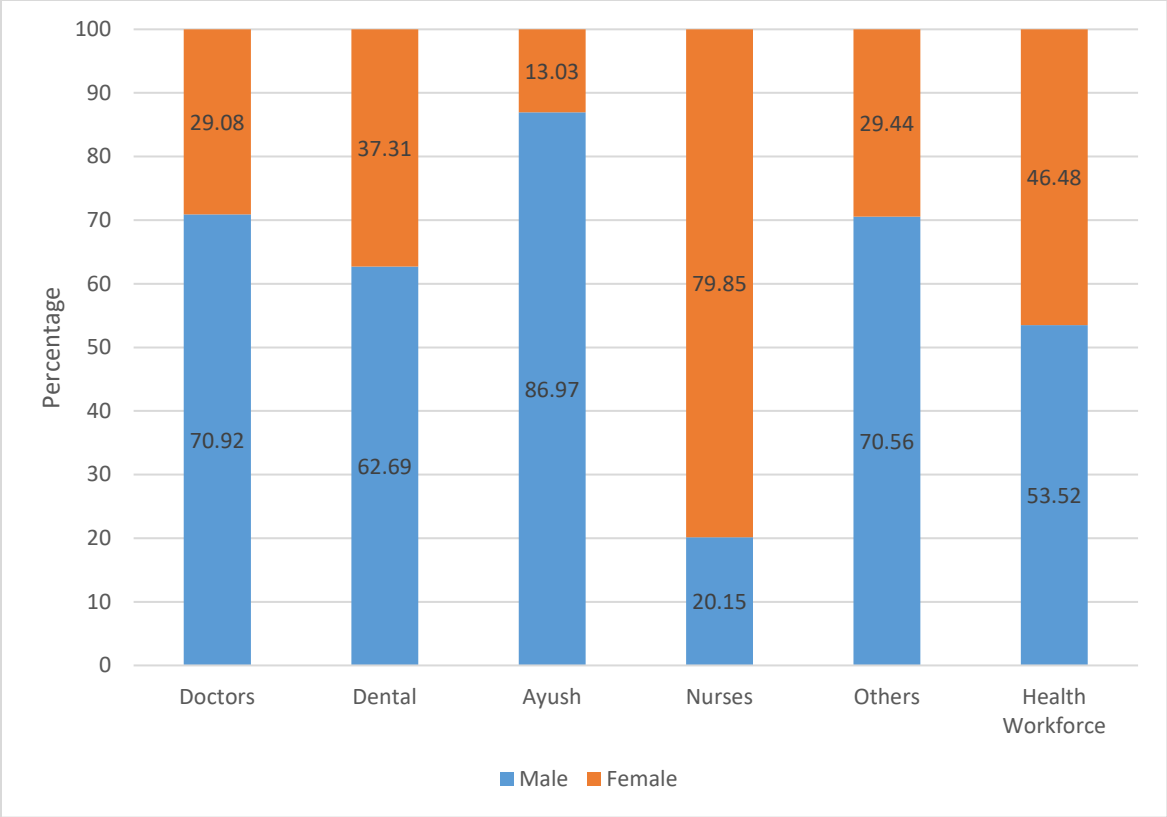


Figure 4. Gender distribution of HRH in India-2018

Source: Estimates from NSSO 2017-18

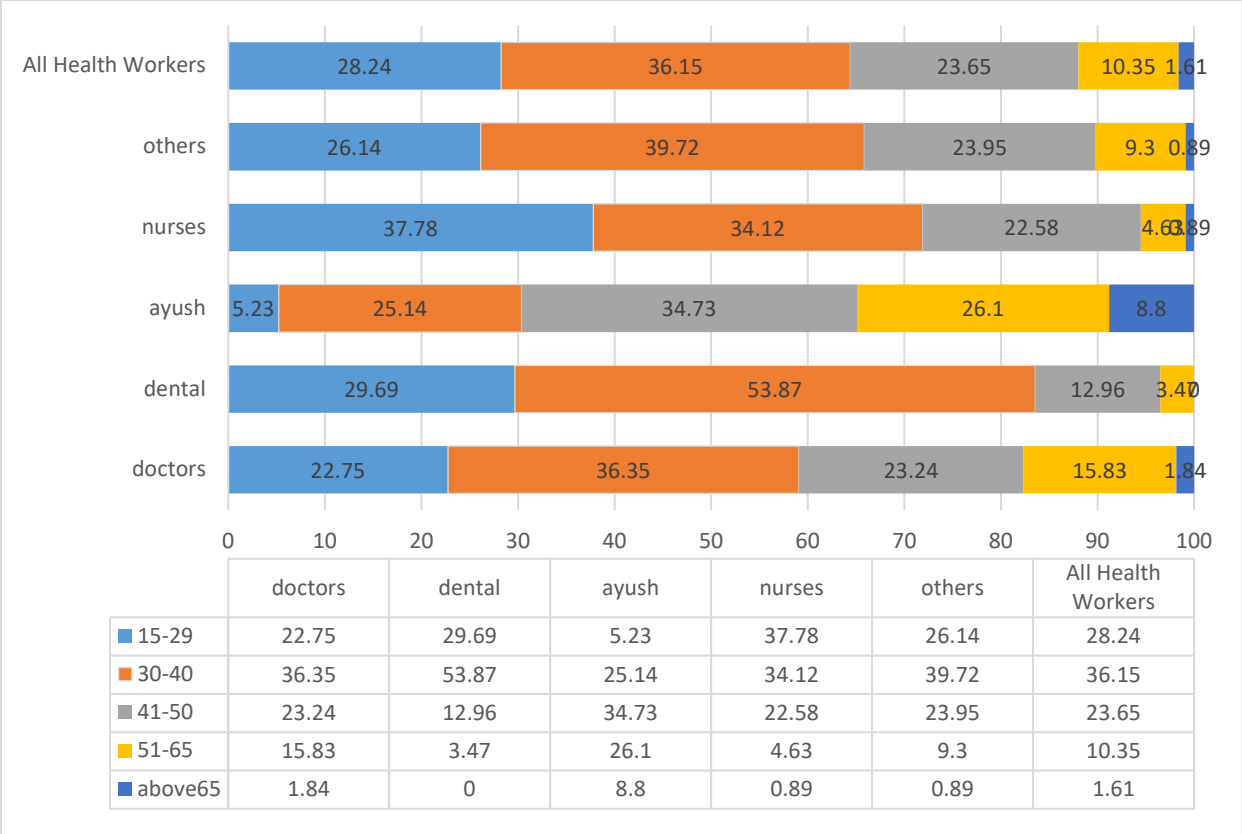


Figure 5. Age distribution of health workforce in India-2018

Source: Estimates from NSSO 2017-18

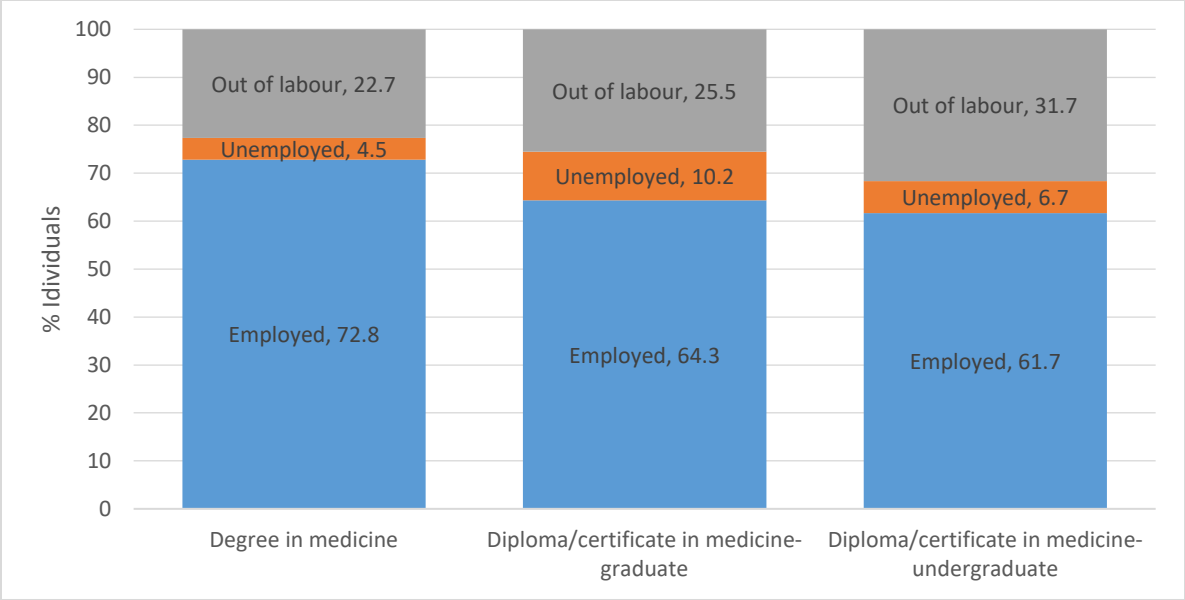


Figure 6: Percentage distribution of individuals with various levels of technical education in medicine as employed, unemployed and out of labour force, 2018
 Source: Estimates from NSSO 2017-18

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 (millions)		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 (in million)			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

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 1st January 2018 from Census of India 2011

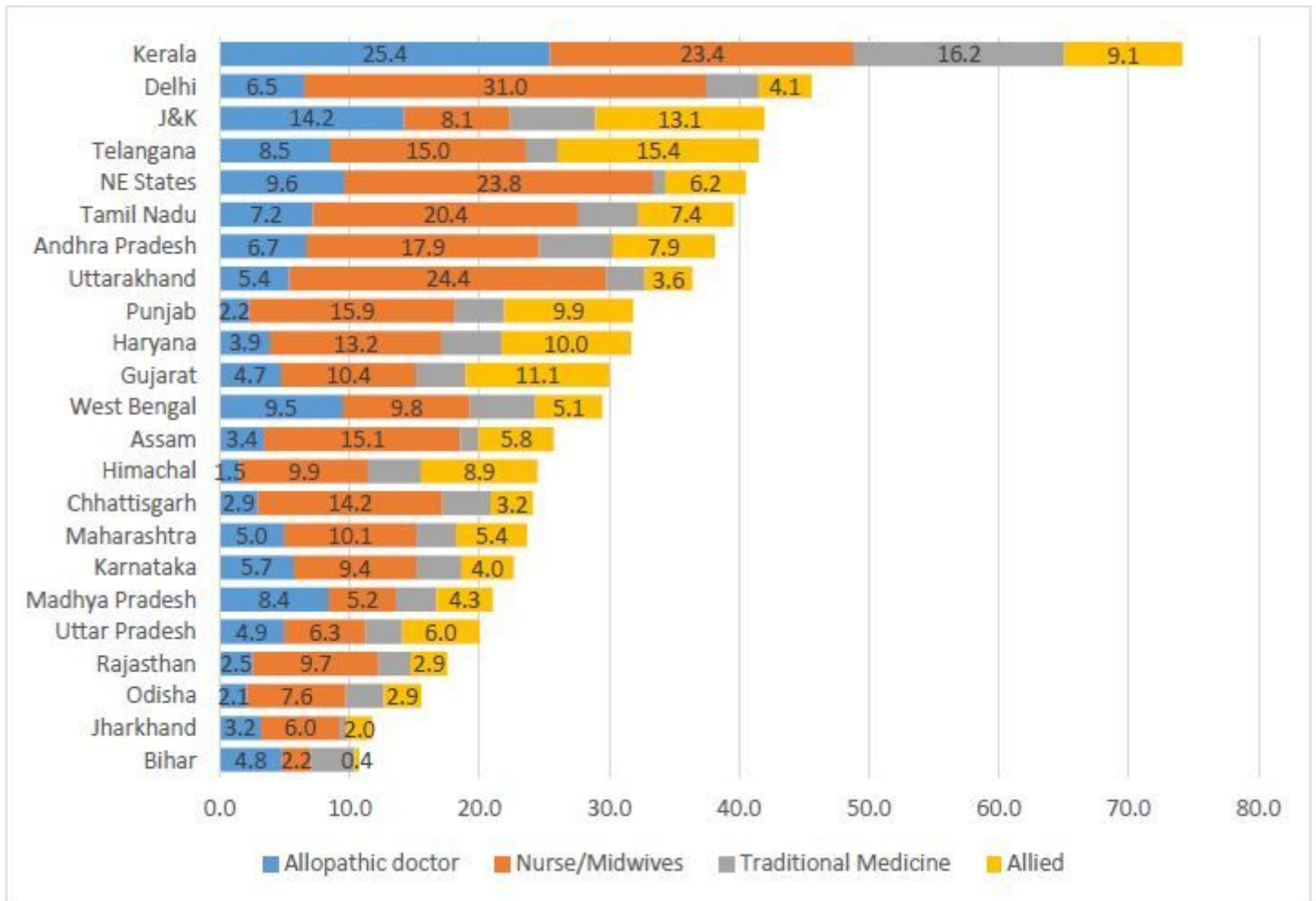


Figure 2

Density of health workers/professionals in states, 2018 Sources: Estimates from NSSO 2017-18 Note: using population projection as of 1st January 2018 from Census of India 2011

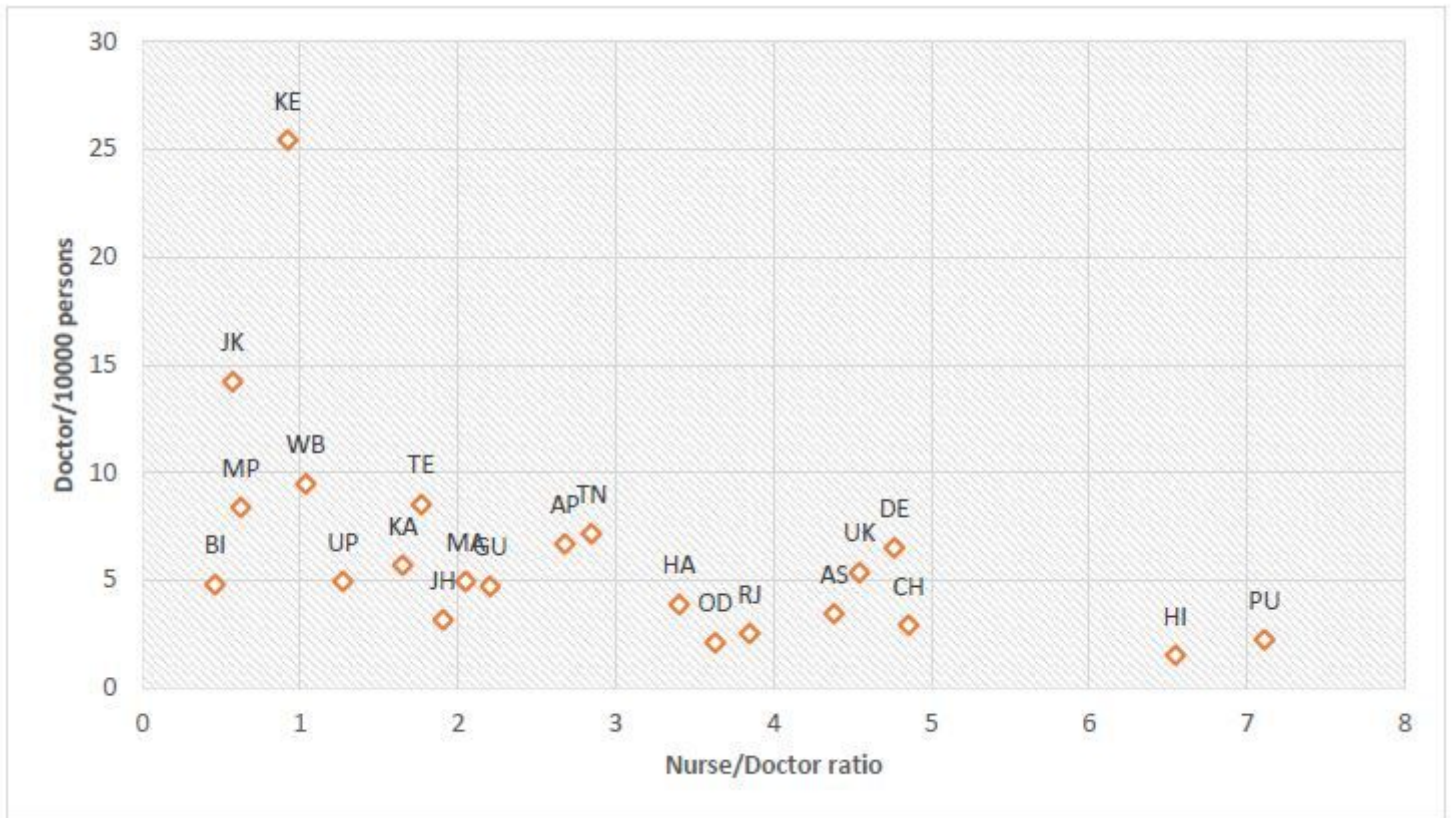


Figure 3

States with varied density of doctors and nurse/doctor ratio Source: Sources: Estimates from NSSO 2017-18 and Census of India 2011. Note: using population projection as of 1st January 2018 from Census of India 2011

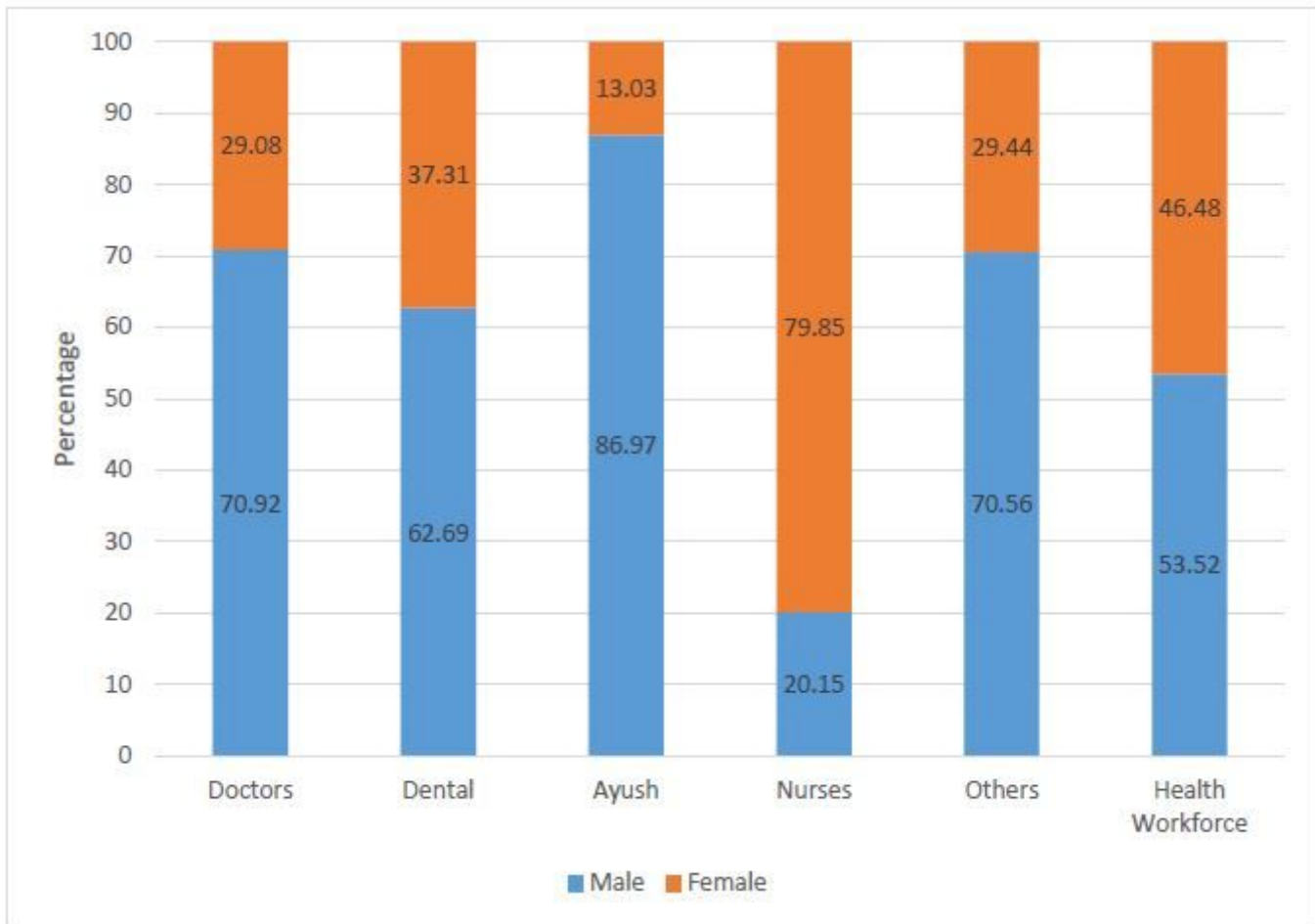


Figure 4

Gender distribution of HRH in India-2018 Source: Estimates from NSSO 2017-18



Figure 5

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

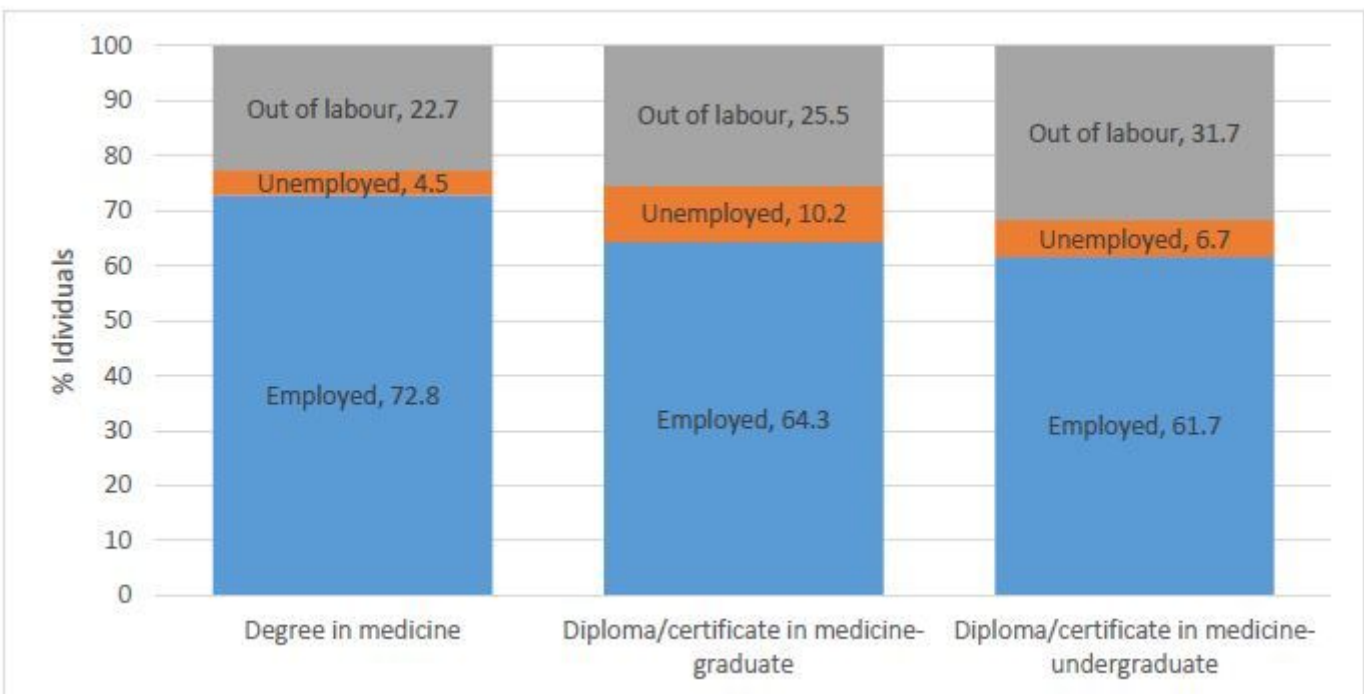


Figure 6

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

Supplementary Files

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