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Rajasthan: Health professionals supply and demand

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ABSTRACT

Background: Till recently the government is planning for national level availability of doctors. However, to improve health care service delivery, robust regional planning for production and supply of health professionals is need of hour. The study aims to understand the demand and supply of trained doctors and tertiary care facilities in different regions of Rajasthan.

Materials and Methods: Data of undergraduate medical entrance were used to adjust against the voluntary attrition rate, superannuation rate, natural death rate and external additions to define the pool of available practicing doctors. The estimates were generated by forecasting the population and expected supply of doctors till the year 2035 by projecting the data by Average Exponential Growth Rate (AEGR).

Results: The study suggests that in 2018 the density of doctors was 0.32 per thousand population in Rajasthan than that of 0.7 in India. At the current AEGR of 5.53 %, density of doctors will only improve to 0.73 in year 2035. There are 16 districts with 41.1 % of the population of Rajasthan have no medical school or any tertiary health care institution. Similarly, undergraduate enrollment varies in different regions from 1.5 to 13.5 students per 100000 population.

Conclusion: The challenge of availability of qualified doctors in Rajasthan will persist even in year 2035. There is an urgent need to ensure regionally balanced production and supply of skilled doctors.

1. Introduction

India is one of the fastest growing economies and the second most populous country in the world. Despite encouraging development in other sectors, health care parameters still lag behind the set goals. Unavailability of qualified medical practitioners is challenge to provide Universal Health Coverage and reduce the Out-of-Pocket expenditure of beneficiaries. India faces not only the huge shortage of health professionals but also maldistribution within its health workforce.[1] The authors,[2] establishes a positive correlation between human health resources and better health outcomes, including decreasing death rates and prolonged life.

The availability of health professionals is highly influenced by the diversity of socioeconomic status, poor governance in health,[3] health systems and rural and remote parts of India.[4] To understand this regional malaise of health workforce distribution and availability, we need to segregate supply and demand of health professionals not only at the province level but also at local geographical levels.

This study aims to explore the inequality in the distribution of health workforce with evidence from official data to assess the production, availability and distributional pattern of skilled physicians across the different regions of the Rajasthan state.[5]

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2. Materials and Methods

(*No ethics committee approval was required for this research.*)

This study uses the undergraduate student enrollment in medical school for the five-year medical education programme as input for skilled physicians. Once these medical students pass undergraduate degree (MBBS) they are required to register with Rajasthan Medical Council (RMC, a regional arm of Medical Council of India). Official data was collected from RMC since 1970 of yearly registration of physicians. However, the RMC does not maintain any live register to suggest the position of actively enrolled practitioners at any point in time. Furthermore, there is no valid information about those doctors who left the practice voluntarily or involuntarily.

2.1. Study design

To understand the dynamics of health labour market, not only the available stock of health workforce but also the factors affecting demand and supply of health workforce need to be factored in. The projected population of Rajasthan is estimated using the annual increase in the projected population of India by the United Nations[6] as the basis to estimate population for Rajasthan till 2035.

One doctor per 1000 population is the minimum recommended standard against the WHO recommended minimum benchmark of 2.28 Skilled Health Professionals, which include 1 doctor and 1.28 nursing staff per 1000 population. However, for better delivery of health services, WHO Report 1993 recommends nurse-physician ratio 2 to 4.[7] The Medical Council of India (MCI) Vision 2015 adopted WHO norms of 1:1000 doctor population and aspired to achieve this target by the year 2031 for all India.[8,9]

The trends for the number of doctors over time is measured using AEGR, which is the most suitable for growth rate in population and labour force increase.[10] In this W_n and W_1 are latest and first observation in enrollment of undergraduate medical students.

$$AEGR = \frac{Ln\ (Wn\ /\ W1)}{n} = 1$$

2.2. Supply projection model for physicians

The supply of physicians is calculated by using inflow of enrolling undergraduate students by adjusting for attrition rate,[11] Natural death rate, Graduation ratio[12] and Immigration inflow of doctors who completed their degree outside of India.(Table 1) The immigration ratio is calculated by the using number of students passing Foreign Medical Graduate Examination conducted by National Board of Examination India for the year 2012-14 (9690 students) the immigration rate calculated to be 6.58% of total national enrollment in that period.

Generally, doctor joins the health labour market at the age of 30 years and retire at the age of 68 years (assumed same as the Life expectancy in years in Rajasthan). The professional active life of doctors is considered coterminous with the life expectancy. The attrition rate is calculated by voluntary exits (i.e. switching to other jobs) and illness and premature retirement. Involuntary attrition includes retirement due to age over 68 years. The involuntary attrition rate is calculated by expected future retirements based on medical school enrollment in corresponding period 38 years ago. This superannuation rate will be 1.61 % for the next 17 years in Rajasthan.
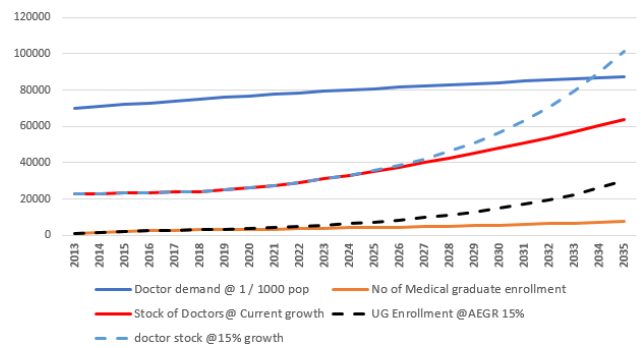

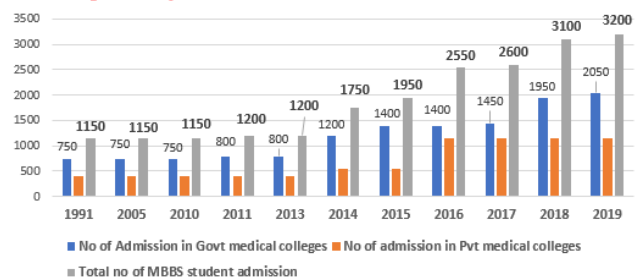**Fig. 1:** Rajasthan: Demand supply gap of basic doctors

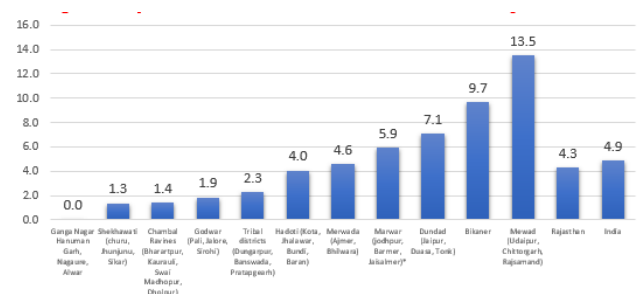**Fig. 2:** Rajasthan: Trend in medical under graduate enrollment

Fig. 3: Rajasthan: Under graduate enrollment per 100000 population

The Demand-Supply model constructed by Exploratory data analysis in Excel (Microsoft Office, Microsoft 2016

Table 1: Different rates for health workforce: there is no conclusive study from India

Attributes	Probability	Reference
Average Attrition rate	0.033	Voluntary attrition rate 1.7 % for physicians of the USA.11 The superannuation rate for Rajasthan is 1.61% for the next 17 years till 2035.
Graduation ratio	0.966	8 year MD student graduation rate AMA US 2014 (96.6%)12
Natural death rate	0.0073	2015 data.worldbank.org. 7.303/ 1000
Immigration*	0.066	Students in undergraduate medical course in different countries

Table 2: Regional distribution of under graduate enrollment 100000 population

S.No	Regions (of Districts)	% of population	Projected Population 2018	Total No of med Schools	Total Enrollment in Schools	Per 100000 UG enrollment
1	Shekhawati, Chambal Ravines, Godwar (10 districts)	26.7%	19989240	3	300	1.5
2	Tribal districts (Dungarpur, Banswara, Pratapgarh)	5.9%	4425458	1	100	2.3
3	Hadoti, Merwada (6 districts)	15.6%	11670946	4	500	4.3
4	Marwar (Jodhpur, Barmer, Jaisalmer)*	10.1%	7597571	3	450	5.9
5	Dundad (Jaipur, Duasa, Tonk)	14.2%	10610310	5	750	7.1
6	Bikaner	3.5%	2583847	1	250	9.7
7	Mewar (Udaipur, Chittorgarh, Rajsamand)	8.4%	6296868	5	850	13.5
8	Ganganagar, Hanumangarh, Alwar, Nagore	15.6%	11709759	0	0	0.0
	Rajasthan	100.0%	74884000	22	3200	4.3
	India		1337409993	471	65060	4.9

Table 3: Regional maldistribution of medical schools and tertiary care medical institutions

Distance from Nearest Tertiary Care Hospital	No of Districts	Population	% of Population of Rajasthan
At least 100 kms away	14	27692687	36.98%
More than 200 kms	3	4824696	6.44%
100 to 150 Kms	11	22867991	30.54%

version 16.2) with the following formula.

Projected workforce$_{(t)}$ = Projected Workforce $_{(t-1)}$ + (Students in Final Year of study * Graduation Rate) + (Nos of graduate in final year $_{(t-1)}$ * Immigration inflow) — (Projected workforce $_{(t-1)}$ * Attrition rate) — (Projected workforce $_{(t-1)}$ * Natural death rate)

3. Results

The model calculates the availability of doctors from the year 2005 to 2035. The estimates suggest that the availability of 0.32 doctors per 1000 population in the year 2018. This is in spite of the significant growth in undergraduate enrollment of medical schools from 1150 students in year 2005 to 3200 students in the year 2019.[13] The stagnation of availability is mainly due to rapid increase in the population of Rajasthan in the corresponding period. The physician availability ratio may improve to 0.73 in the year 2035 provided enrollment for medical undergraduate grows at AEGR of 5.53%. The doctor density of Rajasthan is much lower than that of India, which is 0.7 doctors per 1000 population in the year 2015.[9]

The modelling estimates indicate a very high deficit of physicians' availability in Rajasthan than previously

thought. These estimates serve an illustrative purpose and also used to inform policy-makers about the magnitude of future challenges and to redesign the traditional models of education, deployment, and management of the health workforce.[14] Figure 1 shows not only the historical gap in the supply of trained doctors but also estimates future shortfall of basic doctors. In the year 2018, against the requirement of 74884 basic doctors, only 24228 doctors were available making a deficit of 2/3 of total required strength of doctors. It is alarming to know that even if Rajasthan continues to supply doctors at the current AEGR rate of 5.53%, it will not be in a position to achieve the target of 1 physician for 1000 population in the year 2035. There is a gap of 23215 physicians in the year 2035 against the demand of 87057 which amounts to shortage of 36.7%. A hypothetical scenario is created by assuming the augmented supply of doctors at the AEGR of 15% which is almost three times of current exponential growth rate. At this unrealistic augmented supply, we could achieve the target of 1 doctor per 1000 population in the year 2034 only.

In the year 2016 the doctor density was 0.33 in Rajasthan against than that of 3.4 in OECD countries, 1.8 in China and 2.6 in the USA.[14] To meet the aspirations of MDGs (Millennium Development Goals) and provide commensurate health care to rising economic status and aspiration of new India, we need to provide more than 1 doctor per 1000 population. To understand this extra demand of health professionals, this model was extrapolated to calculate supply at the demand of 1.5 doctors per 1000 population. In 2019 against the availability of 25056 doctors we have a deficit of 88686 doctors.

3.1. Improving supply of medical graduates

It is estimated that there will be an increasing growth in demand for health workers in middle income countries, driven by economic and population growth and ageing.[14] The middle-income countries such as India will face workforce shortage because demand exceeds supply. This disproportionate gap is estimated to be more pronounced in Rajasthan than that for India. However, there has been an increase in number of medical schools and under graduate medical students' enrollment since 1991. (Figure 2). In 1991, there were only 10 medical schools, which included 3 private schools. In the year 2019, there are 14 government and 8 private medical schools. The percentage increase over last three decades in number of medical schools is 167% and enrollment increase is 188% in private sector, while corresponding increase in number of schools and enrollment was 100% and 173% respectively for government medical schools. It is found that the private sector in medical education provisioning outperformed the government institutions.

4. Discussion

Several research studies have been conducted by many authorities and authors to estimate doctors and doctor's density in India.[1–17] Although there is one article[18] that states that India has attained it's WHO recommended doctor patient ratio, however it takes into account the number of doctors both from modern and traditional system of medicine. The findings from different sources are varying. This study is unique in the fact that there is hardly any attempt to provide doctor supply information for states and sub regional distribution in India. Particularly for Rajasthan, any specific study or paper could not be found for assessment of physicians' stock and prediction for future requirements and possible supply of skilled physicians.

4.1. Regional maldistribution of doctors production

Rajasthan is the largest geographical state of India. The major clustering of trained doctors is in the major cities of the Rajasthan. By having more medical colleges and associated hospitals in all districts including tribal and backward area, will ensure equitable distribution of not only of health care professionals but also of health care facilities in whole state. Further the increased supply of doctors will push more doctors to smaller cities and towns if not villages. As an example, the Jhalawar district, which is 400 kms away from Jaipur. Where before establishing a medical school in year 2010, available doctors at district hospital were not even 20, but now this number is more than 15 times of that number. Which includes teaching faculty and resident doctors.

The whole state is further segregated into 8 different socio-cultural and geographical regions namely- Marwar, Mewar, Hadoti, Tribal districts and Chambal ravines etc. These regions share many common features like availability of means of transport, socioeconomic status, health seeking behaviours and provisioning of health care system etc. Since there are no separate tertiary care institutions in Rajasthan other than tertiary care institutions associated with medical schools, the distribution of medical schools not only represent the supply of trained medical practitioner but also a proxy indicator for quality secondary and tertiary care in the state of Rajasthan. Out of the total 31 districts in Rajasthan, 16 districts do not have any medical school or any good secondary or tertiary care institution. The skewed distribution presents a picture of faulty planning and non-priority of health institutions by the policy.

A better indicator for future supply of trained physician is enrollment of medical students in undergraduate programme per 100000 population. For Rajasthan the average is 4.3 which is much lower than the national average of 4.9 enrollment 100000 population. Further, the distribution of undergraduate enrollment in different geographical regions is varying from 1.5 to 13.5 per 100000

population (Table 2).

An analysis of medical schools and associated tertiary care facilities is done on distance factor which is an important determinant of accessibility and universal coverage of health care services.

The 14 districts out of 31 districts of Rajasthan are located at least 100 kms away from the nearest tertiary care hospital and medical school (Table 3). These districts cater to 36.98% population of the Rajasthan state. This translates into at least two hours of road journey to reach the well-equipped hospital to avail better health care facilities. The three districts namely Ganganagar, Hanumangarh and Jaisalmer are more than 200 kms away from tertiary care facilities. This long commute time of 3-4 hours by road, puts this marginalized population residing in these areas under severe disadvantage of poor access to quality health care.

Not only the availability of competent health professionals but also the equitable distribution and accessibility to local people can strengthen the health systems. This in turn translates into an effective health service coverage.[15] Similarly, High level commission on health employment and economic growth[19] has recommended for health workforce growth so that delivery of quality universal health coverage and access can be ensured.

5. Recommendations

The study intends to draw attention of policy makers towards identifying the discrepancy in production, supply, demand and distribution of trained doctors at regional level in the state of Rajasthan. Although several factors drive the health outcomes, having fewer trained doctors severely cripples the ability of health systems to effectively deliver preventive and curative health services.[20,21]

Since the effective coverage of health services can be ensured not only by availability of doctors but also by equitable distribution of professional health workers and health care institutions. Besides improving production of physicians, there is urgent need to use alternatives ways such as skill mix, task shifting, redesigning service delivery platforms to address this huge projected deficit of physicians. The policy needs to factor in the new age Internet based service delivery methods such as teleservices, health data repository services and online monitoring services. Such innovative methods can help government to reach more people even at the last mile with existing resources, thereby improving footprint of health system.

5.1. Limitation of study

Model does not consider the of role Ayurvedic, Unani and naturopathy health professional in health care delivery. This model does not include the nursing staff as this is beyond the purpose of the study. Furthermore, the optimization of resources, productivity and innovations in delivery are assumed to be constant over time.

6. Source of Funding

None.

7. Conflict of Interest

None.

References

1. Hazarika I. Health workforce in India: assessment of availability, production and distribution. *WHO South East Asia J Public Heal*. 2013;2(2):106–12. doi:10.4103/2224-3151.122944.
2. Jebeli SSH, Hadian M, Souresrafil A. Study of health resource and health outcomes: Organization of economic corporation and development panel data analysis. *J Educ Health Promot*. 2019;8:70. doi:10.4103/jehp.jehp_101_18.
3. Rao M, Rao KD, Kumar AKS, Chatterjee M, Sundararaman T. Towards Universal Health Coverage 5 Human resources for health in India. *Lancet*. 2011;377(9765):587–98. doi:10.1016/S0140-6736(10)61888-0.
4. Pati S, Swain S, Nallala S, Das S, Kasam S. Why medical students do not like to join rural health service? An exploratory study in India. *J Fam Community Med*. 2015;22(2):111–7. doi:10.4103/2230-8229.155390.
5. Banerjee A, Deaton A, Duflo E. Wealth, health, and health services in rural Rajasthan. *Am Econ Rev*. 2004;94(2):326–30. doi:10.1257/0002828041301902.
6. World Population Prospects - Population Division - United Nations; 2018. Available from: https://population.un.org/wpp/.
7. Wharrad H, Robinson J. The global distribution of physicians and nurses. *J Adv Nurs*. 1999;30(1):109–20. doi:10.1046/j.1365-2648.1999.01056.x.
8. Zodpey S, Sharma A, Zahiruddin QS, Gaidhane A, Shrikhande S. Allopathic Doctors in India. *J Health Manag*. 2018;20(2):151–63.
9. Health at a Glance; 2017. p. 274. doi:10.1787/19991312.
10. Martin PF, Arias GM. Martin PF, Arias GM. NO HEALTH WITHOUT A WORKFORCE. Forum Rep Third Glob Forum Hum Resour Heal Glob Heal Work Alliance World Heal Organ; 2013. Available from: http://www.who.int/workforcealliance/knowledge/resources/GHWA_AUniversalTruthReport.pdf.Accessed.
11. Lopes C, Arias SG, Buchan M, Martin JP, Nove F. A rapid review of the rate of attrition from the health workforce. *Hum Resour Health*. 2017;15:2–9. doi:10.1186/s12960-017-0195-2.
12. Maher BM, Hynes H, Sweeney C. Medical School Attrition-Beyond the Statistics A Ten Year Retrospective Study. *BMC Med Educ*. 2013;13(1):13. doi:10.1186/1472-6920-13-13.
13. Registrar Rajasthan Medical Council. RMC, Jaipur Doctors Registration. Available from: https://www.rmcjaipur.org/.
14. World Health Organization (WHO). Global strategy on human resources for health: Workforce 2030. 2016:48. doi:10.1017/CBO9781107415324.004; 2016. Available from: http://apps.who.int/iris/bitstream/handle/10665/250368/9789241511131-eng.pdf;jsessionid=854F039C72EC306CDC37D33EB4C90BF8?sequence=1.
15. Global strategy on human resources for health: Workforce 2030; 2016. doi:10.1787/9789264239517-en.
16. Anand S, Fan V. World Health Organization. The health workforce in India. *Hum Resour Heal Ob*. 2016;16:16058.
17. Rao K, Shahrawat R, Bhatnagar A. Composition and distribution of the health workforce in India: estimates based on data from the National Sample Survey. *WHO South East Asia J Public Heal*. 2016;5(2):133–40. doi:10.4103/2224-3151.206250.
18. Kumar R, Pal R. India achieves WHO recommended doctor population ratio: A call for paradigm shift in public health discourse!

J Fam Med Prim Care. 2018;7(5):841–4. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6259525/?report=printable. doi:10.4103/jfmpc.jfmpc_218_18: 10.4103/jfmpc.jfmpc_218_18.

19. Horton R, Araujo EC, Bhorat H. Final Report of the Expert Group to the High-Level Commission on Health Employment and Economic Growth. WHO Press; 2016.; 2016. Available from: www.who.int. Accessed.

20. Rao KD, Bhatnagar A, Berman P. So many, yet few: Human resources for health in India. *Hum Resour Health*. 2012;10(1):19. doi:10.1186/1478-4491-10-19.

21. Wu J, Yang Y. Inequality trends in the demographic and geographic distribution of health care professionals in China: Data from 2002 to 2016.   *Int J Health Plann Manage*. 2019;34(1):487–508.

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