Review Article

Retaining health workforce in rural and underserved areas of India: What works and what doesn't? A critical interpretative synthesis

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ABSTRACT

Background. Human resource for health is critical in quality healthcare delivery. India, with a large rural population (68.8%), needs to urgently bridge the gaps in health workforce deployment between urban and rural areas.

Methods. We did a critical interpretative synthesis of the existing literature by using a predefined selection criteria to assess relevant manuscripts to identify the reasons for retaining the health workforce in rural and underserved areas. We discuss different strategies for retention of health workforce in rural areas on the basis of four major retention interventions, viz. education, regulation, financial incentives, and personal and professional support recommended by WHO in 2010. This review focuses on the English-language material published during 2005–14 on human resources in health across low- and middle-income countries.

Results. Healthcare in India is delivered through a diverse set of providers. Inequity exists in health manpower distribution across states, area (urban–rural), gender and category of health personnel. India is deficient in health system development and financing where health workforce education and training occupy a low priority. Poor governance, insufficient salary and allowances, along with inability of employers to provide safe, satisfying and rewarding work conditions—are causing health worker attrition in rural India. The review suggests that the retention of health workers in rural areas can be ensured by multiplicity of interventions such as medical schools in rural areas, rural orientation of medical education, introducing compulsory rural service in lieu of incentives providing better pay packages and special allowances, and providing better living and working conditions in rural areas.

Conclusions. A complex interplay of factors that impact on attraction and retention of health workforce necessitates bundling of interventions. In low-income countries, evidence-based strategies are needed to ensure context-specific, field-tested and cost-effective solutions to various existing problems. To ensure retention these strategies must be integrated with effective human resource management policies and rural orientation of the medical education system.

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INTRODUCTION

Health workforce is defined as the 'people engaged in actions with primary intent to enhance health'.[1] The number of health workers available in a country is a key indicator of that country's capacity to provide delivery of interventions.[2] The importance of the health workforce can be gauged from the fact that healthcare is a human resource-intensive industry and production of health workers is expensive and time-consuming. The Joint Learning Initiative (2004) for Human Resources for Health estimates a requirement of 2.5 workers per 1000 population for achieving 80% coverage of the population.[3] In 2006, the *World Health Report* drew attention to the global health workforce crisis and its dramatic impact in 57 priority countries. It estimated a need for additional 4.3 million health workers in these countries to fulfil the Millennium Development Goals.[1] These countries are affected by severe shortages, inequitable distribution, poor motivation and uneven performance of healthcare workers.[1]

In 2009, a high-level taskforce on International Financing for Health Systems identified health workforce as a priority area, requiring critical attention and additional investments. Poor coverage of primary healthcare interventions, e.g. measles immunization and antenatal care was observed in countries with less than 23 skilled workers (physicians, nurses and midwives) per 10 000 population. It suggested to governments that all people, including rural and remote populations, have access to safe, high-quality and essential healthcare services.[4]

Globally, the health workforce per 1000 population ranges from as low as 2.3 and 4.3 in Africa and Southeast Asia,

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respectively, to as high as 24.8 in the USA.[1] The situation is critical in 57 countries where a billion people have no access to essential healthcare services due to shortage of trained health workers.[1] Worldwide, there is also unbalanced distribution of health personnel between and within countries. All countries, rich and poor, report a higher proportion of health personnel in urban and wealthier areas. Approximately half of the global population lives in rural areas, but these areas are served by only 38% of the total nursing workforce and by less than a quarter of the total physician workforce. A comparison of two large health labour markets, India and China, showed that India has a lesser workforce population ratio and greater inequality compared to China.[5] According to a report published in June 2016, using the Census 2001 data of India, nearly 2.01 health workers and of them 0.8 allopathic doctors exist per thousand population.[6] With these projections there will be a shortage of around 12.9 million healthcare workers globally by 2035; 80% of them in poor nations.[1]

India, with a population of over one billion, is placed in the lowest category of human resource for health (HRH) indicators.[7] This deficiency is worsened by the unfavourable distribution of HRH in rural areas, where a majority of the population resides. There are only 100 skilled health workers per 100 000 population against the international norm of 228 per 100 000 population.[8] Despite several attempts, the government has failed to tackle the problem effectively. We reviewed the literature to capture various aspects that lead to human resource shortage in India and the strategies deployed globally which could be replicated and scaled up in developing countries such as India.

METHODS

We did a critical interpretative synthesis (CIS) of a diverse body of evidence on HRH to generate a theory with considerable explanatory powers. The predefined selection criterion used to assess relevant manuscripts in this literature review was to identify 'the reasons for retaining health workforce in rural and underserved areas'. The tasks of searching, sampling, critiquing and analysing were done as dynamic and mutually informative processes.[9] Search engines such as PubMed, Google Scholar and IndMed were used to identify relevant articles. The keywords 'health workers or nurses or doctors or mid-level workers' AND 'retention or recruitment or shortage' AND 'rural area or underserved area in India' were used in 24 combinations for the search (Fig. 1). We also used a snow-balling approach to identify further literature from the reference lists of relevant journal articles. The search was limited to articles in English published from 2005 to 2014.

The article search followed an iterative strategy aimed at theoretical saturation. From a total of 170 articles identified, 90 were shortlisted. We rejected 80 articles because of duplication in different search engines and after screening their abstracts. Of the 90 articles, those dealing with subject-based training, new medical education techniques, methods of quality assurance, quality improvement of healthcare staff, continuous medical education and cross-country migration were excluded from review as they did not meet the predefined criteria of the study. Further, these articles considered short-term effect of pre- and post-test knowledge scores, rather than long-term impact of job satisfaction or motivation. Finally, 56 articles were included in the review on the basis of a screening of the full text of each article (Fig. 1).

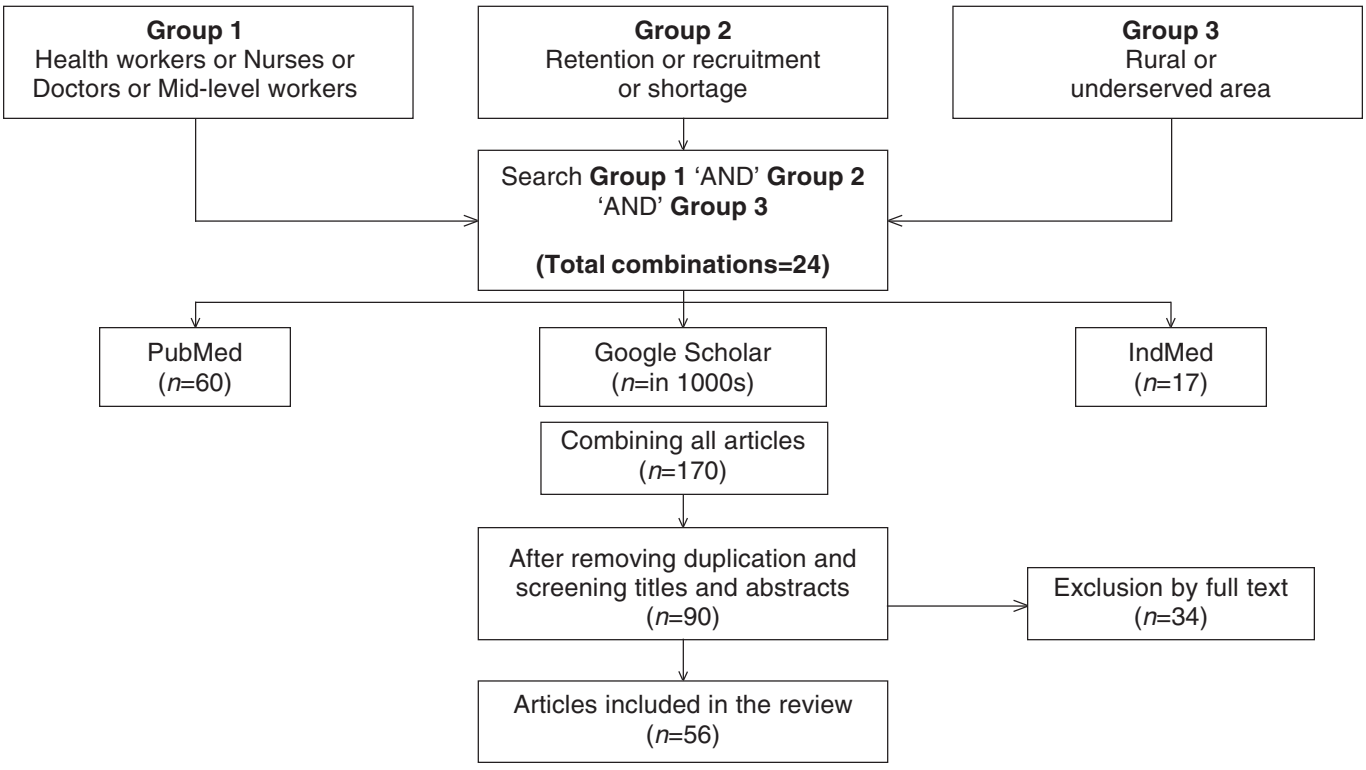

FIG 1. Scheme used in the study for literature search

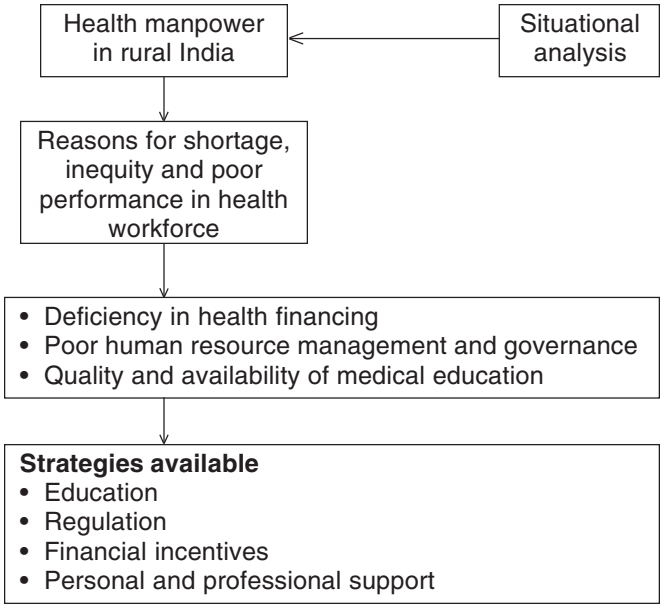

FIG 2. Framework for analysis

On the basis of our search, we attempt to explain the existing HRH in India along with the distribution in rural and remote areas. We also discuss the reasons for shortage of HRH in various countries along with successful initiatives undertaken by some countries. These strategies are discussed in terms of their merits and demerits in the Indian context. The results are summarized according to the framework given in Fig. 2.

HISTORY OF HRH POLICIES IN INDIA

Before Independence in 1947, there were two classes of allopathic physicians in the Indian health workforce; namely, doctors who underwent a five-and-a-half-year course and Licentiate Medical Practitioners (LMPs) who underwent a three-to-four-year course. Nearly two-thirds of qualified medical practitioners practising in rural areas were LMPs. The abolition of the licentiate system post-Independence resulted in an immediate and massive crunch of health manpower in rural areas.[10] The situation remained grim until the health sector reforms in the early 1990s provided marginal relief to the HRH problem. Many private medical colleges were opened to augment the existing manpower.[11] In 2004, the World Health Assembly passed a resolution to address the migration of health workers from rural and underserved areas.[12] In 2005, the National Rural Health Mission (NRHM)—now the National Health Mission (NHM)—provided for the recruitment of contractual staff to fill in the HRH gap in rural areas in India.

CURRENT STATUS OF HEALTH WORKFORCE IN INDIA

The wide range of HRH in India includes formal and informal medical practitioners. According to the Rural Health Statistics Report 2015, India had almost 2.2 million health personnel including about 677 000 allopathic doctors and 200 000 AYUSH (Ayurveda, Yoga and naturopathy, Unani, Siddha and Homoeopathy) practitioners.[13] India had roughly 20 health workers per 10 000 population, which consists of allopathic doctors (31%), nurses and midwives (30%), pharmacists (11%), practitioners of AYUSH (9%), and others (9%). The National Sample Survey Organization estimates an adjusted population of healthcare workers (adjusted for educational qualifications) as 8 per 10 000 people (3.8 allopathic doctors and 2.4 nurses and nurse-midwives). The combined density of allopathic doctors, nurses and midwives (11.9/10 000) is about half the WHO benchmark (25.4/10 000 population), which declines further when adjusted for qualification.[13]

Recent data from the Rural Health Statistics Report 2015 indicate that 8.1% of primary health centres (PHCs) were without a doctor, 38.1% were without a laboratory technician and 21.9% were without a pharmacist. The situation of community health centres (CHCs) with respect to human resources is even poorer in terms of the sanctioned posts: 74.6% of surgeons, 65.4% of obstetricians and gynaecologists, 68.1% of physicians and 62.8% of paediatricians were vacant. Overall, 67.6% of the sanctioned posts of specialists at CHCs were vacant.[14] The Workforce Indicators and Staffing Need (WISN) approach which calculates the expected demand a package of services should generate, found a considerable gap in the supply of health workers across all categories in Ganjam district of Odisha and estimated a need for an additional 43 physicians, 15 nurses and 80 nurse midwives.[15]

There is an uneven distribution of health workers across India, which ranges from 23.2 per 10 000 population in Chandigarh to 2.5 per 10 000 population in Meghalaya. The states of Goa and Kerala have a very high number of allopathic doctors (41.6 per 10 000 and 38.4 per 10 000, respectively) compared with states such as Odisha (19.7 per 10 000) and Chhattisgarh (15.8 per 10 000) and other north-central states. The inequity in distribution is also observed in terms of male–female ratio of health workers. Almost two-thirds of all health workers are men. The number of women doctors across different states of India ranges from 7.5 in Chandigarh to 0.26 in Bihar per 10 000 population. There are 6.5 women allopathic doctors per 10 000 population in urban areas compared to 0.5 per 10 000 in rural areas.[13]

A gross imbalance in health workers between urban and rural areas is seen as there are 42 health workers in urban areas as compared to 11.8 in rural areas per 10 000 population. This imbalance is even more (three times) when we consider allopathic doctors (13.3 in urban *v.* 3.9 in rural areas), nurses and midwives (15.9 in urban *v.* 4.1 in rural areas) and AYUSH practitioners (3.6 in urban *v.* 1.0 in rural areas) per 10 000 population. Further, a majority (70%) of the existing health workforce works in the private sector.[13] This imbalanced distribution of health workers in terms of men or women, urban or rural, public or private impedes the universal access to healthcare goals.

EXPLAINING HEALTH WORKFORCE SHORTAGE IN RURAL AND UNDERSERVED AREAS OF INDIA

A multitude of interconnected causes result in health manpower deficit in rural and underserved areas of India. Different factors operate in different states. Various case studies of Indian states published by the Central Bureau of Health Intelligence (CBHI), India revealed an absence of a formal mechanism to undertake manpower planning and forecasting on a regular basis. The planning exercise focused mostly on the creation of new infrastructure rather than recruiting specialized manpower. Other reasons cited were non-existence of specialized human resource department, poor recruitment, and transfer and promotion system.[16] Moreover, sociodemographic and economic factors of the region have a considerable role in the distribution of their health workforce.[17] Shortages of health workers can also be caused by conditions in other countries, wherein one country's domestic and foreign policies can affect health worker shortages in other countries.[18]

India is deficient in health system development and financing because health workforce education, training and continuing field education are given a low priority. India has moved from 19 medical schools post-Independence to more than 380 at present. Private medical institutions have contributed to this rapid rise as 57% schools are privately operated nowadays compared to 33% in 1990.[19] However, regional imbalances exist in medical education with less number of colleges in areas where they are required most. Since southern India has about 63% of the total medical colleges, northern India has to enhance its medical education infrastructure to correct the imbalance. Even with appropriate number and mix of trained health workers, the availability of jobs is a concern which depends on money to pay for salaries and other benefits. This is attributed to poor governance and insufficient budget allocation to healthcare. The Government of India is committed to increase the public healthcare budget under the 12th Five-year Plan (2012–17) as a part of its flagship NRHM, which is expected to lessen manpower woes.[20] Evaluation of the NRHM (2005–10) has shown an additional appointment of 8624 MBBS doctors, 2640 specialists and 26 793 staff nurses.[21] Inability of employers to provide safe, satisfying and rewarding work conditions is another important factor for healthcare worker attrition in rural India. Compulsory postings and financial incentives in rural areas are stop-gap measures for securing a postgraduate seat or job in an urban area. Although contractual appointments done under the NRHM have resulted in some immediate gain in health outcomes, they have done little to address dissatisfaction and attrition of health manpower in the long run.

Due to poor working and living conditions, lack of monetary and non-monetary incentives, health workers prefer to migrate within and across countries. Other reasons include lack of employment opportunities, appropriate work environment and wages, growing demand in high-income countries due to demographic transition, and favourable country policies for financial remittances by migrant workers. Thus, the migration of health workers to urban areas leads to a heavy workload for health workers in rural areas. This leads to a domino effect; i.e. those in dire situations look for areas where they may be able to find more satisfactory and less demanding working conditions.

STRATEGIES FOR RETENTION IN RURAL AND UNDERSERVED AREAS

Development of appropriate strategies requires an understanding of the factors that influence decisions to accept and/or stay in a remote area. Several theoretical models categorize factors impacting workforce mobility. The Neoclassic Wage Theory suggests that the choice is driven largely by financial motives and probability of finding employment. Behavioural theories show a complex decision-making process emphasizing on job satisfaction. The recent literature on health workforce mobility has classified influencing factors into 'pull' and 'push' categories. 'Pull' factors include improved employment opportunities and/or career prospects, higher income, better living conditions and more stimulating environment. 'Push' factors act to repel the individual from a location and include poor administrative policies, nepotism, poor job satisfaction, poor growth opportunities, lack of incentives, etc.[22]

WHO has identified four key strategies that influence recruitment and retention of the health workforce in rural and remote areas. These strategies are education, regulation, financial incentives, and personal and professional support.[23] WHO has also suggested that interventions should respond to factors that health workers value in their work.[24] Therefore, policy should design the interventions in the local context. Many countries have implemented these interventions in their local context to attract and retain health workers in remote and rural areas.[25] However, a Cochrane review on HRH suggested the need for well-designed studies on HRH to support interventions.[26]

There is limited evidence of successful attraction and retention strategies in developing countries such as India. We provide a review of different strategies for retention of health workforce in rural areas on the basis of four major retention interventions recommended by WHO in 2010.

EDUCATIONAL INTERVENTIONS

Studies done in the developed world indicate that retention of the health workforce in rural areas can be ensured by having medical schools in rural areas and recruiting staff with a rural background. A review of studies on undergraduate medical education suggests placement of medical students in rural settings to be a positive influencer for placement in a rural area, wherein they displayed better performance, greater clinical exposure, more satisfaction and considerable improvement in clinical skills compared to their urban counterparts.[27] A retrospective study from Japan found that rural medical school graduates were 4-times more likely to work in rural areas than others.[28] Rural training experience in medical schools of Australia elicited increased interest in rural medicine among students.[29] Barriers for recruitment identified by a rural clinical school were quality of teaching and education at school, location, transport, ability to get preferred internship and family concerns.[30] Studies in Norway and the USA have also concluded that students from rural background achieve similar level of success in nursing education as their urban counterparts.[31,32]

No studies on rural orientation of medical education have been done in India, as the majority of medical colleges are located in urban areas. In a study done in medical schools of Bengaluru, India, 44% medical interns preferred to serve in rural areas immediately after undergraduation, but <10% wanted to settle permanently.[33] Another study in two medical colleges of central India with nearly 80% students from a rural background rated the status of rural health services in India as highly unsatisfactory (88.6%) and indicated (54.7%) an interest in working in rural areas after graduation.[34] Few states have introduced state-specific cadre of health workers focusing on recruiting students from rural background, e.g. Chhattisgarh deployed rural medical assistants (RMAs) and women RMAs in peripheral health centres. Similarly, Assam introduced a new cadre of health workers to fill up vacant positions in remote, far-flung and rural areas.[35] The 'Bachelor in Rural Health' was envisioned to train science students from rural schools in public healthcare institutions to practise under supervision in a population <50 000. However, these courses were fraught with challenges in structure of training, type of service delivery and quality of healthcare.[36] It would also be difficult to stop those employed in rural areas from migrating to urban areas for lucrative practice opportunities.[37] Factors such as infrastructure and salary were perceived as potential barriers for a career in rural health.[38]

REGULATORY INTERVENTIONS

Regulatory interventions with regard to recruitment and retention in rural areas seek to expand the scope of practice of rural health workers, produce different types of health workers, and influence compulsory service requirements and bonding schemes.

In Thailand, students recruited by the Ministry of Public Health receive heavily subsidized tuition and free clothing, room and boarding, and learning materials during their studies in return for doing compulsory public health service—usually in remote areas—after graduation.[39,40] Many Latin American countries have made use of compulsory rural service, particularly for medical doctors, to help them stay in rural areas.[41]

In India, states such as Assam, Chhattisgarh, Kerala, Himachal Pradesh, Haryana, Punjab, Andhra Pradesh and Tamil Nadu reserve postgraduate seats for in-service doctors who complete a fixed quota of rural service. The states of Kerala, Mizoram and Uttarakhand provide additional marks to candidates who serve in rural areas for 2–3 years; these marks are added to their marks obtained in entrance examination. Compulsory rural bonds for those receiving medical education from government colleges have been used in many states such as Kerala, Tamil Nadu, Meghalaya and Nagaland to fill vacancies in rural areas. The state of Nagaland has introduced the Diplomate of National Board in Family Medicine for in-service candidates. Effectiveness of most of these initiatives has not been evaluated. However, an initiative of Andhra Pradesh of a postgraduation incentive scheme was evaluated and has shown to be effective in reducing the vacancies of medical officers and specialists in the public health system.[42] The experiences from Tamil Nadu and Karnataka have also shown a beneficial effect on worker morale by providing rotational posting in difficult areas followed by a posting in the area of their choice.[43] Many other states have made rural service mandatory for admission into postgraduate programmes.[44] Since most medical graduates are eager to pursue postgraduation, rural postings have been shown to be acceptable if they are made a mandatory component of postgraduate rather than undergraduate degrees.[45]

FINANCIAL INTERVENTIONS

Financial measures are adopted in policies over professional and personal support measures as they are proven better for influencing choices and preferences for work in underserved areas.[25] Financial incentives encompass all additional benefits given to health workers to entice them to work in a remote or rural area. They include monetary bonuses and in-kind benefits (a free house or vehicle).

In Thailand, financial incentives started with special allowances for physicians working in remote district hospitals.[40] In the Philippines, a special financial package, the Magna Carta, was created for public health workers which included increased salaries and benefits, particularly for physicians.[46] In Indonesia, graduates who work in very remote areas receive a higher salary and a guarantee of a civil service career after completion of the 3-year compulsory contract.[47] Zambia has introduced a package of measures to attract doctors to and retain them in remote rural areas.[48] The package includes a rural allowance equivalent to about 30% of their salary, accommodation, contribution to school fees, vehicle and/or housing loans and some support for further education.

Financial incentives are one of the most commonly used strategies in India to attract and retain doctors in rural areas. Eighteen states have monetary incentive schemes to compensate doctors for service in underserved areas.[8] These schemes, which are focused mainly on allopathic doctors, are more effective when combined with incentives such as better living environment, housing and schooling. However, such incentives need to be substantial in order to retain health workers in rural areas, especially for doctors as compared to nurses and other staff. Effectiveness of monetary incentives has not been widely evaluated in India. An Indian study found in 2013 that, for every salary level, a considerably higher proportion of nursing students and nurses were willing to accept a rural job compared to medical students and doctors.[49]

PERSONAL AND PROFESSIONAL INTERVENTIONS

Personal and professional interventions relate mainly to living and working conditions in rural areas. Personal preferences that rank high among health workers include good infrastructure, opportunities for social interaction, schooling for children and employment for spouses. Professional preferences include opportunities for career advancement as well as for networking with peers. Limited evidence exists of strategies aimed at improving working conditions and job satisfaction, although a number of studies discuss the benefits of introducing participatory management and flexibility in US institutions.[50–52] Case studies in countries such as Papua New Guinea and the Philippines found that supportive supervision improved not only work satisfaction but also performance and quality of care in remote settings.[53,54] These results are supported by a six-country study which showed that the quality of care improved by focusing on supporting performance of staff.[55]

Thailand invested heavily in general rural infrastructure (roads, phones, water supplies and radio communication) and staff housing at rural district hospitals, which led to improved retention of health workers.[39] The Zambian Health Worker Retention Scheme included refurbishment of government housing and school fees to allow staff to send their children away for better education.[48] However, little is known about the long-term impact of the retention scheme.

States such as West Bengal and Chhattisgarh have introduced group housing schemes for health workers living in remote areas. In a qualitative research study in Chhattisgarh, the prime reasons for staying in rural areas included availability of schools, geographical and ethnic affinities, co-location with spouses and professional interest. Effective management policies and provision of improved infrastructure for health personnel in Tamil Nadu, Karnataka and Nagaland have had a major impact on worker morale.[56] Access to training, healthcare and education for children, career opportunities, the availability of electricity, water and housing are the main reasons for favouring urban jobs.[57,58]

BUNDLING OF INTERVENTIONS

Considering the complexity of attraction and retention of health workforce in rural and underserved areas, the emphasis globally is on bundling of different interventions. In Indonesia, a 'bundle' of interventions, such as compulsory service, training and financial incentives, is employed for increasing the density of health workforce in remote areas.[47] The Ministry of Health of South Africa introduced compulsory service as well as financial incentives to influence the staffing of rural hospitals.[56] Zambia introduced a 'package' of measures, such as rural allowances, vehicle and house loans, contribution to school fee of children and support for further education, to retain doctors in remote rural areas.[48]

Few studies in India have also reported that the interplay between factors, such as career growth, organizational setup, bureaucracy, the work and living environment, influences the choices health workers make regarding job location, thus requiring bundling of interventions.[34,58–60] Bundling of financial and educational incentives across states of India has resulted in attracting doctors and nurses to rural postings.[61] Many states of India have adopted a bundle of interventions, however, their

impact has largely not been evaluated. These interventions need to be field-tested and adapted in different states, with a view to improve efficiency and effectiveness of the healthcare services.

CONCLUSION

Healthcare delivery is labour-intensive where quality, efficiency and effectiveness are dependent on successful planning of the health workforce. Over the past two decades, various strategies for attraction and retention of the health workforce were successfully and un-successfully implemented by the Indian government. The diversity of India with each state having its own challenges and assets makes it obligatory for designing tailor-made, field-tested, cost-effective interventions and strategies. A complex interplay of factors that impact the attraction and retention of health workforce necessitates a bundling of interventions.

Conflict of interest. None declared.

CONTRIBUTIONS

SG conceived the study, designed the framework of manuscript and did critical analysis. NB did the literature review and prepared the draft of the manuscript. FA provided critical inputs in the design and coordination and helped to draft the manuscript. MG provided insights on the issues plaguing the health system of India and the scenario in rural and underserved parts of the country. NS did the literature review and critically reviewed the manuscript. HM did the critical review and approved the final draft for submission. All authors read and approved the final manuscript.

REFERENCES

1 WHO. *The World Health Report, 2006 – Working together for health.* Geneva: World Health Organization, 2006. Available at *www.who.int/whr/2006/en/index.html* (accessed on 15 Sep 2013).
2 WHO. *The World Health Report 2003: Shaping the future.* Geneva:WHO; 2003. Available at *www.who.int/whr/2003/en/whr03_en.pdf* (accessed on 18 Sep 2015).
3 *Human Resources for Health: Overcoming the crisis: Joint Learning Initiative.* Boston:Rockfeller Foundation, Harvard University Press; 2004. Available at *www.issuelb.org/organizations/profile/rockfeller_foundation* (accessed on 18 Sep 2015).
4 McCoy D, Brikci N. Taskforce on innovative international financing for health systems: What next? *Bull World Health Organ* 2010;**88:**478–80.
5 Anand S. *Measuring health workforce inequalities: Methods and application to China and India. Human Resources for Health Observer, Issue No. 5.* Geneva:WHO; 2010. Available at *http://whqlibdoc.who.int/publications/2010/9789241500227_eng.pdf* (accessed on 25 Sep 2013).
6 Anand S, Fan V. *The Health Workforce in India. Human Resources for Health Observer Series. No 16.* World Health Organization 2016. Available at *www.who.int* (accessed on 13 Nov 2016).
7 Chen L, Evans T, Anand S, Boufford JI, Brown H, Chowdhury M, *et al.* Human resources for health: Overcoming the crisis. *The Lancet* 2004;**364:**1984–90.
8 Sundararaman T, Gupta G. Indian approaches to retaining skilled health workers in rural areas. *Bull World Health Organ* 2011;**89:**73–7.
9 Dixon-Woods M, Cavers D, Agarwal S, Annandale E, Arthur A, Harvey J, *et al.* Conducting a critical interpretive synthesis of the literature on access to healthcare by vulnerable groups. *BMC Med Res Methodol* 2006;**6:**1.
10 Rao MS. The history of medicine in India and Burma. *Med Hist* 1968;**12:**52–61.
11 Jan Swasthya Abhiyan. *Health system in India: Crisis and alternatives.* Delhi: National Coordination Committee, Jan Swasthya Abhiyan; 2006 Available at *www.communityhealth.in/~commun26/wiki/images/8/85/JSA_Health_system_in_India.pdf* (accessed on 25 Sep 2013).
12 World Health Organization. *International migration of health personnel: A challenge for health systems in developing countries. Resolution WHA57.* Geneva:WHO; 2004:19. Available at *http://apps.who.int/gb/ebwha/pdf_files/WHA57/A57_R19-en.pdf* (accessed on 25 Sep 2013).
13 Rao KD, Bhatnagar A, Berman P, Saran I, Raha S. *India's health workforce: Size, composition and distribution. India Health Beat.* New Delhi:World Bank and Public Health Foundation of India; 2009.
14 Health Management Information System. *Rural Health Statistics 2015, Health Management Information System, A digital initiative under the National Health Mission.* New Delhi:Ministry of Health and Family Welfare, Government of India. Available at *https://nrhm-mis.nic.in/Pages/RHS2015.aspx?RootFolder=%2FRURAL%20HEALTH%20STATISTICS%2F(A)RHS%20-%202015&FolderCTID=&View=%7BC50BC181-07BB-4F78-BE6F-FCE916B64253%7D* (accessed on 18 Sep 2015).
15 Hagopian A, Mohanty MK, Das A, House PJ. Applying WHO's 'workforce indicators of staffing need' (WISN) method to calculate the health worker requirements for India's maternal and child health service guarantees in Orissa State. *Health Policy Plan* 2012;**27:**11–18.
16 Managing CB. *Human resources for health in India—a case study of MP and Gujarat.* New Delhi:DGHS, Ministry of Health and Family Welfare; 2007.
17 De Costa A, Al-Muniri A, Diwan VK, Eriksson B. Where are healthcare providers? Exploring relationships between context and human resources for health Madhya Pradesh province, India. *Health Policy* 2009;**93:**41–7.
18 O'Brien P, Gostin LO. *Health worker shortages and global justice. Millbank Memorial Fund, 2011; U of Melbourne Legal Studies Research Paper No. 569.* Australia:Melbourne Law School; 2011. Available at *SSRN: https://ssrn.com/abstract=1965786* (accessed on 18 Sep 2015).
19 Medical Council of India. *Annual Report 2013–14.* Available at *www.mciindia.org/pdf/Annual%20Report.pdf* (accessed on 18 Sep 2015).
20 Richards T. Medical education in India—in poor health. *Br Med J (Clin Res Ed)* 1985;**290:**1132–5.
21 Ministry of Health and Family Welfare. *Four years of NRHM—2005–09. Making a difference everywhere.* New Delhi:Ministry of Health and Family Welfare, Government of India; 2009.
22 Todaro M. Internal migration in developing countries: A survey. In: Easterlin RA (ed). *Population and economic change in developing countries.* Chicago:National Bureau of Economic Research, University of Chicago Press; 1976.
23 World Health Organization. *Increasing access to health workers in remote and rural areas through improved retention.* Geneva:WHO; 2010. Available at *www.searo.who.int/nepal/mediacentre/2010_increasing_access_to_health_workers_in_remote_and_rural_areas.pdf* (accessed on 18 Sep 2015).
24 World Health Organization. *Policies and practices of countries that are experiencing a crisis in human resources for health: Tracking survey.* Geneva:WHO; 2010. Available at *http://whqlibdoc.who.int/publications/2010/9789241500821_eng.pdf* (accessed on 18 Sep 2015).
25 Dolea C, Stormont L, Braichet JM. Evaluated strategies to increase attraction and retention of health workers in remote and rural areas. *Bull World Health Organ* 2010;**88:**379–85.
26 Grobler L, Marais BJ, Mabunda SA, Marindi PN, Reuter H, Volmink J. Interventions for increasing the proportion of health professionals practising in rural and other underserved areas. *Cochrane Database Syst Rev* 2009;**1:**CD005314.
27 Barrett FA, Lipsky MS, Lutfiyya MN. The impact of rural training experiences on medical students: A critical review. *Acad Med* 2011;**86:**259–63.
28 Matsumoto M, Inoue K, Kajii E. Characteristics of medical students with rural origin: Implications for selective admission policies. *Health Policy* 2008;**87:**194–202.
29 Eley D, Baker P. Does recruitment lead to retention? Rural clinical school training experiences and subsequent intern choices. *Rural Remote Health* 2006;**6:**511.
30 Jones GI, DeWitt DE, Cross M. Medical students' perceptions of barriers to training at a rural clinical school. *Rural Remote Health* 2007;**7:**685.
31 Norbye B, Skaalvik MW. Decentralized nursing education in Northern Norway: Towards a sustainable recruitment and retention model in rural Arctic healthcare services. *Int J Circumpolar Health* 2013;**72:**22793.
32 Bigbee J, Mixon D. Recruitment and retention of rural nursing students: A retrospective study. *Rural Remote Health* 2013;**13:**2486.
33 Gaikwad V, Sudeepa D, Madhukumar S. A study on career preferences and attitude towards the rural health services among the graduating interns of a medical college in Bangalore rural. *Int J Biol Med Res* 2012;**3:**1577–80.
34 Saini NK, Sharma R, Roy R, Verma R. What impedes working in rural areas? A study of aspiring doctors in the National Capital Region, India. *Rural Remote Health* 2012;**12 (1967):**1–7.
35 Rao KD, Khanna S, Kumar N, Kokho P, Bhatnagar A, Gupta G, *et al. Which doctor for primary health care? An assessment of primary health care providers in Chhattisgarh, India.* New Delhi:Public Health Foundation of India and National Rural Health Mission; 2010. Available at *http://cghealth.nic.in/ehealth/studyreports/Which%20Doctor%20For%20Primary%20Health%20Care.pdf* (accessed on 15 Sep 2013).
36 Taneja DK. Rural doctors course: Need and challenges. *Indian J Public Health* 2010;**54:**1–2.
37 Garg S, Singh R, Grover M. Bachelor of rural health care: Do we need another cadre of health practitioners for rural areas? *Natl Med J India* 2011;**24:**35–7.
38 Ranmuthugala G, Humphreys J, Solarsh B, Walters L, Worley P, Wakerman J, *et al.* Where is the evidence that rural exposure increases uptake of rural medical practice? *Aust J Rural Health* 2007;**15:**285–8.
39 Nitayarumphong S, Srivanichakom S, Pongsupap Y. Strategies to respond to health manpower needs in rural Thailand. In: Ferrinho P, Van Lerberghe W (eds). *Providing health care under adverse conditions: Health personnel performance and individual coping strategies.* Antwerp:ITG Press; 2000:157–62.
40 Wibulpolprasert S, Pengpaibon P. Integrated strategies to tackle the inequitable distribution of doctors in Thailand: Four decades of experience. *Hum Resour Health* 2003;**1:**12.
41 Cavender A, Albán M. Compulsory medical service in Ecuador: The physician's perspective. *Soc Sci Med* 1998;**47:**1937–46.
42 Shroff ZC, Murthy S, Rao KD. Attracting doctors to rural areas: A case study of the post-graduate seat reservation scheme in Andhra Pradesh. *Indian J Commun Med* 2013;**38:**27–32.

43 Bruno Mascarenhas JM. Overcoming shortage of doctors in rural areas: Lessons from Tamil Nadu. *Natl Med J India* 2012;**25:**109–11.
44 Matsumoto M, Kajii E. Medical education program with obligatory rural service: Analysis of factors associated with obligation compliance. *Health Policy* 2009;**90:** 125–32.
45 Garg S, Singh R, Grover M. India's health workforce: Current status and the way forward. *Natl Med J India* 2012;**25:**111–13.
46 Wibulpolprasert S. *Inequitable distribution of doctors: Can it be solved?* Thailand:Ministry of Public Health; 1999.
47 Chomitz K, Setiadi G, Azwar A. *What do doctors want? In developing strategies for doctors to serve in Indonesia's rural and remote areas. World Bank Policy Research Working Paper no. 1888*. Washington, DC:The World Bank Development Research Group; 1998.
48 Koot J, Martineau T. Mid-term review: *Zambian Health workers retention scheme (ZHWRS) 2003–2004. Final Report, 2005.*
49 Rao KD, Ryan M, Shroff Z, Vujicic M, Ramani S, Berman P. Rural clinician scarcity and job preferences of doctors and nurses in India: A discrete choice experiment. *PLoS ONE* 2013;**8:**e82984.
50 Buchan J, Calman L. *The global shortage of registered nurses: An overview of issues and actions.* Geneva:International Council of Nurses; 2004.
51 MacPhee M, Scott J. The role of social support networks for rural hospital nurses: Supporting and sustaining the rural nursing work force. *J Nurs Adm* 2002;**32:** 264–72.
52 Wells N, Roberts L, Medlin LC. Issues related to staff retention and turnover. *Semin Nurse Manag* 2002;**10:**171–9.
53 Douglas M. Supervision of rural health centres in Papua New Guinea: Consolidation of the delivery of health services. *PNG Med J* 1991;**34:**144–8.
54 Loevinsohn BP, Guerrero ET, Gregorio SP. Improving primary health care through systematic supervision: A controlled field trial. *Health Policy Plan* 1995;**10:**144–53.
55 Marquez L, Keane L. Making supervision supportive and sustainable: New approaches to old problems. In: Health MS, Marquez L, Kean L (eds). *Management and leadership program, produced for the maximizing access and quality initiative (MAQ), Management Sciences for Health [MSH], Supplement to Population Reports* 2002;30, No. 4.
56 Reid S. Community service for health professionals. In: Ijumba P (ed). *South African Health Review 2002.* Durban:Health Systems Trust; 2003.
57 Dussault G, Franceschini MC. Not enough there, too many here: Understanding geographical imbalances in the distribution of the health workforce. *Hum Resour Health* 2006;**4:**12.
58 Lindelow M, Serneels P. The performance of health workers in Ethiopia: Results from qualitative research. *Soc Sci Med* 2006;**62:**2225–35.
59 Schofield D, Fletcher S, Fuller J, Birden H, Page S. Where do students in the health professions want to work? *Hum Resour Health* 2009;**7:**74.
60 Stephen E. Attracting generation next to the rural health sector. *Natl Med J India* 2007;**20:**46.
61 Ramani S, Rao KD, Ryan M, Vujicic M, Berman P. For more than love or money: Attitudes of student and in-service health workers towards rural service in India. *Hum Resour Health* 2013;**11:**58.