

Preferences of Medical Students for Rural Medical Internships in South Africa: A Discrete Choice Experiment

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Research

Keywords: medical students, rural health, careers, decision making, health economics, human resources, incentives, labour market, developing countries, occupational health.

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27 **Abstract**

28 **Background:** Globally the proportion of medical doctors to population in rural areas in low- and
29 middle-income countries remains insufficient to address their health care needs. Therefore, it is
30 imperative to design strategies that attract medical doctors to rural areas to reduce health
31 inequalities and achieve universal health coverage. **Methods:** This study assessed preferences of
32 medical students for rural internships using a discrete choice experiment. Attributes of rural job were
33 identified through literature and focus group discussions. A D-efficient design was generated with 15
34 choice sets, each with forced binary, unlabelled, rural hospital alternatives. An online survey was
35 conducted, and data analysed using mixed logit models of main effects only and main effects plus
36 interaction terms. **Results:** Majority of the respondents were females (130/66.33%) and had urban
37 origin (176/89.80%). The main effects only model showed advanced practical experience, hospital
38 safety, correctly fitting personal protective equipment, and availability of basic resources as the most
39 important attributes influencing take up of rural internship, respectively. Respondents were willing to
40 pay ZAR 2645.92 monthly (95%CI: 1345.90; 3945.94) to gain advanced practical experience
41 (equivalent to 66.15% of current rural allowance). In contrast, increases in rural allowance and the
42 provision of housing were the least important attributes. Based on the interaction model, female
43 respondents and those intending general practise associated higher weight for hospital safety over
44 advanced practical experience. **Conclusion:** In the context of limited budgets and resource
45 constraints, policy makers and rural health facility managers are advised to prioritise meaningful
46 internship practise environments that offer supervised learning environment, safety from physical
47 and occupational hazards and the provision of basic resources for healthcare system-wide benefits to
48 both staff and rural health facility users alike.

49 **Keywords:** medical students, rural health, careers, decision making, health economics, human
50 resources, incentives, labour market, developing countries, occupational health.

51

52 **Background**

53 The health workforce as a critical building block of a functional health system requires the availability,
54 accessibility, acceptability, and quality of health workers to determine the level of health service
55 coverage and attainment of the highest possible standard of health (1,2). The move towards universal
56 health coverage cannot be realized without motivated and empowered health workers with required
57 competencies, equitably distributed to provide needed services of good quality to the population (3).
58 The Demographic and Health Survey revealed that many countries that accelerated the move towards
59 universal health coverage “have left the poor and rural population behind”(1). The struggle for health
60 equity is faced by countries globally, with the delivery of healthcare to those living in remote and rural
61 areas identified as a pressing challenge (4). The lack of adequate skilled personnel in rural areas has
62 been attributed as the top limiting factor to the scale up of health interventions such as life-saving
63 anti-retroviral treatment and the improvement of maternal and child-health outcomes (5).

64

65 Rural medical practice is often seen to be challenging due to social and cultural isolation, lack of
66 infrastructure and transport, electricity, telecommunications and restricted access to goods and
67 services (6). The South African National Department of Health’s (DOH) strategies for rural doctor
68 recruitment includes recruiting rural-origin students to be trained in Cuba on condition of fixed-term
69 mandatory rural service and the provision of on-site housing which is both expensive and time-
70 consuming to maintain (7). South African medical doctors are trained in undergraduate medical schools
71 (either in South Africa or Cuba), followed by a two-year compulsory internship at an approved
72 government hospital and additional one-year mandatory community service before they can be
73 certified for independent practice (7).

74

75 The minimum recommended doctor-population ratio for middle-income countries; such as, South
76 Africa (SA) is 18 doctors per 10,000 people(8); but in 2017, the medical doctors per 10,000 population

77 in SA was only 9.1 (9). Only 2.9% of doctors in the SA public sector practise medicine at rural facilities
78 where an estimated 33% of the population live (10,11). The doctor shortage is both an absolute as well
79 as relative issue, as there is unequal division of doctors along public-private lines, provincial lines, rural-
80 urban lines, poor-wealthy lines and state dependant-medically insured lines (12). The overall
81 distribution of public sector post-internship medical posts are approximately 75% urban, 25% rural (13).
82 Despite a desperate need for health workers, in 2003, there was 31% vacancy rate in the SA public
83 health sector (5). In 2010, there were 10,860 unfilled public sector medical practitioner vacancies, with
84 the rural province of Limpopo contributing to 46.5% of these unfilled posts compared to the urbanised
85 province of Gauteng which shared only 10.2% of the total unfilled posts (14).

86

87 The first five years of practice after graduation as a medical doctor are critical for retention in
88 practising medicine (15). This is further illustrated by SA studies of public sector doctors which found
89 that between 6.6%-45% of newly graduated doctors planned to leave medicine, citing lack of
90 equipment at facilities and unbearable workload as push factors (16,17). A qualitative cross-sectional
91 study showed that medical interns were motivated to choose an internship based on proximity of
92 facility location to family and the fulfilment of their provincial bursary obligations, however, that
93 research was not investigating the preferences for rural facilities specifically (16). (18,19)Although
94 there is data available to describe health worker's practise location intentions, there is currently a
95 dearth of knowledge on the job preferences of medical students. This study therefore seeks to
96 uncover preferences for rural internship job among final-year medical students at the authors
97 institute.

98

99 **Methods**

100 Study Design

101 The study population was the entire final-year medical students at the authors institute who applied
102 for internship placement in 2019 for commencement of work in 2020 (N= 224 students, of which 200

103 SA trained, 24 Cuban trained.) Cuban trained medical students commenced their internship in the
104 latter half of 2019 whereas their SA- trained counterparts commenced internship in January 2020.

105

106 Discrete choice experiment

107 A discrete choice experiment (DCE) is an attributed-based stated preference method used to elicit

108 preferences for goods or services (20,21). In DCE, respondents are presented with a sequence of

109 hypothetical choice questions described by different attributes and levels to select the most preferred

110 alternatives yielding maximum utility (22–24).

111

112 Attribute Identification

113 Design of a DCE involves identification of attributes and their levels. Attributes are the characteristics

114 of the goods/services. Attribute levels are the specific values that describe the various features of

115 attributes (25). In this study, job attributes that are relevant to healthcare workers were identified

116 from literature and validated by focus group discussions (FGDs) conducted with the study population.

117 Three FGD sessions were held with a total of 15 medical students representing the gender and

118 provincial distribution of the class. Using the FGD guide, students were probed to discuss their views

119 on working at rural areas and what factors can facilitate take up of an internship job in rural areas. On

120 average, the FGDs took 60 minutes per session. All FGDs were conducted in English and recorded with

121 respondents' consent. The FGDs were transcribed verbatim and thereafter a thematic analysis was

122 conducted to identify common attributes. Based on the literature review and the FGDs, seven final

123 attributes were selected (Table 1). Attributes from literature that were dismissed by FGD participants

124 were: proximity of health facility to children's schools and work opportunities for spouses. Attributes

125 that were identified through the FGDs : Personal protective equipment (PPE) in the form of N95

126 respirator masks to protect against occupational tuberculosis exposure, practical experience and

127 seniority of supervisor.

128

129 Questionnaire design

130 Using the selected attributes and levels, Sawtooth Software (Sawtooth Software Inc., Sequim, WA,
131 USA) was used to generate D-efficient choice sets which consist of 15 hypothetical job postings. The
132 choice scenarios were binary with generically named 'Rural Hospital A' and 'Rural Hospital B'
133 alternatives. There was no 'opt-out' option to reflect the mandatory nature of the internship process
134 for accreditation. The DCE questionnaire was piloted with 25 final year medical students from the
135 preceding graduating class. Based on their feedback the attribute "occupational hazard" was specified
136 to include the level 'incorrectly fitting masks', these are prone to air-leaks which undermine their
137 effectiveness (26). The attribute "Practical experience" was reworded to provide clarity and examples
138 for each of its levels. The levels of the attribute 'supervision' are defined based on seniority with
139 'medical officer' the most junior doctor authorised to practise independently, followed by 'registrar'
140 who is a specialist-in-training, finally 'consultant' who is an experienced medical specialist. Rural
141 allowance is presented in local currency, South African Rands (ZAR). The attribute 'rural allowance'
142 base level of ZAR 4,000¹ is based on current SA internship rural allowance at 20% of monthly base
143 salary of ZAR 20,000 excluding overtime (27). The second level was calculated according to historical
144 wage increases as 8% increase on the base level (28). The third level is a 20% increase on the base
145 level suggested by FGD participants. The attributes 'Housing', 'Basic Resources', 'Practical experience',
146 and 'Hospital safety' have two levels each as described in Table 1.

147

148 The final DCE questionnaire was administered over a one-month period in February 2019. The
149 questionnaire link was sent to the study population at the authors institute via email. It was
150 anonymous and self-administered on devices (laptop/tablet/mobile). It took on average 20 minutes to
151 complete (Figure 1). All students have access to computers on campus at computer laboratories as
152 well as Wi-Fi access. First author was also in person at class lectures to encourage participation
153 among students and provide refreshments.

¹ Exchange rate as at 24 August 2020 ZAR17.02=1USD

154 **Data Analysis**

155 The analysis of the DCE responses followed the random utility theory framework in which individuals
156 are assumed to have an indirect utility for choice alternatives and make choices based on their
157 discrimination capabilities (21,29). Given binary choice alternatives of 'Rural Hospital A' and 'Rural
158 Hospital B' as described by the attributes, students choose the alternatives that give them the highest
159 utility. The deterministic part of the utility (V_{jnt}), which is observable, is defined as a linear function of
160 the job attribute levels and is given by:

$$\begin{aligned} V_{jnt} = & \beta_0 + \beta_1 \text{sup_regist}_{nt} + \beta_2 \text{sup_consul}_{nt} + \beta_3 \text{allowance}_{nt} + \beta_4 \text{house_provided}_{nt} \\ & + \beta_5 \text{reso_avail}_{nt} + \beta_6 \text{exp_proced}_{nt} + \beta_7 \text{safety_good}_{nt} + \beta_8 \text{mask_poor}_{nt} \\ & + \beta_9 \text{mask_correct}_{nt} \end{aligned}$$

161 Where, the variables are defined in Table 1. The attribute rural allowance is modelled as a continuous
162 variable while the remaining variables were categorical, and effects coded. Thus, β_3 indicates change
163 in utility for a unit change in rural allowance while the coefficients of the categorical variables capture
164 the effect of the presence of the attribute levels on utility. Two mixed logit (MXL) models, based on
165 500 Halton draws, were estimated assuming a normal distribution in Stata v14; (i) a main effects only
166 model which is a function of job attributes only Model 1, and (ii) main effects plus interaction of
167 attributes with some respondent characteristics (i.e., gender, career aspiration, and prior rural
168 medicine exposure) to explore differences in the valuation of rural internship attributes by sub-
169 population Models 2.1-2.6. Willingness to pay (WTP) represents the respondent's preferences
170 for rural health facility attributes in monetary terms. Marginal WTP which indicates how
171 much money a final year medical student is willing to pay to work at a rural health facility
172 with attribute level (k) in comparison to a facility with the reference attribute level (r) is
173 estimated; this is then expressed in ZAR and as a percentage of current rural allowance.
174 Given effects coding, for attributes with two levels, marginal WTP was estimated as

175 $2 * \beta_k / -\beta_3$ while for attributes with more than two levels it is calculated as $\beta_k - \beta_r / -\beta_3$;
176 where $k \neq 1$ and $k \neq r$. Delta method is used to estimate the 95% confidence intervals for the
177 WTP estimates (30).

178

179 Results

180 Table 2 presents the respondents' characteristics. The number of respondents who completed the
181 questionnaire were 193 (86.16%) of 224 final-year medical students. The mean age of respondents,
182 24 years (95% CI 23.65; 23.75), is consistent with an undergraduate, 6-year medical degree. The
183 sample's female majority 130 (66.33%) and the distribution of province of origin are reflective of the
184 institute's admission criteria. Majority of participants came from urban areas 176 (89.80%), were not
185 married 183 (93.37%), and did not have child dependants 193 (98.47%). For respondents who had
186 reported undergraduate exposure to rural medicine, opt-in rural electives 43 (32.09%) and family
187 medicine rotations 51 (38.06%) proved most popular. Few respondents were provincial bursary
188 holders 45 (22.96%) or completed their training in Cuba 7 (3.57%). One hundred ninety-two (97.96%)
189 participants intended to complete their internship in SA with the majority opting to specialise
190 (109/55.61%) instead of entering general practise.

191

192 Table 3 illustrates the estimation results of mixed logit model with main effects only and main effects
193 plus interaction terms. Other things constant, a larger mean coefficient translates into a greater
194 relative likelihood of choosing a job alternative. An advanced practical experience was the most
195 valued attribute followed by hospital safety, the provision of correctly sized N95 masks, and
196 availability of basic resources. Importantly, the provision of subsidised doctor's quarter and rural
197 allowance were among the least valued attributes. Respondents also preferred job alternatives with
198 consultant supervisors compared to medical officers. A poorly fitting N95 mask was less preferred
199 than having no mask at all. The standard deviations of the mean coefficients of attributes are

200 significant at the 1% level indicating preference heterogeneity among the respondents in relation to
201 these attributes.

202

203 Further analysis of the heterogeneity using the main effects plus interaction models shows that;
204 overall, females valued the provision of basic resources, correctly fitted masks and advanced practical
205 experience to a greater extent than their male counterparts. The difference in valuation of hospital
206 safety was more pronounced with females weighing hospital safety by more than double that of the
207 valuation by males. Based on interaction of job attributes and career aspirations (intending to
208 specialise or join general practice), being supervised by a consultant was more important for those
209 who intended to specialise. In comparison, hospital safety and the provision of basic resources had
210 higher valuation by those intending general practice. Considering the interaction of undergraduate
211 rural medicine exposure, respondents without undergraduate rural medicine exposure highly valued
212 the provision of housing and having basic resources available. In contrast, their colleagues who have
213 had rural medicine exposure valued supervision by consultants and hospital safety more.

214

215 It can be concluded that there was a level of left-right bias present in this sample indicated by
216 significant Rural Hospital A constant term 0.375 (p-value 0.021). Participant fatigue was ruled to be
217 unlikely by a heteroscedastic conditional logit model which demonstrated the later choices being not
218 significantly different from earlier choices. Respondents valuation for their professional development
219 and safety were quantified; they were willing to pay the equivalent of 66.15% in current rural
220 allowance to work in a facility with advanced practical experience compared to a facility which only
221 offered limited practical experience, all other things being equal(Table 4).

222

223 **Discussion**

224 This study found the most influential attributes to a final year medical student when considering a
225 rural internship are: advanced practical experience, safety, and provisions for protection against

226 occupational hazard. Advanced practical experience is a natural selling point of rural health facilities
227 due to being understaffed and situated far from referral hospitals. Therefore, facility managers of
228 rural facilities should publicise to prospective staff the valuable “hands-on” experience they stand to
229 gain.

230

231 Sub-group analysis by gender showed the value of hospital safety for female students. This is a
232 genuine concern in the context of rural facilities which are often geographically isolated. This finding
233 supports those of Walker and Gilson (31) who documented the experiences of female SA nurses who
234 were victims of crime at their facilities. An integrated approach is needed that co-ordinates facility
235 management, local law-enforcement, and community structures to provide staff and users of rural
236 health facilities with a peaceful environment to work and recuperate. Investment is needed in
237 providing trained security personnel, access control to various sections of the facility as well as
238 adequate lighting of the facility and surrounding areas to deter crime.

239

240 Occupational tuberculosis exposure is a unique attribute identified that has not been studied in other
241 health worker recruitment DCE studies. An individual N95 mask cost approximately ZAR7.76 (32) and
242 are ideally replaced on a daily basis, resulting in a monthly cost of approximately ZAR200 (5% of
243 current rural allowance) at the time of this study’s data collection. Interestingly, a poorly fitting N95
244 mask was less preferred than having no mask at all, highlighting the priority with which medical
245 students value their health and their understanding that a poorly fitting N95 mask is just as ineffective
246 as having no mask at all. In a survey among SA medical and physiotherapy students they rated
247 themselves at a 4.4 times increased risk of contracting TB compared to the general population (33). In
248 the same study 49% of students reported no access to N95 respirators at the health facilities where
249 they were training(33). Likewise, access to basic resources such as gloves, syringes and needles was a
250 preference that significantly influenced choices both in overall and sub-group analysis. In rural

251 facilities which are situated far from medical supply depots, the budgeting and timely procurement of
252 basic resources is vital for the provision of quality healthcare and achieving positive health outcomes.

253

254 A new threat has emerged necessitating the urgent provision of PPE to healthcare workers. At the
255 time of writing, the COVID-19 pandemic has infected an estimated 55,000 healthcare workers in SA;
256 its rapid spread attributed to the pre-existing shortage of PPE (34). Globally the swift response to roll
257 out protective measures and improve the use of PPE have reduced the infection risk among
258 healthcare workers (35). The resulting increase in demand, has led to rapid price surges with N95
259 masks trebling in price since the pandemic began (36). Therefore, the recruitment cost-effectiveness
260 of PPE and basic resource provision as argued in this study, pre COVID-19, may no longer be tenable.
261 The authors do however remain committed to the continued protection of healthcare workers as an
262 immediate and long-term health priority.

263

264 The preference of medical students for consultant supervision places rural facilities at a disadvantage
265 as they are often manned by junior staff. This lack of senior staff may deter graduates, intent on
266 specialising, from working at rural facilities. Conversely, rural facilities that have consultants should
267 provide them with the responsibility to supervise intern doctors as this is a noted drawback. This
268 finding supports existing literature that SA doctors at rural facilities receiving supervision from seniors
269 reported greater levels of job satisfaction and patient care (37).

270

271 The popularity of rural allowance and housing provision as a recruitment strategy is thought to be due
272 to its ability to offset travel expenses, thereby lowering the living expenses associated with living in a
273 rural area (37–44). This study however, showed that both rural allowance and housing provision were
274 less important to the study medical students than the other attributes investigated. This supports the

275 findings of Vujicic *et al.*(19) who denounced the cost-effectiveness of housing provision as a
276 recruitment strategy in Vietnam. Although higher wages are associated with lower rates of worker
277 attrition, this relationship is inelastic at higher salary levels (as in the case of SA doctors), in which
278 instance other job attributes become a more important influence (45). Pending further research, the
279 DOH should reconsider the implementation of its rural allowance policy for doctors as systematic
280 alternatives, which have been mentioned above, may prove to be impactful and cost-effective in the
281 long-term.

282

283 The sub-population analysis further highlight heterogeneity in preference of these job attributes by
284 gender, career aspiration, and rural medicine exposure. The finding that female medical students
285 were marginally more sensitive to rural allowance and housing provision is supported by studies in
286 Burkina Faso and Indonesia which found that females were twice more likely to choose a job offer
287 with free housing and were more sensitive to the recruitment effect of rural allowance compared to
288 their male counterparts respectively (42,46).

289

290 Career intentions of medical students has been studied in qualitative and quantitative studies
291 (16,47,48). This study contributes to this knowledge with the first attempt at interacting self-stated
292 career intention with rural health facility attribute preference. This result provides insight into how
293 rural health facilities can offer graduates what they are looking for based on their career aspirations.
294 For the graduate who intends to specialise, rural health facilities can provide the advance practical
295 skills they seek to learn. For those who prefer general practise, a rural facility's safety and resource
296 track record is more influential.

297

298 Medical students with rural medicine exposure valued hospital safety highly reflecting the safety
299 concerns they may have encountered personally or heard about during their time at the rural facility.
300 That medical students without rural medicine exposure preferred being provided with housing more

301 so than their rural-exposed colleagues contrasts with existing literature (49). This could be due to
302 rural-exposed students feeling more confident to organise their own accommodation
303
304 Given the hypothetical nature of the experiment and use of forced choice scenarios overestimation of
305 parameters is a possibility. Despite the alternatives being unlabelled, students chose the alternative
306 that appeared on the left side of their screen more often implying a degree of bias in their choices.
307 The small sample size limits the generalisability of results to all (prospective) medical doctors in the
308 country. It is argued that discrete choice experiment results should be validated by revealed
309 preference data by conducting policy experiments (39). In reality minimal information is available
310 about the attributes of a facility, leading job-seekers to base their decisions on rumours of facility
311 reputation therefore, Robyn et al. (50) encourage greater transparency regarding job listings,.

312

313 **Conclusion**

314 In the context of limited budgets and resource constraints, policy makers and rural health facility
315 managers are advised to pay heed to the implications of this study's findings to assist in priority-
316 setting targeted recruitment initiatives to attract underrepresented medical graduates especially
317 females and those with intention to remain in general practise through transparent and informative
318 rural facility descriptions. This discrete choice experiment identified the range of preferences for rural
319 health facility attributes valued by a diverse sample of final-year medical students at a public
320 university. The authors are confident that the results are representative for SA trained- medical
321 graduates' expectations for a meaningful rural internship placement experience, one that would offer
322 them a supervised learning environment, safety from physical and occupational hazards and the
323 provision of basic resources to complete their clinical responsibilities. It is hoped that these cost-
324 effective facility-based incentives would have healthcare system-wide benefits to both staff and rural
325 health facility users alike.

326 Lst of Abbreviations

327 South African National Department of Health's (DOH)

328 South Africa (SA)

329 Discrete choice experiment (DCE)

330 Focus group discussions (FGDs)

331 South African Rands (ZAR)

332 Willingness to pay (WTP)

333 Personal protective equipment (PPE)

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348

349 **Declarations**

350 Funding: This study received no external funding and was self-funded by the corresponding Author.

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353

354 Data and materials: The datasets used during this study are available from the corresponding author

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356

357 Ethical clearance: In addition to University of Cape Town Human Research Ethics Committee approval,

358 the study was approved by the University of Cape Town Student Affairs Departments to conduct

359 research involving students enrolled at the University.

360

361 Author's contributions: OA contributed to study proposal, MJ conducted the data collection, AO and

362 MZ contributed to data modelling and analysis. All authors read and approved the final manuscript."

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365 Conflicts of Interests: The authors declare no conflicts of interest.

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Figures

If these were your only internship options, which would you choose?
(1 of 15)

	Rural Hospital A	Rural Hospital B
Supervision	Supervised by Medical officer	Supervised by Registrar
Practical experience	Limited to filling out forms and taking bloods	Includes filling out forms, take bloods and doing procedures e.g. lumbar punctures
Resources	Daily stock out of gloves, syringes and suture packs	Gloves, syringes and suture packs available daily
Rural allowance	R4000 (current level)	R4340 (8% increase)
Hospital Safety	There have been few reports of theft, hijacking and protests in and around the hospital in the past year	There is a high level of crime in and around the hospital with many reports of theft, hijacking and protests in the past year.
Occupational Hazard	Correctly sized N95 masks always available	Poorly fitting N95 masks always available
Housing	Provided with subsidised doctors quarters on hospital premises	Rent private accommodation
	<input type="button" value="Select"/>	<input type="button" value="Select"/>

0%  100%

Figure 1

Example of Discrete Choice Experiment choice set presented to participant.