Job preferences for medical and nursing students to work in rural Guizhou Province, China: a discrete choice experiment

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Abstract

Background: Maldistribution of health workers between urban and rural areas has been a critical difficulty in China. The shortage of health workers in disadvantaged areas reduces access to essential health services delivery, and adversely affects the population health. Policies on attracting health workers to locate in rural areas are needed to be explored. In order to identify the appropriate incentives, we conducted a discrete choice experiment to determine how specific job attributes might be valued by final year students in medical university in Guizhou Province, China.

Methods: Attributes of potential job were developed through literature review, in-depth semi-structured interviews and pretest. Salary, education opportunity, transportation, job location, workload, essential equipment, medical order, and identification ('bianzhi') were included. The questionnaire was formulated through a fractional factorial experiment design using %MktRuns macros of SAS 9.4. All medical and nursing students in the final year at Guizhou Medical University were invited to participate in the study. Mixed logit model was used to estimate stated preferences of attributes. Willingness to pay and uptake rates for a defined job were also calculated based on the mixed logit estimates.

Results: The final sample comprised 787 respondents, including 388 medical students and 399 nursing students. Attributes were statistically significant (with the exception of once every two years for education opportunity) and had expected signs. The results indicate that physical conflict between doctors and patients and identification ('bianzhi') were two of the most important non-monetary job characteristics for both

medical and nursing students. And nursing students placed more value on identification ('bianzhi'). Policy simulation suggests that as for the individual incentive respondents were most sensitive to salary increasing. Incentive packages effects were stronger for students from rural background.

Conclusions: Strategies on medical order, identification ('bianzhi') and salary should be considered to attract final year medical and nursing students to work in rural areas. In addition, specific recruitment policy design tailored for subgroups should be taken into account.

Keywords: Discrete choice experiment, Job preferences, Health workers, Recruitment

Background

The uneven distribution of health workers reduces access to essential health services delivery, and contributes to inequalities in health outcomes [1]. As one study found that, reductions in under-five mortality rate were associated with increased health workers[2]. Several studies have cast light on the systematic categories of imbalances in the health workforce, including geographic imbalances, institutional imbalances, public/private imbalance, and profession/specialty imbalance[3]. Among all these imbalance categories, the lack of health workers in disadvantaged areas will impede the universal health coverage and ultimately adversely affect the population health living in remote and rural areas[4]. As one study found that, reductions in under-five mortality rate were associated with increased health workers[2]. Disparity between urban and rural areas in terms of health workforce has become a critical health policy concern in many countries [5, 6]. China is not an exception, since health workers are inclined to serve in tertiary hospitals in urban areas rather than in primary care facilities in rural areas because of working conditions, career development, etc.

China's higher education system reform has been launched in 1998, since then a major expansion of universities has facilitated to a fast growth of health education[6]. However, a big dilemma is that faculty numbers might not have kept pace with numeric expansion of students[7]. Although China's total health workforce rose remarkably from 6.7 million people in 2006 to 10.2 million in 2014[8], a shortfall of over 500 000 physicians exits in rural areas[9]. In addition, the low nurse to doctor ratio (1.1:1) to some extent constrains the development of clinical practice [8]. Further,

the density of nurses in urban areas is much higher than in rural areas and the gap is widening [10].

Undergraduate health students' job preferences will influence the distribution of health workers in the future. Thus, it is necessary to elicit policy incentives specific for final year medical and nursing students, which can be tailored to make the posts in rural areas more attractive, since posts in primary care facilities in rural areas are usually considered less desirable because of high workloads, inconvenient traffic and poorly infrastructure[11]. Incentives to attract health workers to locate in disadvantaged areas have been well described by World Health Organization(WHO) including education interventions, regulatory interventions, financial incentives, personal and professional support [12]. WHO also proposed that countries need to identify the appropriate interventions that are suitable for their local context, given diverse health labor market and local demand [13]. Thus, the development of such strategies really needs a precise insight into job preferences of health workers in various counties.

The policy implication could be elicited from the use of discrete choice experiment (DCE) method. DCEs have been commonly used in health economics, while recently determining health workers job preferences in human resource research field can be informed by the results from this methodology. In particular, a user guide on how to conduct a DCE for health workforce recruitment and retention in rural areas was developed by WHO and other two agencies, which mentioned that DCE could assess the stated preferences of health workers for a job [14]. The choice experiment is a

combination of the characteristics theory of demand and random utility theory [15]. The method assumes the utility associated with a good or service is made up of the utilities of its attributes[16],which is well-established for identifying the relative value that people place on factors (attributes) [17]. The benefit of DCE is that of opportunity cost. Individuals want the best of everything, but when resources are limited, the method gives a weighed relevance to distinguish which attributes are the most highly valued. In addition, quantitative information on the relative strength of the selected attributes could be provided, as well as the trade-offs between these attributes and the probability of take-up of defined jobs [14, 18].

Under the circumstances of China's reform and opening-up, doctors has confronted and undergone the challenges of ongoing economic reforms and medical reforms. With the emergence of new problems such as violence against medical staff, previous difficulties still exit, e.g. identification ('bianzhi'). The surge in hospital violence seriously affects the normal medical order, which is a proper status where health workers and patients in the medical relation share orderly interactions. And a widespread concern among the health workers has been caused by the assaults on them [19]. On the other hand, China had a special employment system from 1949 to 1978 in which the government decided the number of personnel for each employer, which was called 'bianzhi'. But since the economic reforms in 1978, a transition in employment system is the decrease of 'bianzhi' positions and the increase of contract-based workers. However, 'bianzhi' positions are still highly valued by Chinese public because of the benefits and belonging sense [20]. In our study, medical

order and 'bianzhi' were included as job factors to identify the impact on the preference of medical students for job.

Undergraduates may have a lot of choices and puzzles when facing various jobs of different characteristics. Where to locate, what kind of work can give them not only bread and but also dignity, even safety may be weighed. Although there have been a couple of studies to explore the job preferences of health workers using DCEs in china[10, 21], and which found that identification ('bianzhi') , as well as income, benefits, equipment, career development, respect from the community, training opportunity, education environment for children could be the push and pull factors affecting Chinese health workers' decision on location in rural areas [21, 22]. However, the paucity of evidence on how incentive policies influence undergraduate' decision to work in rural areas is cause for concern. And to our knowledge, this is the first study to explore the impact of medical order on rural recruitment. More evidence would be needed to inform practical policy decisions. In this paper, we aim to explore a set of factors that are amenable to job preferences among final year students, and to assist policy-makers in designing better-informed interventions for attracting them to rural areas.

Methods

Study setting and sampling

This research was conducted in Guizhou province, located in western-southern part of China. This province was selected purposively for four reasons: 1) as one of the most

underdeveloped province in China, urbanization rate ranking was the last but one in all provinces in 2015; and 2) the geographic access to health workers was poorly, since Guizhou province is the only one which has no plains but hills among all the provinces, villagers may climb a few mountains to see a doctor; 3) the proportion of rural resident population was 56%, while the proportion of health workers working in rural areas was 30%; 4) in 2016, the density of licensed (assistant) doctors in China was 2.31 per 1,000 population, whereas in Guizhou province was 1.94. Density figures for nurses were 2.54 and 2.42 per 1,000 population in China and Guizhou province, respectively[23,30].

In this study we examined the preferences of Undergraduate health students who are seen as the fresh blood of health professionals. China has a vast and complex system of health professional education. The most common education program for medical students is 5-year curricular plans, meanwhile 3-year schools after senior high school or junior high school and 7-8-year degree programs exist all at once. Graduates can be awarded Bachelor's degree after 5-year curricular plans, while graduates for 3-year schools cannot get bachelor's degree and will be assistant doctors. For 7-year degree program, graduates can be awarded Master's degree, and for 8-year degree program, graduates can be awarded Doctoral degree. Graduates of 7-8-year degree programs usually enter tertiary hospitals, medical colleges and research institutions. For nursing students, 3-year and 4-year schools co-exist. Graduates can be awarded Bachelor's degree after 4-year schools, while 3-year schools not.

Target group of our research was final year medical students of 5-year schools and

157 nursing students of 3-year and 4-year schools training to be doctors and nurses, since
158 doctors and nurses have been identified by health officers in Health Commission of
159 Guizhou Province as the most needed staffing to effectively run a primary health
160 facility through semi-structured interviews we have done in August in 2017. We
161 selected final year students because they had experienced the clinical training and
162 were considering career options but had not yet made their post decisions. Guizhou
163 Medical University was selected purposively for it was the most influential medical
164 school and had the most number of graduates in Guizhou province.

165 While exact recommendations vary, a minimum of between 20 and 50 respondents
166 per experiment group is required to reliably estimate respondent preferences[24].
167 Thus, all medical and nursing students in the final year at Guizhou Medical University
168 were invited to participate in the study (excluding the 33 students who participated in
169 the pilot test).

170

171 **Identification and selection of attributes and levels (instrument development)**

172 DCE is an evaluation method, which is founded on the random utility theory. This
173 theory of utility requires a multiple attribute approach that consists of breaking down
174 the examined good into its different components or attributes for which the levels
175 vary systematically between choice sets [25, 26]. The first stage of developing a DCE
176 tool involves identifying attributes and then determining the levels of these attributes.
177 DCE attributes were selected by literature review, semi-structured interviews and
178 pretests. Possible attributes (n=15) were identified through literature review, which

179 then were narrowed down through semi-structured interviews conducted with 23
180 doctors and 18 nurses present on the day of the visit. These interviewees were from
181 nine primary health facilities in Guizhou province. To ensure common views were
182 captured, we conducted the interviews in four counties and one district during July in
183 2017(TableA1). Semi-structured interviews with six senior government officers in
184 charge of the primary health care in Health Commission of Guizhou Province were
185 conducted to ensure the realistic concerning development of policy incentives.
186 Interviews were digitally recorded and transcribed. Thematic analysis and constant
187 comparison was used to analyze the data. Content analysis of current policy
188 documents was conducted. Prior to data collection, DCE instruments were pretested
189 once with final year medical students. Minor modification was made.

190 Informed by these work, eight attributes were important to warrant inclusion in the
191 final DCE (Box 1): salary, education opportunity, transportation, job location,
192 workload, essential equipment, medical order, and 'bianzhi'. Salary was meant the
193 monthly net salary (after tax). A salary attribute was always included in DCE studies,
194 for the estimation of willingness to pay (WTP) for improvements in other
195 attributes[21]. Given the hypothetical nature of the levels of attribute, and in order to
196 compare the job preferences between medical students and nursing students, the
197 difference of practical salary between the two groups was not shown in this study. The
198 lowest salary level included in the instrument represented the average salary estimated
199 through the interviews with health officers. Education opportunity represented the
200 training opportunity which should substantially improve health workers' clinical skills,

not like some ways, for example expert assistance for the primary health facilities from upper hospitals which some interviewed health workers reflected they could not improve as much as they expected through this way. As for the transportation attribute, 'inconvenient' was meant that from post location to living zone it would take almost 1.5 hours or more, 'convenient' was meant it would take around 0.5 hour or least. Job location, the definition of location was according to the administrative division in China. Villages and towns were corresponding to rural areas. Workload, given working for 50 hours per week was common phenomena among health workers known through interviews with health workers and officers mentioned above, 50 hours per week was the reference. Essential equipment was described as medical equipment and facilities which was regular and equipped enough for common and frequently-occurring disease. Medical order was included, because escalating doctor-patient tension has been a serious concern in current China[19]. In addition, our research team worked closely with the health officers in Health Commission of Guizhou Province who requested that medical order related attributes should be included in the DCE. Suit (synonymous with the terms 'lawsuit' or 'litigation' as relevant throughout the document) was one of its levels we identified, which meant that the medical dispute needs to be adjusted in court. Identification ('bianzhi'), 'iron rice bowl' positions with life-time job security is called 'bianzhi' in China, as opposed to 'bianzhi', contract-based health workers have fewer job benefits and less belonging sense to the job[20]. In order to clarify the attributes and levels and confuse the respondents least, most of them were described quantitatively and concretely. For

example, we used frequencies (e.g. once a year) to describe education opportunity instead of qualitative description i.e. 'insufficient, some, sufficient'.

Experimental design and choice set construction

As described in Box 1, there were two attributes with four levels, another two attributes with three levels and four attributes with two levels. This design generated 2304 ($4^2 \times 3^2 \times 2^4$) potential scenarios with different combinations of levels of the eight job attributes and 2,653,056 ((2304×2303)/2) potential choice tasks. As this was too many to present to each individual, the number of potential scenarios was reduced by a fractional factorial experiment design using %MktRuns macros of SAS 9.4 to optimize D-efficiency, maximize level balance and orthogonality, and minimize overlap among attributes levels, furthermore a restrictions macro was also used to avoid dominated alternatives[27,33]. Dominance in a DCE means a participant always selected job scenarios on the basis of one attribute.

The final design consisted of 40 sets. Systematic review identified that 16-20 choice tasks was the mode for previous DCEs administered to health workers[28]. In order to not exhaust the respondents, the 40 sets were blocked into 2 questionnaire versions, each containing 20 choice sets. The blocks were randomly allocated to the respondents. Each choice set was comprised of two job scenarios (Job A and Job B) (Figure A1). A forced choice approach was employed for two reasons: 1) to elicit more information on respondents' preferences for the attributes; 2) since students had not empirical understanding of the job in reality, the opt-out option (to choose their

current job) was not included. We used an unlabeled DCE, because some evidence suggested that labels may distract respondents from job attributes and thus diminish the reliability of estimates of job preferences[29]. The questionnaire was presented in three sections. Section one was an introductory script. The purpose of this part was to acclimate respondents to the hypothetical nature of the DCE they were about to take. The telephone number of research group member was also in this part for the interviewees to connect while they had problems during the process of filling in questionnaires. Section two included socio-demographic characteristics, such as gender, age and location of birth. Section three was 20 choice sets. The survey was conducted during October and December 2017.

Survey administration

The self-administered questionnaire was emailed to the class tutor who uploaded it to the Class QQ Population (instant message software, widely used in China), the questionnaire was then downloaded by students who would send it to the class monitor after finishing it. All final-year medical and nursing students in this school were invited to participate except the students who participated in the pilot-testing. The class monitor collected, packed and emailed the questionnaires to the research group.

Pilot-testing

Prior to the start of data collection, we piloted with 33 medical students. This process

267 provided an opportunity to determine if the presentation was conceptually clear.
268 Minor correction was made. Respondents did not think 20 choice sets were a
269 cognitive burden, and they completed the survey within 20 minutes.
270
271 **Statistical analysis**
272 All data from the DCE questionnaires was entered and stored using Microsoft Excel
273 2010 (Microsoft Corporation, USA). Descriptive statistics were calculated for
274 demographic variables. The main effects mixed logit models were adopted to analyze
275 the DCE data.
276 Recently, the use of mixed logit models is increasing [1, 10, 15, 26, 30-38] which
277 take the preference heterogeneity among respondents into consideration. The
278 underpinning of discrete choice model is random utility theory, stipulating that
279 respondents as a rational economic individual consider all the relevant information
280 and choose the option that can maximize the utility. The utility of alternative *i* for
281 individual *n* in a choice situation *j* can be specified as:
282 $U_{inj}=V_{inj}+\varepsilon_{inj}$
283 $i=A,B; \quad n=1,\ldots n; \quad j=1,\ldots,20$
284 The utility is made up of two independent additive parts: a deterministic part, V_{inj}, and
285 a stochastic part, ε_{inj}. Where $V_{inj}=V(X_{inj}, \eta_n)$ is the systematic component of the utility
286 which is the explainable of the variance in the choice, with individual characteristics
287 η_n. The ε_{inj} is unobservable to the researcher and treated as indepentdent and identical
288 distributed extreme value[21].

289 Assuming a linear additive utility function, the observable component for
290 individual n for alternative i becomes $V_{inj} = \beta_n x_{inj}$, where $x_{inj}=(x_1, x_2,\ldots,x_t)$ is a vector of
291 attributes, each valued at a certain 'weight' $(\beta_1,\ldots,\beta_t)$. Coefficient vector β_n varies in
292 the population with density $(\beta_n|\theta)$, where θ are the true parameters. Thus, the
293 probability of choosing alternative i from j alternatives is the standard logit formula:

$$L_{inj} = \frac{e^{\beta_n x_{inj}}}{\sum_j e^{\beta_n x_{jnj}}}$$

294 The modification in mixed logit is the researcher does not know the value of β_n or
295 ε_{inj}. The solution of the equation requires integrating L_{inj} over all the possible values of
296 β_n weighted by the density selected, usually the standard normal distribution. The
297 probability of the observed sequence of choices for a given choice set becomes[31]:

$$P_{inj}(\theta) = \int L_{inj} f(\beta_n|\theta) d\beta_n$$

298 The estimated coefficients can only give information about the direction and
299 significance of the effect of changing the levels of one attribute, all other things being
300 equal. However, analysis on the valuation and comparison of different policies may be
301 the most instructive part for policy makers. We then use the value of coefficients to
302 calculate willingness to pay (WTP) and policy simulations.

303 Willingness to pay estimates were calculated by dividing attribute coefficients by
304 the salary coefficient for each model, conveying in monetary terms respondents'
305 preferences for one level of an attribute as compared to the reference level. The WTP
306 for attribute x is given by the following equation:

$$\mathrm{WTP}(x) = -\frac{\beta_n}{\alpha_1 + 2\alpha_2 w_{inj}}$$

307 Where α_1, α_2 are the coefficients for the income and income squared, w_{inj} is the
308 attribute of income[39].

309 A simulation study was conducted to assess the potential impact of various
310 incentives that can be used to attract undergraduates to rural areas. Predicted
311 probabilities calculated to estimate an uptake rate of choosing a 'rural job' rather than
312 an 'urban job' can be depicted as [26]:

$$P_{rural} = \frac{Exp(V_{rural})}{Exp(V_{rural}) + Exp(V_{urban})}$$

313 All attributes variables were coded as dummy variables except for salary, which
314 was specified as continuous variable to facilitate the calculation of willingness to pay.
315 Sex and rural-urban background information was then used to divide the sample into
316 subgroups and separate analysis on each subgroup was carried out. All mixed logit
317 models were fit using StataMP 14's mixlogit command (Stata Corporation, USA), and
318 were specified with 500 Halton draws.

319 Several validity tests were conducted to determine the appropriateness of model
320 specifications. The theoretical validity of the model was assessed by determining
321 whether the coefficients were of the anticipated sign. We repeated the analysis using
322 conditional logit models (all data available from the authors). In this study, the results
323 from each conditional logit model were not substantively different from the mixed
324 logit model. As for the external validity test, telephone number of students was
325 acquired on a voluntary basis at the end of the questionnaire in order to follow them in
326 the future and ascertain the actual choices they made after graduation.

327

Results

Of 1168 eligible final year medical and nursing students in Guizhou medical university, overall 879 (75%) agreed to participate in the survey: 438 were medical students and 441 were nursing students. The response rates were 61% and 97%, respectively. Questionnaires that were not completed were excluded from the sample, thus the final sample comprised 787 respondents, including 388 medical students and 399 nursing students. The questionnaire qualification rates were 89% and 90%, respectively.

The mean age of medical and nursing students were all 24 years old (SD=1.3), with ages ranging from 21 to 29 years. Nursing students were predominantly female (92%), while 58% of medical students were female. Medical students of rural origin were 52%, whereas 66% of nursing students had a rural background (Table 1).

Preferences for job attributes

Output from two mixed logit models for medical students and nursing students fit to DCE data are represented in Table 2. The signs on all estimates were as expected, which implies that respondents derived a higher level of utility from the superior attribute level and made rational choices[16]. As for our study, workload of 60 hours per week and tuneless medical order had an adverse effect on preferences while all the others had the positive effects. Attributes were statistically significant at the 5% level (with the exception of once every two years for education opportunity), indicating that they impact on the probability of choosing a job. Physical conflict, 'bianzhi' and

essential equipment were major predictors of the preference for medical students (β=-0.893, β=0.411, β=0.271, respectively), while physical conflict, 'bianzhi', and transportation were major predictors of the preference for nursing students (β=-0.498, β=0.454, β=0.359, respectively). From the standard deviation of the regression coefficients, we find significant preferences heterogeneity exits over transportation, workload of 40 hours per week, essential equipment, physical conflict, suit and 'bianzhi' for both medical and nursing students. Job location appeared to be an important attribute for both medical and nursing students, and there was no preference heterogeneity for nursing students' preferences while had for medical students.

Willingness to pay

Table 3 shows the results of the WTP calculation. Mean utility coefficients are the basis for estimations of WTP, which can be compared across different groups[30]. These measures explain how much of the salary a final year student is willing to sacrifice to have an improvement on a particular job attribute. The WTP for medical order gave us a clear indication about the importance of harmonious medical order, the medical students and nursing students had to be compensated with RMB 3138 (US$ 464) and RMB 1719 (US$ 254) per month to take a job with physical conflict, respectively. The medical students and nursing students were willing to pay RMB 1443 (US$ 213) and RMB 1566 (US$ 231) in order to obtain 'bianzhi', respectively. In terms of essential equipment, medical students and nursing students were willing to reduce the almost same monthly salary that was RMB 954 (US$ 141) to have a job

with adequate essential equipment.

Analysis for subgroups on sex for medical students suggests that women would be compensated with more money for tuneless medical order than men. And men would pay more money to obtain the other attributes than women with the exception of adequate essential equipment. Medical students from rural background would pay or be compensated with more money for all attributes than those from urban background except the job location of city (Table A2).

Policy simulation

The relative impact of DCE attributes is often better appreciated to predict the impact of different policies. Figure 1 showed the likely uptake of rural jobs to reflect the relative effectiveness of different policies proposing improved rural jobs, for the medical and nursing students, as well as the rural and urban background students. Not surprisingly, urban jobs were more strongly preferred than rural ones, especially for nursing students and urban background students (the total uptake rate for rural postings at the baseline was 2% and 4%, respectively). It appears that of all the single incentives that could be introduced to improve the current rural job offers, the most effective would be to offer rural posts with increased salary for the four groups. As salary level went up, the impact on rural recruitment would increase. As the simulation result showed, if the salary increase from 5000RMB to 7000RMB, the probability of accepting the job would increase by 19%. Intervention packages were also explored (Table 4). For example, intervention packages including salary of RMB

5000 (US$ 739) per month, educational opportunities for once a year and having 'bianzhi' would yield the same impact as the scenario of salary of 7000RMB (US$ 1035) per month for medical students. Incentive packages effects were stronger for students from rural background than those from urban background. Nursing students were more responsive to intervention policies, although they were less likely to choose rural jobs at the baseline.

Discussion

In the absence of any well-designed studies using revealed preference data, we conducted a DCE among final-year health students in order to identify a better understanding of their preferences for job attributes. Effective interventions need to be matched with their job preferences and expectations. In addition, it is vitally important to ensure that health workforce incentive policies are developed and evaluated on the basis of comprehensive empirical evidence which could stem from this rigorous methodology in our study. Further, DCEs are useful in that they can examine the likely effects of policies that have not been executed, thereby providing important information to guide the design of such incentives.

This DCE analysis offers important insights into the nature of the health workers labor market in China. We found that final year health students preferred a job with sufficient opportunities for education, adequate equipment and city location, light working strength, convenient transportation, harmonious medical order, 'bianzhi', higher monthly salary. This finding suggested that there could be a range of policy interventions to improve the probability of choosing a rural job.

Our findings are in agreement with results of other studies. Education opportunity, equipment, workload and transportation were also valued by other studies [15, 36, 40]. The lack of a significant effect for once every two years of educational opportunity indicated that it has a limited effect on determining job selection. The fact that respondents gave the high value to training opportunity for once a year implied that policy options should focus on the factor. This finding echoes the DCE conducted for students in Tanzania, revealing that they are eager to gain more knowledge[39]. For educational opportunities, the government might consider a program where health workers in rural areas are guaranteed access to educational training courses that are most in demand and at least for once a year.

We found that adequate health facility equipment is an important determinant of job choice. This is particularly true for medical and nursing students, who are often disappointed by the gap between what they have been taught to do, often based in a tertiary hospital infrastructure, and the availability of equipment in rural health facilities where they are expected to work after the graduation. These results are consistent with those from other DCEs [13, 35, 37, 38, 41]. Also, a review paper on health worker's motivation and retention indicates that the improvement of hospital infrastructure and resource available could increase retention[42].

Subsequently, we found that respondents wished to have adequate leisure time and there were some aversion to higher workload. A generational shift in the health students could be likely the reason. The respondents were the so-called generation post-90s, who have grown up after China's reform and opening up, and with the

weakening sense of material deprivation which has been strongly had by the generation post-70s and 80s. The belief of hard working for food may be away, and the life style to control over their own spare time may be popular with them. As a result, unlike their parents, working for more hours may not be appreciated by the new power of the workforce market. Therefore, it will be necessary for authority to reconcile work with rest in the future in order to make working in rural areas sufficiently attractive to future health workers.

The result of our study highlighted the importance of convenient traffic. The responsibility for creating such an environment will require an integrated approach that necessarily goes beyond the health commission and include other departments (e.g. finance, road).

Both medical students and nursing students placed high adverse value on tuneless medical order, which was consistent with the context of tense relationship between doctor and patient in China. Indeed, there are complaints among patients over the lack of communication and empathy from doctors, and then the emerging phenomena are widespread physical attacks on doctors[43]. Patients are given a strong impression that health workers pay more attention to earnings than the patients themselves. Gradually, health workers in medical facilities lose the trust and respect from patients. However, one study in China showed that, from the perspective of health workers, respect from community would be of great importance for them[21]. The DCE information presented here may be used to inform the development of specific policy intervention. Given the high doctor-patient tensions in China and the results of our

studies, the introduction of humanistic practice and the inculcation of professional norms in medical schools could be urgent and essential[8]. 'Physical conflict' was the most disliked scenario for medical and nursing students, followed by 'suit'. The findings suggest that these students place more value on their life safety, rather than medical event that could be solved through suit in court. Thus, in order to attract final year students to locate in positions in disadvantaged areas, regulations and institutions need to be improved to protect the safety of them.

Not surprisingly, 'bianzhi' had a large effect on job preferences. This key finding has important policy implications. The majority of health workers in China work at state-owned health facilities, 'bianzhi' can attach them with not only identification from the government, but also corresponding benefits. Nursing students were willing to pay more money to obtain 'bianzhi' than medical students, partly because of a high utilization of contract-based nurses as opposed to 'bianzhi' nurses in China and the inequities between the two types of nurses in terms of wages and job-related benefits. Further, study finds that the disparities may adversely affect both nurse and patient satisfaction in hospitals [20]. In real life, such environments are hard to change, but its substantial impact on job preferences should be considered in health policy discussions. For example, 'equal pay for equal work' strategy could be emphasized by government in order to eliminate the disparities between 'bianzhi' and contract-based.

Our findings confirm that financial incentives are very important in attracting final year students to locate in a rural posting. Final year health students viewed a higher salary as a very important attribute. This reinforces previous studies in China [33],

which might be due to the fact that they are less satisfied with their salaries. As Chinese health students still value the most fundamental needs, the lowest level of needs in Maslow's theory, that is basic needs for safety[21]. From a health policy makers' perspective, future programs should focus on not only non-financial strategies, like educational opportunities or adequate equipment, but also financial incentives. Unlike several studies showing that financial incentives were not found to be most powerful policy levers [13, 26, 28, 31, 33, 36, 38, 44]. However, our findings conformed that monthly income had a significant impact on the job choices of undergraduate health students, similar with other studies [10, 37, 45].

Willingness to pay was used as an estimate of the minimum compensation. The WTP results from the sub-group analysis on sex for medical students showed that women would pay more money for harmonious medical order than men. As a result, female doctors could be considered to be absorbed in the clinical team to smooth the relationship between doctor and patient. Policymakers could target interventions to different sub-groups of students or at least consider the differential impact in their planning.

Our studies found that medical students from rural background would pay more money on the all attributes of the hypothesized work with the exception of rural job location. This finding is in line with previous research [26], but is somewhat at odds with study in India [46]. It follows that the rural shortage of health workers could be mitigated to some extent by preferential admission of health students from rural areas. On the other hand, we could infer that if students with rural background can obtain the

potential work, they maybe cherish the job opportunity. So these were all prompts that need to be taken into account when planning an attraction strategy. This also suggests that preferential selection of rural students by training institutions can be an effective strategy, and it also lends support to claim that student selection policies are a key important of human resource intervention packages. This could be considered, e.g., through a scholarship or student loan scheme for students who are from a rural area and who are willing to accept a job in a rural area upon completing their study.

The results of policy simulation indicate if these forms of incentives are provided, medical and nursing students would take up the job even if it is in a rural area. From a policy perspective, salary increasing would have the largest effect on recruitment, concurring with previous studies especially conducted in poorer areas [1, 36]. Besides, policy makers should attach greater importance to the recruitment of nurses in rural areas. However, nursing students would be more sensitive to policy interventions although they were unwillingly to locate in rural areas at the base line. Some have argued that packages of interventions are essential for improving the distribution human resources, and DCEs are one of the few methods available for comparing such packages. Mounting evidence indicates that incentive packages may be more effective [18]. This study has examined the likely effect of incentive packages on the probability of attracting students to rural areas, and also confirms the importance of developing incentive packages.

This study had several limitations. First, the stated preference method used, even if it allowed us to determine relative strengths of the different attributes, cannot fully

anticipate the decisions eventually made by participants in real life situations. In order to follow them along time to ascertain the actual choices they made, the respondents were asked to provide telephone number on the basis of voluntary. Second, the diverse intrinsic and extrinsic factors influencing job choices in real life are amenable to change over time, and this need to be considered when designing recruitment policies. Third, this research was conducted in Guizhou province, so if the findings can be generalized to other place should be considered deliberately. Fourth, our research did not consider the costs of each type of incentives, which is also an important aspect of any incentive strategies. Further research should be on costs information and monetary valuation of different policies to identify the most cost effective one affecting health students' job choices.

Conclusions

The results of this study help develop priorities for the human resources for health reforms currently on the policy agenda in China and add evidence to the literature on job preferences of final year medical and nursing students, examining the relative importance of factors influencing their job choices. Our research suggests that a variety of possibilities exist to improve doctors and nurses' deployment in rural setting e.g. increasing salary, providing harmonious medical order and eliminating the disparities between 'bianzhi' and contract-based. These findings pose major challenges for planning human resources policies aimed at prioritizing rural areas. Meanwhile, subgroup analysis indicates that one uniform recruitment policy is not recommended.

548 The results presented here should be considered by policy makers for its
549 implementation, while weighing carefully the labor market and policy cost.

550 **Abbreviations**

551 WHO: World Health Organization; DCE: Discrete choice experiment; WTP: Willingness to pay.

552 **Declarations**

553 **Ethics approval and consent to participate**

554 This study was approved by Medical Ethics Committee of Guizhou medical university and the
555 study was undertaken with permission from the director in Health Information Center of Health
556 and Family Planning Commission of Guizhou Province. Participants were informed about the
557 research, and gave informed consent prior to study participation. Respondents participated on a
558 voluntary basis.

559 **Consent for publication**

560 Not applicable.

561 **Availability of data and materials**

562 The datasets used and/or analysed during the current study are available from the corresponding
563 author on reasonable request.

564 **Competing interests**

565 The authors declare that they have no competing interests.

566 **Funding**

567 Not applicable.

568 **Authors' contributions**

569 MB designed the study and data collection tools, conducted the data analysis and drafted the

manuscript. CH contributed to the development of the research design, monitored the data collection activities and contributed to preparing the draft manuscript. Both authors read and approved the final manuscript.

Acknowledgments

We thank the medical and nursing students who participated in the study. We also appreciate the health officials and health workers who gave their valuable time to participate in the study.

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Box 1 Posting attributes and levels used in discrete choice experiment	
attributes	**levels**
Education opportunity	Once every five years
	Once every two years
	Once a year
Transportation	Inconvenient
	Convenient
Salary[a]	RMB3000/month
	RMB5000/month
	RMB7000/month
	RMB9000/month
Job location	Villages and towns
	City
Workload	50 hours per week
	40 hours per week
	60 hours per week
Essential equipment	Inadequate
	Adequate
Medical order	No(quarrel, Physical conflict and suit)
	Quarrel
	Physical conflict
	Suit
'Bianzhi'	No 'bianzhi'
	Have 'bianzhi'

[a]For analysis, salary was treated as a continuous variable. All other attributes were dummy coded. A base level was defined to reflect the current labor market conditions, whereas other levels were modifications from that base level.

Table 1 Characteristics of participants (*N*=787)

variables	Medical students		Nursing students	
	frequency	%	frequency	%
N	388		399	
Sex				
Male	163	42	30	8
Female	225	58	369	92
Age group				
21-25 years old	341	88	368	92
26-29 years old	47	12	31	8
Background				
Urban	188	48	134	34
Rural	200	52	265	66

Table 2 Mixed logit model results for medical and nursing students' job preferences

Attributes	Parameter	Medical students		Nursing students	
		Coefficients [a]	SE	Coefficients	SE
Salary [b]					
Salary	Mean	0.000285***	0.00	0.000290***	0.00
Education opportunity [c]					
Once every two years	Mean	0.035	0.043	0.061	0.039
	SD	0.002	0.091	0.120	0.163
Once a year	Mean	0.161***	0.046	0.107**	0.042
	SD	0.139	0.115	0.060	0.110
Transportation [d]					
Convenient	Mean	0.235***	0.037	0.359***	0.041
	SD	0.308***	0.055	0.475***	0.045
Job location [e]					
City	Mean	0.218***	0.055	0.231***	0.049
	SD	0.371***	0.089	0.111	0.190
Workload [f]					
40 hours per week	Mean	0.153***	0.046	0.227***	0.044
	SD	0.332***	0.069	0.224***	0.085
60 hours per week	Mean	-0.106**	0.043	-0.150***	0.038
	SD	0.013	0.105	0.054	0.138
Essential equipment [g]					
Adequate	Mean	0.271***	0.040	0.277***	0.033
	SD	0.475***	0.045	0.284***	0.050
Medical order [h]					
Quarrel	Mean	-0.351***	0.049	-0.255***	0.048
	SD	0.081	0.195	0.122	0.136
Physical conflict	Mean	-0.893***	0.064	-0.498***	0.056
	SD	0.714***	0.068	0.445***	0.071
Suit	Mean	-0.884***	0.071	-0.497***	0.054
	SD	0.830***	0.079	0.346***	0.089
'Bianzhi' [i]					
Have 'bianzhi'	Mean	0.411***	0.046	0.454***	0.039
	SD	0.635***	0.047	0.465***	0.044
Constant		0.118	0.034	-0.059	0.034
Number of respondents		**388**		**399**	
Number of observations		**15520**		**15960**	
Log likelihood		**-4464.6944**		**-4583.6866**	
LR chi-square		**275.86**		**124.41**	
Prob >chi-square		**0.0000**		**0.0000**	

$^{***}P<0.01$, $^{**}P<0.05$.

SD, standard deviation.

SE, standard error.

[a]The coefficient represents the mean relative utility of each attribute conditional on other attributes in a choice set, while the standard deviation of the random coefficients reflects the degree of heterogeneity in respondent preferences for a given attribute.

[b]Continuous variable; the coefficient represents the magnitude of increase in utility by having one extra RMB.

[c]Compared with once every five years.

[d]Compared with inconvenient transportation.

[e]Compared with rural job location.

[f]Compared with 50 hours per week.

[g]Compared with inadequate essential equipment.

[h]Compared with no quarrel, physical conflict and suit.

[i]Compared with no 'bianzhi'.

Table 3 Willingness to pay[a] for medical and nursing students

Variable	Medical students	Nursing students
Education opportunity		
Once every two years	121	211
	(177, 419)[b]	(-51, 474)
Once a year	566	370
	(248, 885)	(86, 654)
Transportation		
Convenient	827	1237
	(572, 1081)	(965,1510)
Job location		
City	766	797
	(390, 1142)	(465, 1128)
Workload		
40 hours per week	536	783
	(216, 856)	(488, 1078)
60 hours per week	-372	-517
	(-667,-76)	(-776, -258)
Essential equipment		
Adequate	953	954
	(674, 1232)	(725,1183)
Medical order		
Quarrel	-1233	-880
	(-1577, -888)	(-1199, -561)
Physical conflict	-3138	-1719
	(-3588, -2688)	(-2097, -1341)
Suit	-3103	-1716
	(-3598, -2609)	(-2085, -1346)
'Bianzhi'		
Have 'bianzhi'	1443	1566
	(1123, 1763)	(1302, 1830)

[a]RMB per month. RMB 1= US$ 0.1479, in 2017.

[b]95% confidence intervals in parentheses, the confidence intervals are calculated with the nlcom-command in Stata.

728 **Table 4 Predicted impact of different policy interventions on uptake of rural postings**

729

Intervention	Medical students		Nursing students		Rural background		Urban background	
	Change (%points)	Total uptake (%)	Change (%points)	Total uptake (%)	Change (%points)	Total uptake (%)	Change (%points)	Total uptake (%)
Base uptake		28		2		29		4
Single interventions								
Education for once a year	7	35	5	7	6	35	6	10
Convenient transportation	7	35	15	17	12	41	7	11
Salary 5000 RMB per month	22	50	25	27	22	51	25	29
Salary 7000 RMB per month	41	69	47	49	42	71	47	51
Salary 9000 RMB per month	58	86	65	67	59	88	64	68
Workload for 40 hours per week	6	34	9	11	6	35	7	11
Adequate essential equipment	12	40	12	14	13	42	9	13
Have 'bianzhi'	15	43	20	22	21	50	13	17
Intervention packages								
Education+5000salary+'bianzhi'	41	69	47	49	54	83	42	46
Transportation+5000salary+'bianzhi'	42	70	54	56	61	90	43	47
Workload +equipment +'bianzhi'	32	60	39	41	46	75	28	32
7000salary+ equipment +'bianzhi'	61	89	68	70	66	95	62	66
7000salary + equipment	51	79	56	58	60	89	54	58

730 Compared with a baseline job posting defined as: education for once every five years; inconvenient
731 transportation; salary for 3000RMB per month; workload for 50 hours per week; inadequate essential
732 equipment; medical order for no quarrel, physical conflict and suit ; no 'bianzhi'.

Figure 1 Changes of total uptake rate of taking a rural job under different intervention.

a: Medical students versus nursing students.

b: Rural background students versus urban background students.

736 **Additional file**

737

738 **TableA1 County or district interviewed in Guizhou province**

739

County(District)	GDP[a] (RMB100 million)	Facility Numbers	Interviewee Numbers
Zhijin	154.41	2	10
Hezhang	112.06	2	9
Weining	189.37	1	2
Zhongshan	384.69	2	11
Shuicheng	206.29	2	9

740 GDP, gross domestic product.

741 The average GDP of 44 counties (districts) was RMB196.32 (100 million) in Guizhou
742 province, 2015. RMB 1= US$ 0.1479, in 2017.

743 [a]Data from Guizhou Statistical Yearbook[47][47][47][47].

744 **Figure A1 Example of a choice set**

745 **Table A2 Willingness to pay[a] for medical students of sex and background difference**

746

Variable	Female	Male	Rural	Urban
Education opportunity				
Once every two years	9	50	236	18
	(-426, 445)[b]	(-427, 529)	(-52, 525)	(-315, 278)
Once a year	584	615	544	484
	(110, 1060)	(92, 1137)	(228, 861)	(154, 815)
Transportation				
Convenient	614	694	1112	606
	(277, 950)	(322,1066)	(880, 1345)	(364, 850)
Job location				
City	428	657	495	797
	(-99, 956)	(69, 1245)	(138, 851)	(415, 1179)
Workload				
40 hours per week	367	786	600	557
	(-69, 803)	(293, 1278)	(302, 900)	(232, 883)
60 hours per week	-449	-240	-564	-339
	(-899,-2)	(-733, 253)	(-862, -266)	(-702, -96)
Essential equipment				
Adequate	1307	782	1184	706
	(958, 1657)	(408, 1158)	(949, 1417)	(468, 943)
Medical order				
Quarrel	-1695	-885	-1394	-956
	(-2224, -1166)	(-1444, -326)	(-1738, -1050)	(-1320, -592)
Physical conflict	-3946	-2396	-2741	-2193
	(-4532, -3359)	(-2997, -1795)	(-3118, -2364)	(-2589, -1797)
Suit	-3681	-2268	-2818	-2038
	(-4295, -3067)	(-2907, -1630)	(-3216, -2418)	(-2442, -1634)
'Bianzhi'				
Have 'bianzhi'	1304	1419	1898	1001
	(952, 1657)	(1030, 1809)	(1653, 2143)	(757, 1245)

747 [a]RMB per month. RMB 1= US$ 0.1479, in 2017.

748 [b]95% confidence intervals in parentheses, the confidence intervals are calculated with
749 the nlcom-command in Stata.