

## Advances in the Application of Discrete Choice Experiments in Health Human Resources: Post-print

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### Abstract

**Background:** The application of Discrete Choice Experiment (DCE) to study job choice preferences among health workers can provide scientific and effective evidence for policy-making aimed at attracting and retaining health personnel in rural and remote areas.

**Objective:** To review, summarize, and synthesize studies applying DCE in the field of health human resources, with the aim of providing reference for future research.

**Methods:** From February to April 2022, we systematically searched Web of Science, PubMed, CNKI, Wanfang Data Knowledge Service Platform, and VIP for literature related to the application of DCE in health human resources. We extracted information on study subjects, analysis models, choice task design, and study results from the included literature.

**Results:** A total of 44 articles were included, published between 2000 and 2020. The study subjects were primarily practicing health workers and students. Among the included literature, 6 used a labeled design while the remainder used generic designs. The number of attributes ranged from 4 to 8, with the number of levels predominantly being 2-4 (88.6%, 39/44). Studies from high-income countries included general practitioner teamwork and workload as job attributes. In studies from low- and middle-income countries, the most frequently selected job attribute was housing (21 times), followed by availability of facilities and drugs (19 times), and learning/training opportunities (16 times). All literature included income (salary) as a job attribute. The developed framework of job attributes comprised four dimensions: social dimension, including hospital size, social support/respect, and job security (formal establishment or permanent employment); work dimension, including work location, working conditions, workload, work (management) atmosphere, teamwork, and supervision

from superiors (for primary health workers); career development dimension, including years to promotion, training (continuing education) opportunities, and academic and research opportunities; and lifestyle dimension, including income, housing, transportation, and children's education. The most frequently used analysis model was the Mixed Logit Model (19 times), followed by the Conditional Logit Model (9 times) and the Generalized Multinomial Logit Model (3 times).

Conclusion: There is considerable heterogeneity in research findings in this field, making it difficult to draw unified conclusions. Moreover, the application of DCE in health human resources requires further global promotion, relevant research is very limited, and the evidence obtained needs to be confirmed by further studies.

## Full Text

### Preamble

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## Abstract

**Background:** Using discrete choice experiments (DCE) to study employment preferences of health personnel can provide a scientific and effective basis for formulating policies to attract and retain health workers in rural and remote areas. **Objective:** To review, summarize, and synthesize research on the application of DCE in the field of human resources for health, in order to provide reference for future studies. **Methods:** From February to April 2022, we systematically searched Web of Science, PubMed, CNKI, Wanfang Data, and VIP for literature related to DCE applications in health human resources. We extracted data on study subjects, analysis models, choice set designs, and results. **Results:** A total of 44 papers published between 2000 and 2020 were included. Study subjects were primarily in-service health workers and students; six studies used labeled designs while the rest were unlabeled; the number of attributes ranged from 4 to 8; the number of levels was predominantly 2-4

(88.6%, 39/44). Studies from high-income countries used general practitioner teamwork and workload as job attributes; in low- and middle-income countries, the most frequently selected attributes were housing (21 times), followed by availability of facilities and medications (19 times), and learning/training opportunities (16 times). All studies included income (salary) as a job attribute. A conceptual framework of job attributes was developed comprising four dimensions: (1) Social dimension, including hospital size, social support/respect, and identity confirmation (establishment or permanent employment); (2) Work dimension, including work location, working conditions, workload, work (management) atmosphere, teamwork, and supervision (for primary health workers); (3) Career development dimension, including promotion timeline, training (continuing education) opportunities, and academic/research opportunities; (4) Life dimension, including income, housing, transportation, and children's education. The most frequently used analysis model was Mixed Logit Model (19 times), followed by Conditional Logit Model (9 times) and Generalized Multinomial Logit Model (3 times). **Conclusion:** Research findings in this field show substantial heterogeneity, making it difficult to draw unified conclusions. Moreover, the application of DCE in health human resources requires further global promotion, as relevant studies remain limited and the evidence requires confirmation from additional research.

**Keywords:** Discrete choice experiment; Health workforce; Health personnel; Employment preferences; Research methods

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## Methods

Shortages and maldistribution of health human resources undermine the equity and accessibility of health services, representing a widespread and far-reaching global health issue [?]. The World Health Organization (WHO) has proposed a series of recommendations for attracting and retaining health workers in rural and remote areas, which can be categorized into four dimensions: education, regulation, financial incentives, and personal/professional development mechanisms [?]. WHO also emphasizes that countries and regions should develop appropriate intervention policies based on their actual circumstances, labor market conditions, and local needs [?]. To formulate effective and targeted interventions and ensure successful implementation, policymakers must consider multiple factors, among which health workers' job preferences are particularly important. Discrete choice experiments (DCE) provide a robust methodological foundation for studying these preferences. Originating in the late 1950s within microeconometrics, DCE has evolved into a powerful tool for analyzing individual choice behavior. Initially applied to market and transportation re-

search, DCE has been used in health services to explore patient preferences for treatment modalities, community preferences for general practitioner service delivery models, stakeholder preferences for health surveillance system operation modes, and policymakers' preferences for health policy development criteria [?]. By the late 1990s, researchers began applying DCE to health human resources [?], though its adoption in China occurred later and remains in the application phase.

Consumer theory underpins DCE, positing that all goods, services, and health jobs consist of various attributes. Each attribute can be described using different levels—for example, the job attribute “availability of basic equipment and facilities” can be described with the levels “adequate” and “inadequate.” DCE can identify respondents' preferences for different attribute levels, providing quantitative information on preference tendencies ( $\beta$  values) and trade-off information between levels (willingness to pay, WTP), and can calculate the probability of choosing a particular job (uptake rates). This represents a mixed qualitative-quantitative research method for confirming the relative importance of attribute levels [?]. As a comprehensive methodology, DCE employs qualitative research, literature review, and pilot studies in its preliminary phase to determine the attributes and levels to be included. Qualitative research is crucial to ensure that selected attributes and levels adequately represent target population perspectives while maintaining policy operability and foresight [?]. Based on selected attribute levels, choice sets are generated, typically comprising 4–20 “choice tasks” (Figure 1 [Figure 1: see original paper]). Using health workers' job preferences as an example, each choice task typically presents two hypothetical jobs (Job A and Job B) defined by attribute levels, asking respondents to select their preferred option. Choice tasks can be generic (unlabeled) or labeled. The “Job A” and “Job B” format shown in Figure 1 represents a generic design; replacing these with “Rural Clinic” and “Urban Hospital” would constitute a labeled design. Data analysis can employ various statistical models such as Mixed Logit Model (MXL), Conditional Logit Model (CLM), Generalized Multinomial Logit Model (G-MNL), and Latent Class Model (LCM). G-MNL extends MXL by using a single parameter to adjust the parameter distribution. Compared with CLM, MXL better accommodates respondent heterogeneity. LCM's advantage lies in stratifying analysis based on respondent demographics and other characteristics to explore preference heterogeneity in depth. In summary, as a relatively novel methodology applied to health human resources, DCE requires examination of its current application status. This paper reviews and synthesizes DCE literature in health human resources to summarize the current state of research and provide reference for future studies.

### 1.1 Literature Search

From February to April 2022, we systematically searched Web of Science, PubMed, CNKI, Wanfang Data, and VIP for literature on DCE applications in health human resources. Chinese search terms included “离散选择实验” (discrete

choice experiment), “卫生人力资源” (health human resources), “卫生技术人员” (health technical personnel), “医生” (doctors), and “护士” (nurses). English search terms included “discrete choice experiment,” “health workers,” “doctors,” and “nurses.” Inclusion criteria were: (1) studies reporting complete DCE results meeting at least 90% of the “validity assessment criteria” proposed by MANDEVILLE et al. [?], which comprises 4 dimensions and 13 criteria for evaluating DCE research quality; (2) publications in Chinese or English; (3) full-text availability. Exclusion criteria were: (1) studies reporting only DCE qualitative methods and results; (2) studies lacking description of attributes and levels. We also manually searched references of included studies.

## 1.2 Literature Screening and Data Extraction

We first screened retrieved literature by removing duplicates, then reviewed titles and abstracts against inclusion/exclusion criteria. Full texts of eligible studies were examined for final selection. The literature screening process is shown in Figure 2 [Figure 2: see original paper]. Extracted data included publication year, country/region, study subjects, analysis models, results, and DCE choice set, attribute, and level designs.

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## Results

### 2.1 Publication Countries/Regions

A total of 44 papers [?] were included. (1) Twelve studies (27.3%) were from high-income countries: Australia (6) [?], Denmark (2) [?], Norway (2) [?], United Kingdom (1) [?], and Germany (1) [?]. (2) Thirty-two studies (72.7%) were from low- and middle-income countries, including one multinational study covering Kenya, South Africa, and Thailand [?]. Asian countries contributed 12 studies: China (3) [?], India (2) [?], Laos (1) [?], Indonesia (1) [?], Timor-Leste (1) [?], Thailand (1) [?], Iran (1) [?], Vietnam (1) [?], and Nepal (1) [?]. African countries contributed 17 studies: Ghana (3) [?], Uganda (3) [?], Tanzania (2) [?], Malawi (2) [?], and one each from Kenya [?], Mozambique [?], Burkina Faso [?], Cameroon [?], Senegal [?], Zambia [?], and Sudan [?]. South America contributed 2 studies from Peru [?].

### 2.2 Publication Timeline

Publications were distributed as follows: 1 each in 2001 [?] and 2008 [?], peaking in 2015 with 8 studies [?, ?, ?, ?, ?, ?], followed by a gradual decline with a small peak of 6 studies in 2019 [?, ?, ?, ?, ?] (Table 1 ).

### 2.3 Study Subjects and Sample Size

Study subjects were primarily in-service health workers and students. In-service health workers mainly included doctors (23 studies) and nurses (10 studies),

while students comprised medical students (7 studies) and nursing students (7 studies). Doctors included general practitioners and specialists, with specialists primarily being neurosurgeons, obstetrician-gynecologists, physiotherapists, speech pathologists, and psychiatrists (Table 2).

## 2.4 Choice Set Design

Among included studies, six used labeled designs [?, ?, ?], with the remainder using generic designs.

## 2.5 Number and Selection of Attributes and Levels

The number of attributes ranged from 4 to 8 across studies, with all including income (salary) as a job attribute. Work location was also a common attribute (13 studies). The number of levels ranged from 2 to 8, predominantly 2-4 levels (88.6%, 39/44) (Table 3).

Job attribute selection varied across different economic and cultural contexts. High-income country studies included general practitioner teamwork and workload as attributes [?, ?, ?]. In low- and middle-income countries, the most frequently selected attribute was housing (21 times), followed by availability of facilities and medications (19 times), learning/training opportunities (16 times), transportation (8 times), management atmosphere (5 times), children's education (4 times), career promotion opportunities (3 times), private practice (2 times), and identity recognition (permanent employment) (1 time). Some studies included country-specific attributes, such as library availability in Iran [?] and supervision by senior doctors in Uganda [?].

Based on varying labor market contexts, each study selected different job attributes. We synthesized and organized these attributes into a conceptual framework comprising four dimensions: (1) Social dimension, including hospital size, social support/respect, and identity confirmation (establishment or permanent employment); (2) Work dimension, including work location, working conditions, workload, work (management) atmosphere, teamwork, and mentoring by supervisors (for primary health workers); (3) Career development dimension, including promotion timeline, training (continuing education) opportunities, and academic/research opportunities; (4) Life dimension, including income, housing, transportation, and children's education (Figure 3 [Figure 3: see original paper]). Hospital size was categorized under the social dimension because individuals and society generally perceive employment at larger hospitals as conferring higher social status. Identity confirmation affects both benefits and social belonging, warranting its inclusion in the social dimension. Some studies categorized work (management) atmosphere into hierarchical and interactive levels, with interactive atmospheres being more valued [?], as harmonious work environments can enhance motivation. Teamwork is crucial for work support, with well-functioning teams facilitating both work performance and physical/mental well-being. The specific attributes included in any given study depend on local

labor market conditions and the priorities of policymakers and health workers.

## 2.6 Analysis Models

The most frequently used analysis model was MXL (19 studies), followed by CLM (9 studies) and G-MNL (3 studies). Some studies also employed LCM (2 studies).

## 2.7 Relative Importance of Job Attributes

Due to variation in included job attributes (except income) and study subjects across studies, horizontal comparison is inappropriate. For example, a multinational study found that graduating nursing students in Kenya and South Africa prioritized education opportunities and rural allowances, while improved medical insurance was the most attractive attribute in Thailand [?]. Income was included as an attribute in all studies. Compared with low- and middle-income country studies, high-income country studies showed respondents valued non-income attributes more highly. For instance, SIVEY et al. [?] found that increasing job technical content was the most attractive attribute for Australian junior doctors considering general practice, increasing the proportion choosing general practice by 13 percentage points—more than moderate income increases. Norwegian research found junior doctors valued disposable work time more than income increases [?]. In low- and middle-income countries, ROCKERS et al. [?] found income and permanent employment status were key concerns for Laotian nurses, while HUICHO et al. [?] found that increased income, working in health centers rather than clinics (a higher-level facility), and professional training funding enhanced rural job attractiveness for Peruvian nurses and midwives.

Different subgroups of respondents valued job attributes differently. For example, compared with nursing students, in-service nurses did not particularly value housing and transportation [?]. Junior doctors with student loans valued income more highly [?]. Doctors with rural experience valued 45% salary increases and work locations in provinces near their hometown, but were less concerned about reducing night shifts [?]. Some negative findings also emerged: female doctors and doctors with children did not have specific preferences regarding work hours compared with other doctors [?].

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## Discussion

Shortages and maldistribution of health human resources represent a global problem. DCE provides a methodology that can inform policy priority areas, yet relevant studies remain limited. Interestingly, HOLTE et al. [?] found Norwegian general practitioners' income preferences followed a nonlinear distribution consistent with reference dependence theory, where losses and gains are evaluated relative to a reference point. Respondents weighted income losses three

times more heavily than equivalent gains.

Explorations of DCE methodological validity and reliability have been conducted. DOIRON et al. [?] used a two-stage approach to examine the temporal stability of stated preferences in DCE, finding preferences stable enough to identify key areas for policy intervention. However, instability in the income attribute requires further investigation. “Attribute non-attendance”(ANA) refers to strategies where respondents ignore one or more attributes when making choices. LAGARDE [?] found most respondents considered only 1-2 attributes, but comparisons between models accounting for ANA and standard models showed no differences in estimated probabilities, suggesting DCE can produce “unbiased policies,” though confirmation from other studies is needed. In 2017, HEIDENREICH et al. [?] investigated whether ANA represents heuristic decision-making or true preferences, concluding ANA generally reflects true preferences and that concerns about inappropriate policy recommendations are unfounded.

In summary, DCE application in health human resources—including subject selection, sample size, choice set design, attribute/level selection, analysis models, and relative importance of attributes—requires clarification. Through comprehensive review and analysis of relevant English literature, this paper elaborates on the basic characteristics of these studies and develops a conceptual framework of job attributes. We found DCE application in health human resources requires further global promotion, with limited studies and evidence needing confirmation. This paper also reviews DCE methodological validity, finding the method can strongly support policy recommendations, but the limited literature requires additional research. Considering WHO’s recommendation for DCE application, this paper offers suggestions for DCE design and implementation to inform future research.

### 3.1 Qualitative Research

Many studies have conducted qualitative work with subjects, including focus group discussions (FGD) and in-depth interviews. Some employed iterative team discussions among interviewers, analysts, researchers, and DCE technical advisors [?]. COAST et al. [?] utilized an iterative approach: the first iteration involved exploratory work with expert input to validate selected attributes, emphasizing the importance of comparative techniques where new data are compared with previous data to identify novel characteristics; the second iteration continued attribute discussions to determine whether to add or remove attributes; after the third iteration, all attributes were fully elaborated.

MULLEI et al. [?] used a combination of quantitative (Likert scale responses) and qualitative methods to identify job attributes, representing a valuable approach. While literature review, FGD, and in-depth interviews can identify attributes of concern to subjects, strong evidence supporting the effectiveness of such qualitative work is lacking. This evidence gap hinders generalization

of findings and provision of guidance to other researchers. The field needs theoretical or at least more systematic approaches [?]. Final attribute and level determination requires pilot testing [?], with rigorous and repeated piloting facilitating attribute-level balance.

### 3.2 Experimental Design

Labeled designs help respondents connect with real-world scenarios and avoid confusion about attributes and levels. Label meanings can also assist decision-making. However, researchers cannot confirm whether their understanding of labels aligns with respondents' , and labels correlate with attributes and levels, making it impossible to separate their functional contributions in analysis. Yet for evaluating how respondents perceive different job positions with identical attributes or for investigating preferences for specific job types in labor markets, this becomes advantageous rather than disadvantageous. Generic designs are more suitable when research interest lies in comparing trade-offs among different attributes within a single job type [?].

Choice tasks presented to respondents include binary ( “Job A” vs. “Job B” ), trinary, quaternary, and mixed (binary and trinary) formats. For example, a Peruvian study on doctors' preferences for rural work used a trinary labeled design [?]. LAGARDE et al. [?] employed a quaternary labeled design, though other research suggests increasing choice options may reduce response quality [?]. Based on consumer theory, choice tasks should include an “opt-out” option; otherwise, the strength of relevant options may be artificially inflated, distorting subsequent WTP estimates. In reality, health workers in labor markets always have multiple options, including remaining in their current position or even leaving the healthcare sector—the latter being an objective reality for recent medical graduates. Regarding opt-out inclusion, when respondents' employment information is available, a two-stage choice method is recommended. The first stage presents two options ( “Job A” and “Job B” ) without an opt-out, requiring a forced choice. The second stage adds the opt-out to the same two options. The two-stage approach ensures information utilization even when respondents select the opt-out (from the first stage). Researchers should emphasize opt-out inclusion to improve WTP estimation accuracy [?]. Only a minority of included studies employed this two-stage method.

### 3.3 Work Attributes and Levels

Attribute and level design must be both targeted and comprehensible to respondents. Concepts and scopes of attributes and levels require clear definition—for example, whether income refers to monthly or annual salary, and whether after-tax salary includes performance pay. Some studies treated performance pay as a separate attribute.

Attribute and level selection should consider not only subjects' and policymakers' perspectives but also local labor market characteristics, as locally appropriate

interventions prove more effective than standardized, uniform policies. Additionally, attribute and level design must consider future policy operability and practical significance. Questionnaire instructions are crucial, as respondents' attribute understanding may differ from designers'. Most studies include income as an attribute because it is a primary factor influencing job choice and the basis for calculating WTP. Attributes must be non-overlapping, one-dimensional, and mutually independent, meaning each should contain only one aspect of a characteristic to maximize information extraction from choices and enhance interpretability. Omitting key attributes introduces bias, requiring trade-offs with including more attributes, which may increase response variability [?].

Considering simplified DCE design, task complexity, non-compensatory decision rules, and survey costs, the number of attributes typically ranges from 5 to 8. No studies have examined multi-attribute DCE design in health human resources, though WITT et al. [?] explored including more attributes (11 attributes) in quality-of-life evaluation, attempting blocked orthogonal designs—a method requiring further validation. Levels reflect attribute range and scope, with 2-4 levels being most common. Level setting should be non-overlapping and encompass existing job attribute characteristics while reflecting target population expectations (the foresight mentioned earlier). Inter-level distances should be appropriate, as overly narrow or wide ranges affect respondent judgment. Level descriptions should be quantified when possible—for example, describing the “continuing education” attribute using “once every 2 years” and “twice per year” is clearer than using “few” and “many.”

In China, attribute selection should consider both universal concerns among health workers (e.g., income, continuing education) and context-specific attributes, such as the controversial establishment (编制) issue. As an employment form coexisting with contract-based employment in medical institutions with待遇 disparities, establishment has been included as a job attribute in DCE studies, though findings on its importance vary, warranting further research. Socially relevant issues such as workplace violence should also be considered.

In conclusion, DCE as a stated preference experimental method can overcome real-world constraints on choice, providing reference for policy development. However, experimental design process and quality ultimately affect result reliability. This study has limitations: it did not include grey literature or conference papers, potentially missing relevant studies, and included only English-language literature, introducing language bias.

**Author Contributions:** BAO Meiling conducted literature search, data review, and drafted the manuscript; HUANG Cunrui provided revision suggestions; WANG Haoxiang revised and finalized the manuscript.

**Conflict of Interest:** The authors declare no conflict of interest.

## References

[?] DUSSAULT G, FRANCESCHINI M C. Not enough there, too many here:

understanding geographical imbalances in the distribution of the health workforce. *Hum Resour Health*. 2006;4:12. DOI:10.1186/1478-4491-4-12.

[?] WHO. *Increasing access to health workers in remote and rural areas through improved retention: global policy recommendations*. Geneva: World Health Organization; 2010.

[?] SMITZ M F, WITTER S, LEMIERE C, et al. Understanding health workers' job preferences to improve rural retention in timor-leste: findings from a discrete choice experiment. *PLoS One*. 2016;11(11):e0165940. DOI:10.1371/journal.pone.0165940.

[?] LAGARDE M, ERENS B, MAYS N. Determinants of the choice of GP practice registration in England: evidence from a discrete choice experiment. *Health Policy*. 2015;119(4):427-436. DOI:10.1016/j.healthpol.2014.10.008.

[?] GOOSSENS L M, UTENS C M, SMEENK F W, et al. Should I stay or should I go home? A latent class analysis of a discrete choice experiment on hospital-at-home. *Value Health*. 2014;17(5):588-596. DOI:10.1016/j.jval.2014.05.004.

[?] RUSSO P L, CHEN G, CHENG A C, et al. Novel application of a discrete choice experiment to identify preferences for a national healthcare-associated infection surveillance programme: a cross-sectional study. *BMJ Open*. 2016;6(5):e011397. DOI:10.1136/bmjopen-2016-011397.

[?] MIRELMAN A, MENTZAKIS E, KINTER E, et al. Decision-making criteria among national policymakers in five countries: a discrete choice experiment eliciting relative preferences for equity and efficiency. *Value Health*. 2012;15(3):534-539. DOI:10.1016/j.jval.2012.04.001.

[?] MANDEVILLE K L, LAGARDE M, HANSON K. The use of discrete choice experiments to inform health workforce policy: a systematic review. *BMC Health Serv Res*. 2014;14:367. DOI:10.1186/1472-6963-14-367.

[?] ROCKERS P, RYAN M, KOLSTAD J R, et al. *How to conduct a discrete choice experiment for health workforce recruitment and retention in remote and rural areas: a user guide with case studies*. Geneva: World Health Organization; 2012.

[?] 刘童童, 李顺平, 陈钢. 离散选择实验用于癌症筛查偏好的国际研究进展. *中国卫生经济*. 2017;36(5):75-78. DOI:10.7664/CHE20170521.

[?] SIVEY P, SCOTT A, WITT J, et al. Junior doctors' preferences for specialty choice. *J Health Econ*. 2012;31(6):813-823. DOI:10.1016/j.jhealeco.2012.07.001.

[?] SCOTT A, WITT J, HUMPHREYS J, et al. Getting doctors into the bush: general practitioners' preferences for rural location. *Soc Sci Med*. 2013;96:33-44. DOI:10.1016/j.socscimed.2013.07.002.

[?] LI J H, SCOTT A, MCGRAIL M, et al. Retaining rural doctors: doctors' preferences for rural medical workforce incentives. *Soc Sci Med*. 2014;121:56-64. DOI:10.1016/j.socscimed.2014.09.053.

- [?] GALLEGO G, DEW A, LINCOLN M, et al. Should I stay or should I go? Exploring the job preferences of allied health professionals working with people with disability in rural Australia. *Hum Resour Health*. 2015;13:53. DOI:10.1186/s12960-015-0047-x.
- [?] SCOTT A, WITT J, DUFFIELD C, et al. What do nurses and midwives value about their jobs? Results from a discrete choice experiment. *J Health Serv Res Policy*. 2015;20(1):31-38. DOI:10.1177/1355819614554924.
- [?] SCOTT A, HOLTE J H, WITT J. Preferences of physicians for public and private sector work. *Hum Resour Health*. 2020;18(1):59. DOI:10.1186/s12960-020-00498-4.
- [?] PEDERSEN L B, GYRD-HANSEN D. Preference for practice: a Danish study on young doctors' choice of general practice using a discrete choice experiment. *Eur J Health Econ*. 2014;15(6):611-621. DOI:10.1007/s10198-013-0500-5.
- [?] KJÆER N K, HALLING A, PEDERSEN L B. General practitioners' preferences for future continuous professional development: evidence from a Danish discrete choice experiment. *Educ Prim Care*. 2015;26(1):4-10. DOI:10.1080/14739879.2015.11494300.
- [?] HOLTE J H, KJÆER T, ABELSEN B, et al. The impact of pecuniary and non-pecuniary incentives for attracting young doctors to rural general practice. *Soc Sci Med*. 2015;128:1-9. DOI:10.1016/j.socscimed.2014.12.022.
- [?] HOLTE J H, SIVEY P, ABELSEN B, et al. Modelling nonlinearities and reference dependence in general practitioners' income preferences. *Health Econ*. 2016;25(8):1020-1038. DOI:10.1002/hec.3208.
- [?] SCOTT A. Eliciting GPs' preferences for pecuniary and non-pecuniary job characteristics. *J Health Econ*. 2001;20(3):329-347. DOI:10.1016/S0167-6296(00)00083-7.
- [?] GÜNTHER O H, KÜRSTEIN B, RIEDEL-HELLER S G, et al. The role of monetary and nonmonetary incentives on the choice of practice establishment: a stated preference study of young physicians in Germany. *Health Serv Res*. 2010;45(1):212-229. DOI:10.1111/j.1475-6773.2009.01045.x.
- [?] BLAAUW D, ERASMUS E, PAGAIYA N, et al. Policy interventions that attract nurses to rural areas: a multicountry discrete choice experiment. *Bull World Health Organ*. 2010;88(5):350-356. DOI:10.2471/blt.09.072918.
- [?] SONG K M, SCOTT A, SIVEY P, et al. Improving Chinese primary care providers' recruitment and retention: a discrete choice experiment. *Health Policy Plan*. 2015;30(1):68-77. DOI:10.1093/heapol/czt098.
- [?] LIU S M, LI S P, YANG R Y, et al. Job preferences for medical students in China. *Medicine*. 2018;97(38):e12358. DOI:10.1097/md.00000000000012358.
- [?] LIU T T, LI S P, YANG R Y, et al. Job preferences of undergraduate nursing students in Eastern China: a discrete choice experiment. *Hum Resour Health*.

2019;17(1):1. DOI:10.1186/s12960-018-0335-3.

[?] RAO K D, RYAN M, SHROFF Z, et al. Rural clinician scarcity and job preferences of doctors and nurses in India: a discrete choice experiment. *PLoS One*. 2013;8(12):e82984. DOI:10.1371/journal.pone.0082984.

[?] ABDEL-ALL M, ANGELL B, JAN S, et al. What do community health workers want? Findings of a discrete choice experiment among Accredited Social Health Activists (ASHAs) in India. *BMJ Glob Health*. 2019;4(3):e001509. DOI:10.1136/bmjgh-2019-001509.

[?] ROCKERS P C, JASKIEWICZ W, KRUK M E, et al. Differences in preferences for rural job postings between nursing students and practicing nurses: evidence from a discrete choice experiment in Lao People's Democratic Republic. *Hum Resour Health*. 2013;11:22. DOI:10.1186/1478-4491-11-22.

[?] EFENDI F, CHEN C M, NURSALAM N, et al. How to attract health students to remote areas in Indonesia: a discrete choice experiment. *Int J Health Plann Manage*. 2016;31(4):430-445. DOI:10.1002/hpm.2289.

[?] SMITZ M F, WITTER S, LEMIERE C, et al. Understanding health workers' job preferences to improve rural retention in timor-leste: findings from a discrete choice experiment. *PLoS One*. 2016;11(11):e0165940. DOI:10.1371/journal.pone.0165940.

[?] LAGARDE M, PAGAIYA N, TANGCHAROENSATHIAN V, et al. One size does not fit all: investigating doctors' stated preference heterogeneity for job incentives to inform policy in Thailand. *Health Econ*. 2013;22(12):1452-1469. DOI:10.1002/hec.2897.

[?] RAFIEI S, ARAB M, RASHIDIAN A, et al. Policy interventions to improve rural retention among neurosurgeons in Iran: a discrete choice experiment. *Iran J Neurol*. 2015;14(4):211-218.

[?] VUJICIC M, SHENGELIA B, ALFANO M, et al. Physician shortages in rural Vietnam: using a labor market approach to inform policy. *Soc Sci Med*. 2011;73(7):970-977. DOI:10.1016/j.socscimed.2011.06.010.

[?] GAUTAM B, SAPKOTA V P, WAGLE R R. Employment preferences of obstetricians and gynecologists to work in the district hospitals: evidence from a discrete choice experiment in Nepal. *Hum Resour Health*. 2019;17(1):96. DOI:10.1186/s12960-019-0427-8.

[?] KRUK M E, JOHNSON J C, GYAKOBO M, et al. Rural practice preferences among medical students in Ghana: a discrete choice experiment. *Bull World Health Organ*. 2010;88(5):333-341. DOI:10.2471/blt.09.072892.

[?] AGEYI-BAFFOUR P, ROMINSKI S, NAKUA E, et al. Factors that influence midwifery students in Ghana when deciding where to practice: a discrete choice experiment. *BMC Med Educ*. 2013;13:64. DOI:10.1186/1472-6920-13-64.

- [?] SHIRATORI S, AGYEKUM E O, SHIBANUMA A, et al. Motivation and incentive preferences of community health officers in Ghana: an economic behavioral experiment approach. *Hum Resour Health*. 2016;14(1):53. DOI:10.1186/s12960-016-0143-6.
- [?] ROCKERS P C, JASKIEWICZ W, WURTS L, et al. Preferences for working in rural clinics among trainee health professionals in Uganda: a discrete choice experiment. *BMC Health Serv Res*. 2012;12(1):1-13. DOI:10.1186/1472-6963-12-212.
- [?] BRUNIE A, WAMALA-MUCHERI P, OTTERNESS C, et al. Keeping community health workers in Uganda motivated: key challenges, facilitators, and preferred program inputs. *Glob Health Sci Pract*. 2014;2(1):103-116. DOI:10.9745/ghsp-d-13-00140.
- [?] KASTENG F, SETTUMBA S, KÄLLANDER K, et al. Valuing the work of unpaid community health workers and exploring the incentives to volunteering in rural Africa. *Health Policy Plan*. 2016;31(2):205-216. DOI:10.1093/heapol/czv042.
- [?] KOLSTAD J R. How to make rural jobs more attractive to health workers. Findings from a discrete choice experiment in Tanzania. *Health Econ*. 2011;20(2):196-211. DOI:10.1002/hec.1581.
- [?] KOK M, ABDELLA D, MWANGI R, et al. Getting more than “claps” : incentive preferences of voluntary community-based mobilizers in Tanzania. *Hum Resour Health*. 2019;17(1):101. DOI:10.1186/s12960-019-0438-5.
- [?] MANGHAM L J, HANSON K. Employment preferences of public sector nurses in Malawi: results from a discrete choice experiment. *Trop Med Int Health*. 2008;13(12):1433-1441. DOI:10.1111/j.1365-3156.2008.02167.x.
- [?] MANDEVILLE K L, ULAYA G, LAGARDE M, et al. The use of specialty training to retain doctors in Malawi: a discrete choice experiment. *Soc Sci Med*. 2016;169:109-118. DOI:10.1016/j.socscimed.2016.09.034.
- [?] TAKEMURA T, KIELMANN K, BLAAUW D. Job preferences among clinical officers in public sector facilities in rural Kenya: a discrete choice experiment. *Hum Resour Health*. 2016;14:1. DOI:10.1186/s12960-015-0097-0.
- [?] HONDA A, VIO F. Incentives for non-physician health professionals to work in the rural and remote areas of Mozambique: a discrete choice experiment for eliciting job preferences. *Hum Resour Health*. 2015;13:23. DOI:10.1186/s12960-015-0022-8.
- [?] YAYA BOCOUM F, KONÉ E, KOUANDA S, et al. Which incentive package will retain regionalized health personnel in Burkina Faso: a discrete choice experiment. *Hum Resour Health*. 2014;12(suppl 1):S7. DOI:10.1186/1478-4491-12-S1-S7.

- [?] ROBYN P J, SHROFF Z, ZANG O R, et al. Addressing health workforce distribution concerns: a discrete choice experiment to develop rural retention strategies in Cameroon. *Int J Health Policy Manag.* 2015;4(3):169-180. DOI:10.15171/ijhpm.2015.27.
- [?] HONDA A, KRUCIEN N, RYAN M, et al. For more than money: willingness of health professionals to stay in remote Senegal. *Hum Resour Health.* 2019;17(1):28. DOI:10.1186/s12960-019-0363-7.
- [?] PRUST M L, KAMANGA A, NGOSA L, et al. Assessment of interventions to attract and retain health workers in rural Zambia: a discrete choice experiment. *Hum Resour Health.* 2019;17(1):26. DOI:10.1186/s12960-019-0359-3.
- [?] NURELHUDA N, BASHIR A, ELKOGALI S, et al. Encouraging junior doctors to work in rural Sudan: a discrete choice experiment. *East Mediterr Health J.* 2018;24(9):838-845. DOI:10.26719/2018.24.9.838.
- [?] HUICHO L, MIRANDA J J, DIEZ-CANSECO F, et al. Job preferences of nurses and midwives for taking up a rural job in Peru: a discrete choice experiment. *PLoS One.* 2012;7(12):e50315. DOI:10.1371/journal.pone.0050315.
- [?] MIRANDA J J, DIEZ-CANSECO F, LEMA C, 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. DOI:10.1371/journal.pone.0050567.
- [?] DOIRON D, YOO H I. Temporal stability of stated preferences: the case of junior nursing jobs. *Health Econ.* 2017;26(6):802-809. DOI:10.1002/hec.3350.
- [?] LAGARDE M. Investigating attribute non-attendance and its consequences in choice experiments with latent class models. *Health Econ.* 2013;22(5):554-567. DOI:10.1002/hec.2824.
- [?] HEIDENREICH S, WATSON V, RYAN M, et al. Decision heuristic or preference? Attribute non-attendance in discrete choice problems. *Health Econ.* 2018;27(1):157-171. DOI:10.1002/hec.3524.
- [?] COAST J, HORROCKS S. Developing attributes and levels for discrete choice experiments using qualitative methods. *J Health Serv Res Policy.* 2007;12(1):25-30.
- [?] MULLEI K, MUDHUNE S, WAFULA J, 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. DOI:10.1186/1472-6963-10-S1-S1.
- [?] LOUVIERE J, LANCSAR E. Choice experiments in health: the good, the bad, the ugly and toward a brighter future. *Health Econ Policy Law.* 2009;4:527-546. DOI:10.1017/S1744133109990193.
- [?] 宋奎劼, 孟庆跃, Anthony Scott, 等. 利用离散选择实验研究卫生服务人员工作偏好的国际研究进展. *中国卫生经济.* 2012;31(10):91-93.

[?] LANCSAR E, LOUVIERE J. Conducting discrete choice experiments to inform healthcare decision making: a user' s guide. *Pharmaco Economics*. 2008;26(8):661-677. DOI:10.2165/00019053-200826080-00004.

[?] LAGARDE M, BLAAUW D, CAIRNS J, et al. Cost-effectiveness analysis of human resources policy interventions to address the shortage of nurses in rural South Africa. *Soc Sci Med*. 2012;75(5):801-806. DOI:10.1016/j.socscimed.2012.05.005.

[?] WITT J, SCOTT A, OSBORNE R H. Designing choice experiments with many attributes. An application to setting priorities for orthopaedic waiting lists. *Health Econ*. 2009;18(6):681-696. DOI:10.1002/hec.1396.

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*Note: Figure translations are in progress. See original paper for figures.*

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