Policy interventions to improve rural retention among neurosurgeons in Iran: A discrete choice experiment

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Abstract

Background: Health workforce shortages in rural and remote areas are a global challenge that almost every health system has to deal with. This study aimed to discover neurosurgeons’ job preferences and propose policy interventions that could possibly increase their retention in rural, remote, or underserved areas.

Methods: A discrete choice experiment (DCE) was conducted in November 2014 with a sample of Iranian neurosurgeons selected from five contrary’s provinces representing the geographical diversity. Job attributes included income, dual practice opportunities, workload, proximity to family, clinical infrastructure, housing, educational facilities, and work location. Probit regression model was used to estimate the importance of different job attributes and examine the extent to which neurosurgeons were willing to tradeoff between monetary and nonmonetary attributes.

Results: Findings indicated that increased salary, permission to undertake dual practice and access to adequate clinical infrastructure were the most important retention policies. Provision of subsidized housing and educational facilities also increased neurosurgeons’ attraction and retention in rural areas.

Conclusion: A range of policy interventions focusing on both monetary and nonmonetary incentives are required to increase neurosurgeons’ retention in rural, remote, or underserved areas.

Introduction

Inequitable distribution of physicians between large metropolitan cities and remote or noncapital areas has become a serious concern and a priority to deal with.¹,² Despite being a universal concern,³,⁴ low and middle income countries made great efforts to give a best possible answer to the question of how to attract physicians and improve their retention in underserved areas.⁵,⁶ World Health Organization (WHO) has identified 16 retention strategies, including regulation and compulsory policies, financial motivations, education and training, personal and job-related support plans.⁷ All around the world different policies have been developed to cope with uneven distribution of physicians. Some were related to monetary incentives⁸ and some
nonfinancial motivations, although the successfullness of strategies were highly dependent on the local context and type of health cadres. One method to determine effective strategies for attracting and retaining health workforce in underserved areas is discrete choice experiment (DCE). This method has recently been used in health care as a form of stated preferences methods. DCE helps policy makers to determine a ranking of health providers’ preferences toward possible incentive packages in a way that each attribute’s value is comparable to another. Recently, DCE has increasingly been used in several developing countries for rural retention problems.

Islamic Republic of Iran is a middle income country located in south west of Asia. Iran Ministry of Health and Medical Education has recently faced with challenges in attracting and retaining health professionals particularly physicians in rural and remote areas. Nearly, 2000 general practitioners and 1700 specialists are lacking to serve in such areas of the country. In addition, there are around 2200 specialists working in 270 underserved areas who are not satisfied with their income and work condition and seek an opportunity to leave their workplace in a shortest time possible. Therefore, a particular attention must be paid to this issue and appropriate action plans should be proposed to encourage physicians to serve in rural, remote and nonmetropolitan areas of the country. In this study, we conducted a DCE with technical assistance from WHO guidelines to inform the selection of appropriate recruitment and retention strategies based on physicians’ preferences. In this study, we chose neurosurgeons as they play important role in diagnosis, treatment and rehabilitation of neurospine illnesses or injuries and their shortage in some areas would cause irreparable damages.

The study objective was to examine physicians’ preferences for different job attributes and to find out important determinants for deciding to serve in a rural remote area. We also evaluated the effects of different policy interventions on the probability of choosing to serve in rural or underserved areas.

Materials and Methods

A DCE was conducted in November 2014 with a sample of Iranian neurosurgeons selected from five contrary’s provinces representing the geographical diversity. Neurosurgeons under study were asked to choose between hypothetical job profiles describing as a combination of job attribute levels.

In the DCE literature, it is suggested to have at least 50 participants for each subgroup of interest. Following this rule, we considered two main subgroups of interest: those under 35 compared to those over 35, and those with rural background compared with those with urban background. Regarding to potential difficulties in data collection we increased target sample size by 20%, which led to 120 neurosurgeons. We used three stage sampling. First, five provinces were selected in a way to include geographical diversity. Second, remote and nonurban areas of each province where neurosurgeons were working in were defined and all included in the study. In the last stage, all in service neurosurgeons from public facilities were selected to reach the target sample.

Prior to conduct DCE, 17 in-depth interviews were done with in service neurosurgeons working in nine provinces of Iran to generate job attributes and corresponding levels from their own point of view. Physicians were asked about factors that could be influential in their retention in nonmetropolitan and remote areas. The qualitative data were used to decide on attributes and corresponding levels. Levels of each attribute were created in a way to reflect the existing work condition. Then additional levels were produced from a rational increase in the base levels. Appendix 1 depicts job attributes and levels determined as a result of the qualitative study.

Once the eight attributes and related levels were determined, alternative job profiles were generated consisting of all possible combinations of attribute levels. To reduce this to a practical number, SPSS software (version 22, SPSS Inc., Chicago, IL, USA) orthoplan procedure was used and produced a fractional factorial design with 16 scenarios. The criteria of level balance, orthogonality and minimum overlap among attribute levels were considered in designing an efficient experimental design. One of the job profiles in an urban city with average attribute levels was selected as a constant scenario comparing to the remaining job profiles and provided 15 choice sets for each physician to regard. The questionnaire also included a number of socio demographic questions to collect background characteristics of the physicians. The sequence of presenting job pairs and the attributes was different in the questionnaire to reduce any risk of careless response and boredom of respondents. Face and content validity of the questionnaire was tested in a pilot study conducted on 17 neurosurgeons who had participated in the interviews to identify any modification needed to be applied in a prior questionnaire. Final DCE questionnaire was applied to 120 in service neurosurgeons working in public health facilities of selected districts during November and December 2014. An example of a choice set is shown in table 1.
Ethical issues related to the research were taken into account. Permission to conduct the research was obtained from Tehran University of Medical Sciences, Iran, and participation in the study was considered to be voluntarily.

Data were entered in SPSS and checked for consistency. To analyze survey results, questionnaire data were transformed into STATA (version 13, Stata Corp LP, College Station, USA) wherein dependent variable (whether to choose Job A or Job B) was defined in a binary form. Probit regression model was used to analyze preference data and determine whether physician selected Job A or Job B. To investigate the correlation between physicians’ responses to different job choices, we used a random effect probit model. Estimated coefficients in the model equation would illustrate the marginal utility of each attribute level from physicians’ point of view. They also provided information about the significance and direction of the effects related to change in levels of attributes:

\[
\text{Prob}[U_{\text{job B}} > U_{\text{job A}}] = \beta_1 \text{location} + \beta_2 \text{income (2-4)} + \beta_3 \text{income (4-5)} + \beta_4 \text{income (5-6)} + \beta_5 \text{dual} + \beta_6 \text{workload (average-light)} + \beta_7 \text{workload (average-heavy)} + \beta_8 \text{family} + \beta_9 \text{education} + \beta_{10} \text{clin} + \beta_{11} \text{housing (basic-none)} + \beta_{12} \text{housing (basic-superior)} + \xi + \mu
\]

Where location, income (2-4), income (4-5), income (5-6), dual, workload (average-light), workload (average-heavy), family, education, clin, housing (basic-none) and housing (basic-superior) represent the difference in attribute levels between Job A and B and corr (\(\xi, \mu\)) stands for the correlation among individual choices.

As evaluation of different policies to identify most effective interventions in physicians’ retention is one of the most interesting analyses for policy makers we used regression results to calculate willingness to pay (WTP) and policy impact measures in our study. First we measured the amount of monetary attributes physicians were willing to overlook in obtaining more of nonmonetary attributes using marginal rate of substitution (MRS). This way, WTP for each attribute was calculated by dividing the attribute regression coefficient by income coefficient. Although WTP could be calculated for all income levels, but we only reported it for the lowest level to best reflect current situation.

\[
\text{MRS}_{\text{hh}}^{\text{kk}} = -\beta_h |\beta_k|
\]

Where MRS_{\text{hh}}^{\text{kk}} is the individual q’s marginal WTP for attribute h, \(\beta_h\) represents the coefficient of attribute h and \(\beta_k\) corresponds to the coefficient of attribute k (income) of the model.

Finally, we simulated the impact of various policy interventions on probability to choose rural job positions among physicians. To do so, we considered a baseline job (a job with the lowest level of attributes) and estimated the change in the probability of taking it up following a change in one of the job attributes. Marginal effect analysis was conducted for the purpose.

### Results

In total, 120 neurosurgeons working in public hospitals of 5 country provinces’ 15 districts completed the questionnaire (response rate = 83.6%). Respondents were mainly male and married (96.7%), and had urban background (55.8%). All respondents have chosen the best job profile with superior attribute levels verifying the internal consistency of responses.

The results for random effects probit model on which job neurosurgeons would choose confirmed that regression coefficients were statistically significant for seven of the attributes (location, income, dual practice, workload, educational facilities, clinical infrastructure, and housing) verifying their importance for neurosurgeons to make decision about different job choices. We tested the theoretical validity of the model by checking out the attribute levels’ sign and determined whether they were in compatible with anticipated sign or not. At 5% of confidence interval level, physicians positively valued working in urban area, higher salary, opportunity for dual practice and more number of surgeries per month, having access to adequate clinical infrastructure, educational facilities, and proper subsidized housing. Relative impacts of the attributes were also estimated using partial log-likelihood analysis.

| Table 1. An example of a choice set |
|-------------------------------------|
| **Job A**                           | **Job B**                           |
| Location: Rural, remote or underserved area | Location: National capital or urban developed city |
| Income: 200% increase in current income | Income: 150% increase in current income |
| Dual practice: Yes                   | Dual practice: No                   |
| Workload: Heavy                      | Workload: Heavy                     |
| Proximity to family: No              | Proximity to family: No             |
| Clinical infrastructure: Adequate     | Clinical infrastructure: Adequate   |
| Educational facilities: Superior     | Educational facilities: Basic       |
| Housing: Basic                       | Housing: No                        |

Which job profile do you prefer to choose? Job A ○ job B ○
Table 2. Probit regression results and monetary value of different job attributes

| Independent variables | From … to … | Coef.  | SD    | P     | WTP (%) |
|-----------------------|-------------|--------|-------|-------|---------|
| Location              | Urban to rural | -0.17  | 0.08  | 0.040 | -8.5    |
| Income 1              | 2000-4000 $  | 1.00   | 0.17  |       |         |
| Income 2              | 4000-5000 $  | 1.29   | 0.15  | < 0.001 | -      |
| Income 3              | 5000-6000 $  | 1.49   | 0.21  |       |         |
| Dual practice         | Not permitted to permitted | 2.79   | 0.11  |       | 139.5   |
| Workload 1            | Low to moderate | 0.37   | 0.08  |       | 18.5    |
| Workload 2            | Moderate to high | 0.17   | 0.06  | 0.006 | 8.5     |
| Family proximity      | Near to far   | 0.10   | 0.08  | 0.200 | -       |
| Educational facilities| Basic to superior | 0.20   | 0.08  | 0.001 | 14.0    |
| Clinical infrastructure| Inadequate to adequate | 0.70 | 0.11  |       | 36.5    |
| Housing 1             | None to basic | 0.63   | 0.10  | < 0.001 | 31.5   |
| Housing 2             | Basic to superior | 0.58   | 0.11  |       | 29.0    |

WTP: Willingness to pay; SD: Standard deviation

Table 3. Estimated take up rates for a rural job under different policy options

| Independent variables | From … to … | Marginal effect | Take up rates (%) | P     |
|-----------------------|-------------|----------------|-------------------|-------|
| Location              | Urban to rural | -0.046  | 4                | 0.040 |
| Income 1              | 2000-4000 $  | 0.205   | 20               |       |
| Income 2              | 4000-5000 $  | 0.280   | 28               |       |
| Income 3              | 5000-6000 $  | 0.335   | 33               | < 0.001 |
| Dual practice         | Not permitted to permitted | 0.654   | 65               |       |
| Workload 1            | Low to moderate | 0.103   | 10               |       |
| Workload 2            | Moderate to high | 0.047   | 4                | 0.005 |
| Family proximity      | Near to far   | 0.028   | -                | 0.200 |
| Educational facilities| Basic to superior | 0.080   | 8                | 0.001 |
| Clinical infrastructure| Inadequate to adequate | 0.178 | 18               |       |
| Housing 1             | None to basic | 0.163   | 16               | < 0.001 |
| Housing 2             | Basic to superior | 0.149   | 15               |       |

Results showed that the most important attribute was dual practice, which physicians put the greatest value on it and the least important attribute was workload from their point of view.

The magnitude and sign of estimated attribute levels’ coefficients suggested that physicians regarded a higher level of utility for superior attribute levels except for workload that respondents preferred a moderate level rather than superior. The negative sign of location coefficient confirmed that respondents desired a job in urban area rather than rural, remote, or underserved town (Table 2). The sixth column of the table 2 reports the WTP estimates for different attribute levels. As data shown, neurosurgeons required a remuneration of 170 $ per month (8.5% of their income) to work in a rural area. They were willing to give up (2790 $ or 139.5% of income) to work in a private sector. To attain a moderate level of workload, having access to superior educational facilities and adequate clinical infrastructure, they were willing to sacrifice (370 $ or 18.5%), (280 $ or 14%) and (730 $ or 36.5%), respectively. In terms of housing, there was a WTP (630 $ or 31.5% of income) to be provided with basic subsidized housing.

The impact of improvement in the level of nonmonetary attributes as policy intervention on the probability to choose a rural job was also analyzed in the study. The marginal effect estimates in table 3 showed that an increase in workload from low to moderate level was associated with 10% increase in probability of choosing such a job.

Providing a chance to undertake dual practice and having access to basic subsidized housing would respectively raise the probability by 65% and 16%. If physicians were supposed to have access to superior educational facilities and adequate clinical infrastructure, 8 and 18% increase could be achieved in the likelihood of choosing a remote job. Raising the monthly income up to 4 and 5 thousand dollars increased the probability of taking a rural job by 20% and 28%. Finally, enlarging the salary up to 6000 $ enhanced the probability by 33%. The results showed that although wage increases were important incentives, but they became less effective as income increased. In addition to check for the effects of promotion in single attribute levels; we also examined the impact of different scenarios combined of a group of attribute levels on the
probability of choosing a rural job among neurosurgeons. As table 4 depicts, a combination of 150% salary increase, opportunity for dual practice and access to adequate clinical infrastructure would result in 99% increase of rural uptake.

By providing the opportunity to access adequate clinical infrastructure and subsidized housing, rural uptake would increase up to 54%. If neurosurgeons in rural areas were provided with superior educational facilities and moderate level of workload, the uptake rate would be very similar to the effect of 200% increase in salary and providing a superior housing for physicians.

Discussion
This study revealed important findings about neurosurgeons’ job preferences and policy interventions that could possibly influence their attraction and retention in rural, remote and underserved areas. Data analysis found that all job attributes except proximity to family had statistically significant effect on neurosurgeons’ preferences in their job choices. This finding implied that there could be a range of policy interventions to improve the probability of choosing a rural job among physicians. To consider an attractive job profile, physicians had strong preference to have opportunity for dual practice and to gain higher levels of salary. Besides monetary bonuses, there were some nonmonetary incentives, which played an important role in physicians’ recruitment and retention in underserved areas. Literature supports the findings and emphasizes on the importance of different nonmonetary factors such as opportunity to undertake dual practice, access to subsidized housing, adequate clinical infrastructure, and decent educational facilities as important issues in physicians’ preferences. Rockers et al. indicated that regulations in favor of dual practice would make rural jobs attractive. Another study acknowledged that lack of resources and medical equipment acted as a barrier for health workforce to accept a rural job. Kolstad and Mangham and Hanson considered decent housing as a main incentive to work in rural areas. Hanson and Jack recognized that physicians put the maximum value on the ability to work in private sector. Improved housing, adequate medical equipment, and reduced time commitment were other key factors in their decision to retain.

In our study, participants were willing to tradeoff between different job attributes. They were ready to give up some amount of income in return to obtain subsidized housing and opportunity for dual practice. To work in a national capital or large developed cities rather than rural or remote areas, they requested an increase in current level of income. Similar to our findings, Kolstad found that respondents were willing to give up some amount of income to work in a place with sufficient clinical infrastructure and subsidized housing. Mangham and Hanson also confirmed that nurses would sacrifice some pay increases to obtain the opportunity for continuous education and basic government housing.

The study findings revealed that individual incentives or mixtures of them could improve neurosurgeons’ recruitment and retention in rural or remote areas. Miranda et al. confirmed that combinations of incentives could lead to higher rates of attraction or retention in rural jobs. In a study conducted in Uganda with the purpose of determining retention policies to attract and retain health workforce in rural areas, Rockers et al. found that salary increase, quality improvement of health facilities and monetary support for continued education would make rural jobs more attractive. Kruk et al. in a study of rural practice preferences among medical students in Ghana declared that the joint of three non-financial attributes, including better housing, adequate infrastructure and shorter contract duration would increase the uptake rate of rural areas. A similar research in Zambia suggested government housing, adequate clinical infrastructure, car loans, and educational facilities as important role players for the purpose.

Table 4. Prediction of the uptake rate for rural jobs under different policy scenarios

| Policy scenarios                                                                 | Take up rates (%) | P     |
|----------------------------------------------------------------------------------|-------------------|-------|
| Permission for dual practice + 150% salary increase + adequate clinical infrastructure | 99.0              |       |
| Permission for dual practice + subsidized/government housing                      | 96.0              |       |
| Adequate clinical infrastructure + subsidized/government housing + Permission for dual practice | 98.0              |       |
| 100% salary increase + permission for dual practice + subsidized/government housing | 97.0 < 0.001      |       |
| 100% salary increase + moderate workload + subsidized/government housing           | 52.0              |       |
| Adequate clinical infrastructure + subsidized/government housing                   | 54.0              |       |
| Rural location + superior educational facilities + moderate workload               | 58.6              |       |
| 200% salary increase + superior housing                                          | 58.4              |       |
Vujicic et al.\textsuperscript{14} directed a research to estimate the impact of different policies on improving rural recruitment and retention. They recognized that increasing the amount of salary and possibility for long-term education could play an important role in increasing the take up rate of rural jobs.

**Strengths and limitations of the study**

There are some strength points regarding to this study. The fact that little studies have been conducted on health human resource management in developing countries,\textsuperscript{16} we have attempted to close the research gap and provide valuable information about neurosurgeons’ job preferences to work in rural areas. Second, we have assigned the attributes and related levels on the basis of information obtained from a qualitative study conducted among neurosurgeons. Third, we piloted the study with 17 neurosurgeons to ensure that the hypothetical alternatives were well defined and respondents understood how to make their choices. Finally, we collected information from those neurosurgeons currently in service to provide useful information about their perceived incentives rather than medical students or those who have not entered in to the work market yet.

On the other hand, some limitations could be mentioned for the study. First of all we limited our research to one group of specialists because of practical matters. Second, we did not consider costs information and monetary valuations of different policies to determine the most cost effective one affecting physicians’ job choices. Finally, because of Inaccessibility to experimental design software solutions to construct efficient designs for choice experiments, we used a constant comparator.

**Conclusion**

The study findings recommended that in order to resolve geographical imbalances, policy makers should respect not only appropriate reimbursement, but also improvement in a number of non-financial job attributes in rural or remote areas. Analysis revealed some retention strategies to make rural jobs more appealing for neurosurgeons. Increase in salary, legislation in agree with dual practice, improvement in clinical infrastructure, providing subsidized housing and opportunity for continuous education were some of the main inputs suggested to be included in retention policy packages. As there are relatively inadequate numbers of researches on job preferences of health workforce in developing countries, this study can have a significant contribution to the literature.

**Conflict of Interests**

The authors declare no conflict of interest in this study.

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**References**

1. World Health Organization. Increasing Access to Health Workers in Remote and Rural Areas Through Improved Retention: Global Policy Recommendations. Geneva, Switzerland: World Health Organization; 2010.

2. Afzal M, Cometto G, Rosskam E, Sheikh M. Global Health Workforce Alliance: increasing the momentum for health workforce development. Rev Peru Med Exp Salud Publica 2011; 28(2): 298-307.

3. Chen LC. Striking the right balance: health workforce retention in remote and rural areas. Bull World Health Organ 2010; 88(5): 323, A.

4. Dussault G, Franceschini MC. Not enough there, too many here: understanding geographical imbalances in the distribution of the health workforce. Hum Resour Health 2006; 4: 12.

5. Chomitz KM, Chomitz KG, Azwar SA, Ismail N, Widyarti P, What Do Doctors Want?: Developing Incentives for Doctors to Serve in Indonesia's Rural and Remote Areas, Issue 1888. Washington, DC: World Bank Publications; 1998.

6. Kirigia JM, Gbary AR, Muthuri LK, Nyoni J, Seddoh A. The cost of health professionals' brain drain in Kenya. BMC Health Serv Res 2006; 6: 89.

7. Lehmann U, Dieleman M, Martineau T. Staffing remote rural areas in middle- and low-income countries: a literature review of attraction and retention. BMC Health Serv Res 2008; 8: 19.

8. Hicks V, Adams O. Pay and Non-Pay Incentives, Performance and Motivation [Online]. [cited 2013]; Available: from URL: http://www.who.int/hrh/en/HRDI_4_3_02.pdf.

9. Dambisya YM. A review of non-financial incentives for health worker retention in east and southern Africa [Online]. [cited 2007]; Available from: URL: http://chwcentral.org/sites/default/files/pdf.

10. Dolea C, Stormont L, Braitche JM. Evaluated strategies to increase attraction and retention of health workers in remote and rural areas. Bull World Health Organ 2010; 88(5): 379-85.

11. Mullei K, Mudhune S, Wafula J, Masamo E, English M, Goodman C, et al. Attracting and retaining health workers in rural areas: investigating nurses' views on rural posts and policy interventions. BMC Health Serv Res 2010; 10(Suppl 1): S1.

12. Bridges JF, Onukwugha E, Johnson FR, Hauber AB. Patient preference methods - A patient-centered evaluation paradigm. ISPOR Connections 2007; 13(6): 4-7.

13. Szeinbach S, Harpe S, Flynn T, Lloyd A, Bridges J, Muhlburger A, et al. Understanding Conjoint Analysis applications in health. ISPOR Connections [Online]. [cited 2011]; Available from: URL: http://www.ispor.org/news/articles/jan-feb2011/understanding-conjoint-analysis.asp.

14. Vujicic M, Alfano M, Mandy Ryan C, Brown-Annan J. Policy options to attract nurses to rural Liberia: Evidence from a Discrete Choice Experiment. Washington, DC: The World Bank; 2010.

15. Hanson K, Jack W. Incentives could induce Ethiopian doctors and nurses to work in...
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16. Kolstad JR. What affects the career choices of health workers? Four essays on preferences, incentives and career choices in a low-income context [Thesis]. Bergen, Norway: The University of Bergen; 2010.

17. Mangham LJ, Hanson K. Employment preferences of public sector nurses in Malawi: results from a discrete choice experiment. Trop Med Int Health 2008; 13(12): 1433-41.

18. Kruk ME, Johnson JC, Gyakobo M, Agyei-Mensah G, Blaauw D, Erasmus E, Pagaiya N, et al. Rural practice preferences among medical students in Ghana: a discrete choice experiment. Bull World Health Organ 2010; 88(5): 333-41.

19. Blaauw D, Erasmus E, Pagaiya N, Tangcharoensathien V, Mullie K, Mudhune S, et al. Policy interventions that attract nurses to rural areas: a multicountry discrete choice experiment. Bull World Health Organ 2010; 88(5): 350-6.

20. Salamatnews. Factors Influencing physician retention in underserved areas [Online]. [cited 2014 Sep 3]; Available from: URL: http://www.salamatnews.com/news/118632

21. A plan for physician retention in rural and underserved areas. Health sector evolution [Online]. [cited 2014 Nov 10]; Available from: URL: http://tahavol.behdasht.gov.ir/index.aspx?act_id=994212

22. Bewley TF. A Depressed Labor Market as Explained by Participants. The American Economic Review 1995; 85(2): 250-4.

23. World Bank. How to Conduct a Discrete Choice Experiment for Health Workforce Recruitment and Retention in Remote and Rural Areas: A User Guide with Case Studies. Washington, DC: World Bank Publications; 2012.

24. Ryan M, Gerard K, Amaya-Amaya M. Using Discrete Choice Experiments to Value Health and Health Care. Berlin, Germany: Springer Science & Business Media; 2007.

25. Hensher DA, Greene WH. The Mixed Logit Model: The State of Practice and Warnings for the Unwarly. Sydney, Australia: Institute of Transport Studies, the University of Sydney and Monash University; 2002.

26. Scott A. Eliciting GP's preferences for pecuniary and non-pecuniary job characteristics. J Health Econ 2001; 20(3): 329-47.

27. Rafeie S, Arab M, Rashidian A, Mahmoudi M, Rahimi-Movaghar V. Factors Influencing Neurosurgeons' Decision to Retain in a Work Location: A Qualitative Study. Glob J Health Sci 2015; 7(5): 42432.

28. Addelman S. Symmetrical and Asymmetrical Fractional Factorial Plans. Technometrics 1962; 4(1): 47-58.

29. Huber J, Zwerina K. The Importance of Utility Balance in Efficient Choice Designs. Journal of Marketing Research 1996; 33(3): 307-17.

30. Hensher DA, Rose JM, Greene WH. Stated preferences of doctors for choosing a job in rural areas of Peru: a discrete choice experiment. PLoS One 2012; 7(12): e50567.

31. Christofides NJ, Muirhead D, Jewkes RK, Penn-Kekana L, Conco DN. Women's experiences of and preferences for services after rape in South Africa: interview study. BMJ 2006; 332(7535): 209-13.

32. Wordsworth S, Skatun D, Scott A, French F. Preferences for general practice jobs: a survey of principals and sessional GPs. Br J Gen Pract 2004; 54(507): 740-6.

33. Rockers P, Jaskiewicz W, Wurts L. Determining Priority Retention Packages to Attract and Retain Health Workers in Rural and Remote Areas in Uganda. Washington, DC: 2011.

34. Vujicic M, Zum P, Diallo K, Adams O, Dal Poz MR. The role of wages in the migration of health care professionals from developing countries. Hum Resour Health 2004; 2(1): 3.

35. Rabinowitz HK, Diamond JJ, Markham FW, Paynter NP. Critical factors for designing programs to increase the supply and retention of rural primary care physicians. JAMA 2001; 286(9): 1041-8.

36. MacPhee M, Scott J. The role of social support networks for rural hospital nurses: supporting and sustaining the rural nursing workforce. J Nurs Adm 2002; 32(5): 264-72.

37. Wells N, Roberts L, Medlin LC. Issues related to staff retention and turnover. Semin Nurse Manag 2002; 10(3): 171-9.

38. Zaidi SA. Why medical students will not practice in rural areas: evidence from a survey. Soc Sci Med 1986; 22(5): 527-33.

39. Hensher DA, Rose JM, Greene WH. Stated preferences of doctors for choosing a job in rural areas of Peru: a discrete choice experiment. PLoS One 2012; 7(12): e50567.

40. Miranda JJ, Diez-Canseco F, Lema C, Lescano AG, Lagarde M, Blaauw D, et al. Stated preferences of doctors for choosing a job in rural areas of Peru: a discrete choice experiment. PLoS One 2012; 7(12): e50567.

41. Koot J, Martineau T. Mid Term Review: Zambian Health Workers Retention Scheme (ZHWRS) -2003-2004 [Online]. [cited 2005]; Available from: URL: http://www.hrresourcecenter.org/hosted_docs/Zambian_Health_Workers_Retention_Scheme.pdf
## Appendix 1. Job Attributes and levels

| Attribute          | Definition                                                                                           | Level       |
|--------------------|------------------------------------------------------------------------------------------------------|-------------|
| Location           | This attribute provides an alternative for respondents to choose between two job profiles (rural and urban areas). Rural areas represent remote, underserved, and nonmetropolitan districts of the country. Urban areas stand for national capital, regional, or district headquarters. | Rural Urban |
| Income             | This is the income obtained from governmental sources such as salary, allowances, fee for service, but not those from private practice. Four levels had been defined for income attribute. First level represents the base income; the second, third, and the forth levels stand for 100%, 150%, and 200% increase in base level of income, respectively. | Base income Base + 100% Base + 150% Base + 200% |
| Dual practice      | This means whether physicians are permitted to work in private sector besides public facilities or not. | No Yes      |
| Workload           | This attribute identifies three levels. Low level relates to 5-15 surgical operation per month, moderate level relates to 15-25 operation and high level relates to more than 250 operations per month. | Light Moderate Heavy |
| Proximity to family| This attribute identifies whether physician has to work in a place apart from family or live together in a same place. | No Yes      |
| Educational facilities | This attribute is defined in two levels. Basic refers to having access to a general medical library with few specialized books and journals and wireless internet access. Superior level refers to availability of a specialized library with up to date scientific references and fast internet access also possibility to hold journal clubs and training sessions. | Basic Superior |
| Clinical infrastructure | This attribute is defined in two levels. Basic refers to availability of simple diagnostic and treatment facilities in an area. Superior refers to availability of MRI, CT scan and specialized operating rooms. | Inadequate Adequate |
| Housing            | This attribute identifies three levels. None depicts a situation which government does not provide a free housing for physician. Basic refers to a situation which government provides a suite with shared kitchen and bathroom for physician. Superior refers to a situation which government provides an apartment with bedroom, kitchen, and bathroom. | None Basic Superior |

CT: Computed tomography, MRI: Magnetic resonance imaging