HNP DISCUSSION PAPER

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Innovative Analytic Work to Inform Policy Making

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Getting Health Workers to Rural Areas:
Innovative Analytic Work to Inform Policy Making

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Abstract: Decision makers face serious challenges in attracting health workers to rural areas, in both the developed and developing world, but while they have access to a wide range of policy options, the effectiveness of interventions is highly contingent on context. To make them more effective, decision makers need to have an in-depth understanding of, especially, the factors that influence individual workers' decisions on choice of practice, particularly regarding relocation to rural areas. The current paper presents results of an empirical study conducted in Liberia and Vietnam using a discrete choice experiment (DCE). The study's aim was to predict the likelihood of health workers taking up a rural area job under alternative incentive schemes. This study is the first DCE analysis to then go the extra step of costing out the alternative packages. The analysis revealed quite different results for the two countries. The most powerful single incentive in motivating workers to practice in rural areas was increased pay in Liberia, and long-term education in Vietnam. The cost-effectiveness of incentives also varied by country. In Liberia, monetary incentives were by the most cost effective while in Vietnam it was opportunities for skills development. While the study methodology needs further enhancement – especially costing of incentive packages – our work shows that a DCE analysis can be a powerful tool in informing the design of rural area incentive schemes in developing countries.

Keywords: human resources for health, workforce, labor market, Vietnam, Liberia

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INTRODUCTION

One of the biggest challenges for policy makers in the health sector, in both developed and developing countries, is attracting health workers to rural areas. Globally, approximately one-half of the population lives in rural areas, but these areas are served by only 38 percent of the total nursing workforce and by less 25 percent of the total physician workforce. In Bangladesh, 30 percent of nurses are located in four metropolitan districts, where only 15 percent of the population lives (WHO 2010). In Vietnam, 53 percent of physicians are concentrated in urban areas, where only 28 percent of the population lives; and according to recent estimates, one out of three commune health centers do not have a doctor (Ministry of Health 2009). In the United States and Canada, 9 percent of physicians practice in rural areas, where about 20 percent of the population lives (WHO 2010). As noted in numerous studies, this lack of qualified health workers in rural areas is a significant barrier to service delivery (Dolea et al. 2010; WHO 2010; Vujicic et. al. 2009; Zurn et al. 2004).

As noted in a recent review of the policy evidence (WHO 2010), decision makers have a wide variety of policy options to choose from, including compulsory rural service for new graduates, recruiting students from rural areas into training programs, financial bonuses, and scholarship schemes. There are no "magic bullet" solutions to the rural retention problem and the appropriate policy response will depend heavily on country context. The choice of interventions ought to be informed by an in-depth understanding of the health workforce which entails, at a minimum, a comprehensive labor market analysis and an analysis of the factors that influence the decisions of health workers to relocate to, stay in, or leave rural areas.

One analytic technique that is increasingly used to understand health worker preferences in developing countries is the discrete choice experiment (DCE). The DCE is a stated preference technique that provides a quantitative estimate of how health workers value different aspects of their job—such as working conditions, pay, and whether the job is located in a rural area—in monetary terms. Results from the analysis can also be used to predict how health workers would respond to alternative hypothetical incentive packages offered in rural areas. DCE studies that focus specifically on understanding the willingness of doctors and nurses to locate in rural areas have been carried out in several developing countries (Table 1).

Table 1: Summary of previous DCE studies focusing on rural area retention

Country	Cadre(s)	Sample	Reference
Tanzania	Clinical Officers	Final year students	Kolstad (2010)
Indonesia	Physicians	Final year students	Chomitz et al. (1998)
Ethiopia	Physicians, Nurses	Working	Hanson and Jack (2008)
Malawi	Nurses	Working	Mangham (2007)
Ghana	Physicians	Final year students	Kruk et al. (2010)
Kenya, S.Africa, Thailand	Nurses	Final year students	Blaauw et al. (2010)

However, while previous DCE studies have predicted the impact of alternative incentive packages on health worker behavior, none has estimated the cost of providing these packages. This is an extremely important step in translating the DCE results into a "decision-informing" tool. With fixed budgetary resources, policy makers would benefit greatly by understanding not only the expected impact of a particular policy, but its associated cost as well. In fact, almost all the previous studies explicitly acknowledge that for DCE studies to have maximum value for policy-making decisions, it is vital to take the next step and incorporate job-attribute cost data (for example, Kolstad 2010 and Blaauw et al. 2010). This is precisely what we do in this paper. Specifically, we summarize results from DCEs carried out on a sample of nurses in Liberia and physicians in Vietnam that focus specifically on understanding what incentives are most likely to attract staff to rural areas. We take the predicted take-up rates of rural jobs under alternative incentive schemes that are derived from the DCE analysis and combine these with the estimated costs of actually providing those incentive schemes. This allows us to compare the expected cost and predicted impact of alternative policy options to produce a powerful decision making tool for human resources for health policy.

Section 2 describes the DCE methodology and how it was applied in Liberia and Vietnam. Section 3 presents the results and discusses how they can be used by policy makers to inform the design of incentive packages to recruit staff to rural areas. Section 4 concludes.

THE DCE METHODOLOGY

The DCE methodology is based on utility maximization among health workers and is described in detail elsewhere (see, for example, Kolstad 2010). The theoretical underpinning for the empirical analysis of health worker location decision is the random utility model. 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*). Thus, individual *n* will choose job *i* if and only if

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

The random utility model assumes that the utility associated with a particular job is made up of two components. The deterministic component V_{ni} is a function of m job attributes ($x_1 \ldots x_m$) that are observed, such as pay, working conditions, and location, each valued at a certain "weight" or "preference" ($\beta_1 \ldots \beta_m$). The random component ε_{ni} is a function of unobserved job attributes as well as individual-level variation in tastes.

$$V_{ni} = \alpha_1 + \beta_1 x_{1ni} + \beta_2 x_{2ni} + \ldots + \beta_m x_{mni}$$

$$U_{ni} = V_{ni} + \varepsilon_{ni}$$

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

The utility of a job is not directly observable. This means that the coefficients in equation (1) cannot be estimated directly. The DCE methodology takes advantage of the fact that the jobs that individuals choose are observed along with all the other jobs that they do not choose. Thus, when individual n is presented with a pair of jobs, the probability that he or she chooses job i over job j can be written as

$$P_{ni} = \Pr[U_{ni} > U_{nj}] \qquad \forall i \neq j \in J$$

$$P_{ni} = \Pr[V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj}] \quad \forall i \neq j \in J$$

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

By making various assumptions on ε_{ni} (most commonly, that it is independent and identically distributed), equation (2) can be estimated using standard econometric techniques,[1] giving estimates of $\alpha_1, \beta_1 \ldots \beta_m$. The results are then used to calculate the monetary value that health workers place on various job attributes (that is, willingness to pay). The take-up rate of a rural job under alternative policy scenarios can also be predicted. For any pair of jobs, A and B—one in a rural area and one in an urban area, for example—the model can be used to predict the take-up rate of job A for various job-attribute levels.

To identify job attributes and associated levels we followed the recommended steps that are well known in the DCE literature (Mangham et al. 2009 and Ryan et al. 2008, for example). We carried out extensive qualitative work in both Liberia and Vietnam. Through in-depth interviews with nurses in Liberia, doctors in Vietnam and policy makers in both countries, we identified separate sets of job attributes that are both important to health workers and are amenable to policy change. The associated levels were informed by the qualitative stage, current values where data were available, and extensive pretesting. A full summary of the qualitative analysis is available elsewhere

[1] The two most commonly used techniques used in health worker DCEs are conditional logit and mixed logit. For example, Kolstad (2010) uses a conditional logit model for medical officers in Tanzania. Kruk et al. (2010) and Blaauw et al. (2010) use a mixed logit model.

(Vujicic, Alfano, Wesseh, and Brown-Annan 2010 for Liberia; Witter et al. 2010 for Vietnam). The final set of job attributes and associated levels that were used in the DCE analysis are shown in Tables 2 and 3.

Table 2: Job attributes and levels for nurses used in DCE, Liberia

Attribute	Level	Definition
Location	Urban	County capital
	Rural	At least 2-hour drive from the county capital
Equipment	Adequate	Medical equipment, drugs, and facility standards allow you to provide about 75% of the government's full basic package of health services
	Inadequate	Medical equipment, drugs, and facility standards allow you to provide about 25% of the government's full basic package of health services
Total Pay	US$ 120	This is total monthly income from working in the facility. If you currently get an incentive, it is the incentive amount plus any allowances. If you are on the government payroll, it is the salary amount plus any allowances
	US$ 160	
	US$ 200	
	US$ 240	
Transportation	Yes	A motorbike is available to you during working hours. It is shared with other health workers and is not for personal use
	No	No motorbike provided
Housing	Yes	Housing is provided to you free of charge. It is self-contained, concrete, apartment-style housing on-site at the facility
	No	No housing provided
Workload	Heavy	You barely have enough time to care for patients, you are always on call, and you work 1–2 extra hours every day
	Normal	You have enough time to see patients and you leave work on time

Table 3: Job attributes and levels for doctors used in DCE, Vietnam

Attribute	Level	Definition
Location	Remote rural area Urban center area	This attribute specifies whether the place of work is in a remote rural area or in an urban center. Remote rural area is defined as a sparsely populated area, which is more than a 1-hour drive from a main urban center
Equipment	Inadequate Adequate	This attribute includes medical tools and facilities to support your work (clinical diagnosis, for instance). "Adequate" is the government standard package and "Inadequate" is lower than the government standard package for that level
Institutional Payment	Level 1 (VND 4 million) Level 2 (VND 8 million) Level 3 (VND 12 million) Level 4 (VND 16 million) Level 5 (VND 20 million)	This is the income from specific government sources, such as salary, occupational allowance, overtime allowance, hospital autonomous funds, but not those from private practice or private consultancies
Skills Development (short-term training)	No skills development program Short-term courses, expert exchange, and supportive supervision	This attribute is the opportunity to develop professional skills. Staff may be given the possibility to attend short-term courses or workshops on specific issues, to work with a range of experienced colleagues, and to receive more supportive technical supervision
Long-term Education (specialist training)	None Possibility to enter advanced medical school after 5 years on the job	This attribute states that, on the condition that the doctor stays at least 5 years on the job, she or he will be offered the opportunity to go back to a formal medical school in a central teaching hospital for training of at least one year. This training would enable a doctor to get the full medical doctor degree, if not yet received, or to acquire a specialization degree
Housing	None Government-provided housing	This job attribute specifies whether or not the government will provide free housing in addition to the wage

To generate the choice sets we used well-established statistical methods. We chose to limit the number of choice sets to 16 in both settings. This is within the acceptable range for DCE studies. We used DCE macros in the statistical program SAS to generate a D-optimal design that maximized D-efficiency, taking account of orthogonality (job-attribute levels are independent of each other), level balance (job-attribute levels appear with the same frequency), and minimal overlap (job attributes do not take the same level within a choice set). [2] (We also inserted tests of rationality where one job dominates the other in every attribute. However, we found that, ex post, it was possible for individuals with certain preferences to actually prefer the "inferior" job. Thus, we did not use these rationality tests.) Prior to the field data collection, the questionnaire was pretested extensively to evaluate the reactions of the respondents, the appropriateness of the questions, and the suitability of format and wording of questions. A sample choice set from Liberia is provided in Figure 1.

[2] For more information see, for example, Kuhfeld and Tobias (2005).

Figure 1: Example of a choice set from DCE, Liberia

In this section of the questionnaire we want to try and understand what types of nursing jobs you most prefer.

We will be doing this by presenting you with two different nursing jobs and then asking you tell us which you prefer. You will see that each job has advantages and disadvantages and you will need to carefully trade-off the advantages and disadvantages in telling us which job you prefer.

For each pair of jobs, we would also like to know whether you would accept this job over your current job if the Ministry of Health offered it to you.

You can assume that the length of service in all jobs is 3 years.

Job 1	
Location	Urban
Equipment	Inadequate
Total Pay	160
Transportation	Yes
Housing	No
Workload	Heavy

Job 2	
Location	Rural
Equipment	Adequate
Total Pay	240
Transportation	Yes
Housing	Yes
Workload	Normal

Which of these two jobs do you prefer? ☐ **Job 1** ☐ **Job 2**
Would you accept this job over your current job? ☐ **Yes** ☐ **No**

Our sampling strategy in Liberia had three phases. In the first stage we stratified facilities by staffing size. We had to exclude some facilities simply due to travel logistics; these excluded facilities accounted for only 8 percent of nurses in Liberia. In the second stage we randomly selected facilities within each stratum. In the third stage we randomly selected individual nurses within facilities, or interviewed all nurses in smaller facilities. This yielded a total sample of 197 nurses, corresponding to about 11 percent of the nursing workforce in the country. Our sample is representative of nurses in Liberia for key measures such as age, education, gender, and type of contract (Vujicic, Alfano, Wesseh, and Brown-Annan 2010).[3]

In Vietnam we also used multi-stage sampling. In the first stage facilities were randomly selected from seven predefined strata based on facility level and province. In the second stage, doctors were randomly selected from facilities. The final sample size was 292 doctors, representing about 0.6 percent of the doctor population in Vietnam. Our sample is similar to the national profile on several key variables such as age, education, and earnings.[4]

[3] These are the only variables for which there is information in both the DCE and the national health worker census.

[4] For more information, see Vujicic, Shengelia, Alfano, and Ha (2010).

RESULTS

Tables 4 and 5 summarize the predicted take-up rate of rural jobs (and 95 percent confidence interval) under alternative policy scenarios that we simulated for Liberia and Vietnam. These estimated take-up rates were derived from regression estimates of equation (2) using a mixed logit model.[5] The focus of this paper is to combine these predicted take-up rates with job-attribute cost data to show how such an analysis can be used as a decision-informing tool by policy makers involved in human resources for health. As noted earlier, this is the first DCE study on health workers (that we know of) that goes on to this next step that is, in our experience, so crucial to making the results useful to policy makers. Moreover, using DCEs to compare cost-effectiveness of alternative policies is a relatively new and unexplored area in general. We could not find any published DCE studies that incorporated attribute cost data to explore cost-effectiveness issues. Thus, there is little guidance from previous work on attribute costing methodology.'

Table 4: Expected cost and predicted impact of alternative policies, Liberia

Policy option to be implemented in rural area	Predicted % of nurses willing to accept a rural job			Additional cost per month per nurse (US$)	
	Mean	95% CI		Min	Max
Baseline	44	43.7	44.5		
Nonfinancial Incentives					
Improve equipment	48	47.6	48.4	168	318
Provide transportation	49	48.6	49.4	102	
Provide housing	48	47.6	48.4	141	191
Financial Incentives					
Increase monthly pay by US$ 25	46	45.7	46.3	25	
Increase monthly pay by US$ 50	48	47.7	48.3	50	
Increase monthly pay by US$ 100	53	52.6	53.4	100	
Increase monthly pay by US$ 200	62	61.6	62.4	200	
Combination of Incentives					
Provide housing and transportation	54	53.6	54.4	243	293
Increase monthly pay by US$ 50 and provide housing	53	52.6	53.4	191	241
Increase monthly pay by US$ 50 and provide transportation	54	53.6	54.4	152	

Notes: (i) In the baseline scenario both the urban and rural jobs are assumed to have inadequate equipment levels, no transportation, no housing, the same workload level, and the same total pay of US$ 150. This is a fairly accurate depiction of the current situation in Liberia. (ii) Percentage of nurses willing to accept a rural job is calculated based on the DCE analysis. For more details, see Vujicic, Alfano, Wesseh, and Brown-Annan (2010). (iii) Estimates of the additional cost per month per nurse are from the appendix. Where multiple cost estimates are available, the minimum and maximum are given.

[5] The full regression analysis, estimated willingness to pay (including subgroup analysis), and a detailed explanation of the methodology for calculating take-up rates is discussed elsewhere: for Vietnam see Vujicic, Shengelia, Alfano, and Ha (2010), and for Liberia see Vujicic, Alfano, Wesseh, and Brown-Annan (2010).

Table 5: Expected cost and predicted impact of alternative policies, Vietnam

Policy option to be implemented in rural area	Predicted % of doctors willing to accept a rural job			Additional cost per month per doctor (US$)
	Mean	95% CI		
Baseline	23	22.7	23.3	
Nonfinancial Incentives				
Improve equipment	32	31.7	32.3	520
Provide housing	29	28.6	29.4	175
Provide skills development	32	31.7	32.3	138
Provide long term education	34	33.6	34.4	250
Financial Incentives				
Increase pay by VND 0.5 million	24	23.7	24.3	26
Increase pay by VND 1 million	25	24.7	25.3	52
Increase pay by VND 2 million	26	25.7	26.2	103
Increase pay by VND 3 million	28	27.6	28.4	154
Combination of Incentives				
Provide housing and VND 1 million	31	30.6	31.4	227
Provide skills development and VND 1 million	34	33.6	34.3	190
Provide long term education and VND 1 million	36	35.6	36.4	302

Notes: (i) In the baseline scenario the urban area job has adequate equipment, institutional pay of VND 4.0 million (US$ 206) and skills development opportunities. The rural job has the same pay but has inadequate equipment and no skills development opportunities. Neither the rural or urban jobs have any provisions for entering long-term education after five years nor do they offer free housing. This is an accurate depiction of the current situation in Vietnam. (ii) Percentage of doctors willing to accept a rural job is calculated based on the DCE analysis. For more details see Vujicic, Shengelia, Alfano, and Ha (2010). (iii) Estimates of the additional cost per month per doctor are from the appendix. Where multiple cost estimates are calculated, the simply average is used in the table. (iv) An exchange rate of US$ 1 = VND 19,500 is used throughout.

Estimating the cost of providing alternative incentive packages in rural areas requires information on the incremental cost associated with improving one or more job-attribute levels. We found this process to be challenging for several reasons. First, job-attribute levels are often defined in descriptive, non-quantitative ways that are sometimes open to subjective interpretation. This makes it difficult to identify the exact set of inputs and associated costs that would be needed to move from one level to the next. In our case, the equipment and workload job-attribute levels are defined in a way that allows much room for interpretation and subjectivity.

Second, some job attributes involve the provision of durable goods, making it challenging to determine a monthly or annual cost. To transform investment costs into recurrent costs requires making assumptions on the useful life, maintenance costs, and salvage value of these durable goods. In our case, the equipment, housing, and transportation job attributes fall within this category.

Third, there needs to be a clear decision on whose perspective will be taken when calculating costs and, related to this, what time horizon is most appropriate. Different job attributes may fall under the authority of different actors in the health sector. In such a

situation, with multiple decision makers controlling different job attributes, the analysis of expected cost and predicted impact becomes complicated. In our case this problem was not relevant as, in both Liberia and Vietnam, we deliberately chose job attributes that were in the direct control of the government. Thus, we viewed the cost calculations from the perspective of a single actor—the government—as this work was requested by the government.

In terms of time horizon, the key issue is how to handle job-attribute costs that are likely to vary considerably over time. For example, will financial incentives be increased at the rate of inflation or will the nominal value be fixed over time? Is it appropriate to consider long-term costs (such as equipment maintenance costs) and if so, how should they be discounted into present-day values? In our calculations, we took a long-term horizon and attempted to discount into today's dollars all the long-term costs associated with the alternative policies.

Fourth, some job attributes by nature do not benefit only a single health worker but, rather, are determined at the facility level. For example, improving equipment levels requires investments at the facility level. How that cost is spread across health workers in the analysis requires making assumptions on, among other things, average staff levels per facility. The same is true for the case of training programs for health workers when those programs are delivered in groups. An assumption needs to be made on how many health workers can be trained for a given budget.

Finally, even when these methodological and conceptual decisions are resolved, actual cost data are often scarce in developing countries. For these reasons, it is almost impossible to arrive at an accurate point estimate for several job attributes. In such cases, and whenever feasible, it is extremely important to use a range of costs (such as maximum and minimum estimates) in the analysis rather than point estimates or simple averages.

The appendix contains a detailed description of our costing methodology, data sources, and calculations for Liberia and Vietnam. Several important points stand out. First, we decided to focus on the monthly cost per health worker, as our focus is on comparisons of expected cost and predicted impact, not affordability. To estimate total costs would require identifying the target populations (that is, the number of health workers in rural areas receiving the incentive package) over time. Second, we use real net present value costs. We convert capital investments (such as equipment and, in the case of Liberia, housing and transportation) into monthly costs by amortizing their value over their useful life. We also assume that the real value of all recurrent costs will remain constant.[6] With this approach, we can compare the cost per month per (eligible) nurse that is required for a given increase in the take-up rate of rural jobs using different incentive packages. Alternatively, we can also compare the expected increase in the take-up rate of rural jobs

[6] For example, US$ 50 in additional pay will actually increase at the rate of inflation in nominal terms so that it will retain its purchasing power of US$ 50 forever. Similarly, the monthly cost per doctor of providing long-term education will stay constant in real terms.

for a given amount of additional resources available per nurse using different incentive schemes. We cannot compare the total cost of any scheme and whether it is affordable to the government. It is important to emphasize that there are many other methods for estimating job-attribute costs, each of which has its merits and challenges.

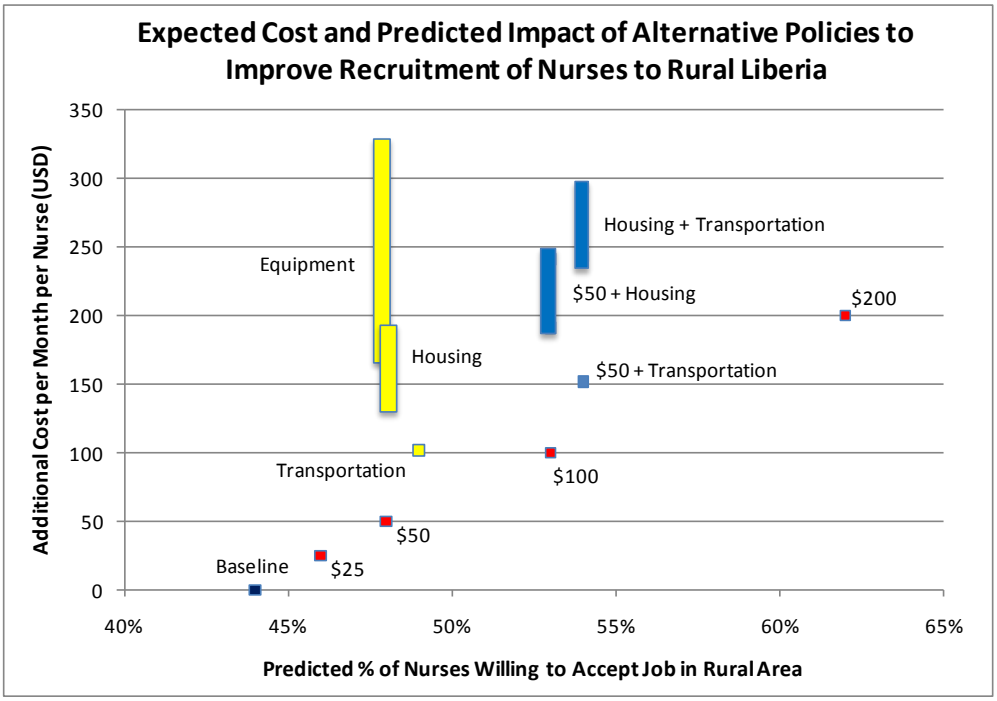
The last column of Tables 4 and 5 shows the additional monthly cost per health worker associated with the various rural incentive schemes. As noted, these costs are estimated from the perspective of the government, the key stakeholder and driving force for undertaking our analysis. For example, we estimated that the monthly cost of providing housing to a nurse in rural Liberia ranges from US$ 141 to US$ 191; we used several different sources in an effort to "triangulate" values. In Vietnam, the cost of providing housing to a doctor in a rural area is estimated to be US$ 175 per month. We had to rely on a single source of data in Vietnam for the job attributes and, therefore, have less confidence in the estimates.[7] It is important to emphasize that the particular incentive packages presented in Tables 4 and 5 are illustrative. The great advantage of the DCE methodology is that results can be used to simulate any number of combinations of incentive packages that governments might be interested in.

The data in Tables 4 and 5 are most easily interpreted when they are presented in graphic form (Figure 2 for Liberia and Figure 3 for Vietnam). In Liberia, the upper and lower estimates of the cost of the incentive package are graphed. In Vietnam, as we had only a single source for cost estimates, we arbitrarily set upper and lower bounds at + / - US$ 50 of the point estimate for all nonfinancial incentives. In this way, the vertical distance of the bars captures the level of unreliability of cost data.

Similarly, a range of estimates for the predicted take-up rate of rural jobs can also be graphed. For example, the 95 percent confidence interval values can be used as upper and lower bounds. In our case, these confidence intervals are very narrow and the resulting horizontal distance is small. But this may not be the case in other settings. The area of the bars, therefore, can be thought of as a "rectangle of reliability" for the estimated cost and predicted impact values. When the data are arranged this way, it is very easy to compare the alternative incentive packages.

[7] We were fortunate to have access to multiple sources of data in Liberia and more time to collect and validate the data. In Vietnam, due to time and resource constraints, we relied much more on single sources, in most cases government agencies.

Figure 2: Expected cost and predicted impact of alternative policies to improve recruitment of nurses to rural areas, Liberia



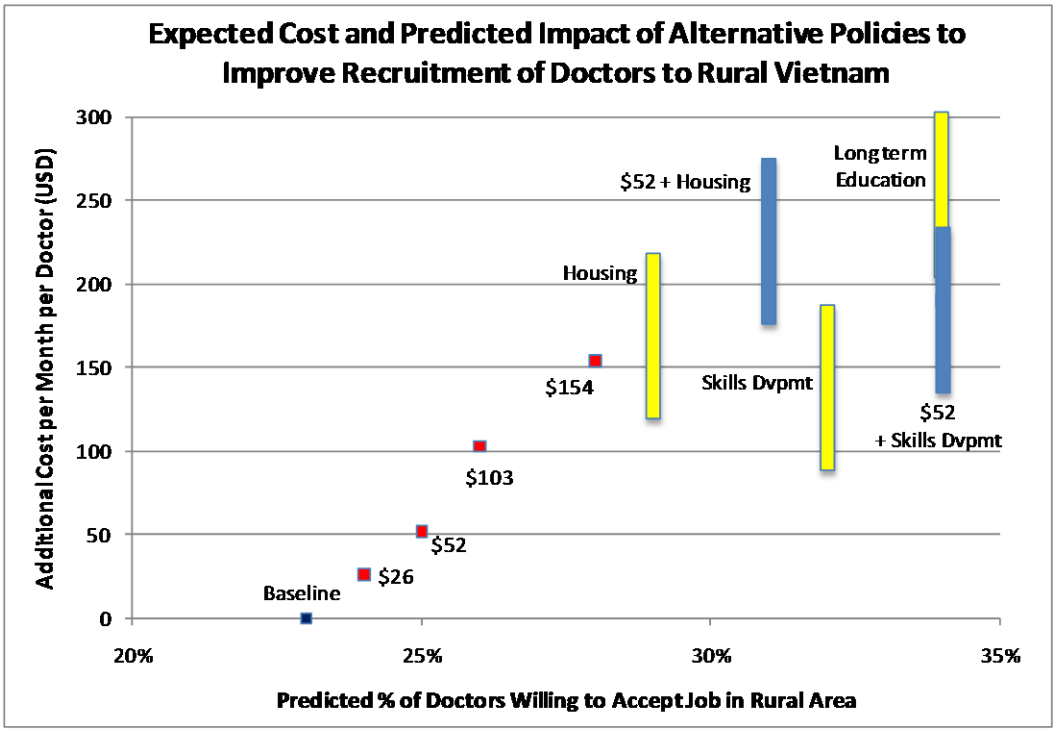
Notes: (i) Predicted % of nurses willing to accept a job in a rural area is from Table 4. (ii) Additional cost per month per nurse is from the appendix. (iii) Vertical range of bars represents upper and lower estimate of cost. (iv) Red markers indicate financial incentives, yellow markers nonfinancial incentives, and blue markers a combination of financial and nonfinancial incentives.

In Liberia, providing US$ 100 in additional total pay in rural areas has a predicted impact on take-up rates of rural jobs that is within a few percentage points of providing US$ 50 in additional total pay plus free housing, or US$ 50 in additional total pay plus free transportation. However, providing US$ 100 in additional total pay is much less costly to the government, according to our estimates, than either of the other two options. Improving equipment levels in facilities—even using the lowest cost estimate—appears to be one of the least cost-effective methods of attracting nurses to rural areas (although it would certainly have other extremely positive effects on the health system). In fact, according to our results, financial incentives in Liberia seem to be more cost-effective than nonfinancial incentives in attracting nurses to rural Liberia. The graph clearly shows that this is not because the nonfinancial incentives have less of a predicted impact on nurse decisions, but rather because it is much more costly to provide them.

In Vietnam, our results show a different story. Providing opportunities for skills development to doctors in rural areas appears to be the most cost-effective policy within its cost range. For example, providing opportunities for skills development is expected to cost roughly the same as providing a US$ 154 monthly financial incentive but is predicted to bring about a much larger impact on recruitment. Similarly, providing free housing to doctors in rural areas is expected to have roughly the same cost and predicted impact as

US$ 154 in extra pay. These results suggest that some nonfinancial incentives are more cost-effective than financial incentives in attracting doctors to rural Vietnam.

Figure 3: Expected cost and predicted impact of alternative policies to improve recruitment of doctors to rural areas, Vietnam



Notes: (i) Predicted % of doctors willing to accept a job in a rural area is from Table 4. (ii) Additional cost per month per doctor is from the appendix. (iii) Vertical range of bars represents upper and lower estimate of cost, which in the case of Vietnam is set arbitrarily at + / - US$ 50. (iv) Red markers indicate financial incentives, yellow markers nonfinancial incentives, and blue markers a combination of financial and nonfinancial incentives.

CONCLUSION

DCEs are increasingly being used to study health worker preferences, particularly toward locating in rural areas. Our study is the first DCE on health workers that we are aware of that incorporates job-attribute cost data into the analysis. We feel that this step is crucial to transforming results from a DCE into a decision-informing tool. The results presented in this paper from Liberia and Vietnam—two countries at very different ends of the development spectrum—demonstrate how collecting job-attribute cost data allows for a direct comparison of the expected cost and predicted impact of any number of alternative incentive schemes.

However, it is important to be clear on how we recommend such analysis should be used and, more importantly, how we believe it should not be used. The external validity of DCEs has not been adequately studied, especially in health (Ryan forthcoming); Louviere and Lancsar 2009; Ryan et al. 2008). Moreover, our experience in Liberia and Vietnam has shown that estimating job-attribute costs and, therefore, the cost of alternative incentive packages, is conceptually and empirically challenging. As a result, the estimated cost and predicted impact of a particular policy should be interpreted with considerable uncertainty. In other words, is it more appropriate to always use a range of values rather than point estimates? And if so, how big should this range be?

This decision needs to be based on the researcher's and policy maker's opinions on the reliability of results, as well as the decision maker's acceptable level of error for the estimated cost and predicted impact. For example, the results from Liberia indicate that even for a very broad range of estimates, financial incentives appear considerably more cost-effective than nonfinancial incentives. Thus, we believe a reasonable policy message from our analysis is that, at least in the short term, the government may want to focus on financial incentives. However, an unreasonable application of these results, in our opinion, would be to use them to determine the exact dollar amount of additional pay the government should offer to fill 12 nursing vacancies in the outlying areas of Grand Kru and Maryland county.

Similarly in Vietnam, we believe a reasonable policy message is that if the government can afford to spend an additional US$ 150 per month per doctor in rural areas, that money would be best used to pay for long-term education or skills development programs for these rural doctors. Such information would be incredibly useful, for example, in budget negotiations with the Ministry of Finance or with agencies responsible for admission policies to medical training programs. But the DCE results cannot say anything about whether long-term training programs will have exactly the same impact on vacancy rates in a district hospital in Lao Cai and a commune health center in Dong Thap province.

Recently launched policy guidelines emphasize the need to tailor rural recruitment and retention strategies to local contexts (WHO 2010). Our findings suggest that this recommendation has real validity. Both the results and policy messages from the DCE in Liberia and Vietnam are very different. As future DCEs incorporate job-attribute cost data, it will be interesting to see whether any trends emerge. For example, are

nonfinancial incentives more cost-effective than financial incentives? Taking things further, are bundled incentives more cost-effective than single interventions?

On a final note, the objective of this paper is not to arrive at specific recommendations on which incentive packages ought to be implemented in Liberia and Vietnam. Rather, it is to demonstrate the value of using a DCE and, specifically, in incorporating job-attribute cost data, as a decision-informing tool. An alternative methodology for designing the DCE, or an alternative econometric model for data analysis, or an alternative approach to estimating job-attribute costs, may give very different results. These are all areas that need to be explored in research in the future. Nevertheless, our experience in these two countries leads us to believe that the DCE methodology can be one useful analytic method to improve the evidence base for designing rural incentive schemes in developing countries.

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APPENDIX: METHODOLOGY FOR ESTIMATING JOB-ATTRIBUTE COSTS

Calculations for Vietnam

The calculations for estimating job-attribute costs are based on doctors working in district-level facilities. The 2008 Census reports 1,366 of these facilities in Vietnam, employing a total of 14,352 physicians (doctors). On average, therefore, each facility at this level employs around 10 physicians. The exchange rate between US$ and VND used here is VND 19,495 = US$ 1.

Equipment. The monthly cost per physician of providing adequate equipment in a district-level facility is based on the purchase cost of the equipment required in district facilities according to government standards. Key informants within the Ministry of Health suggested that since equipment conditions in rural areas are so poor, it might be reasonable to assume that facilities would almost require a complete refurbishment. Alternatively, we could have chosen fixed percentages of the total purchase cost of new equipment (for example, assuming that bringing equipment levels up to adequate from inadequate would require an investment equivalent to 50 percent of the cost of the full equipment list). The purchase prices and expected useful life were provided by the Ministry of Health. The monthly cost per doctor of providing adequate equipment is calculated as:

Total cost of purchasing all equipment for an average district-level facility with 100 beds ÷ Estimated months of useful life ÷ Average number of physicians per district level facility

= US$ 500,000 ÷ 96 months ÷ 10 physicians = US$ 520 per doctor per month

Long-term education. For this attribute, we simply calculated the cost to the government of providing long-term, specialty training. All information was provided by the Ministry of Health. The monthly cost per doctor of providing long-term education is calculated as:

Overall annual training costs for specialist medical education ÷ Months per year

= US$ 3000 ÷ 12 months = US$ 250 per doctor per month

Skills development. Through the preparatory qualitative research we were able to ascertain that doctors would value short-term training two or three times a year in order to improve their skills. We took estimates of the average total cost to the Ministry of Health of running a one-week training program, and used this to calculate the cost per doctor based on enrollment norms. The monthly cost per physician of providing skills development (that is, short-term training) is calculated as:

Average cost of a one week training course ÷ Number of participants ÷ Months per year × Number of training courses offered per annum

= US$ 25,000 ÷ 30 participants ÷ 12 months × 2 courses per annum = US$ 138 per doctor per month

Housing. In Vietnam we calculated housing costs based on market rates. This implicitly assumes that the government will procure housing on behalf of doctors in the open market rather than build the actual housing infrastructure. Based on our discussion with Ministry of Health officials this assumption indeed was current government thinking. The estimated rental price for an apartment acceptable to a government doctor, with accommodations for four people, in a rural area is between US$ 150 and US$ 200 per month. This information was provided by key informants in Vietnam.

The monthly cost per physician of providing housing is:

(US$ 150 + US$ 200) ÷ 2 = US$ 175 per doctor per month

Calculations for Liberia

Equipment. In Liberia we were able to develop a more robust methodology. We needed estimates of the incremental cost of improving medical equipment, drugs, and facility standards to a point where nurses can provide 75 percent of the basic package of health services (BPHS) instead of 25 percent. To estimate this cost we relied on the recent BPHS costing report (MOHSW 2009), the most recent facility accreditation results (MOHSW 2010), and expert opinion.

The BPHS costing report summarizes the operating costs (including salaries, drugs, and medical supplies but not infrastructure and medical equipment) in clinics, health centers, and hospitals for delivering the full BPHS. First, the volume of services within facilities was estimated based on catchment population and service delivery coverage scenarios. The low service delivery scenario represents levels that should be achievable in the short term. It is based on current utilization levels for a sample of facilities and can be regarded as a reasonable goal for the average facility. The number of services per capita under this scenario is 0.72, which represents a coverage rate of 27 percent (that is, 27 percent of "needed" services are delivered). The 27 percent coverage rate was used for all services except immunizations, for which the individual coverage rates for each county were used based on the 2007 Demographic and Health Survey. As a comparison, the medium service delivery scenario assumes a 77 percent coverage rate for immunization and 50 percent for other services.

Second, the staffing, drugs, and medical supplies (but not infrastructure and medical equipment) required to meet the target service delivery levels were determined by a team of local experts comprising primarily physicians, nurses, and midwives from the Ministry of Health and Social Welfare (MOHSW) and four nongovernmental organizations. The standards were based, where possible, on MOHSW official guidelines and standards of treatment. The team provided detailed information on the staff time and activities, drugs

and supplies, and laboratory tests required for each service. These inputs were then costed.

We used the drugs and medical supplies cost estimates for clinics and health centers under the low service delivery scenario as this most accurately reflects the current situation. We then assumed that *x* percent of this total cost would be a good proxy for the cost of drugs and medical supplies needed to deliver *x* percent of the full BPHS. To convert per facility costs to per nurse costs we simply divided by the average number of nurses per facility.

Thus, the monthly cost per nurse for improving drugs and medical supplies to a point where nurses can provide 75 percent of the BPHS (instead of 25 percent) is calculated as:

Annual recurrent cost of drugs and supplies needed to deliver BPHS in clinics × (Share of cost needed to deliver 75% of BPHS – Share of cost needed to deliver 25% of BPHS) ÷ Months in year ÷ Average number of nurses per facility

= US$ 9,899 × (75% - 25% = 50%) ÷ 12 ÷ 1.39 = US$ 297 per nurse per month for clinics

= US$ 15,439 × (75% - 25% = 50%) ÷ 12 ÷ 4.38 = US$ 147 per nurse per month for health centers

For equipment costs, we could not use this same methodology because data on total equipment costs were not available in the same way. However, the most recent facility accreditation report (MOHSW 2010) provides a list of the most common equipment items that were missing from clinics and health centers. We then assumed that if these missing pieces of equipment were provided, this would be a good proxy for raising equipment standards from where nurses can provide 25 percent of the basic package of health services to 75 percent. Unit costs and expected useful life for the equipment items were provided by the Liberia National Drug Service.

Thus, the monthly cost per nurse for improving medical equipment to a point where nurses can provide 75 percent of the BPHS (instead of 25 percent) is calculated as:

Cost of purchasing equipment needed in clinics and health centers ÷ Estimated useful life (in months) ÷ Average number of nurses per facility

= US$ 1,429 ÷ 48 ÷ 1.39 = US$ 21 per nurse per month for clinics

= US$ 4,504 ÷ 48 ÷ 4.38 = US$ 21 per nurse per month for health centers

Taken together, the total monthly cost per nurse for improving drugs, medical supplies, and medical equipment to a point where nurses can provide 75 percent of the BPHS is:

= US$ 297 + 21 = US$ 318 per nurse per month for clinics

= US$ 147 + 21 = US$ 168 per nurse per month for health centers

Transportation. The MOHSW provided cost estimates for motorbikes. The most recent cost for a motorbike with headgear is US$ 3,724. The average monthly maintenance and fuel cost is estimated to be US$ 100. The expected useful life is 36 months with no salvage value. Assuming straight-line depreciation, this results in a monthly operating cost of US$ 203 per motorbike. Consistent with the definition of the transportation attribute in the DCE survey, and based on consultations with decision makers, we decided on a rough allocation of one motorbike for every two nurses.

Thus, the monthly cost per nurse of providing motorbikes is

Monthly cost of providing a motorbike ÷ Nurses per motorbike = US$ 203 ÷ 2 = US$ 102 per nurse per month

Housing. We calculated housing cost based on building costs, because the government was considering building living quarters for health workers on site at facilities. The Infrastructure Unit of the Department of Planning and Research, MOHSW provided one set of cost estimates for housing. The Ministry of Education also provided estimates of housing costs for teacher quarters. According to the MOHSW, the most recent estimates of the construction cost of a standard staff housing unit (two-bedroom duplex that could house two nurses) including materials, labor, and transportation of goods is US$ 95,000. According to the Ministry of Education the cost for a housing unit for teachers (that could house one nurse) is US$ 35,000. In both cases the average annual maintenance cost is estimated at 1.5 percent and the expected useful life is 30 years with no salvage value. We assume straight-line depreciation.

This results in a monthly operating cost for newly constructed housing per nurse of:

US$ 191 per nurse per month according to MOHSW estimates

US$ 141 per nurse per month according to Ministry of Education estimates

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