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HNP DISCUSSION PAPER

How to Attract Health Workers to Rural Areas?

Findings from a Discrete Choice Experiment from India

Krishna D. Rao, Zubin Shroff, Sudha Ramani, Neha Khandpur, Seema Murthy, Indrajit Hazarika, Maulik Choksi, Mandy Ryan, Peter Berman and Marko Vujicic

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HNP
HEALTH, NUTRITION AND POPULATION
THE WORLD BANK

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Health, Nutrition, and Population (HNP) Discussion Paper

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Health, Nutrition, and Population (HNP) Discussion Paper

How to Attract Health Workers to Rural Areas?
Findings from a Discrete Choice Experiment from India

Krishna D. Rao,[a] Zubin Shroff, [a] Sudha Ramani, [a] Neha Khandpur, [a] Seema Murthy,[a] Indrajit Hazarika,[a] Maulik Choksi,[a] Mandy Ryan, [b] Peter Berman,[c] and Marko Vujicic[d]
[a] Public Health Foundation of India, New Delhi
[b] Health Economics Research Unit, University of Aberdeen, UK
[c] Department of Global Health, Harvard School of Public Health, Harvard University, Boston, MA
[d] World Bank, Washington DC

Abstract: India faces significant challenges in attracting qualified health workers to rural areas. In 2010 we conducted a Discrete Choice Experiment (DCE) in the Indian states of Uttarakhand and Andhra Pradesh to understand what health departments in India could do to make rural service more attractive for doctors and nurses. Specifically, we wanted to do the following: (a) examine the effect of monetary and nonmonetary job attributes on health worker job choices; and (b) develop incentive "packages" with a focus on jobs in rural areas. Our study sample included medical students, nursing students, in-service doctors and nurses at primary health centers.

An initial qualitative study identified eight job attributes — health center type, area, health facility infrastructure, staff and workload, salary, guaranteed transfer to city or town after some years of service, professional development, and job in native area. Respondents were required to choose between a series of hypothetical job pairs that were characterized by different attribute-level combinations. Bivariate probit and mixed logit regression was used for the statistical analysis of the choice responses.

Our findings suggest that the supply of medical graduates for rural jobs remained inelastic in the presence of individual monetary and nonmonetary incentives. In contrast, the supply of nursing students for rural jobs was elastic. Further, medical and nursing students from rural areas had a greater inclination to take up rural jobs. The supply of in-service doctors and nurses for rural posts was elastic. Higher salary and easier enrolment in higher education programs in lieu of some years of rural service emerged as the most powerful driver of job choice. Overall, better salary, good facility infrastructure, and easier enrolment in higher education programs appear to be the most effective drivers of uptake of rural posts for students and in-service workers. Combining these incentives can substantially increase rural recruitment.

Incentivizing medical graduates to take up rural service appears to be challenging in India's context. This can be improved to some extent by offering easier admission to specialist training and recruiting students from rural backgrounds. In contrast, nursing students and in-services nurses are much more receptive to incentives for uptake of rural service. This suggests that cadres such as nurse practitioners can play an important role in delivering primary care services in rural India.

Keywords: India, health workers, DCE, Andhra Pradesh, Uttarakhand.

Disclaimer: The findings, interpretations, and conclusions expressed in the paper are entirely those of the authors, and do not represent the views of the World Bank, its Executive Directors, or the countries they represent.

Correspondence Details: Krishna D. Rao, Public Health Foundation of India, ISID Campus, 4 Institutional Area, Vasant Kunj, New Delhi-110070; telephone +91-11-49566000; kd.rao@phfi.org.

TABLE OF CONTENTS

ACKNOWLEDGMENTS

This study was conducted at the Public Health Foundation of India (PHFI), with support from the World Bank. Our sincere thanks to the Ministry of Health and Family Welfare, Government of India. In the states of Andhra Pradesh and Uttrakhand we would like to thank the Medical Education Department, Departments of Nursing and AYUSH, and the heads of various medical, nursing, and AYUSH colleges for their assistance in facilitating this study. We are grateful to all the students and primary health care staff in both states who participated in the interviews and survey. We thank the administrative and finance team at the Public Health Foundation of India for their enabling support throughout the study.

EXECUTIVE SUMMARY

India faces significant challenges in attracting qualified health workers to rural and underserved areas. Available estimates indicate that the urban-rural divide is considerable: there are approximately 13.3 doctors per 10,000 population in urban India versus only 3.9 per 10,000 in rural India (Rao et al. 2011). Health facilities, particularly those at the periphery, experience chronic staff vacancies, severely compromising their ability to provide care. Importantly, India's attempt to make basic health services available to all citizens in the coming years will crucially depend on the extent to which underserved areas can be adequately populated with qualified health workers.

The need to create the right conditions to attract and retain health workers in underserved areas is well recognized by state health departments across India, and many of them offer a range of incentives to improve rural recruitment and retention. However, current approaches to this problem have several limitations. First, they haven't evolved from a systematic assessment of health worker needs. This does not mean that these strategies are necessarily ineffective; however, it does keep the door wide open for a range of alternative approaches to the problem. Second, there is little evidence on how well current strategies work since there have been few assessments of their implementation experience. Third, current strategies typically focus on single incentives (for example, salary), which again highlight the myopic approach to this problem. Finally, most current incentives in India target doctors; understanding of the concerns of other cadres (like nurses) is insufficient.

This study has the following aims: (a) to examine the relative effect of monetary and nonmonetary job attributes on health worker job choices; (b) develop incentive "packages" based on different combinations of monetary and nonmonetary job attributes with a focus on jobs in rural areas; and (c) estimate the cost-effectiveness of these incentive packages. The Discrete Choice Experiment (DCE) methodology is used to elicit stated preferences of health workers. The method provides a quantitative estimate of the job attributes that drive health worker job preferences.

Findings presented in this study are based on a health worker survey conducted between January and December 2010 in two states of India, Uttarakhand and Andhra Pradesh. The sample of health workers — medical students, nursing students, in-service doctors and nurses at primary health

centers (PHCs) — drawn from these states operate in diverse geographical contexts and institutions. The sample in Andhra Pradesh included 163 medical students, 145 nursing students, 154 in-service primary care doctors, and 187 in-service nurses. In Uttarakhand, the survey was completed with 68 in-service primary care doctors and 51 nurses.

A qualitative study was conducted to inform the design of the DCE questionnaire, which resulted in identifying eight job attributes — type of health center, area characteristics, health facility infrastructure, staff and workload adequacy, salary, guaranteed transfer to a location near to city or town after some years of service, professional development, and job location in native area. Each attribute had two or more levels, and respondents were required to choose between a series of hypothetical job pairs that were characterized by different attribute-level combinations. Bivariate probit and mixed logit regression was used for the statistical analysis of the choice responses.

Our findings suggest that both monetary and nonmonetary incentives have small effects on the uptake of rural jobs by medical students. This is expected since their immediate ambition is to become specialists rather than to enter the job market or to become a rural doctor. In contrast, nursing students had much stronger preference for rural jobs, even at baseline levels. Indeed, among both medical and nursing students, the incentive of easier enrolment in higher education programs (postgraduate specialist seats for medical students and post-basic for nursing students) had the biggest effect on uptake of rural jobs. For both medical and nursing students, a rural job in a hospital (as opposed to a PHC) or a well-equipped PHC did not increase uptake over baseline levels. Providing good housing or postings in places with good connectivity and education facilities for children or guaranteed transfers after three years marginally improved uptake of rural jobs. Interestingly, postings in native area locations did not improve uptake of rural jobs.

For in-service doctors and nurses, salary emerged as a powerful driver of job choice. A doubling of salary, from base levels of Rs 40,000 for doctors and Rs 10,000 for nurses resulted in the majority opting for rural posts. Among nonmonetary incentives, for doctors, reserving seats for higher education (postgraduate specialization) emerged as the strongest incentive for uptake of rural posts. It was also the most cost-effective. For both in-service doctors and nurses, the job’s location was important — well-connected areas with good housing and education facilities for children

substantially increased uptake of rural jobs. While this underscores the importance of location attributes, it also highlights the fact that only improving housing conditions — a policy that many health departments resort to — will likely be ineffective in attracting health workers to rural posts. For nurses, a health facility with good infrastructure also had a large effect on uptake of rural jobs. For in-service doctors and nurses, jobs in a hospital (as opposed to a PHC), guaranteed transfers after three years, or native area postings had little effect on uptake of rural jobs.

Packages of interventions were more powerful and cost-effective in attracting health workers to rural posts than were single interventions (with the exception of salary). This suggests that policies to recruit health workers to rural areas should focus on a package of incentives rather than single interventions.

Medical and nursing students from rural areas had a greater inclination to take up rural jobs compared to their urban counterparts. This finding corroborates the growing international literature on this issue. An important policy implication is that giving preferential admission to students from rural areas in medical and nursing colleges might be an important strategy for improved recruitment of doctors and nurses to rural posts.

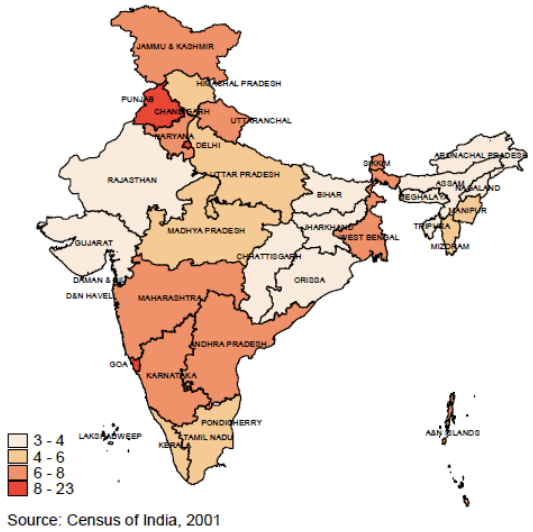
The findings from this DCE provide useful policy guidance on how to better incentivize rural recruitment of health workers. In India's context, it appears that incentivizing medical graduates to serve in rural areas is challenging. Consequently, the potential of nurse-practitioners or other types of non-physician clinicians needs to be explored. Better salary, good facility infrastructure, and reserving seats for higher education appear to be the most effective drivers of uptake of rural posts. Combining these incentives can provide a powerful way to increase rural recruitment of doctors and nurses. Common interventions implemented in states across India to improve the attractiveness of rural service such as providing better housing or simply posting health workers in their native areas, while important, do not appear to be effective. Finally, increasing the enrolment of medical and nursing students from rural backgrounds could lead to greater rural recruitment.

INTRODUCTION

The geographic maldistribution of health workers in India severely constrains the health system's ability to deliver adequate and quality services to many regions of the country. This also significantly impedes India's efforts to achieve universal health care. States with poorer health have fewer health workers. Across states, health workers in both the public and private sectors are concentrated in urban areas even though about two-thirds of Indians live in rural areas. One study estimates that over 80 percent of the qualified private provider market is concentrated in urban areas (WHO 2007). While the public sector has made considerable efforts to place qualified health workers in rural locations, the reluctance of key health workers like doctors and nurses to serve in such areas, in addition to issues like absenteeism, have compromised this effort. The presence of few qualified medical professionals in rural India has resulted in the majority of rural households receiving care from private providers, many of whom have little or no formal qualification to practice medicine (WHO 2007).

THE HEALTH WORKFORCE, ITS DISTRIBUTION, AND GOVERNMENT INITIATIVES

Figure 1. Doctor Density (per 10,000 population)

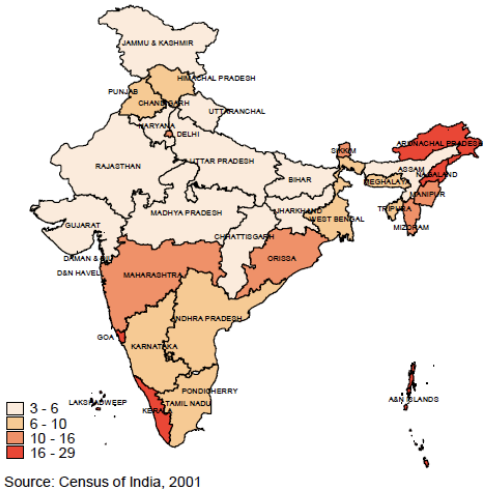


Source: Census of India, 2001

India's health workforce is characterized by a diversity of health workers offering health services in various systems of medicine. According to the National Occupation Classification (NOC), providers of allopathic health services broadly include doctors (general, specialists, and dentists), nurses, midwives, pharmacists, technicians, optometrists, physiotherapists, nutritionists and a range of administrative and support staff. Physicians and surgeons trained in Indian systems of medicine — Ayurveda, Yoga, Unani, Sidha, and Homeopathy — collectively known as AYUSH, are also important health care providers and operate in both

the public and private sectors. In addition, a substantial number of community health workers have recently been inducted into the workforce. Finally, a number of unqualified providers also provide clinical care, particularly in rural areas (Rao et al. 2011).

Figure 2. Nurse and Midwife Density (per 10,000 population)



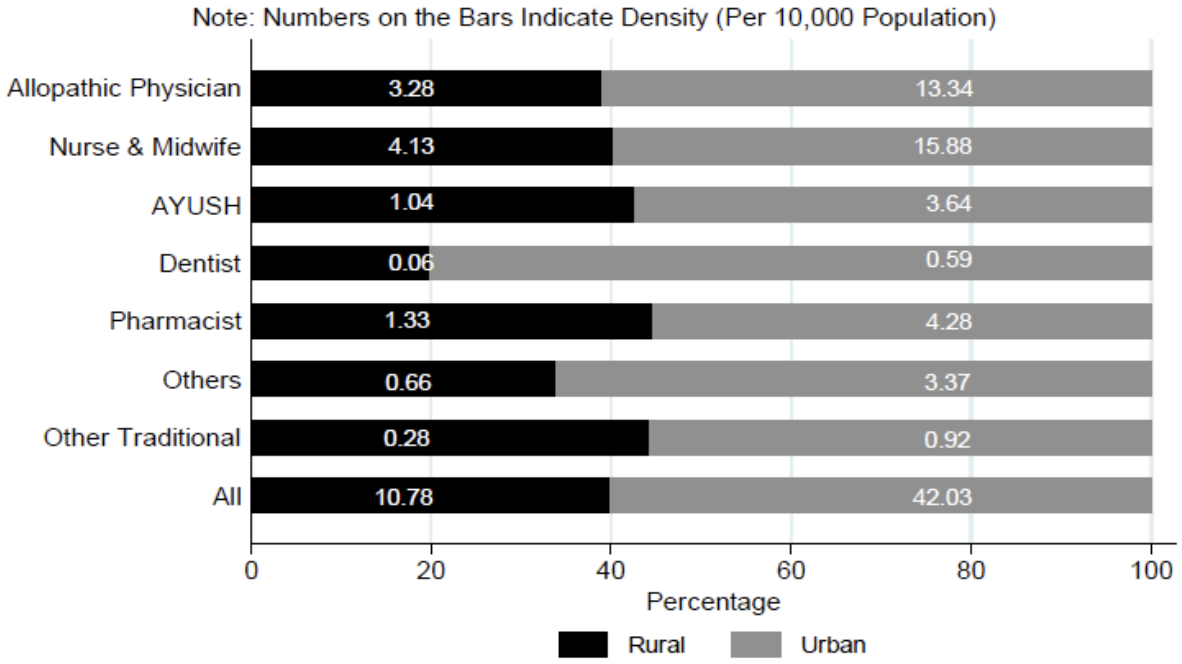
Source: Census of India, 2001

Figures 1 and 2 show the health workforce distribution across states of India. In general, states in the central region of the country, which tend to be poorer both economically and in health, have fewer health workers for a given population. The southern states tend to have a higher concentration of health workers and better population health. In general, these patterns follow the distribution of medical and nursing schools, suggesting that this maldistribution in partly due to inadequate production. The five southwestern states of Andhra Pradesh, Maharashtra, Karnataka, Kerala, and Tamil Nadu (with 31 percent of the country's population) account for 58 percent of medical colleges in India, both public and private. The four poor health states — Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh with 36 percent of the country's population, account for only 15 percent of the medical colleges (MCI 2011). The four southern states (Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu) have 63 percent of the General Nurse and Midwifery (GNM) nursing colleges in the country, 95 percent of which are private, with the remaining unevenly distributed across the rest of the country (TNAI 2006). States like Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh have nurse densities lower than the national average, and account for only 9 percent of the nursing schools in the country.

India faces several challenges in attracting qualified health workers to rural, remote, and underserved areas (figure 3). Almost 60 percent of health workers reside in urban areas (Rao, Bhatnagar, and Berman 2009). This maldistribution is substantially exacerbated when adjusted for the larger share (around 74 percent) of the population in rural areas. The density of health workers in urban is nearly four times that of rural areas (42 versus 11.8 per 10,000 population). The density of allopathic doctors is four times larger in urban compared to rural areas (13.3 versus 3.9), and for

nurses and midwives, the difference is three times as large (15.9 versus 4.1). AYUSH physicians also have a stronger presence in urban compared to rural areas (3. 6 versus 1.0). Health facilities, particularly those at the periphery, generally experience vacancies of key staff, which compromises their performance.

Figure 3. Urban Rural Distribution of Health Workers



Source: Census of India 2001

Others = Dietician & Nutritionist, Opticians, Dental Assistant, Physiotherapist, Medical Assistant & Technician and Other Hospital Staff; Other Traditional = Traditional Medicine Practitioner, Faith Healer

In India's constitutional framework, since health is under state as opposed to federal jurisdiction, different states have responded in different ways to this well-recognized problem in the distribution of human resources. One set of strategies simply involves increasing production capacity by building more medical and nursing schools. In some other states, rural service is compulsory after completing medical school. However, it is unlikely that either addressing supply-side issues or compulsion will improve the rural-urban maldistribution in the long term. Several states have also followed strategies that incentivize health workers to serve in rural areas (box 1). These include providing educational incentives for doctors and monetary compensation for rural service, and

direct recruiting by the state health department of health workers to rural posts. However, there is no policy of recruiting students from rural areas given their potential for greater retention.

Evidence suggests that both pecuniary and nonpecuniary incentives play a part in where health workers choose to serve. Salary is an important determinant of employment choice as various studies have shown (Scott 2001; Serneels et al. 2010; Blaauw et al. 2010; Kruk et al. 2010; Kolstad 2011). Nonsalary incentives are also important (Ubach and Scott 2007; Blaauw et al. 2010; Kruk et al. 2010; Kolstad 2011), and some of them relate to the improvement of living conditions, better educational opportunities for children, training, and better future career prospects. Clearly, any government policy to encourage health workers toward rural service would require offering a package of salary and nonsalary incentives.

Box 1. Some Current Strategies to Increase Availability of Health Workers in Rural Areas

Compulsory rural service	Several states like Meghalaya require graduating medical students to serve one or more years in a rural post. Other states have introduced mandatory rural service for doctors as a precondition for admission to postgraduate specialization programs.
Educational incentives	Compulsory rural service bonds have been introduced by some states (for example, Tamil Nadu and Kerala for specialist doctors) in exchange for subsidized government-provided medical education. Other states like Tamil Nadu, Gujarat, and Andhra Pradesh reserve postgraduate seats or provide additional marks on the postgraduate examination for those who have completed a certain number of years of rural service.
Monetary incentives for difficult areas	Almost all states in India offer higher salary for public sector medical officers serving in rural, tribal, or remote areas, though the amount of the incentive varies across states. For example, in the state of Karnataka, Medical Officers receive Rs 5,000 to 8,000/month and staff nurses Rs 3,000 to 4,500/month for serving in a rural or remote area.

OBJECTIVES OF THIS STUDY

The need to create the right conditions to attract and retain health workers in underserved areas is well recognized by state health departments across India, and many of them offer a range of incentives to improve rural recruitment and retention. However, current approaches to this problem have several limitations. First, they haven't evolved from any systematic assessment of health worker needs but rather from a bureaucratic understanding of the issue. This does not mean that the

strategies that have emerged are necessarily ineffective; however, it does keep the door wide open for a range of alternative approaches to the problem. Second, there is little evidence on how well current strategies work since there have been few assessments of their implementation. Third, current strategies typically focus on single incentives (for example, salary), which again highlight the myopic approach to this problem. Finally, most current incentives in India target doctors; understanding of the concerns of other cadres (like nurses) is insufficient.

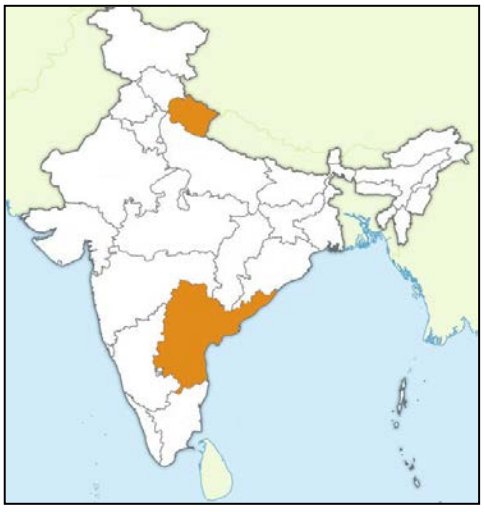
In an earlier study we explored and identified job attributes important to trainee (medical and nursing students) and in-service (doctors and nurses) health workers at primary health care facilities. This study attempts to quantify the relative effect of different job attributes on health worker job choices using a Discrete Choice Experiment methodology. The specific objectives of this study are the following:

1. Examine the effect of monetary and nonmonetary job attributes on worker job choices.
2. Develop incentive packages based on different combinations of monetary and nonmonetary job attributes with a focus on jobs in rural areas.
3. Estimate the cost-effectiveness of these incentive packages.

Ethical approval for the study was obtained from the Ethical Review Committee of the Public Health Foundation of India. Funding for the study was from the World Bank.

THE STUDY STATES: ANDHRA PRADESH AND UTTARAKHAND

Figure 4. Andhra Pradesh and Uttarakhand



This study was conducted in two states of India — Andhra Pradesh and Uttarakhand. These states were purposively chosen because of the diversity they represented in terms of their geography, terrain, size, and capacity to produce doctors and nurses.

The state of Andhra Pradesh, in southeastern India, is the country's fifth largest state and has a population of 76

million. The state is located on a low plateau with its eastern parts bordering the Bay of Bengal. Large rivers such as the Godavari and Krishna flow through the fertile plains of the coastal districts of the state. The state has 23 districts and is divided into three regions: Telangana, comprising ten districts in the north and west of the state; coastal Andhra Pradesh consisting of seven districts in the northern part of the coast; and Rayalseema, which comprises six districts in the south. These regions vary widely in their social, economic, and political characteristics. Andhra Pradesh has 36 medical colleges and 206 nursing colleges.[1]

Box 2. Postgraduate (PG) Seat Reservation Scheme in Andhra Pradesh

The state of Andhra Pradesh has been incentivizing government service through its Postgraduate (PG) Reservation Scheme for a long time. This scheme takes advantage of the strong desire among medical graduates to gain specialist training.

50 percent of the PG seats in preclinical (anatomy, physiology, and biochemistry) and paraclinical (pathology, pharmacology, microbiology, and forensic medicine) specialties and 30 percent of seats in clinical specialties (including medicine, surgery, gynecology, and pediatrics) are reserved for candidates serving in the public sector. To be eligible for this scheme, a doctor serving in the public sector currently has to complete two years of service in a tribal area, three years in a rural area, or five years in an urban area. Eligible Medical Officers take the PG entrance examination, a requirement for all aspirants, but only compete among themselves for the reserved seats. Students using the in-service quota currently have to sign a bond of 20 lakh rupees (approximately $45,000) to serve the state government for five years after completing their PG education.

The increased competition for PG seats has enhanced the popularity of this scheme over the past few years with the number of in-service candidates applying to take the examination increasing from 670 in 2007 to 1,495 in 2010. The state has very few Medical Officer vacancies in PHCs.

Source: Z. Shroff, S. Murthy, and K. D. Rao. *Attracting Doctors to Rural Areas: A Case Study of the Post Graduate Reservation Scheme in Andhra Pradesh*.

Uttarakhand in northern India is a relatively small state and has a population of about eight million. The state comprises a narrow strip of plains and a mountainous zone that includes the middle and high Himalayas. Uttarakhand has 13 districts spread over the two divisions of Garhwal and Kumaon. Currently, there are no public medical or nursing colleges in the state (though in 2010 two government nursing colleges and a government medical school were established).

1. From NTR University of Health Sciences, Andhra Pradesh data.

METHODS

THE DISCRETE CHOICE EXPERIMENT (DCE) METHODOLOGY

The Discrete Choice Experiment (DCE) method is a quantitative technique that elicits stated preferences of individuals (Mangham et al. 2009). This technique helps to uncover how individuals value particular attributes of a program, product, or job by asking them to state their preferred choice over hypothetical alternatives. DCEs have been widely used for health policy, planning, and resource allocation decisions in high-income settings (Mangham et al. 2009). Recently, the technique has been applied to the retention of rural health workers in developing countries (Blaauw et al. 2010; Kruk et al. 2010; Kolstad 2011; Ryan et al. forthcoming).

The DCE technique has some advantages over traditional survey methods — first, it provides a quantitative estimate of how health workers value different job attributes (Vujicic et al. 2010); second, it allows for several job attributes to be compared against each other simultaneously; and third, the survey is fairly straightforward for health workers as the choices closely resemble real-world decisions (Lagarde and Blaauw 2009). Combined with cost, a DCE provides policy makers with estimates of the cost-effectiveness of alternative policy options.

One challenge of the DCE is that it relies on stated and not actual or revealed choices; actual behavior can be different from stated behavior (Lagarde and Blaauw 2009). The number of job attributes and levels within each attribute is limited. This forces the researcher to carefully narrow down job attributes and attribute levels. Further, the analysis of DCE data requires a good understanding of econometric techniques. Lagarde and Blaauw (2009) provide a more detailed discussion of the benefits and shortcomings of using the DCE technique to elicit health worker preferences in developing countries.

THEORY

The DCE methodology is based on utility maximization among health workers. In the random utility framework, which is the basis of DCEs, a health worker n is assumed to choose among J alternative jobs. He or she will choose the job that has the highest satisfaction or utility level (U)

(Vujicic et al. 2010). Therefore, individual *n* will choose job *i* if and only if the following holds true:

$$U_{ni} > U_{nj} \qquad \forall i \neq j \in J$$

The random utility framework assumes that the utility of a given job has two components — deterministic and random. The deterministic component V_{ni} is a function of *m* observable job attributes ($x_1 \ldots x_m$) — for example, pay, working conditions, location — each of which is valued at a certain "weight" ($\beta_1 \ldots \beta_m$). The random component ε_{ni} is determined by unobserved job attributes in addition to individual-level preference variation (Vujicic et al. 2010).

$$U_{ni} = V_{ni} + \varepsilon_{ni}$$
$$V_{ni} = \alpha_1 + \beta_1 x_{1ni} + \beta_2 x_{2ni} + \ldots + \beta_m x_{mni} \qquad (1)$$

The utility of a job is not directly observed, implying that coefficients in equation (1) cannot be directly estimated (Vujicic et al. 2010). In the DCE methodology, jobs individuals choose are observed along with all other jobs they do not choose. Therefore, when an individual *n* is asked to choose between two jobs, the probability he or she chooses job *i* over job *j* can be written as the following (Vujicic et al. 2010):

$$P_{ni} = \Pr[U_{ni} > U_{nj}] \qquad \forall i \neq j \in J$$
$$P_{ni} = \Pr[V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj}] \quad \forall i \neq j \in J$$
$$P_{ni} = \Pr[\varepsilon_{ni} - \varepsilon_{nj} > V_{nj} - V_{ij}] \quad \forall i \neq j \in J \qquad (2)$$

By making various assumptions on e_{ni} (most commonly that it is independent and identically distributed), equation (2) can be estimated using standard econometric techniques, giving estimates of $\alpha_1, \beta_1 \ldots \beta_m$. It should be noted that an underlying assumption of these models is that individuals have a complete ranking of employment opportunities that is determined by their preferences for the varying job attributes.

QUALITATIVE PHASE: SELECTING ATTRIBUTES FOR THE DCE

Between January and June 2010, a qualitative study was conducted to inform the design of the DCE (Rao et al. 2010). This study was done in two Indian states, Uttarakhand and Andhra Pradesh. A total of 80 in-depth interviews were conducted with a variety of participants — medical students (allopathic and AYUSH), nursing students, and doctors and nurses working at PHCs.

This study showed that while financial and personal development incentives were considered important, these were not adequate to attract doctors to rural settings. Frustration among rural health workers often stemmed from the lack of infrastructure, support-staff, and drugs. Mundane issues such as lack of water, electricity, and transport increased dissatisfaction. In general, medical students and in-service doctors felt strongly against the rural context (poor housing, schooling, social life) as well as some organizational aspects of rural jobs (limits in career growth, poor management, political interference in the job). Further, there was a strong preference among doctors and medical students to become specialists. Nurses expressed similar concerns as MBBS doctors; however a government job was held in high esteem. In general, students from private colleges were less inclined toward rural jobs.

Box 3. What Is rural?

One of the important findings from this study was that the word "rural" was not necessarily associated with hardship. For most health workers, postings in rural areas but within a reasonable commute to an urban setting were much sought after. Postings in rural areas that were not well connected, lacking education facilities for children, and with poor living conditions in terms of housing, drinking water, and electricity were undesirable postings. When health workers spoke of rural areas they meant places lacking these desirable attributes. This highlights the importance of describing location in terms of such attributes and we have incorporated this when defining levels of location attributes for the discrete choice experiment.

Source: Rao and others, 2010.

Considering these differences and the diversity of attributes, selecting the final attributes of the DCE was a challenging task. Attributes were clustered together after a series of deliberations within the team. Based on the frequency with which attributes were cited in health worker interviews and on information from policy-maker ratings on how *actionable* an attribute was felt to be, eight attributes were finally identified (table 1).

In the attribute list (table 1), we have deliberately refrained from specifying “rural” or “urban” as a job attribute because these could mean different things to different people (box 3). For example, a rural health center within an hour’s commute from an urban center might not be considered rural by all respondents.

Table 1. Discrete Choice Experiment Attributes

	Attribute	Levels
1	Type of health center	1. Clinic 2. 20–30 bed hospital 3. 50–100 bed hospital
2	Area	1. Located in a well-connected place, having good education facilities for children and good quality housing provided 2. Located in a well-connected place, having good education facilities for children but poor quality housing provided 3. Located in a poorly connected place with bad education facility for children but good housing provided 4. Located in a poorly connected place with bad education facility for children and poor housing
3	Health center infrastructure	1. Well-maintained building, adequately equipped with few shortages of supplies and drugs 2. Building in poor condition, inadequate equipment, and frequent shortages of supplies and drugs
4	Staff	1. Fully staffed and moderate workload 2. Few staff and heavy workload
5	Salary (including allowances, Rs/month)	Doctors: 30,000, 45,000, 65,000, 80,000 Nurses: 10,000,15,000, 25,000, 30,000
6	Change in location to city/town	1. On completion of 3 years 2. Uncertain
7	Professional development	1. Short duration training courses for skill development 2. Easier admission to PG after 3 years of service in same job through reservation/quota
8	Job location	1. The job is located in your native area 2. The job is not located in your native area

Source: Rao and others. 2010.

To give a sense of where the job is located, we defined the location in terms of housing and educational facilities for children and whether the area was well connected or not (see attribute 2). We also avoided using the terms “government” or “private” job.

Type of health center was added to the attribute list because health workers viewed a job in a clinic differently from one in a hospital. The three types of health facilities represent the generic type of public sector health facilities in rural areas, but they are easily translatable into the types of health facilities in a private setting.

For the *area* attribute, three subattributes were used to define the location of the job: connectivity (in terms of transport), housing available to health workers, and educational facilities available to children of health workers. Each of these three subattributes had two levels (good and poor). We arrived at the four levels by looking at all possible combinations of these three subattributes and identifying those combinations that were plausible. In addition, we assumed that places with good connectivity would also have good educational facilities for children in the sense that children of health workers would be able to travel to a good school even if one were not locally available. This also implies that areas with poor connectivity would have poor educational facilities for children. In effect, this reduces the number of subattributes to two because good education and good connectivity always occur together.

The *health center infrastructure* attribute has two subattributes, which define the condition of infrastructure: building maintenance, adequacy of equipment and availability of drugs and supplies. This attribute has two levels — facility infrastructure was “good” when all three subattributes were positive and “poor when all three were negative. In effect, the same levels of these three subattributes occur together.

The *staff* attribute is defined by two subattributes: adequacy of staff and workload. Two levels define this attribute — fully staffed facilities and moderate workload, and few staff and heavy workload.

The *salary* attribute levels are derived from responses in the qualitative interviews. Respondents were asked about the importance of salary in deciding on a job and how much they would require to take up rural posts. The range of reported salary levels was considered in determining the minimum and maximum salary levels for this attribute. Identifying salary levels of health workers was problematic because of the different types of health workers involved in the study. For example, there was little overlap between the salary levels of nurses and doctors. This required specifying separate salary levels for health worker types.

The *change in location to city/town* attribute had two levels: transfer after three years of service in the current post, and no specific time for transfer ("uncertain"). The latter represents current service rules in public health sector jobs.

The *professional development* attribute had two levels: short training courses offered as part of in-service training, and reservation for postgraduate studies after completion of three years of service. The latter is what some states typically offer to incentivize rural service.

The *job location* attribute had two levels: the job posting is in an area (village, district, town) where the respondent grew up or belongs (that is, native area), and job posting is in a nonnative area.

FROM JOB ATTRIBUTES TO DCE CHOICE SETS AND QUESTIONNAIRE DEVELOPMENT

Since there are eight attributes, five of them having 2 levels, one having 3 levels, and two having 4 levels; the total number of possible unique jobs that can be derived from different combination of these attributes is 1,536 ($2^5*3^1*4^2$) jobs. To limit the number of job choices to 16 (which is generally the convention for DCE studies), a statistically efficient fractional factorial design was used. Within the DCE experimental design literature, statistical efficiency has been defined in terms of *D*-efficiency, which can be interpreted as minimizing the determinant of the covariance matrix. This ensures minimum variation around the parameter estimates by minimizing the estimated standard errors. SAS software was used to generate the design (Kuhfeld 2010; http://support.sas.com/documentation/index.html).

A sample choice set for students and in-service respondents is presented in table 2. The first example in the table represents the type of choice sets presented to students, and the second one to in-service respondents. Respondents were asked two questions about each choice set they viewed — first, which of the two jobs they preferred, and second, would they accept this job if it were offered to them. This opt-out option took the form of "Will you accept this job if it is offered to you?" for students, and "Will you accept this job in preference to your current job" for in-service respondents.

In addition to the 16 choice sets, additional choices were included**:** (a) Dominance tests – two choice sets inserted between the 16 pairs that served as a test of rationality. In these choice sets, one job dominated the other in terms of all attributes;[2] and (b) Predictive accuracy — two additional "hold-out" choice sets were added at the end of the questionnaire that would serve to test the predictive accuracy of the model.

Respondent characteristics and attitudes toward rural service: The questionnaire also collected information from respondents on (a) general background and demographic characteristics including variables such as age, sex, and marital status; (b) socioeconomic status, including family occupation as well as possession of a list of assets; (c) workplace characteristics, including type of employment (permanent or contractual), location of health facility (town or village), and official designation; and (d) attitudes toward work and rural service. The latter is important because attitudes toward rural life often play an important role in whether health workers are agreeable to take up jobs in rural areas. This was gauged from the intensity of responses to a series of statements about work and life in rural areas. Respondents were asked whether they strongly disagreed, disagreed, agreed, or strongly agreed with each of the statements. The scale items for measuring attitudes were developed by the study investigators.

2. For the attributes "place of work" and "location of job," no level was consistently considered to be dominant over the other, and hence, for the rationality test, the level of these two attributes was kept the same in job 1 and job 2.

Table 2. Sample Choice Set for Students and In-service Respondents

CHOICE SET 1: WHICH OF THESE TWO JOBS DO YOU PREFER?

	JOB 1	JOB 2
Place of work	50-100 bed hospital	20-30 bed hospital
Area	Place is well connected Has good education facilities for children Good housing provided	Place is poorly connected Has poor education facilities for children Poor housing provided
Infrastructure at the place of work	Building in poor condition Inadequate equipment Frequent shortages of supplies and drugs	Building in good condition Adequate equipment No shortages of supplies and drugs
Staff	Fully staffed and moderate workload	Few staff and heavy workload
Salary (with allowances)	80,000 per month	45,000 per month
Change in job location closer to a town/city	On completion of 3 years	On completion of 3 years
Further education	Only short term training programmes to upgrade skills	Easier admission to PG after 3 years of this job through quota
Location of job	Your job is in your native area	Your job is not in your native area

Which of these two jobs do you prefer? **Job 1** ☐ **Job 2** ☐

Would you accept this job if it is offered to you? **Yes** ☐ **No** ☐

CHOICE SET 1: WHICH OF THESE TWO JOBS DO YOU PREFER?

	JOB 1	JOB 2
Place of work	50-100 bed hospital	20-30 bed hospital
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Change in job location closer to a town/city	On completion of 3 years	On completion of 3 years
Further education	Only short term training programmes to upgrade skills	Easier admission to PG after 3 years of this job through quota
Location of job	Your job is in your native area	Your job is not in your native area

Which of these two jobs do you prefer? **Job 1** ☐ **Job 2** ☐

Would you accept this job in preference to your current job? **Yes** ☐ **No** ☐

TRANSLATIONS INTO LOCAL LANGUAGES, PILOT TESTING, AND REVISIONS

Four slightly different questionnaires were designed for in-service doctors, in-service nurses, medical students, and nursing students to account for differences in the levels of salary and current employment status. The first draft of the English questionnaire was pilot tested at the All India Institute of Medical Sciences (AIIMS) in New Delhi. One important finding that surfaced from this pilot was that respondents should be given a sheet of attributes to familiarize themselves with before taking the actual questionnaire

As our study states were Andhra Pradesh and Uttarakhand (see section on Sampling), a second pilot was done at the local level in these two states. While the English questionnaire was used for medical students and doctors, the questionnaire was translated into the local language (Telugu in Andhra Pradesh and Hindi in Uttarakhand) for student and in-service nurses. The questionnaire was back-translated into English to ensure correctness of the translation.

SAMPLING

A team of seven investigators was involved in collecting data. At the outset, the DCE methodology was explained to the respondents using an "attribute sheet" before asking them to complete the questionnaire. The questionnaire was administered in a classroom-like setting. Each completed questionnaire was checked for errors and completeness by the study investigators. In particular, respondents were questioned about any inconsistent responses to the two rationality choice sets in the questionnaire. When an adequate explanation was not forthcoming, respondents were asked to redo the questionnaire. In some instances, respondents were able to justify their irrational preferences by claiming a preference for low pay and hardworking conditions.

Andhra Pradesh: The target sample (size) was final-year undergraduate medical students (150), final-year GNM nursing students (150), in-service doctors (150), and nurses (150) working at PHCs. The target sample size was achieved in all categories (table 3).

The selection of medical and nursing school students was a two-step process — first, medical and nursing schools were purposively selected, followed by the purposive sampling of medical and nursing students. One medical and nursing school was selected from each of the three regions (Telengana, Rayalseema, and coastal Andhra Pradesh) of the state in such a manner that the aggregate sample of colleges had representation from public and private colleges, urban and rural locations, and a range of academic reputations. Students in their final year — fourth year MBBS students and second year GNM nursing students — were invited to participate in the study. Among medical students willing to participate, an equal number of male and female students were administered the questionnaire.

Table 3. Sampled Respondents and Institutions

	Andhra Pradesh			Uttarakhand			Total
	Public	Private	Total	Public	Private	Total	
Schools							
Medical	3	1	4	n.a.	n.a.	n.a.	4
Nursing (GNM)	2	2	4	n.a.	n.a.	n.a.	4
Total (schools)	5	3	8	n.a.	n.a.	n.a.	8
Students							
Medical	112	51	163 (150)	n.a.	n.a.	n.a.	163
Nursing (GNM)	82	63	145 (150)	n.a.	n.a.	n.a.	145
Total (students)	194	114	308 (300)	n.a.	n.a.	n.a.	308
In-service							
Doctors	154	n.a.	154 (150)	68	n.a.	68 (150)	222
Nurses	187	n.a.	187 (150)	51	n.a.	51 (150)	238
Total (in-service)	341	n.a.	341(300)	119	n.a.	119 (300)	460

Note: Target sample size is in parentheses; n.a. = not available.

To select in-service doctors and nurses employed at PHCs, one district from each of the three regions (Telengana, Rayalseema, and coastal Andhra Pradesh) was randomly selected. For in-service doctors and nurses, all candidates from the selected districts who were working in PHCs and had completed their MBBS or GNM degrees were invited to participate in the study. To minimize disturbance to the normal functioning of health services in the district, we administered the

questionnaire on the day of the monthly meeting between medical officers in the district and the Chief Medical Officer. The target sample size of 150 doctors and nurses was achieved.

Uttarakhand: At the time this study was conducted in 2010, the state of Uttarakhand had just established two nursing colleges and one medical college. Consequently, there were no final year medical or nursing students in the state. For this reason no medical or nursing students were sampled in this state.

In-service doctors and nurses working at PHCs were selected as follows. First, a listing was made of the number of sanctioned posts for doctors and nurses in each district of the state. Because the state does not generally post nurses at PHCs, we included nurses posted at Community Health Centers (that is, sub-district hospitals) in the sample. Six districts that had the largest number of sanctioned posts for Medical Officers were selected so that the Medical Officers were from the two regions of the state and included both the plain and the hilly areas of the state.

The total target sample size was 300 — allopathic doctors with an MBBS degree (150) and nurses working at primary and community health centers (150). We achieved a sample size of 119, including 68 doctors and 51 nurses (table 3). The paucity of in-service doctors and nurses in Uttarakhand was the main reason for not achieving sample size. While several sanctioned posts exist, many of these are not filled currently. All candidates from the selected districts who were working in government PHCs and who had completed their MBBS or GNM degrees were invited to participate in the study. To minimize disturbance to the normal functioning of the PHCs in the district, we administered the questionnaire on the day of the monthly meeting between Medical Officers and the Chief Medical Officer of the district.

Study sample: The student questionnaire was administered to 308 medical and nursing students in Andhra Pradesh. The in-service questionnaire was admitted to 460 doctors and nurses in Andhra Pradesh and Uttarakhand.

DATA ANALYSIS

Data collected from the field survey was cleaned and double entered into a CSPro version 4.1 (US Census Bureau) database. A preliminary examination of the data indicated some classification errors, which were corrected. All analysis was stratified by students, in-service respondents, doctors, and nurses.

Each of the two dominance tests consisted of a pair of job choices, one of which would be clearly preferred by a rational decision maker. Individuals who "failed" both were dropped from the regression analysis.

Bivariate probit and mixed logit models were used for the main regression analysis for students and for in-service doctors and nurses, respectively; both the coefficients for attribute levels as well as probability of choosing a job with a given attribute level were estimated (tables 7, 8, 10, and 11).

The predictive accuracy of the model was tested using two "holdout" choice sets (tables 9, 12). Details on the models and use of holdouts are given below.

Data collected on attitudes to rural service were used to construct an index of urban preference (table 5). This index was then regressed on background socio-demographic variables to examine for the determinants of this urban preference (table 13). In addition, subgroup analysis was performed to examine the effect of rural background on uptake of jobs for each category of respondent (table 14). Finally, cost-effectiveness analysis was performed (figures 5 and 6); details on the methodology followed are presented in annex 2.

Regression methods: In this study, medical and nursing students and in-service doctors and nurses chose between two jobs. However, different analytical methods were used for these two groups — for the student group we used bivariate probit regression and for the in-service group, mixed logit regression. Different methods were used because of the manner in which the "opt-out" choice was incorporated in the regression analysis. Both students and in-service respondents were first asked to choose between two jobs (Job A or Job B), after which, they answered the "opt-out" choice —

students indicated if they would accept the chosen job if it were offered to them, and in-service respondents indicated if they would accept the chosen job over their current job. Incorporating the opt-out option, rather than limiting the analysis to forced choices (that is, Job A or Job B), in the analysis presents a more realistic model of the choices made by the respondents. For in-service respondents, job characteristics of their current job were collected, enabling the choice problem to be framed as a choice between three jobs — Job A, Job B, and Job C (current job) — which lends itself well to a mixed logit regression framework. Since there was no information on job characteristics related to the opt-out option for students, bivariate probit regression was used to model the two related decisions — choice between Job A and Job B, and acceptance of selected job. These methods are discussed in more detail below. All analysis was done using Stata v.10 (StataCorpLP, College Station, Texas, USA).

Bivariate probit: Medical and nursing students were first asked to choose between the two job choices (Job A or B) presented. After this, they were asked if they would accept the selected job if it were offered to them. To predict job uptake given its attribute profile, it becomes necessary to model both decisions — the choice between Job A and B, and the choice of accepting this selection if it is offered. The bivariate probit model offers a way of modeling the joint probability of these choices. If X is the vector of job attributes, then it is of interest to estimate the conditional probability $Pr\,(Y_2 = 1 | Y_1 = 1, X_1)$:

$Y_{1i} = X_{1i} + u_{1i}$, where $Y_{1i} = 1$ indexes if person i selects Job A or Job B, otherwise 0 …..(3)

$Y_{2i} = X_{2i} + u_{2i}$, where $Y_{2i} = 1$ indexes if the job selected in (3) is accepted, 0 otherwise …..(4)

and Cov ($u_{1i,}$ u_{2i}) $\neq 0$.

Mixed logit: In-service respondents were first asked to choose between two jobs: Job A or Job B. Second, they were asked whether they would accept the preferred choice over their current job. Further, they were asked to describe their current job in terms of the attributes and levels of the DCE. Consequently, the in-service choice set can be viewed as choosing between three jobs (Hensher and Greene 2001). Mixed logit regression was used to estimate equation (2). This model is being increasingly used in the health economics literature and was applied in two recent

applications of DCE to health worker decisions (Kruk et al. 2010; Blaauw et al. 2010). The regression model coefficients are assumed to be normally distributed, and unobserved heterogeneity is modeled.

Using the mixed logit model, the proportion of health workers that would choose job *i* over all other jobs that are available to them is given by equation (5).

$$P_i = \frac{e^{\alpha_1 + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_m x_{mi}}}{\sum_J e^{\alpha_1 + \beta_1 x_{1j} + \beta_2 x_{2j} + \ldots + \beta_m x_{mj}}} \qquad \forall i, j \in J \tag{5}$$

Equation (5) can then be used to carry out various policy simulations. For example, the proportion of health workers willing to accept a job in a rural area can be estimated for alternative incentive packages offered in rural areas. These types of simulations are useful to policy makers as they show the predicted impact on health worker decisions of alternative levels of job attributes, that is, alternative jobs offered. Furthermore, when cost data are available, these data can be used to estimate the cost-benefit ratios of alternative jobs.

Prediction: The holdout choice sets were used to assess the predictive ability of the statistical model. These contained the full set of attributes, and the attribute levels were within the range used in the other choice sets. However, these two choice sets were unique in terms of the attribute-level combination. The holdout choice sets were not used in the main regression analysis. The accuracy of model prediction was assessed by comparing the distribution of job choice responses on the two holdout choice sets with the distribution predicted by the model (bivariate probit and mixed logit). Chi square tests of independence were applied to test for statistically significant differences between the two distributions.

RESULTS

Of the 308 medical and nursing students in Andhra Pradesh who took the questionnaire, a total of 15 respondents failed both the dominance test (that is, chose the nondominant option both times it

was presented in the questionnaire). While we note that there is no standard practice for dealing with dominance test failures, nevertheless, these respondents were dropped, reducing the sample size to a total of 293 (161 medical and 132 nursing) students. The in-service questionnaire was administered to 457 doctors and nurses in Andhra Pradesh and Uttarakhand. After retaining those observations in the sample that met the sample eligibility requirements (doctors and nurses working at PHCs in Andhra Pradesh and PHCs or CHCs in Uttarakhand), and dropping those that failed both the dominance tests (4) the final sample size was 434 (214 doctors and 220 nurses).

DESCRIPTIVE STATISTICS

Table 4 presents the characteristics of the full sample. Of the 163 medical students who participated almost half were male with a mean age of about 22 years. The 145 nursing students were overwhelmingly female and had a similar mean age. Only 13 percent of medical students had a rural background (that is, had grown up in a rural area) as opposed to 75 percent of nursing students. The majority of medical school students (69 percent) and about half the nursing students were studying at government institutions (table 4).

Table 4. Descriptive Statistics

	Students		In-service			
State	Andhra Pradesh		Andhra Pradesh		Uttarakhand	
Type	Medical	Nursing	Doctors	Nurses	Doctors	Nurses
Male (%)	49	5	68	1	90	10
Age (years)	21.9 (1.2)	20.5 (2.2)	35.8 (8.4)	33.2 (7.8)	36.7(6.6)	30.1(7.0)
Rural upbringing (%)	13	75	31	59	21	22
Public college (%)	69	57	67	85	90	22
Years of service	n.a.	n.a.	5.3 (4.7)	7.3 (7.0)	7.1(4.3)	4.6(5.4)
Sample size	163	145	154	184	68	51

Note: Figures in parentheses are standard deviations. Sample size is for full sample, that is, it includes dropped observations. n.a. = not applicable.

The majority of doctors in both states was male and had a similar average age. Over 31 percent of doctors in Andhra Pradesh and 21 percent in Uttarakhand had grown up in a rural area. The majority of doctors in both states had attended public medical colleges (67 percent in Andhra Pradesh, 90 percent in Uttarakhand) and had served for the same average duration as medical officers (that is, in government service) (table 4).

The overwhelming majority of nurses were female. Nurses tended to be younger, and a greater proportion had rural upbringing (in Andhra Pradesh) relative to doctors in both states. Interestingly, a larger proportion of nurses in Andhra Pradesh (59 percent) were from rural backgrounds compared to those from Uttarakhand (21.6 percent); in fact, a similar proportion of nurses and doctors in Uttarakhand have rural upbringing. While the majority of nurses in Andhra Pradesh (85 percent) had trained in government colleges, strikingly, the opposite was true in Uttarakhand (22 percent). This is expected because until recently there was no government nursing college in Uttarakhand. The mean duration of government service for the sample of nurses was similar in both states (table 4).

Attitudes toward rural life and service — Respondent attitudes toward work and rural service are presented in table 5. Respondents rated the items on a four-point scale — 1 (Strongly Disagree), 2 (Disagree), 3 (Agree), and 4 (Strongly Agree). Items 1 and 2 relate to attitudes toward work, and items 3 to 6 reflect attitudes toward rural living. The latter (items 3 to 6) were combined into an index — the Urban Preference Index. The index had fairly good internal consistency and reliability with Cronbach Alpha scores of 0.77 for student and 0.79 for in-service respondents. Adding item 2 to the index lowered its reliability and was therefore excluded from the index. In all cases, the mean scores range from 1 to 4, with higher scores representing (depending on the case), a positive attitude toward work, greater control over location of work, or preference for urban life.

The first item in the index measures commitment to work in a public sector environment where remuneration remains fixed irrespective of the number of patients seen. Medical students and in-service doctors were less inclined, relative to their nurse counterparts, to take on additional work without being compensated (item 1). They also wanted more control over where they were posted,

if they were placed in a rural area. Finally, medical students and in-service doctors perceived working and living in rural areas to be less satisfactory relative to nurses. This is reflected both in the individual items (3, 4, 5, and 6) and in the composite Urban Preference Index.

Table 5. Attitudes toward Work and Rural Areas (Mean Scores Ranging from 1 to 4)

Item	Students		In-service	
	Medical	Nursing	Doctors	Nurses
1. Doctors/nurses must stay at the health facility until all the patients are seen, even if they are not paid extra	2.92	3.20	3.05	3.22
2. If I have to work in a rural area, it is important to me to be able to choose the location of my job	3.51	3.15	3.25	3.02
3. Living in a rural area is generally difficult	2.89	2.28	3.10	2.61
4. The social life in rural areas is not satisfactory	2.66	2.29	2.91	2.60
5. Bringing up children in rural areas is difficult	3.17	2.34	3.27	2.62
6. Living in an urban area is more satisfactory overall than living in a rural area	3.11	2.66	3.10	2.96
Urban Preference Index (item 3, 4, 5, 6)	2.95 (0.543)	2.39 (0.790)	3.09 (0.594)	2.70 (0.0691)

Note: Responses to items were on a four point scale: 1 (Strongly Disagree), 2 (Disagree), 3 (Agree), and 4 (Strongly Agree); figures in parentheses are mean standard deviations.

Distribution of job choices — Table 6 shows the distribution of student and in-service worker responses to the job choices presented. In both the student and in-service questionnaire, respondents indicated if they would accept the job (Job A or B) they chose if it were offered to them.

Table 6. Distribution of Responses to Job Choices

	Students				In-service health workers			
Choice set	Number of respondents	Selected Job A	Selected Job B	Did not accept selected Job	Number of respondents	Selected Job A	Selected Job B	Selected current job
1	291	175	75	41	432	245	113	74
2	291	160	68	63	434	227	99	108
3	291	243	14	34	433	357	20	56
4	291	133	77	81	432	203	119	110
5	291	21	209	61	434	46	268	120
6	291	282	5	4	434	399	1	34
7	291	225	26	40	434	336	39	59
8	291	50	133	108	433	72	223	138
9	291	197	21	73	434	340	16	78
10	291	166	61	64	433	257	78	98
11	291	69	106	116	432	93	176	163
12	291	86	142	63	433	139	188	106
13	291	92	98	101	434	119	153	162
14	291	268	0	23	434	381	3	50
15	291	43	151	97	433	51	246	136
16	291	129	102	60	434	237	91	106
17	291	147	59	85	433	224	94	115
18	291	251	19	21	432	356	18	58
19	291	194	37	60	434	319	41	74
20	291	81	139	71	433	120	207	106
Total	5,820	3,012	1,542	1266	8,665	4,521	2,193	1,951

MEDICAL AND NURSING STUDENTS

Table 7 presents results from the bivariate probit regressions on medical and nursing students. In these regressions, the rho statistic measuring the correlation between the two regression equations is statistically significant, indicating that the two equations — choosing job A or B and accepting the selected job — are not independent of each other. The reference group or base for both regressions for a given level of salary (Rs 30,000 for doctors and Rs 10,000 for nurses) is a job with the following characteristics: the job is in a clinic; the location is an area with poor connectivity, poor education facilities for children, and poor housing; the clinic has poor infrastructure; the clinic is

poorly staffed and the workload is high; transfer is uncertain; there is no higher education reservation for in-service staff; and the job is not located in the native area of the respondent. At the base level, this corresponds to a government job in a rural or remote area.

Among medical student respondents **a job in a hospital** (relative to a job in a PHC) did not have a significant effect on their decision to accept that job. However while the effect was positive for nursing students, it was weakly negative for medical students. Among nursing students, working at a 50 to 100 bedded hospital had a significant and positive effect on accepting a job. The attribute used to describe job location had four levels based on combinations of good or poor connectivity, housing, and education. **Better location, in terms of having good education, housing, and connectivity** significantly increased the likelihood a job being selected. Having good housing in an area with poor education facilities for children and poor connectivity had a statistically significant effect on the decision for medical students but not for nursing students. **Good health facility infrastructure**, in terms of equipment, building, supply of drugs and medicines, had a positive and statistically significant effect on selecting a job for both medical and nursing students. Similar results were found for a job in a **well-staffed facility with a moderate workload.** As expected, **increased salary** raised the probability of taking up a job. The effect size for salary was greater for nursing students than for medical students; explicable since Rs 5000 is a much larger proportion of a nurse's expected salary than a doctor's. A job with a guaranteed transfer after three years of service had a positive and significant effect on job choice for medical students but had no significant effect on job choice among nursing students.

Table 7. Bivariate Probit Regression Results: Correlates of Job Choice for Medical and Nursing Students

Attribute	Medical students		Nursing students	
	Job A or B	Accept job	Job A or B	Accept job
20–30 bedded hospital	-0.013	0.004	0.103	0.093
	(0.050)	(0.053)	(0.053)	(0.053)
50–100 bedded hospital	-0.039	-0.010	0.189*	0.175*
	(0.049)	(.052)	(0.053)	(0.053)
Good children's education, housing, &	1.001*	0.899*	0.872*	0.782*
connectivity	(0.056)	(0.059)	(0.060)	(0.060)
Good children's education & connectivity, poor	0.441*	0.460*	0.553*	0.553*
housing	(0.053)	(0.060)	(0.056)	(0.057)
Good housing, poor children's education &	0.087	0.191*	-0.006	0.017
connectivity	(0.054)	(0.064)	(0.058)	(0.060)
Good infrastructure	0.513*	0.453*	0.410*	0.375*
	(0.040)	(0.041)	(0.042)	(0.042)
Full staff, moderate workload	0.218*	0.258*	0.179*	0.176*
	(0.039)	(0.041)	(0.042)	(0.042)
Salary (increase of Rs 5,000)	0.102*	0.105*	0.244*	0.232*
	(0.005)	(0.006)	(0.013)	(0.013)
Transfer after three years	0.088*	0.193*	0.025	0.068
	(0.040)	(0.041)	(0.042)	(0.042)
Postgraduate reservation	0.767*	0.849*	0.298*	0.354*
	(0.039)	(0.043)	(0.041)	(0.042)
Job in native area	0.261*	0.370*	0.034	0.074
	(0.039)	(0.042)	(0.041)	(0.042)
Constant	-2.395*	-3.174*	-1.906*	-2.034 *
	(0.092)	(0.102)	(0.093)	(0.094)
Rho	0.997*		0.998*	
Observations	5088		4224	
Individuals	159		132	

* *p*-value < 0.05.

Reservation of seats for higher education, a strategy used by several Indian states to attract doctors to government service showed a strong and statistically significant positive effect on selecting a job. Expectedly, the magnitude was greater for medical students than for nursing students because the desire to specialize is much stronger among the former. While the coefficient for a job in **one's native area** was positive in both groups, it had a statistically significant effect on accepting a job only for medical students (table 7).

Table 8 provides estimates of the proportion of medical and nursing students who will take up a posting due to the presence of different job attributes. The base probability is the estimated proportion of respondents choosing a job at a clinic with only outpatient facilities, in an area with poor housing, connectivity and educational facilities for children, with poor infrastructure, inadequate staff and a heavy workload, a base level salary (corresponding to Rs 10,000 per month for nursing students and nurses and Rs 30,000 per month for medical students), an uncertain date of transfer to a higher level facility with the job not located in one's native area. This corresponds to a job with the state health services (that is, government job) in a rural or remote location. The willingness of nursing students to work in rural conditions was far greater than that of medical students: 75 percent of nursing students versus 15 percent of medical students chose the base job.

Salary had a relatively weak effect on making rural posts attractive to medical students. An increase of salary from the base of Rs 30,000 to Rs 40,000 increased the proportion of students willing to take up a job by 2 percent (from 15 percent to 17 percent). Among the nonmonetary attributes, reserving postgraduate seats had the biggest increase (29 percent) on choosing a rural job. This was followed by jobs located in areas having good education facilities for children, housing and connectivity (23 percent). A job with guaranteed transfer after three years and one where housing was poor but the other area characteristics were good, each attracted 21 percent medical students. A health facility with full staff and moderate workload attracted 19 percent of the medical students and one with good infrastructure attracted 18 percent of the respondents. Being based in a hospital did not increase the proportion selecting a job, compared to the baseline situation (table 8).

Table 8. Effect of Job Attributes and Attribute Packages on Probability of Selecting a Job among Medical and Nursing Students

Job attributes	Medical students	Nursing students
20–30 bedded hospital	15	74
50–100 bedded hospital	15	74
Good children's education, housing, & connectivity	23	74
Good children's education & connectivity, poor housing	21	80
Good housing, poor children's education & connectivity	21	78
Good infrastructure	18	74
Full staff, moderate workload	19	76
Salary (Rs 30,000/10,000): base	15	75
Transfer after three years	21	81
Postgraduate reservation	29	85
Job in native area	15	74
Job packages		
Package A: Salary for doctors (nurses) is Rs 40,000 (Rs 20,000)	17	76
Package B: Package A and postgraduate reservation	33	86
Package C: Package A and improved infrastructure	21	77
Package D: Package B and improved infrastructure	39	86

Note: Base is a job in a clinic, located in an area with poor connectivity, poor education facilities for children, and poor housing; the clinic has poor infrastructure; it is poorly staffed and workload is high; transfer is uncertain; there is no reservation for in-service staff for higher education; job is not located in the native area of the respondent; and salary is Rs 30,000 for doctors and Rs 10,000 for nurses.

Combination of job attributes, (that is, a package), expectedly, holds more attraction than single attributes. Jobs with a salary level of Rs 40,000 a month that also reserve postgraduate seats attracted 33 percent of medical students. Providing better health facility infrastructure, in addition to a salary of Rs 40,000 and reserved postgraduate seats, attracted 39 percent of the medical students to rural jobs (table 8).

Approximately 75 percent of the nursing students selected a rural job for a salary of Rs 10,000 (typical starting salary of nurses in government service), the numbers increased to 76 percent for a salary of Rs 20,000. Among the nonmonetary attributes, reservation of seats for higher education (post-basic B.Sc degree) had a large effect for nursing students: 85 percent would accept a rural job if this attribute were offered. A job with certain transfer after three years attracted 81 percent of respondents. Working in a health facility with full staff and moderate workload (76 percent), if it were based in a hospital (74 percent) and provided better health facility infrastructure (74 percent), attracted the same number of students as the option offering the baseline salary (table 8).

As in the case of medical students, combination of job attributes (as in a package) expectedly, has more attractive power than single attributes. Jobs with a salary level of Rs 20,000 a month that also reserved postgraduate seats attracted 86 percent of nursing students to a rural government job, with other characteristics being similar to the base situation (table 8).

Prediction: The regression model (table 7) was used to predict the proportion of medical and nursing students who would accept Job A or Job B if it were offered, that is, the conditional probability of accepting a job given that they chose it. Table 9 compares the observed and predicted number of individuals accepting Job A or Job B, if it were offered to them.

Table 9. Number of Respondents Willing to Accept the Job They Selected

Student type	Choice set	Observed		Predicted		Chi-sq test *p*-value*
		Job A	Job B	Job A	Job B	
Medical	Choice 19	103	7	121	9	0.86
	Choice 20	36	69	42	89	0.72
Nursing	Choice 19	91	30	90	31	0.88
	Choice 20	45	70	47	77	0.95

* Chi-squared test for independence between observed and predicted.

In general, the difference between the observed and predicted conditional probability of accepting the selected job is not large. For all choice sets tested (table 9), tests for independence between observed and predicted counts within choice sets were not statistically significant (p-value > 0.05). Thus, the null hypothesis could not be rejected, suggesting that the pattern of accepting Job A or Job

B did not differ (statistically) between the observed and predicted groups. This indicates good model goodness-of-fit and predictive accuracy.

IN-SERVICE DOCTORS AND NURSES

Table 10 presents the regression results for in-service doctors and nurses. The reference group for both regressions for a given level of salary is a job with the following characteristics: the job is in a clinic; the location is an area with poor connectivity, poor education facilities for children, and poor housing; the clinic has poor infrastructure; the clinic is poorly staffed and workload is high; transfer is uncertain; there is no reservation for in-service staff for higher education; and the job is not located in the native area of the respondent. This corresponds to the job with the state health services (government job) in a rural or remote location.

The regression results indicate significant unobserved preference heterogeneity between respondents (indicated by significant standard deviation of the random attribute coefficients). For instance, among doctors (nurses), 93 percent (96 percent) had a positive preference for jobs that had all good location attributes (connectivity, children's education, and housing), 86 percent (92 percent) for higher salary, 45 percent (70 percent) for fully staffed health facilities with moderate workload, and 84 percent (84 percent) for postgraduate reservation of seats.

As expected, **salary** had a positive and significant effect on job choice, with the effect size for nurses being larger compared to doctors in both states. The greater effect size for nurses occurs because the increase, which is in increments of Rs 5,000, represents a much larger proportion of a typical nurse's salary relative to a doctor's (table 10).

Table 10. Mixed Logit Regression Results: Correlates of Job Choice for In-Service Doctors and Nurses

Job attributes	Doctors			Nurses		
	Mean	SE Mean	SD	Mean	SE Mean	SD
20–30 bedded hospital	-0.16	0.089	-0.625	0.26*	0.082	0.628*
50–100 bedded hospital	-0.28*	0.079	0.159	0.33*	0.080	0.492*
Good children's education, housing, & connectivity	1.18*	0.100	0.844*	0.89*	0.088	0.505*
Good children's education & connectivity, poor housing	0.98*	0.101	0.388*	0.93*	0.094	-0.567*
Good housing, poor children's education & connectivity	0.37*	0.108	0.628*	-0.18	0.100	0.680*
Good infrastructure	0.62*	0.080	0.725*	0.88*	0.076	0.825*
Full staff, moderate workload	-0.05	0.072	0.375*	0.19*	0.068	-0.370*
Salary (increase of Rs 5,000)	0.19*	0.014	0.173*	0.45*	0.028	0.327*
Transfer after three years	-0.03	0.067	0.148	0.03	0.064	0.230
Postgraduate reservation	1.53*	0.143	1.518*	0.52*	0.098	0.517*
Job in native area	0.25*	0.059	-0.149	0.28*	0.059	0.338*
Job 1	0.77	0.098	0.472*	0.02	0.128	-0.528*
Job 2	0.17*	0.105	0.160	-0.13	0.101	1.282*
Observations		10,245			10,545	
Individuals		214			220	

Note: SE = standard error, SD = standard deviation.

* *p*-value<0.05.

Among the nonmonetary attributes, **working in a hospital** had a negative and significant impact on in-service doctors in selecting jobs (table 10). While the opportunity to work at a larger health facility was expected to positively influence job choice, the contrary observed results could be due to a reluctance among the sampled in-service doctors to move away from their established practice at the PHC, where they may have made a decision to stay. For nurses, a job in a larger health facility (for example, hospital) had a positive and statistically significant effect on job choice. Location was important for both doctors and nurses; for both groups the likelihood of a job being selected improved with better location attributes. **Good education for children, connectivity, and**

housing were positively and significantly associated with job choice for both doctors and nurses. Even when housing was poor, the availability of good education and connectivity exhibited a positive and significant effect on selecting a job. Good housing in an area with poor education facilities for children and poor connectivity had a positive and significant effect on the likelihood of selecting a job among doctors. However, for nurses, only good housing did not have a significant effect on choosing a job.

Expectedly, **good infrastructure** and a lack of drug shortages had a positive and statistically significant effect on the job choices of both in-service doctors and nurses, though the effect size was considerably larger for nurses. The attribute of **fully staffed health facility** with a moderate workload did not have a significant effect on doctor job choice but did influence nurses. One reason for this could be that the staffing of the health facility had little effect on the doctor's ability to perform as his duties are largely confined to consulting. On the other hand, nurses depend a lot more on support staff in their daily work (table 10).

There was no strong preference for a **guaranteed transfer to a higher-level facility** after three years of service for either doctors or nurses. One reason for this could be that the sampled doctors and nurses had already made their location decisions and were not inclined to move. **Reservation of postgraduate seats**, showed a strong and statistically significant positive effect among all groups. The effect size was much larger for doctors than for nurses, showing the high desirability for specialist training among doctors. Having a job in one's **native area** had a positive and significant effect on job choice for both doctors and nurses (table 10).

Table 11 provides estimates of the proportion of sampled in-service doctors and nurses choosing a job with the specified attribute. For each category of health worker, the first column (With attribute) gives the proportion of respondents selecting a job with that particular attribute, all remaining attributes (including salary) are at their reference level. The second column (Base) gives the proportion of respondents selecting a job with base level salary — defined as a monthly salary of Rs 10,000 for nurses and Rs 30,000 for doctors; all other attributes are set to their reference levels. The base proportion differs by attribute included in the model because the probability of selecting a job sums to 1 across the three job choices, and the predicted uptake of a job with a specific attribute

differs according to the attribute selected. The reference or base levels of the other attributes, together, represent a clinic with only outpatient facilities in an area with poor housing, connectivity, and educational facilities for children; with poor infrastructure; inadequate staff and a heavy workload; an uncertain date of transfer to a higher-level facility; with the job not located in one's native area. The reference level of all attributes corresponds to an initial job with the state health services (government job) in a rural or remote location.

Table 11. In-service Doctors and Nurses: Job Attributes and Probability of Selecting a Job

Job attributes	Doctors			Nurses		
	With attribute	Base	Increase	With attribute	Base	Increase
20–30 bedded hospital	32	34	-2	40	30	10
50–100 bedded hospital	27	37	-10	41	30	11
Good children's education, housing, & connectivity	60	20	40	54	23	31
Good children's education & connectivity, poor housing	57	22	35	56	22	34
Good housing, poor children's education & connectivity	42	29	13	31	35	-4
Good infrastructure	48	26	22	53	24	29
Full staff, moderate workload	32	34	-2	38	31	7
Monthly salary doctors (nurses) Rs 40,000 (Rs 20,000)	42	29	13	54	23	31
Transfer after three years	33	34	-1	34	33	1
Postgraduate reservation	64	18	46	45	28	17
Job in native area	39	31	8	40	30	10
Job packages						
Package A: Salary doctor (nurse) Rs 40,000 (Rs 20,000) and postgraduate reservation	68	16	52	63	19	44
Package B: Salary doctor (nurse) Rs 40,000 (Rs 20,000) and improved infrastructure	56	22	34	68	16	52

Package C: Package A and improved infrastructure	72	14	58	73	14	61

Note: The figures in the table are the estimated proportion of respondents choosing a job that has only the specified attribute and a base-level salary (Rs 10,000 per month for nurses and Rs 30,000 per month for doctors); the remaining attributes are set at their reference levels (that is, representing a clinic with only outpatient facilities, in an area with poor housing, connectivity, and educational facilities for children; with poor infrastructure; inadequate staff; and a heavy workload; an uncertain date of transfer to a higher level facility; and the job not located in one's native area).

An increase of Rs 10,000 in salary, which represents a one-third increase in doctor salaries over base levels, increased the proportion of doctors selecting a rural job by 13 percentage points. The same increase in salary doubled nurse salaries over base levels and increased the proportion of nurses selecting rural jobs by 31 percentage points. Among the nonmonetary attributes, for doctors, the offer of reserving PG seats for specialist training was the most powerful incentive for uptake of rural posts — 46 percent more doctors opted for rural service if offered a postgraduate seat after some years of service. Higher education was important for nurses too, but considerably less (17 percent points) than for doctors. Expectedly, better location was a powerful incentive for taking up a post; the proportion of doctors and nurses selecting a job increased with better location attributes. For instance, jobs in areas that had good children's education, housing, and connectivity had 40 (31) percentage point more doctors (nurses) selecting the job compared to base levels (table 11).

The presence of good infrastructure at health facilities was also important — it increased the uptake of rural posts by doctors to 22 percentage points over base levels; and by nurses to 29 percentage points. Other attributes like a job in a native area had a relatively smaller effect on uptake of posts by doctors and nurses. Interestingly, a job located at a hospital had a negative effect on the proportion of doctors (negative 10 percentage points) and moderately increased the proportion of nurses (10 percentage points) selecting a job. Finally, combinations of job attributes had more attractive power than single attributes for both doctors and nurses. This suggests the importance of "packaging" rather than relying on single incentives. For doctors, the combination of increased salary, PG reservation, and better infrastructure had the largest effect on uptake of rural posts over base levels. For nurses, increased salary and better infrastructure had the largest effect (table 11).

Prediction: Two choice sets in the DCE were treated as "holdouts" to assess the predictive accuracy of the statistical model (See Methods). Table 12 compares the observed and predicted number of individuals according to the job they selected.

Table 12. Observed and Predicted Number of Respondents Selecting Jobs

Worker type	N	Choice set	Observed			Predicted			Chi-sq test
			Job A	Job B	Own job	Job A	Job B	Own job	*p*-value*
Doctors	214	Choice 19	177	8	29	163	32	19	0.99
	213	Choice 20	72	91	50	60	132	21	0.99
Nurses	220	Choice 19	142	33	45	128	24	68	0.86
	220	Choice 20	48	116	56	42	119	59	0.38

* Chi-squared test for independence between observed and predicted.

For all choice sets tested (table 12), tests for independence between observed and predicted counts within choice sets were not statistically significant (p-value > 0.05). Thus, the null hypothesis could not be rejected, suggesting that the pattern of accepting Job A or Job B or own job did not differ (statistically) between the observed and predicted groups. This indicates good model goodness-of-fit and predictive accuracy.

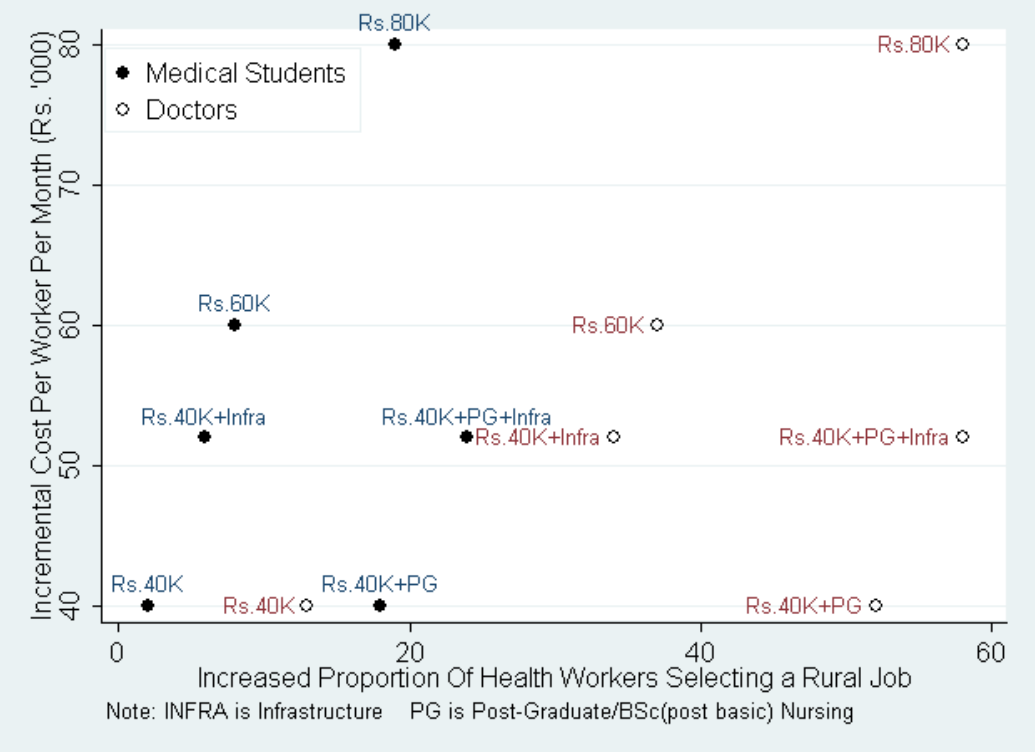
COST-EFFECTIVENESS

To compare the cost-effectiveness of alternative policy options, the predicted probability analysis was combined with costing data of select attributes. Those attributes, which had a substantial effect on the probability of taking-up a rural jobs and were policy actionable were included in the cost-effectiveness analysis. Annex 2 describes in detail the methodology used for calculating the incremental attribute costs. Costing data were collected from the health department in Andhra Pradesh, in-service respondents in the state, and from private medical and nursing colleges in the

state. We assume that these costs do not differ significantly between the two study states.

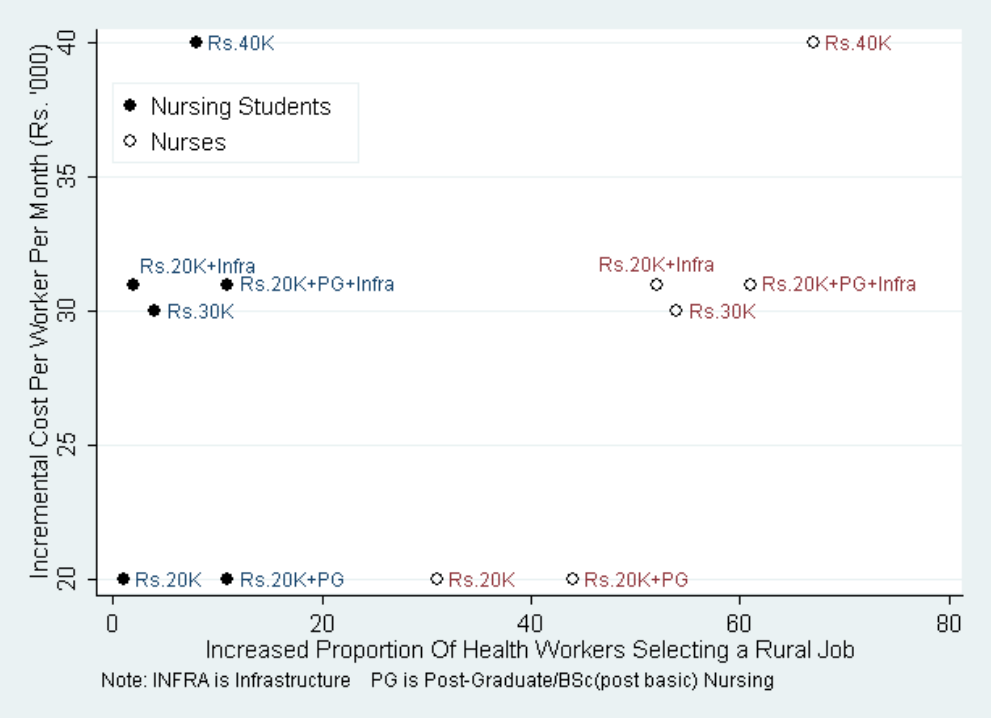
Figures 5 and 6 present the cost-effectiveness of attributes influencing uptake of rural jobs. One significant point that these figures make clear is that the supply of medical graduates for rural posts is more inelastic for students than it is for in-service doctors and nurses. Increases in salary have little effect on the number of students opting for rural jobs, whereas they have a larger effect on the choices of in-service doctors and nurses.

Figure 5. Cost Effectiveness of Attributes for Medical Students and Medical Officers



Source: (a) Proportion or health workers selecting rural job are from Table 8 and 11, (b) See Annex 2 for cost data.

Figure 6. Cost-Effectiveness of Attributes for Nursing Students and Nurses



Source: (a) Proportion or health workers selecting rural job are from Table 8 and 11, (b) See Annex 2 for cost data.

In general, for both doctors and medical students, the most cost-effective interventions were reserving postgraduate seats. Through such schemes for higher training, considerably more health workers can be attracted to rural posts at lower costs than through increases in salary. Further, for a given level of attribute or attribute combination, the effect on rural uptake was stronger for in-service doctors than medical students. This suggests the inelastic supply of medical students for rural jobs. Combining salary with postgraduate reservation is more cost-effective than either single attribute. For example, reservation of postgraduate seats combined with a salary of Rs 40,000 is considerably more cost-effective than either this level of salary or reservation considered individually. If offered this attribute combination, a substantially higher proportion of doctors (52 percent) and medical students (18 percent) can be expected to opt for rural jobs. For the purposes of uptake of rural jobs, improving infrastructure at PHCs did not appear to be as cost-effective as reserving postgraduate seats (figures 5 and 6).

For nursing students and nurses, the most cost-effective interventions were reserving seats in higher

education programs (for example, post-basic or B.Sc. nursing). Further, for a given level of attribute or attribute combination, the effect on rural uptake was stronger for nursing students than nurses. Combination of salary with postgraduate reservation is more cost-effective than single attributes. For example, reservation of postgraduate seats combined with a salary of Rs 20,000 is considerably more cost-effective than either this level of salary or reservation considered individually. If offered this attribute combination, a substantially higher proportion of nurses (44 percent) and nursing students (11 percent) can be expected to opt for rural jobs. For the purposes of attracting nurses and nursing students, improving infrastructure at PHCs did not appear to be as cost-effective as reserving postgraduate seats.

ATTITUDES TOWARD RURAL LIFE AND UPTAKE OF RURAL JOBS

Job preferences of health workers depend on several factors including their demographic characteristics, where they spent their formative years, the number of years of experience they have as practitioners, and the type of schooling they have had (Ebuehi and Campbell 2011). To assess the effect of these factors on job choices, we undertook a two-step process: first, we examined if these variables were correlated with health worker attitudes toward urban living. Second, we conducted a sub-sample analysis of the factors that were found to have significant correlation with urban attitudes.

Table 13 provides results from regressing the Urban Attitudes Index (see table 5) on various socio-demographic variables. In general, the independent variables in the model did not explain much of the variation in the Urban Attitude Index. Certain respondent characteristics were associated with an urban preference attitude. For medical and nursing students, growing up in a rural area was significantly associated with lower preference for urban areas. For medical students, attending a private medical school was significantly associated with a greater preference for urban areas. For in-service doctors, none of the independent variables were significantly associated with urban preference. For in-service nurses, older age was significantly associated with lower urban preference (table 13).

Table 13. Correlates of Urban Preference Attitudes

	Students		In-Service	
	Doctors	Nurses	Doctors	Nurses
Age	-0.006	0.006	0.081	0.189***
	(0.040)	(0.047)	(0.056)	(0.069)
Age-squared			-0.001	-0.002***
			(0.001)	(0.001)
Male	-0.015	0.188	-0.015	0.421
	(0.083)	(0.330)	(0.104)	(0.355)
Grew up in rural area	-0.238*	-0.377**	-0.097	-0.058
	(0.126)	(0.156)	(0.105)	(0.107)
Attended private school	0.316***	-0.122	-0.080	0.211
	(0.086)	(0.153)	(0.105)	(0.133)
Have children			-0.001	-0.082
			(0.124)	(0.156)
Married	-0.158	-0.464	-0.287	-0.272
	(0.340)	(0.363)	(0.364)	(0.315)
Constant	3.000***	2.616***	1.896	-0.491
	(0.867)	(0.956)	(1.147)	(1.252)
Observations	159	132	178	179
R-squared	0.110	0.058	0.030	0.082

Note: Standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

We explore the influence of rural up-bringing on job choice of medical and nursing students by partitioning the student sample into those who grew up in rural areas and those who grew up in urban settings. We estimated the effect of job attributes on job choices for these two groups by estimating the bivariate probit regressions for the two subsamples. These results are presented in table 14.

Table 14 provides estimates of the proportion of medical and nursing students from rural and urban backgrounds who will take up a posting due to the presence of different job attributes. The base is the estimated proportion of respondents choosing a job at a clinic with only outpatient facilities; in an area with poor housing, connectivity, and educational facilities for children; with poor infrastructure, inadequate staff, and a heavy workload; a base level salary (corresponding to Rs 10,000 per month for nursing students and nurses and Rs 30,000 per month for medical students); an uncertain date of transfer to a higher-level facility; with the job not located in one's native area.

This corresponds to a job with the state health services (government job) in a rural or remote location.

Table 14. Proportion of Medical and Nursing Students Selecting a Job

Job attributes	Medical students		Nursing students	
	Rural	Urban	Rural	Urban
20–30 bedded hospital	14	15	83	50
50–100 bedded hospital	14	15	82	54
Good children's education, housing & connectivity	36	21	78	55
Good children's education & connectivity, poor housing	42	18	83	65
Good housing, poor children's education & connectivity	55	18	82	59
Good infrastructure	26	17	81	53
Full staff, moderate workload	33	17	80	62
Salary (Rs 30,000/10,000): base	18	14	83	49
Transfer after three years	18	21	90	56
Postgraduate reservation	26	29	90	69
Job in native area	33	22	88	56

In general, a higher proportion of medical and nursing students who had grown up in rural areas opted for a rural job for any given attribute level, compared to their urban counterparts. For instance, 18 percent of rural medical and 14 percent of urban medical students opted for the base level job. Similarly, 83 percent of rural nursing and 49 percent of urban nursing students opted for the base-level job. For medical students from rural backgrounds, a job with good housing was most attractive, and for those who grew up in urban areas, a job with PG reservation was the biggest draw. For nursing students from both urban and rural backgrounds, a job with reservation for post-basic nursing degree was the biggest draw (table 14).

These findings suggest the importance of background characteristics for uptake of rural jobs by trainee health workers. There is a growing global literature suggesting that health workers from rural backgrounds are more likely to be recruited into rural jobs. Our findings indicate that this holds true in India's case as well. An important policy implication of this finding is that giving

preferential admission or reserving seats for students from rural areas in medical and nursing colleges can improve the recruitment of doctors and nurses to rural posts.

DISCUSSION

The findings from this Discrete Choice Experiment provide policy guidance on how to better incentivize rural recruitment strategies. Our findings suggest that both monetary and nonmonetary incentives have small effects on the uptake of rural jobs by medical students. This is expected since the immediate ambition of medical students is to become specialists rather than to enter the job market or become a rural doctor. In contrast, nursing students had much stronger preference for rural jobs, even at baseline levels. Indeed, among both medical and nursing students, the incentive of reserving seats for higher training (postgraduate specialist seats for medical students and post-basic for nursing students) had the biggest effect on uptake of rural jobs. For both medical and nursing students, a rural job in a hospital (as opposed to a PHC) or a well-equipped PHC did not result in higher uptake job over baseline levels. Providing good housing or postings in places with good connectivity and education facilities for children or guaranteed transfers after three years marginally improved uptake of rural jobs. Interestingly, postings in native area locations did not improve uptake of rural jobs.

For in-service doctors and nurses, salary emerged as one the most powerful drivers of job choice. A doubling of salary, from base levels of Rs 40,000 for doctors and Rs 10,000 for nurses resulted in the majority opting for rural posts. This is not entirely surprising since there is a general feeling among health workers of being substantially underpaid given their education and workload. Among nonmonetary incentives, reserving seats for higher education (postgraduate specialization for doctors) emerged as the most powerful for uptake of rural posts for doctors as well as the most cost-effective. For both in-service doctors and nurses, the job's location was important — a job in an area that was well-connected and had good education facilities for children had large effects on uptake of rural jobs. While this suggests the importance of location attributes, it also highlights the fact that improving housing conditions alone — a policy that many health departments resort to — will likely be ineffective in attracting health workers to rural posts. For nurses, a health facility with good infrastructure also had a large effect on uptake of rural jobs. For in-service doctors and nurses,

jobs in a hospital (as opposed to a PHC), guaranteed transfers after three years, or native area postings had little effect on uptake of rural jobs.

The low level of uptake of rural jobs among medical students is remarkable. This contrasts sharply with nursing students and in-service doctors. Indeed, even with the postgraduate seat reservation incentive, no more than 25 per cent of the medical students would choose a rural job. This finding highlights the great reluctance among medical students to serve in rural areas and in government jobs. Such low levels of uptake suggest that for achieving adequate coverage of quality basic clinical services in rural areas, alternatives to medical doctors might need to be considered. This could include non-physician clinicians like the Rural Medical Assistants (RMAs) of Chhattisgarh state or nurse-practitioners.

For doctors, nurses, and students, the packages of interventions were generally more powerful in influencing job choice than the single interventions (with the exception of salary). This also reflects the multiple needs of health workers to be satisfied.

It is also useful to examine why some attributes did not emerge as important drivers of job choice. Interestingly, these were associated with changing job location (for in-service respondents at PHCs) such as, to a job in a hospital or the desire for a guaranteed transfer or a job in one's native area. For neither doctors nor nurses, was this an important driver of preferences. One reason for this is that in-service respondents had already made their location decisions, such as working in a PHC and felt comfortable in that work environment. Interactions with health department officials have revealed that private practice (allowed in Andhra Pradesh and generally practiced by medical officers throughout India) is one reason for this reluctance. Since it takes time for a doctor to establish his/her reputation in a given community, a certain transfer after a period of three years uproots him/her from investment in that setting. Also, given the difficulty of changing schools for children and jobs for spouses, a long uncertain tenure may be preferred to a fixed length of stay in a particular location with a change after duration of three years.

Medical and nursing students from rural areas had a greater inclination to take up rural jobs compared to their urban counterparts. While this is expected, given that this finding corroborates the

growing international literature on this topic, an important policy implication of this finding is that giving preferential admission to students from rural areas in medical and nursing colleges might be an important strategy for improved recruitment of doctors and nurses to rural posts.

In India's context, it appears that incentivizing medical graduates to serve in rural areas will be challenging. Consequently, there is a pressing need to explore the potential of nurse-practitioners or other types of non-physican clinicians. Among incentives that can be provided within the health department's policy space, better salary, good facility infrastructure, and reserving seats for higher education appear to be the most effective drivers of uptake of rural posts. Combining these incentives can provide a powerful way to bring doctors and nurses to rural posts. The findings from this study also suggest that common interventions implemented in states across India to improve the attractiveness of rural service, such as providing better housing or simply posting health workers to their native areas, while important, appear not to be the main drivers of health worker job choice. Finally, increasing the enrolment of medical and nursing students from rural backgrounds could lead to greater rural recruitment.

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ANNEX 1. DETAILED SAMPLE DESCRIPTION

TABLE A1 SAMPLE DESCRIPTION

Name of the institution	Description	MBBS students	Nursing students	In-Service doctors	In-Service nurses	Total
Andhra Pradesh: Target sample		150	150	150	150	600
Andhra Pradesh: Actual sample		163	145	154	187	649
Osmania Medical College, Hyderabad	public college, city, Telangana region	34	n.a.	n.a.	n.a.	34
Osmania Nursing School, Hyderabad	public college, city, Telangana region	n.a.	45	n.a.	n.a.	45
Deccan Medical College, Hyderabad	private college, city, Telangana region	51	n.a.	n.a.	n.a.	51
Owesi Nursing School, Hyderabad	private college, city, Telangana region	n.a	30	n.a.	n.a.	30
RR Medical College, Kakinada	public college, town, coastal Andhra region	38	n.a.	n.a.	n.a.	38
Kakinada Nursing School, Kakinada	public college, town, coastal Andhra region	n.a.	37	n.a.	n.a.	37
SV Medical College, Tirupati	public college, town, Rayalseema region	40	n.a.	n.a.	n.a.	40
Padmavathi Nursing School, Tirupati	private college, town, Rayalseema region	n.a.	33	n.a.	n.a.	33
Mahbubnagar District	Telangana region	n.a.	n.a.	47	61	108
Chittoor District	Rayalseema region	n.a.	n.a.	49	68	117
East Godavari District	coastal Andhra	n.a.	n.a.	58	58	116

Kakinada	region					
Uttarakhand: Target sample		n.a.	n.a.	150	150	300
Uttarakhand: Achieved sample		n.a.	n.a.	68	51	119
Dehra Dun	Garhwal region	n.a.	n.a.	16	25	41
Tehri	Garhwal region	n.a.	n.a.	12	2	14
Pauri	Garhwal region	n.a.	n.a.	16	0	16
Almora	Kumaon region	n.a.	n.a.	12	4	16
Uddam Singh Nagar	Kumaon region	n.a.	n.a.	4	6	10
Nainital	Kumaon region	n.a.	n.a.	8	14	22

Note: n.a. = not applicable.

ANNEX 2. ESTIMATING COSTS OF ATTRIBUTES

Only costs for the infrastructure and higher training attributes were estimated. This is because the facility type (PHC) and location (area with poor connectivity and education facility for children) were taken as fixed as they define the context of interest. Of the other attributes, it was assumed that no costs were incurred on transfers or on posting to native areas. Since budgetary allocations are made for all sanctioned posts, having a fully staffed health facility was viewed as having no budgetary impact. Good housing did not have a significant effect on health worker job choice.

Infrastructure attribute

To estimate the incremental cost of improving medical equipment, drugs, and the building condition of a PHCs to a level where it can be labeled as having "good infrastructure," we used annual cost data on establishing and operating a fully functioning PHC, as per state norms made available to us from the health department in Andhra Pradesh. These were categorized as equipment, drugs, and supplies; and building construction. We did not include the price of land because this fixed cost has already been incurred.

Table A2 Cost Estimates for Infrastructure Attribute

Cost	Total cost	Useful life (years)	Monthly cost	Share of monthly cost to upgrade PHC	Monthly cost of upgrading PHC	Cost per health worker per month
Building Equipment	8,000,000	10.00	66,666.67	0.10	6,666.67	n.a.
Low	1,500,000	10.00	12,500.00	0.10	1,250.00	n.a.
High	2,000,000	10.00	16,666.67	0.10	1,666.67	n.a.
Drugs & supplies						
Low	160,000	1.00	13,333.33	0.30	4,000.00	n.a.
High	300,000	1.00	25,000.00	0.30	7,500.00	n.a.
Total						
Low	n.a.	n.a.	n.a.	n.a.	11,916.67	11,916.67
High	n.a.	n.a.	n.a.	n.a.	15,833.34	15,833.34

Source: Department of Health, Government of Andhra Pradesh

*Note: (1)*For cost per health worker per month, we assumed that there is one medical officer and one nurse in the PHC. (2) n.a. = not applicable.

Since these were total costs, we assumed a fraction of these total costs would need to be devoted to upgrade infrastructure. We assumed that 10 percent of the cost of construction and equipment would be required to upgrade PHCs. Further, 30 percent of the cost of drugs and supplies would be needed to keep the PHC fully stocked.

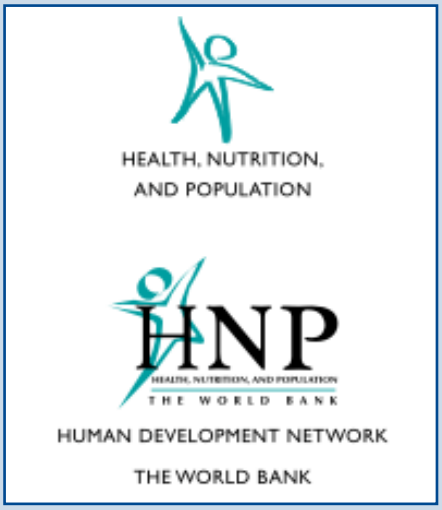
Table A2 provides cost estimates for the infrastructure attribute. For building and equipment, total costs were divided by the number of useful years to arrive at annual costs. This estimate assumes straight-line depreciation. All cost components were further divided by 12 to get monthly costs; the fraction of these costs necessary for upgrades were applied to this to calculate the monthly cost of upgrading the PHC. To arrive at the cost per health worker (that is, doctor or nurse) we assumed that a PHC would have one of each. This is not always the case — in Andhra Pradesh there are two doctors posted at PHCs, though one is an AYUSH doctor. In Uttarakhand, typically nurses are not posted at PHCs. However, the conventional norm is to have one doctor and one nurse in a PHC.

Higher studies attribute

In both Andhra Pradesh and Uttarakhand there is a scheme through which a certain number of postgraduate seats in government medical colleges are reserved for in-service medical officers who have worked in a rural area. For many medical officers, this is a big attraction to join government service. While no such scheme exits for nurses in either state, the desire to obtain a B.Sc. nursing degree is strong among them. Nurses who have already obtained a General Nurse Midwife (GNM) degree (as the nurses in our sample have) can obtain a B.Sc. nursing degree by completing a two-to-three-year post-basic B.Sc. nursing degree, (the normal B.Sc degree takes four years to complete).

Reservation of postgraduate medical seats for in-service candidates is typically made within the existing class size of public and private medical colleges in Andhra Pradesh. In other words, no additional seats are created, but among the existing number of seats, a certain number are reserved for in-service applicants. Candidates who receive a seat in a public medical school do not have to pay any fees; however, those who attend a private medical college are required to pay the regular fees. Either way, there is no additional cost incurred by the government in reserving these seats. In-

service candidates also receive their regular salaries during postgraduate training, but as postgraduate students they are also employed in the medical colleges. Therefore, these costs are not included. There are no tuition fees to be paid by students. In sum, the incremental cost of reserving postgraduate medical seats for in-service candidates is zero. For the same reasons we assume zero incremental cost for reserving B.Sc. (post-basic) nursing seats for in-service candidates.



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1818 H Street, NW
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Telephone: 202 473 1000
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