TABLE 1: Summary of nationwide studies on the human resources for health (HRH) shortage.

Study	Data Source	General Results	Strengths	Limitations
Purohit, 2004[9]	Ministry of Finance. National Sample Survey Organisation (NSSO) 52nd round. Center for Monitoring Indian Economy (CMIE, 1997) presenting HRH data for 1992. Foundation for research in health systems.	1. The low-income states have higher mortality, lower life expectancy, and a higher incidence of diseases. 2.Middle and high-income state HRH density is higher than that of low-income states. 3.Low-income state populations suffer from a higher per capita financial burden of treatment.	1. The CMIE is a private organization that conducts independent surveys. 2. Secondary data is supplemented with data from personal discussions and presentations at forums.	1.Data collected from only 15 states out of the then 25 states and 7 Union Territories.
Sudhir Anand and Victoria Fan, 2016[10]	Census, 2001.	1. HRH concentrated in states with higher GDP. 2. The inter-district Gini coefficient of 0.3 shows further maldistribution. 3. 40.8% HRH serves rural areas where 70.2% population resides. Thus, HRH concentrates in urban	1. The Census data has been obtained at the district level from the Government of India (GoI) authorities.	1. Since the relationships between different cadres are based on regression, no causal estimates can be drawn. 2. There is no mention of community health workers.

		areas.		
		4. Rural areas are served by a higher percentage of unqualified HRH (81.2%) than urban areas (41.6%). 5. 38% HRH, 83.4% nurses, and 16.8% of allopathic doctors were female. For every HRH cadre, more proportion of females had a medical qualification than males.		
KD Rao et al, 2012[11]	Census 2001 NSSO 2004-05.	1. HRH density is lower in the North Central states. 2. 40% of HRH serve rural areas. 3. Rural areas are served by a higher percentage of unqualified HRH than urban areas. 4. 70% of the HRH are employed in the private sector. 5. 17% doctors and 70% nurses and midwives are women. Overall they comprise around 1/3rd of the HRH.		1. The data obtained is a projection of the census 2001 data to NSSO 2004-05 with a consideration of the population trends from 1991-2000. The data is thus a projection.

Indrajit Hazarika, 2013[12]	Indian Ministry of Statistics and Programme Implementation (IMSPI) year-end data for 2009 Medical Council of India (MCI) & Indian Nursing Council (INC) databases.	1.There has been a steady increase in doctors and nurses from 2000 to 2009. 2. There has been a rapid increase in the nursing and medical colleges and their admissions between 1991 to 2013 but their number is lower in the EAG states and states with lower GDP. There is a disproportionate increase in the number of private medical colleges. 3.HRH concentrates in states with higher GDP. 4. Increase in Specialist and MO vacancies at government facilities between 2005-2010. 5. Inter-state Gini coefficient of 0.424 for doctors, 0.412 for nurses.	1. The IMSPI reports contain data from the professional registration councils. The reported data is thus, of qualified workers. 2. A longitudinal trend of HRH density has been provided from 2000 to 2009. A comparison between HRH production and vacancies in the government sector have been made.	1. The registration council data is not adjusted for the death and migration of health professionals. The reported data might thus be inflated. Includes only doctors, nurses, and midwives. 2. Does not include data from North-Eastern states. 3. Does not comment on the qualification of workers and urban-rural disparities. The longitudinal trends have been acquired by an estimation.
KD Rao et al, 2016[13].	NSSO 2011-12.	1. Qualified HRH density is lower in North Eastern and North Central states.	1. The state-wise HRH density has been reported	1. A small number of HRH were sampled and the weighted estimates were used to calculate the HRH density (Only 432

		2. 22.6% of the HRH serve rural areas where 69% of the population resides.		allopathic doctors sampled).
		3. Rural areas are served by a higher percentage (71.2%) of unqualified HRH than urban areas (48.8%). The maldistribution is higher for allopathic doctors than for nurses and midwives (11.4 times higher vs 5.5 times higher).		2. NCO codes considered only up to 3 digits, compensated by NIC codes.
		4. 70% of the HRH are employed in the private sector, the number is lowest for nurses.		3. Data cannot be disaggregated to the district level.
		5. Almost half the qualified HRH comprises women. 88% of the qualified nurses were women.		

TABLE 2A: HRH deficit in the rural public sector.

Study	Area	Study Type	Results	Strengths	Limitations
Mohan Rao et al, 2011[17]	National	The study is a literature review. Vacancy data from Rural Health Statistics (RHS), 2008 has been reported by the study which has been extracted by us.		1.RHS is a government publication that provides national data on the HRH in the rural public sector.	1.Data on shortfall is not reported.
Pallikadavath et al, 2013[22].	National	Study of the data from the District Level Household Survey (DLHS-3), 2007-08.	1. Only 0.4% of sub-centers (SCs) have no health workers. 2. The inter-SC inequality has a Gini coefficient of 0.2 and Theil T of 0.11. 3. The inequality within a state contributes more (71%) than that between states (29%) to the overall inequality while the corresponding numbers are 55% and 45% for districts. The HRH is lower mainly in the	1. This data uses proportional probability sampling to select the SCs to be studied. The data is thus generalizable at the district and state levels.	

			northern states.		
S.Garg et al, 2012[21]	National	Study of the data from Rural Health Statistics, 2011.		1.RHS is a government publication that provides national data on the HRH in the rural public sector.	
Zaman and Laskar, 2010[20]	Dhubri district, Assam. Gulbarga district, Karnataka.	A cross-sectional study of 5 primary health centers (PHCs) in Assam and 10 in Karnataka from September to October 2008.	1. Supervision of SCs by MOs in 60% and HAs done in 80% of PHCs studied in Assam. 2. Supervision of SCs by MOs and HAs done in all PHCs studied in Karnataka.	1. The interview technique was combined with record analysis and observation. 2. One Empowered Action Group state (EAG) (Assam) and one non-EAG (Karnataka) state were selected.	1.The districts were chosen purposely and the states by convenience sampling. The results are hence, not generalizable.
P.R Sodani and Kalpa Sharma, 2011[16]	Bharatpur district, Rajasthan.	A cross-sectional study of all 13 Community Health Centres (CHCs) between	1. The availability of support staff was better as compared to specialists and medical officers (MOs.)	1.Study was conducted at a time when Rajasthan was a high focus state identified by the National	1.The district with poor health outcomes was purposively selected and the results are thus

		September-October 2010.	2. Within specialists, Anesthetists were seen to be the most deficient.	Rural Health Mission (NRHM) 2.All 13 CHCs in the district were included. Data was collected from visits, observations, and records.	not generalizable to the state.
Bayapa Reddy N et al., 2012[18]	Chittoor District, Andhra Pradesh.	A cross-sectional study of 34 SCs from June 2009 to March 2010.	1. 8.8% SCs were visited monthly by a MO on a fixed day while 61.7% by HAs.	1.The SCs were selected by multistage stratified random sampling and head SCs were excluded.	
MA Bashar and Sonu Goel, 2017[19]	Ambala District, Haryana.	A cross-sectional study of 30 SCs from February 2014 to July 2014.	1. 70% SCs were visited monthly by MOs at no fixed dates and 60% were visited weekly by supervisors (Health Assistants). 2. The population covered by each SC ranged widely from 2134 to 12148. The number of SCs under the PHC ranged from 4-16.		1.The SCs were chosen purposely from an area that was close to the Rural Health Training Center of PGIMER college. This was thus, a well-supervised area whose results cannot be generalized to other SCs. 2.Only functional SCs manned by at least one HW were

					included. The deficit measured **is** thus erroneous due to improper sampling.

TABLE 2B: HRH Deficit in the rural public sector (Quantitative Picture).

Study	Deficit
Mohan Rao et al, 2011.[17]	Vacancy: 1. Specialists: 52% 2. MOs at PHCs: 18% 3. Nurses and ANMs (PHCs and CHCs): 18%. 4. Laboratory Technicians (PHCs): 38% 5. Pharmacists (PHCs): 16%.
Pallikadavath et al, 2013.[22]	Health Worker Vacancy: a)Male: 60.7% b)Female: 9.3%
S.Garg et al, 2012.[21]	Shortfall: 1. Specialists: 64% 2. MOs at PHCs: 12% 3. Nurses and ANMs at PHC/CHC: 23% 4. Laboratory Technicians (PHC/CHC): 47.4% 5.Radiographer (PHC/CHC): 53.9% 6. Pharmacist (PHC/CHC): 22.5% 7. Health Assistant: a) Male: 41.6% b) Female: 37.8% 8. Health worker: a) Male (SC) 64.6% b) Female (PHC/SC): 1.9% 9. Block Extension Educators:42.3%

Zaman and Laskar, 2010.[20]	PHCs not fulfilling the requirements (Dhubri): 1. MOs: 20% 2. Nurses: 20% 3. Laboratory technician: 0% 4. Pharmacists: 0% 5. Health Assistant: 60% 6. ANM: 40% 7. Health Educator: 20% PHCs not fulfilling the requirements (Gulbarga): 1. MOs: 10% 2. Nurses: 50% 3. Laboratory technician: 20% 4. Pharmacists: 40% 5. ANM: 30% 6. Health Assistant: 30% 7. Health Educator: 70%.
P.R Sodani and Kalpa Sharma, 2011.[16]	Shortfall (By revised IPHS, 2010): 1. Specialists: 70.8%. 2. MOs: 59.0% 3. Nurses and Midwives: 21.6% 4. Pharmacists: 69.2%. 5. Laboratory Technicians: 33.3%. 6. Radiographers: 50%.
Bayapa Reddy N et al., 2012.[18]	Health Worker Shortfall: a)Male: 67.7% b)Female (ANM): 27.5%
M. A. Bashar and Sonu Goel, 2017.[19]	Health Worker Shortall: a) Male: 66.6% b) Female (ANM): 50%

TABLE 3A: State of HRH in the rural private sector.

Study	Area, Year of data collection	Services provided by unqualified practitioners	Concerns (As reported by the studies)	Strengths	Limitations
Alexander, A & Shivaswamy, M. K. 1971[26]	Mysore	1.Aches and pains, skin and venereal diseases, bites of animals and insects, children's and women's diseases were treated. 2.Majority of the indigenous practitioners preferred Ayurveda (93% of part-time and 73% of full time). 3. Despite this preference, very few full-time practitioners dispense ayurvedic medicines. 4. 95% of practitioners were male.	1.Lack of formal training.	1. Indigenous practitioners from 95% of villages in the study area were enumerated, amounting to 656 by a locally hired field investigator, of which 628 were interviewed with a standard questionnaire.	1. Only practitioners of indigenous systems of medicine were included. 2. Random sampling methods were not employed. Hence, the results are not generalizable.
Neumann, A. K. et al. (1971)[27]	Quilon district, Kerala; Pakawal developme	1.Treat almost any condition that the patients presented with.	1. Indigenous medical practitioners diagnosed no or very few cases of eye and ear pathology and	1. 72 indigenous practitioners (59 from Punjab and 13 from Kerala) were interviewed with semi-structured forms. Efforts were made to include the vast majority of	1. Only practitioners of indigenous systems of medicine were included. 2.Random sampling methods were not employed and the study was limited to within 3 miles of a health center in

	nt block of Ludhiana district, Punjab.		anemia. Many indigenous practitioners use Schedule H & L drugs that can only be sold by prescription from a registered medical practitioner.	practitioners in the Pakawal district of Punjab.	Quilon district of Kerala. Hence, the results are not generalizable.
George, A. & Iyer, A. et al. (2013)[32]	Koppal district, Karnataka. 2004.	1. Mainly addressed outpatient conditions such as coughs and colds, vomiting and diarrhea, headache, stomach pain, joint and body pain. 2. Almost all practitioners were men.	1. There have been cases of these practitioners encouraging treatment when not required which leads to debts and also risks the health of the patients.	1. A private provider census was done in 60 villages in the project area and surrounding 11 market villages and commercial towns. All registered medical practitioners (RMPs) (91) were identified and their qualifications were assessed.	1.Enumeration of providers other than RMPs has not been provided. 2. Koppal district was chosen because it has the worst developmental indicators, the results are hence not generalizable.
P.H.Rao, 2005[28]	Nationwide	1. Majority practice allopathy. 2. Treating common diseases (Fever, diarrhea,	1. Lack of formal training.	1.812 private practitioners were sampled from 507 villages pan-India	1.Authors have not elaborated on the sampling technique and determination

		dysentery, pneumonia, malaria, measles, typhoid, scabies, cough and cold, anemia, gastroenteritis, back pain, leucorrhoea, menstrual problems, TB, asthma, etc.) 3.Less than 5% of rural private practitioners were females. The south zone had the maximum percentage at 11%.		(271 North, 150 East, 203 West, 188 South).	of sample size causing doubt about the generalisability of the study. 2. The numbers stated in the text and table do not match at certain points and explanation for it has not been provided. The % provided in the tables do not add to 100% which could be due to rounding off.
Kumar et al., 2007[30]	Lucknow, Uttar Pradesh.	1. Dispense drugs, provide emergency management, administer injections and iv fluids, perform minor surgeries (Sutures, abscess drainage, hydrocoele). 2. 58.6% practiced modern medicine. 3. 1.6% of 388 private practitioners were women.	1. Injudicious use of antibiotics.	1.Multistage sampling technique was used and the required sample size was predetermined making the study scalable and generalizable to Lucknow district. A sample of 388 was obtained against a required 383. 2.Face-to-face interviews were conducted by the researchers.	1.Practitioners with PG qualifications, in group practice and those who did not charge, were excluded. Only those practitioners with a clinic to practice were included.
Jarhyan et al.,2012[29]	Ballabgarh, Haryana. 2007-08	1. Dispense drugs. No comment on the type of drugs. 2. Injections and IV fluids. 3. Minor surgeries.	1.Inadequate biomedical waste disposal practices.	1.The 28 villages covered were under the Intensive Field Practise area of AIIMS, New Delhi.	1.Only those with a healthcare facility were included, traditional healers were excluded.

		4..The private practitioners combined saw more patients on an average than the 2 PHCs in the area. 5.2.5% of practitioners were female.			
Jishnu Das et al, 2012[25].	Rural Madhya Pradesh. 2010.	1.More than 90% of the providers were male.		1.Good sampling technique generalizable to rural MP.	
Gautham et al., 2014 [31]	A. Tehri Garhwal, Uttarakhand.	1. Allopathic and non- allopathic drugs used, usually dispense medicines, mainly clinic-based practice. 2.. Only 3% of unqualified practitioners were female.	1. Over-prescription of antibiotics and injudicious use of injections, more in Tehri.	1.263 unqualified practitioners in Tehri and 368 in Guntur were mapped. 2.The quality of care was determined with the observation and testing of the provider's knowledge.	1. This being a scoping study that purposely chose 2 distinct areas to build a profile of the providers, the results are not generalizable.
	B. Guntur, Andhra Pradesh. 2011.	1. Only allopathic drugs used, majority prescribe medicines while some dispensed them as well, 40% provided door-to-door service. 2.. Only 2% of unqualified practitioners were female. 3. They were part of a local association of			

		informal providers.			

TABLE 3B: State of HRH in the rural private sector (Quantitative Picture).

Study	The composition of the rural private sector
Alexander, A & Shivaswamy, M. K. 1971[26]	1.Qualified allopaths: 0.9% 2.Indigenous practitioners: 99.1% A.Qualified: 2% B. No qualification or registration: 98%
Neumann, A. K. et al. (1971)[27]	Indigenous practitioners: Kerala: 1.Qualified (Diploma in AYUSH): 54% 2.No qualification: 39% (No information availed on 8%) Punjab: 1.Qualified (Diploma in AYUSH): 13% 2. No qualification: 83% (2% had a diploma in pharmacy and no information was availed on 2%)
George, A. & Iyer, A. et al. (2013)[32]	RMPs (Informal providers): 1.Unrecognized qualification: 46% 2.No qualification: 54%
P.H.Rao, 2005[28]	North: 1. Qualified: 39.7% A. Allopathic: 8.8% B. AYUSH: 91.2% 2. No qualification: 59% East: 1. Qualified: 54.1% A. Allopathic: 27.3% B. AYUSH: 72.7% 2. No qualification: 45.3% West: 1. Qualified: 57.1% A. Allopathic: 8.5% B. AYUSH: 91.5% 2. No qualification: 42.4% South: 1. Qualified: 46.3%

	A. Allopathic: 60% B. AYUSH: 40% 2. No qualification: 53.7%
Kumar et al., 2007[30]	1. Qualified: 47.6% A. Allopathic: 11.9% B.AYUSH: 88.1% (Ayurvedic: 43.2%) 2. No valid qualification: 52.3% (Invalid medical qualifications, RMPs, vaids and those with no medical qualifications who were trained under a qualified or unqualified practitioner).
Jarhyan et al.,2012[29]	1. Qualified: 3.7% 2. No valid qualification: 96.2% (Trained by qualified or unqualified practitioners).
Jishnu Das et al, 2012[25]	1. Qualified with medical degree:11% 2. No medical qualification: 67% The remainder had invalid qualifications.
Gautham et al., 2014 [31]	Tehri - 1. Qualified: 19.3% A. Private: 7.9% B. Public: 92.1% 2. No valid qualification: 80.7% (93% had a health science-related diploma). Guntur - 1. Qualified: 26.4% A. Private: 81.8%

| | B. Public: 18.2% |
| | 2. No qualification: 73.6% (35.6% had a health science-related diploma). |