Rural internship job preferences of final year medical students in South Africa: a discrete choice experiment

by

Student: Dr Maria Jose

Student Number: JSXMAR002

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Supervisor: Dr Olufunke Alaba

Health Economics Unit, University of Cape Town, South Africa

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Name: MARIA JOSE

Student number: JSXMAR002

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Thesis Abstract

To achieve Sustainable Development Goal 3 in developing countries, *Good health and well-being for all*, the health workforce is vital however the unpopularity of rural medical practice results in widening healthcare inequalities between urban and rural areas. This study determined the heterogeneity in valuations for rural facility attributes by final year medical students at one South African public university to inform cost-effective recruitment policy recommendations. Focus groups conducted identified facility attributes, a D-efficient design was generated with 15 choice sets, each with two rural hospital alternatives and no opt-out option. An online, unlabelled discrete choice experiment (DCE) was conducted, the results effects coded, and mixed logit models applied. The final sample size was 193 (86,16% of the class), majority female 130 (66.33%), with urban origins 176 (89.80%), unmarried 183 (93.37%) and without children 193 (98.47%). Most had undergraduate rural medicine exposure 110 (56.12%) and intended to specialise 109 (55.61%). The main-effects mixed logit found advanced practical experience, hospital safety, correctly fitted personal protective equipment (PPE) and availability of basic resources the highest weighted attributes with their mean utilities increasing by 0.82, 0.64, 0.62 and 0.52 respectively (p=0.000). In contrast, increases in rural allowance and the provision of housing provided smaller mean utility increases of 0.001 ($p<0.01$) and 0.09 ($p<0.05$) respectively. The interaction terms; female, general practise and prior rural medicine exposure, were associated with higher weighting for hospital safety, mean utility increases 1.59, 1.82, 1.42 respectively (p=0.000). Participants were willing to pay ZAR 2636.45 monthly (95%CI: 1398.55;3874.355) to gain advanced practical experience (equivalent to 65.91% of current rural allowance). Medical students' facility preferences have been found to be influenced by their gender, career aspirations and prior experienced with rural medicine. The policy recommendations derived from this research include publicising rural health facility "draw-cards" among medical graduates, such as the opportunity to gain practical experience, improving the physical and occupational safety at rural health facilities and providing greater transparency about rural facility attributes to medical graduates.

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PART 1:

RESEARCH PROPOSAL

1. Background

The World Health Organisation (WHO) has identified the health workforce as a critical building block of a functional health system, highlighted the importance of equitably deploying health workers to under-resourced areas where the need for health care is the greatest[1]. The WHO recognises that the struggle for health equity is faced by policy makers globally, with the delivery of healthcare to those living in remote and rural areas identified as a pressing challenge.[1] It is disconcerting that although Africa bears 24% of the global disease burden, it has access to only 3% of the global health work force.[2]

The majority of Sub-Saharan African (SSA) countries do not meet the WHO recommended minimum doctor-population ratio.[3] World Bank assessment shows that a middle income country such as South Africa (SA) would need to have a minimum of 180 doctors per 100000 people to be on par with Brazil and Mexico which are middle income countries, however SA's ratio is more on par with low income countries (50:100000).[4] Moreover, HIV/AIDS, emigration, crime and unstable macroeconomic climates are contributing to "brain drain" from these developing countries.[3]

A study quantifying the cost of doctors emigrating from Sub-Saharan Africa found the estimated loss on investment to be $58700 per South African (SA) medical graduate.[3] Approximately half of the 2400 South African SA medical graduates of 2006 and 2007 are predicted to emigrate, with those remaining split between the public and private sector 25% and 75% respectively.[5] Furthermore, only 2.9% of those in the public sector would be practising medicine at rural facilities in the country.[5] The doctor shortage is both an absolute as well as relative issue, as there is unequal division of doctors along public-private lines, provincial lines, rural-urban lines, poor-wealthy lines and state dependant-medically insured lines.[2]

The economic perspective of Human Resource Management (HRM) views the labour market as constructed of supply, demand, wage and market forces.[6] SA medical school positions are limited and highly competitive, thereby limiting entrance to the profession, driving up wages due to scarcity that is compounded by emigration, and inequitable distribution of doctors.[6] The supply of medical doctors is also constrained by few medical schools and a long process of training.

Medical doctors are trained for six years followed by a two-year compulsory internship and one-year mandatory community service before they can be certified for independent practice. Although higher wages are associated with lower rates of worker attrition, it is important to note that this relationship is inelastic at higher salary levels (as in the case of doctors), in that instance other job attributes become a more important influence on attrition of doctors.[6]

The health care labour market cannot be left to the mercy of market forces as a result of failures in the market due to information asymmetry, supplier induced demands and the uncoupling of wages and customer preferences.[6] Medical doctors gravitate to employment opportunities that pay more which are in urban areas, this occurs at the expense of the provision of health services in rural areas.[6] It is for this reason that there is a need for external regulation in the form of government interventions.[6] This may take several forms; mandatory rural practise for health workers, bonded training schemes, regulations restricting entry to over serviced areas and compulsory exposure to rural practise.[6] Preference studies

shed light on health professional's job attribute preferences to inform the development of responsive government interventions.

2. Problem Statement

Most countries worldwide report a far higher density of doctors in urban areas compared to rural areas which is vastly disproportionate to the overall population densities of these areas.[1] The overall distribution of public sector doctor posts are approximately 75% urban, 25% rural.[7] Despite a desperate need for health workers, in 2003, there was 31% vacancy rate in the SA public health sector.[8] In 2010 there were 10860 unfilled public sector medical practitioner vacancies, with the rural province of Limpopo contributing to 46,5% of these unfilled posts compared to the urbanised province of Gauteng which only contributing 10.2% of the total number of unfilled posts.[9] The lack of adequate numbers of skilled personnel has been attributed as the top limiting factor to the scale up of health interventions such as life-saving anti-retroviral treatment and the improvement of maternal and child-health outcomes.[8]

The first five years of practice after graduation as a medical doctor are a critical time for retention in practising medicine.[10] This is further illustrated by SA studies of public sector doctors which found that between 6.6%-45% of newly graduated doctors planned to leave medicine, citing lack of equipment at facilities and unbearable workload as push factors. [11,12] A cross-sectional South African study made use of an open-ended qualitative questionnaire to elicit medical interns' choice of internship location, it showed that respondents were motivated by proximity to family and fulfilment of bursary obligations.[11] However, this study did not provide information about relative ranking or magnitude of job location preferences. Although there is data available to describe health workers practise location intentions, there is currently a dearth of knowledge on the job preferences of medical students in South Africa. This despite the growing evidence to suggest that important differences may exist between the job preferences of students and active health workers.[13,14]

3. Aims and Objectives

3.1 Aims

This study aims to determine final year medical students' valuations of rural internship placements job attributes.

3.2 Specific Objectives

1. Elicit preferences for, and examine the relative importance of, job attributes of rural internship placement.
2. Determine medical students' willingness-to-pay for variations in job attributes.
3. Explore heterogeneity in preferences associated with internship placement in rural areas.

4. Literature Review

4.1 Introduction

Definitions of "rural areas" vary amongst countries but are commonly based on population density, availability of economic structures and distance from an urban area.[1] Burch et al. [15], derived the definition of rural as "an area more than two hours' travel by road from the nearest urban centre", with "urban" defined as "a centre with a population of more than 250000 people". Rural medical practice is challenging due to social isolation, extreme weather conditions, lack of transport and infrastructure and restricted access to goods and services.[16]

Given this, there are a myriad of factors which influence a medical student's decision-making process when choosing a rural internship placement site, these will now be explored through conceptual frameworks.

4.2 Conceptual Framework

Three conceptual frameworks were evaluated for their relevance to the research question namely the Consumer Choice Process, the Bland model and the Health Worker Retention Framework.

4.2.1 Consumer Choice Process

Louviere et al.[17] proposes a series of stages outlining the consumer's decision process when faced with a choice of goods to purchase (Figure 1). This model assumes that once a consumer becomes aware of their need, they would then search for possible products that can fulfil that need. The consumer would then weigh up the attributes of each alternate product and take into consideration budget and other constraints to form the utility/preferences which inform their choice. The consumer also has the option to not choose, or to delay their choice. Once a choice is made, the consumer can then evaluate their satisfaction with their choice and this in turn may influence future decision making about consuming this product or other alternatives. The limit of this conceptual framework is that medical student's choice of internship placement differs from a consumer choosing a product, in that the medical student is not purchasing a product i.e. there is no budget and they have to make a decision based on incomplete information as often the job attributes of different internship sites are not well advertised. The Consumer Choice Process framework although a helpful guide to generic consumer decision-making behaviour, does not elaborate on the factors that may influence a medical student's practise location decision.

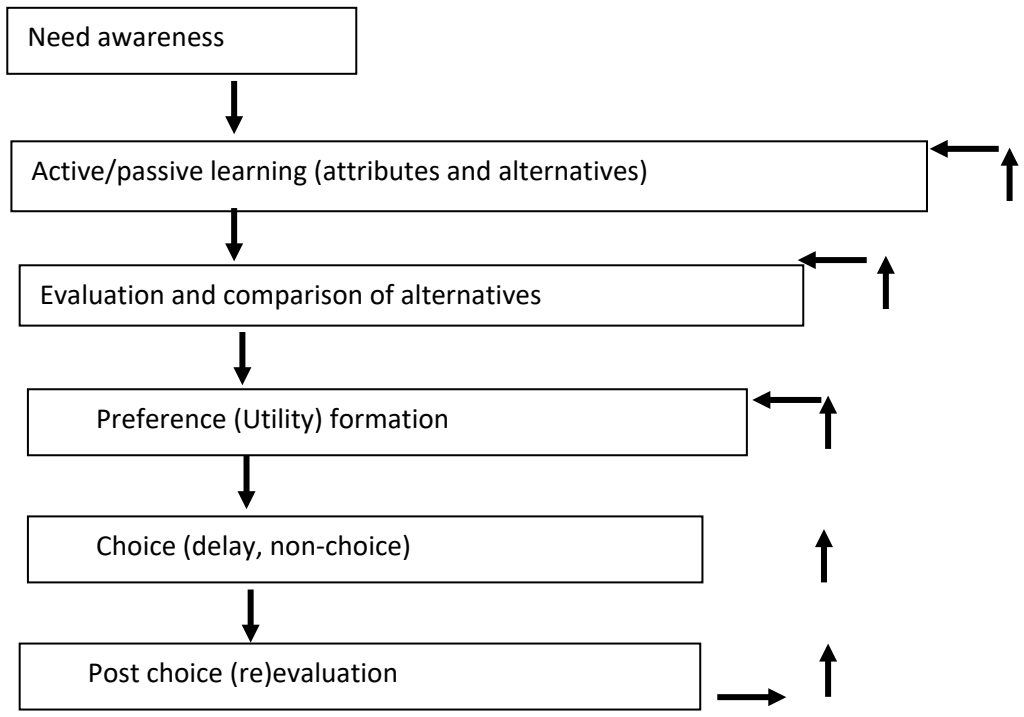

Figure 1: Consumer Choice Process [17]

4.2.2. Adapted Bland Model

In contrast, the Bland Model is a conceptual framework used for analysing medical student specialisation choice in the United States.[18] In their systematic review of factors influencing medical students motivation to work in rural areas, Budhathoki et al.[19] adapted the Bland Model to position medical students' motivation to work in rural areas as a dependant variable influenced by health facility factors, personal & lifestyle factors, medical training & curriculum factors, medical school related factors and policy factors (Figure 2). Health facility factors, are relevant to this study's research question as they represent the job attributes that would influence medical student's preferences. Medical training and medical school although influential, are not within the scope of this study's research question as they do not represent job attributes that policy makers in the Health Department can influence through HRM policy interventions.

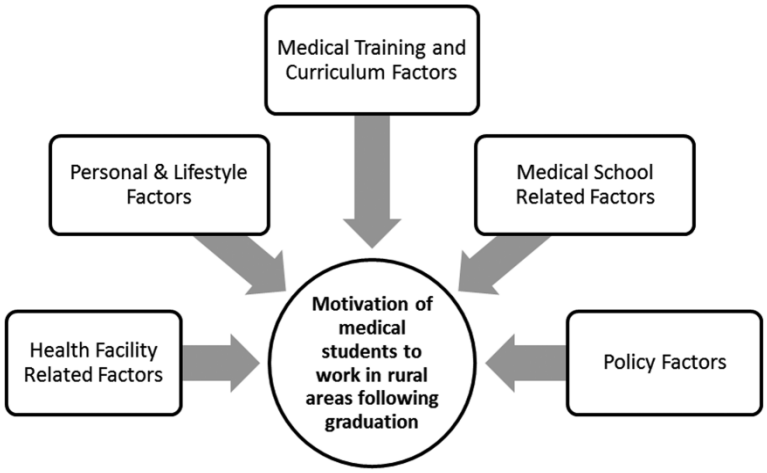

Figure 2: Adapted Bland model by Budhathoki et al.[19]

4.2.3 Framework for Health Worker Retention

The third conceptual framework reviewed is the Framework for Health Worker Retention. Kiwanuka et al. [20], adapted the Health Worker Retention Framework (Figure 3) originally developed by Schaefer and Moos.[21] This framework describes three broad categories of factors that influence a health worker's intention to stay or leave their work environment, namely, organizational factors, facility factors and personal factors.[20] This framework is intended for use amongst health care workers already employed at a facility with health worker retention viewed as the main outcome. This model therefore does not consider medical students decision making processes when choosing an internship placement. This model is valuable however in terms of the level of detail it provides with respect to organizational factors, facility factors and personal factors.

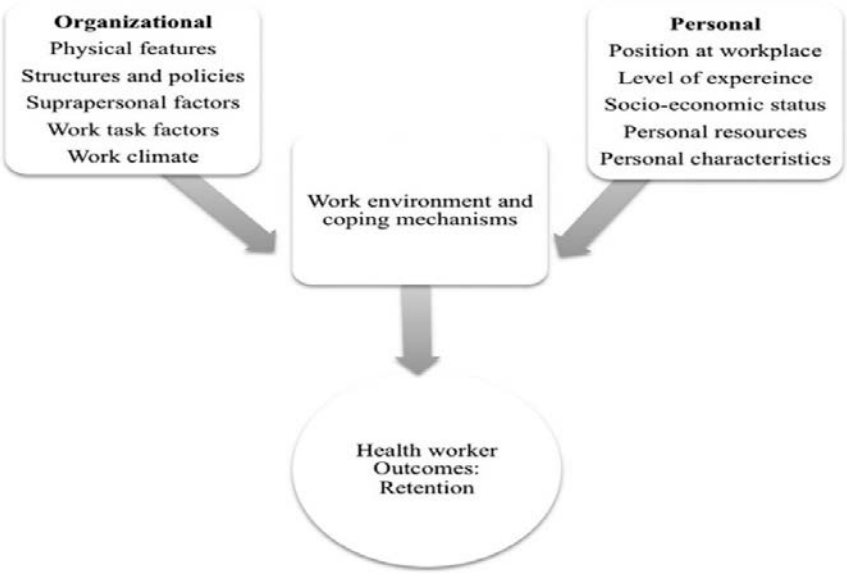

Figure 3: Health worker retention framework by Kiwanuka et al. [20]

4.2.4 South African internship placement decision model

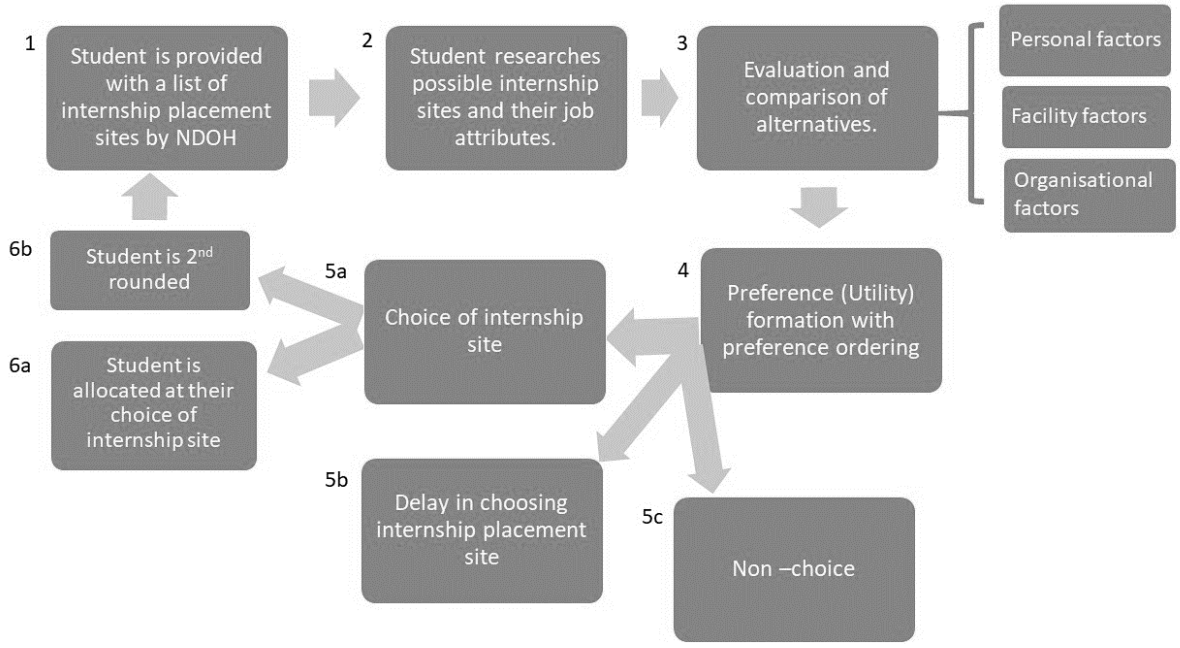

Figure 4: South African internship placement decision model by the author

A South African internship placement decision model has been developed for this study (Figure 4). It is an adaptation of the Consumer Choice Process conceptual framework, adapted Bland Model and Framework for Health Worker Retention. It aims to outline the decision-making process of a final year medical student faced with the decision of their internship practise location.

Step 1, the final-year medical student will be contacted by the National Department of Health (NDOH) requiring them to apply online for their internship placement for the following year.

The list of available sites, how many posts are allocated to each site and the deadline for application is communicated to the student via email.

Step 2, at this point the student may choose to rely on their experience at hospital sites to inform their decision, or they may choose to gather further information about internship placement sites that are of interest to them. This may take the form of word-of-mouth or social media contact with fellow students, family members and more senior medical colleagues in their social circles. The student may also visit potential sites, speak to current staff members at a site, or get information on the internet about certain internship sites before deciding. This research informs the student's set of beliefs regarding the job attributes possessed by each internship site (e.g. based on feedback from a fellow student, the supervision at a hospital is reputed to be very good).

Step 3, the student would then evaluate the list of alternatives available to them and the job attributes of interest to them. This evaluation would be influenced by personal, facility and organisational factors. The student would then formulate a decision rule which is based on trade-offs of job attributes; this results in Step 4, the student developing a preference ordering of internship sites (i.e. 1st choice, 2nd choice, 3rd choice etc.). Other considerations may influence their decision, personal, organisational and facility factors (e.g. family commitments, provincial bursary commitments). Step 5a, the final choice of internship placement site is made by the student on the NDOH website. Step 5b, students also have the option to choose to forego placement, rather waiting until the following year to get a post at the facility of their choice. Alternatively, Step 5c the student may choose not to undergo internship training at all and forego independent medical practise in SA altogether.

After the NDOH receives all applications, posts are allocated, and those with special considerations are allocated first (e.g. married students or those with medical conditions requiring placement at specific areas) and the remaining posts are filled. Step 6a, the final placement decisions are made by the NDOH and communicated to the final-year medical students across the country in time for them to prepare for their new appointment the following year. Step 6b, where there is a mismatch of supply and demand (e.g. too many applications for a specific site and too few posts at that site) some applicants will not be allocated immediately and will instead be placed on a "2nd round" list; these applicants will be contacted and informed that they did not receive placement at their original choice of internship site and therefore are provided with alternative placement sites which do have vacant post. Students in this position would then return to Step 1 to follow the decision-making process to Step 5 where they may eventually choose to accept these alternate sites or choose to delay their choice until the following year in the hopes that a post will open up at the site of their first choice.

What follows in an exploration of Step 3, the personal, facility and organisational factors which act as influencers on medical students' decision-making processes as evidenced in the literature.

4.3 Personal factors

Personal factors include, gender, being of rural origin, marital status, having dependent children and intrinsic motivation.[22] These factors will now be discussed in detail.

4.3.1 Gender differences

A number of studies have demonstrated the influence of social gender norms in a medical graduates' choice of practice location as well as training opportunities. [20,23-24] Although men and women may equally value opportunities for career progression, leadership roles, professional development support, impact on wider society, and opportunities to travel, their career choices often reflect decision making influenced by societal gender norms.[23] Male healthcare workers tend to have more training and promotion opportunities and choose their practise location based on economic consideration, in contrast, females tend to be unable to capitalise on these opportunities due to family responsibilities.[20] Female doctors consider flexibility of work conditions and its impact on childcare responsibilities when choosing to specialise or not.[25] Female doctors are more likely to choose urban practise locations for the sake of children's education and employment opportunities of their spouse.[26-27]

An Australian survey of doctors found that respondents who practiced in rural areas had rural origins, were predominantly female, married, had a spouse with rural origins, and were in general practise.[24] The same study described urban medical practitioners as having urban origins, were predominantly married males, who had decided to specialise and found rural facilities limiting in that respect.[24] This study failed to explore how these demographic differences may contribute to the respondents' job placement choices. Gender has been found to be influential on the effectiveness of specific recruitment policies.

Female healthcare workers in Burkino Faso were twice more likely to choose a job offer with free housing than their male counterparts.[28] Similarly, female final year medical students were more sensitive to the recruitment effect of rural allowance compared to their male counterparts males.[29] Female health care workers were more sensitive to the provision of equipment at facilities as a motivating factor for rural practise.[30] There is contrasting evidence from Rockers et al. [13], showing that preferences for working in rural clinics among trainee health professionals in Uganda was not significantly modified by gender. Therefore the literature strongly supports the need to interrogate the local, gendered, nature of the practice of medicine in order to inform targeted policy incentives to influence choices around practise location, speciality and career progression.

4.3.2 Rural origins

Recruiting medical students based on their rural origins has been correlated with greater retention rates in rural practice.[14,19,29,31] The key influencers of future rural practise include; a medical graduate's rural origin, a spouse with rural origin, and rural exposure during undergraduate training.[24] This effect is not universal however, as amongst Indian doctors and nurses, having rural origin had no significance on uptake of rural job postings.[32] The importance of the interaction between rural origin and other factors was highlighted by a longitudinal cohort study of SA nurses where rural origin coupled with the provision of work supervision contributed to nurses having increased work resilience, similarly, rural origin coupled with older age was predictive of rural practise amongst nurses.[33] A cross-sectional study of the life cycle of doctors in SA indicated that doctors who work in rural public health facilities do so during the early phase of their careers, then move to the private sector as their children reach school-going age, the authors suggest the need for longitudinal analysis

of person-years in rural versus urban practise locations.[34] This lack of longitudinal panel data tracking the career progression and practise locations of SA medical graduates over time should be addressed in order to inform local policy on medical school admission criteria.

4.3.3 Marital status and dependants

Being physically close to one's family, being supported by colleagues and having a commitment to serve others are known to be positive coping mechanisms to deal with work stress.[20] Marital status has been found to be influential in informing health worker priorities as well as work placement choices. Married doctors value a job in an urban centre twice as highly as single doctors, due to the need for work opportunities for their spouse as well as children's need for schooling.[26] Perceived proximity to family when working in rural areas was a motivating factor for medical students to practise in rural areas.[19] A study involving final year midwifery students demonstrated that most did not yet have children, and that the value of future children' well-being did not factor heavily compared to an individual's well-being when making practice location decisions.[35] Married Indonesian final year female medical students with children are less likely to go to rural areas, the cultural expectation of being married and having children deters women from choosing rural areas despite mandatory community service being a pre-requisite for independent practise certification.[29] It has been argued that this policy, meant to bolster rural healthcare, is in fact inequitable as it forces female graduates to be unemployed, practise illegally or leave the medical profession.[29] Female graduates are willing to trade a large sum to be able to complete their compulsory medical service in urban areas.[29]

An SA study of community service doctors concluded that unmarried community service officers were less likely to receive their first choice facility placement; rural placement was more likely among unmarried, male practitioners.[36] These results may not be a true reflection of participant's preferences, instead they may reflect the value the allocation process places on married applicants' requests above those of unmarried applicants. Actual job placement statistics alone do not fully explain the choices made by doctors about their practise locations, their final practise locations may be a result of externalities beyond their control as well as bureaucratic processes. It is for this reason that stated preferences experiments, which use hypothetical job postings, are valuable at eliciting individuals' preferences unhindered by constraints that may be present in their real life.

4.3.4 Intrinsic motivation

Motivation has been described as a state of perceiving a task's importance, believing one is capable of fulfilling the task and then expecting a personal reward.[37] Motivation may be intrinsic i.e. inherent in an individual, or extrinsic i.e. driven by incentives. Intrinsic motivation has been linked to preference for rural work placement. A study measuring altruism among nurses noted that those with higher levels of altruism were more likely to choose rural job placements.[33] Furthermore, altruistic persons are less inclined to respond to extrinsic incentives, and are more likely to self-select into jobs that are less lucrative for the sake of helping others.[16] Studies describe altruistic workers as having selfless devotion to work in communities with the most need.[38] Intrinsic motivation remains a neglected aspect in research, with some researchers arguing that extrinsic incentives, such as financial incentives, should be rejected as a commodification of healthcare.[39]

4.4 Facility and organizational factors

Apart from personal factors, many of which may be out of policy-maker's control, institutional factors remain an influential aspect of doctor's practice location decisions. Organisational factors include structure of remuneration packages, reputation of administrative capacity of the province and being paid on time.[12] Facility factors include availability of necessary equipment at facilities, extent of supervision, opportunities for career development, hospital management, socialisation opportunities with colleagues, perceived safety, proximity to family or place of origin, availability of on-site accommodation and perceived workload.[40,41]

4.4.1 Rural hospital human resource management

For nurses considering a rural health facility placement, Penn Kekana et al.[42] found that efficient hospital management, coupled with well-equipped facilities were as influential as a 15% pay increase in motivating them to choose to work in a rural area. This speaks to the extent to which holistic, health system wide improvements have positive effect on HRM. This is further illustrated in a literature review of medical students from LMIC countries citing weak health system referral structures and mismanaged health facilities as significant demotivating factors for them when considering rural practise.[19] Improved communication channels between doctors and hospital management has been recommended as vital to the success of rural health facilities.[43] Systematic reviews of motivations factors for health personnel highlighted the importance of skilled managers to lobby for the best interests of their staff especially in the context of resource-constrained environments.[44] HRM need to improve in order to boost staff morale and welcome a diverse array of health workers. An open-ended questionnaire given to SA doctors identified "being paid salaries on time" as the most important human resource practice.[12] These criticisms of human resource management extend to the organisational bureaucracy doctors have experienced when applying for promotions as well as the insufficient advertising of vacant posts.[43]

4.4.2 Well equipped facilities

The availability of functional, quality equipment and resources at health facilities is well documented incentive for doctors.[14,19,28,30,35,43,45,46] Budhathoki et al.[19] conducted a literature review of factors influencing medical students' motivation to work in rural areas and found that a lack of infrastructure, equipment, medication and telecommunication discouraged students from working at rural health facilities. This extends to medical student's perception of their safety as rural facilities are considered less safe.[19] Using semi-structured interviews with doctors in rural areas, Kotzee & Couper[43] shed light on the effects of a lack of equipment; limited number of blood pressure machines and blood glucose monitors meant patient care was delayed and this led to frustration among doctors. Medical students in particular have been disappointed by the discrepancy between the tertiary, urban hospitals where they were trained and the sparsely equipped rural health facilities where they are placed upon their graduation.[13,45,47]

4.4.3 Supervision and opportunities for career development

The perception of medical students that work at a rural facility will result in fewer opportunities for career progression impeded students from considering rural health placements.[19] Further study opportunities and fast-tracking specialisation remain a priority

for all cadres of health professionals.[14,32,43,48–50] Nurses and mid-wives in Peru were willing to take up a rural job if they were offered a 75% salary increase combined with a scholarship for specialization.[49] SA doctors who enjoyed professional development opportunities during their community service year were twice as likely to report intentions to remain in rural, underserved communities.[36] Doctors who worked at rural facilities that had regular supervision from senior specialists report their experience to be beneficial to both their job satisfaction and the quality of patient care they were able to provide.[43] Work environments which offered workers autonomy, role-clarity and team cohesion are linked to greater job satisfaction and retention rates.[51] Although early specialisation is an effective incentive for recruitment it has been found to be inefficient as it is cumbersome to administrate and expensive[29].

4.4.4 Availability of on-site housing

The provision of staff accommodation or housing allowance has, in general, been found to be a favourable rural practise recruitment strategy by a number of studies. [28,30,35,43,46,50] This is thought to be due to its ability to reduce travel expenses, thereby lowering the living expenses associated with living in a rural area.[12] In contrast Vujicic et al. [14], did not find housing to be effective and denounced the cost-effectiveness of housing provision as a recruitment strategy. The perception that living on hospital premises puts one at risk of unexpectedly being called to work when there are staffing shortages has also been documented as a cause of resistance to housing provision.[12] Choosing to reside in accommodation off-site from one's workplace instead of doctor's accommodation on site was seen as a means of separating work life from one's private life.[20] The lower preference for housing provision among practising nurses compared to student nurses was postulated to be due to practising nurses being on average older and therefore more likely to have families compared to nursing students, who are thought to be less confident in organising their own accommodation.[52] There is a need to study whether that interaction between age and housing allowance on choice of job placement is relevant in other contexts amongst other cadres of health workers such as medical doctors with a longer training period and therefore an older average graduation age compared to nursing.

4.5 Policy incentives to improve attraction and retention of doctors

In response to the aforementioned HRM challenges, the WHO has developed specific recommendations to attract and retain healthcare workers and these can be categorised into five areas namely, educational, financial, personal and professional support and regulation.[1] A systematic review of the motivation and retention of health workers in developing countries concluded that financial incentives alone are not sufficient, and that community appreciation, adequate resources and infrastructure are influential in doctor retention.[44] Most countries use a bundle of initiatives to improve recruitment and retention of doctors. African countries have implemented a combination of financial incentives and non-financial incentives (e.g. housing, decentralization, salary increments and training opportunities).[20,53]

Thailand actively recruits medicals students from rural backgrounds and offers scholarships to these students with mandatory rural placement upon graduation, these programmes have strengthened the practise of rural medicine in the country.[27] SA uses a number of strategies for rural doctor retention, including the recruitment of rural-origin students to be trained in

Cuban medical schools on condition of mandatory rural service upon graduation. Other interventions include mandatory 1 year community service for all doctors in order to be certified for independent medical practise in SA.[2] However, it is argued that mandatory community service ultimately motivates young doctors to emigrate and that few community service doctors remain in the public sector after their mandated time.[2] This practise thus is a short-term solution which is associated with high staff turnover rates that further destabilise a fragile rural health care system. Consultation with health workers prior to the introduction of incentives and appropriately evaluating the effect of incentives have been identified as gaps in the current HRM functioning in African countries.[37] What follows is a detailed review of rural practise recruitment and retention policy incentives.

4.5.1 Rural allowance

A study of doctors and nurses in a rural region of SA found that rural allowance is effective at attracting workers to rural areas in the short term but was divisive as not all cadres of staff got rural allowance and furthermore there was no clarity on what constituted a rural placement.[54] Interviewees reported spending their rural allowance on transport to urban areas for shopping and recreational activities.[54] A multicounty study revealed that a 30% rural allowance encouraged South African and Kenyan nurses to be 12.4 times more likely to choose a rural job, whereas their Thai counterparts were only 2.0 times more likely to choose the rural job for the same amount of rural allowance, this demonstrates the differential effects of the same incentives in different locations.[31] Studies done on physician assistants and midwives, noted that financial incentives were effective to some degree but that it is the combination with non-financial incentives that provides the largest recruitment effect.[46,48]

4.6 Methods of preference elicitation

A trial and error approach to health care worker recruitment is costly for low/middle income countries and therefore evidence based methods are required.[13] Preference elicitation is a powerful tool to inform HRM policy and is primarily divided into revealed preference (RP) and stated preference (SP).[55] RP is the term used to describe an individual's actual choice behaviour in real-world situations, these may be reported by the individual or based on observation by the researcher across a specific time period.[55] RP data is advantageous due to its external validity as reflects actual choices made by respondents; however it is limited to alternatives that are already present in the market and therefore fails to predict respondents' reactions to new alternatives.[55] It is unable to estimate trade-offs across the features (known as attributes) of a new product or service, additionally, the threat of attribute multicollinearity makes it challenging to isolate each attribute's contribution to utility.[29]

In contrast, stated choice refers to one's choice behaviour in hypothetical situations, this may be elicited in the form of a survey.[55] SP evaluation techniques study individuals' preferences for products or services that are available at present or that may be forthcoming, it makes use of a method of estimating trade-off of the product's attributes to predict future demand.[55,56] Stated preference elicitation allows the researcher to construct hypothetical choice sets free from multicollinearity.[29] The disadvantage of SP is that the results gained in hypothetical scenarios may not correlate with how individuals behave in the actual market.

Forms of stated preference elicitation include contingent valuation and choice modelling. In contingent valuation method, respondents are asked their willingness to accept (WTA) compensation for an attribute variation.[57] WTA makes use of a monetary value to represent marginal improvements in job attributes.[46] For example how much salary one would be willing to accept to work in a facility which lacks equipment. Contingent valuation method is criticised for its questionable reliability and validity of estimates.[57] Alternative forms of preference elicitation such as Likert scales, possess systematic bias as respondents tend to cluster their answers, whilst such ordinal scales may convey order, they are unable to measure magnitude of preferences.[40]

Choice experiments (of which DCE is one type) refers to preference elicitation procedure that involves being presented with a number of choice sets, each containing alternatives with variations of their attributes and levels.[58] The versatility of discrete choice experiments (DCE) takes into account choice behaviour and inter-linked behaviours and has been applied in a variety of industries including transportation, agriculture and healthcare.[58]

4.7 Discrete choice experiments

DCE is an attribute based measure of utility that is underpinned by a number of economic theories; Lancaster's theory of demand, consumer theory and random utility theory.[58,59] Consumer theory assumes that medical students are rational individuals who aim to maximize utility and therefore when stating a preference for an internship placement site, the student is assumed to choose the alternative that yields his/her highest individual utility.[30,58]

Lancaster's economic theory of demand expands on this notion with the assumption that utility is not merely derived from consumption of a good, but instead it is a function of the attributes that constitute that good and that an individual's choices reveal their preferences for those attributes.[13,17,58] Choices that consumers make between alternatives are as a result of a combination of their preferences, affordability and access.[58] To this end, goods may be consumed either individually or jointly to produce the combination of properties that deliver utility to the consumer.[17] Furthermore, discrete choice theory limits an individual's choice to a set list of alternatives not the infinite possibilities of choices.[59] Discrete choice theory introduces the idea that individual choice behaviour is intrinsically probabilistic, hence random.[59] Random Utility Theory is underpinned by the assumption that an individual's utility function cannot be observed by researchers and that the utility function is represented by a systematic component and a random component.[46] The researcher is able to estimate the systematic component in order to provide quantifiable information on the relative importance of job attributes. The random component of the utility function determines which framework is used to analyse the data which then predicts how an individual's choice is influenced by variation in job attributes.[46]

The utility of medical student *i* for internship placement *j* can be expressed as follows:

$U_{ij}=V_{ij}+\varepsilon_{ij}$.....(1)

Where

U_{ij} is the utility of medical student *i* for internship placement *j*,

V_{ij} is the observable component of utility.

ε_{ij} is the random component of utility which is a function of unobserved job attributes as well as individual-level variation in tastes.

A medical student will therefore choose an internship site they perceive to deliver more utility than the alternative internship sites. The probability P that medical student *i* will choose internship site *j* over internship site *k* can be expressed as:

$P_{ij} = P\ [U_{ij} > U_{ik}]$

$P_{ij} = P\ [V_{ij} + \varepsilon_{ij} > V_{ik} + \varepsilon_{ik}]$

$P_{ij} = P\ [V_{ij} - V_{ik} > \varepsilon_{ik} - \varepsilon_{ij}]\ i \neq j$……(2)

This can be express in parameters as a multinomial logit model:

$Uij = \alpha_1 + \beta_1 x_{1ij} + \beta_2 x_{2ij} \ldots \beta_m x_{mij} + \varepsilon_{ij}$……..(3)

Where

U_{ij} Is the utility of medical student *i* for internship placement *j*,

α_1 Represents the intercept/ alternative specific constant (ASC)

$x_1, x_2..x_m$ Represent the observable component of utility as a function of m job attributes These attributes could be rural allowance, supervision, equipment at facilities etc.

$B_1, \beta_2..\beta_m$ These coefficients represent the "weight" or "preferences" of each attribute.

ε_{ij} Is the random component of utility which is a function of unobserved job attributes as well as individual-level variation in tastes.

The assumptions underlying the multinomial logit model is known as the independence of irrelevant alternatives (IIA) which assumes that the random disturbance term ε_{ij} is uncorrelated between alternatives.[29] Therefore the unobservable factors affecting a medical student's preference for internship placement *j* is uncorrelated with the unobservable factors affecting the student's preference for internship placement *k.*[29] Medical students are assumed to have a ranking of internship placement sites with varying attribute levels based on their preferences for job attributes and their levels.[30] For example, medical student *i* will choose internship site *j* over internship site *k* because they prefer to get a rural allowance which is only available at internship site *i* and not available at internship site *k.*

DCE methodology has both advantages and limitations in its application. An advantage of DCE is that the choices are presented exogenously and so avoids the challenges associated with identifying causal effect of job characteristics.[6] Another advantage being DCE's ability to elicit the ranking of preferences in comparison to one another.[6] A DCE should be validated by revealed preference data by conducting policy experiments.[47] Robyn et al. [45] argue that there should be greater transparency regarding job listings, compared to a DCE where job attributes of each alternative are well described, in reality there would be minimal information available about the attributes of a facility, this leads job-seekers to base their decisions on rumours of facility reputation. Most of the internship placement hospitals do not advertise their job attributes, therefore the final year medical students' revealed choice of internship placement can be based on incomplete information, and hence stated preference was chosen for this DCE study instead of revealed preference so as to investigate the role of job attribute preferences in hypothetical internship placement listings.

4.7.1 Role of qualitative methods in DCE

Qualitative methods contribute to DCE in two phases, firstly, the conceptual development and selection and validation of attributes and attribute levels, secondly, the refinement of language, terminology and descriptions used.[61] Conceptual development refers to the acknowledgement that the nature of qualitative research is such that it results in complex, rich data that can provide comprehensive, mutually exclusive, set of attributes.[61] Language refinement is an important aspect of a DCE as it ensures that meaning is conveyed accurately by using terms which will not be misconstrued by the respondents when answering choice sets.[61] In the absence of qualitative data, researchers may rely on policy to inform attribute development; however, this runs the risk of important attributes being omitted, similarly literature review may be used in attribute formation but locally relevant literature on job attributes may be insufficient and literature alone is unable to contribute to language refinement[61].

Methods of qualitative data collection include semi-structured interviews (the most popular method), focus group discussions and meta-ethnography.[61] In-depth interviews allows one to explore sensitive topics in private settings however it requires a higher degree of qualitative research skills.[61] Focus group discussions are, on average, less time intensive compared to interviews and holds the advantage of encouraging group discussion that may offer new information to the researcher.[61] Meta-ethnography is considered the least time intensive but is variable in terms of quality of the data.[61]

Reviews of qualitative methods used in healthcare DCEs show a range of informants were used including carers, patients, professionals, adults, and the general population, often qualitative research was conducted in the same population as the DCE was conducted in.[62] There is great variation with regards to the numbers of informants used in qualitative data collection, between 16 and 40 persons has been cited in the literature.[61,62] The types of analytical methods available for qualitative data included meta-ethnography, framework & constant comparison.[61,62] Coast et al.[61] argue that iterative qualitative methods, constant comparative approaches, are more cost-effective at refining attributes in an inclusive manner as opposed to the use of psychometric methods. It is suggested that purposive sampling is used to gain a wide range of perspectives on attributes to minimise mis-specifying attributes.[61]

To ensure the assumptions of the DCE conceptual framework are not violated, attributes must fulfil the following criteria: include all attributes of importance to respondents, attributes should not include the underlying construct to avoid dominating other attributes, attributes should be such that there is a nonzero probability for the selection of each choice option[61]. The attributes should be able to be manipulated through policy interventions and should not be dependent on personal characteristics.[61] The challenges of qualitative methods include the time-consuming and highly specialised nature of qualitative data collection and analysis and qualitative methods is prone to over-simplifying individual's complex preferences.[61] Many published DCE's do not report the qualitative methods used to inform their attribute development and although guidelines exists for analysis of DCE, there is still a lack of guidelines when reporting the use of qualitative methods for DCE.[62]

4.7.2 Discrete choice experiments in the literature

Literature reviews of health care worker DCEs reveal that doctors and medical students are the most studied cadre of health worker.[46] A DCE conducted on Ghanaian medical students found provision of on-site housing, rural allowance, hospital infrastructure, supportive management and shorter contracts before study leave to be influential job attributes when considering a rural placement.[47] A DCE in Ethiopia found that in order to motivate half of doctors to relocate to rural areas, a rural bonus of approximately 89% of their base salary is required with the probability of accepting a rural job increasing from 27% to 84%.[26] Similar studies have yet to be conducted at SA medical schools to elicit job attribute preferences from future medical graduates.

4.8 Conclusion

To begin to address the lack of medical doctors practising in rural facilities, one needs to acknowledge both the challenges of rural practise as well as the personal, facility and organisational factors that are influential in a doctor's choice of practise location. The South African internship placement decision model was developed to clarify the decision making process of South African medical students when faced with the choice of internship placement location. The literature has highlighted the importance of understanding the local practice of medicine, however the lack of longitudinal panel data tracking the career progression of medical graduates undermines efforts to develop effective recruitment policies.

Marital status, rural origin and gender have all been found to be influential in informing health worker priorities as well as work placement choices. Stated choice experiments hold a key to understanding individuals' preferences. Although extrinsic incentives are seen as a commodification of health care, government regulation of healthcare human resource is required due to market failure in the health care market. Most countries use a bundle of initiatives to improve recruitment and retention of doctors as although financial incentives are effective, at higher salary wages the response is inelastic and therefore other non-financial job attributes are influential. These include the availability of staff accommodation or housing allowance, well equipped facilities, and offering opportunities for further education.

In conclusion, a country such as South Africa, in desperate need to expand and redistribute its cadre of medical doctors, should prioritise research that uncovers the job attribute preferences of its most recent medical graduates. The results of which can provide valuable information to facility managers and the Department of Health, to aid in the design of targeted recruitment and retention packages for doctors whilst acknowledging the influence that personal, facility and organisation factors have on doctor retention.

5. Methodology

5.1 Study Design

A cross-sectional, mixed methods discrete choice experiment will be conducted; Figure 5 outlines the stepwise process of designing and conducting a DCE.

5.2 Population and Sampling

The study population are all final-year medical (MBCHB) students at the University of Cape Town (UCT), who will be applying for internship placement in 2018 for commencement of

work in 2019 (n= approximately 224 students). This study population includes SA medical students who have been trained in Cuba who will commence their internship in the latter half of 2018. This study population also includes UCT final year students who are assigned to the Eden district programme situated in George. With respect to DCE's, a minimum of 50 participants is required for adequate statistical power.[63] Course convenors and student class representatives will be contacted to obtain the complete class list as well as co-ordinate the data collection sessions with the students' timetable to minimise interruption of their course commitments.

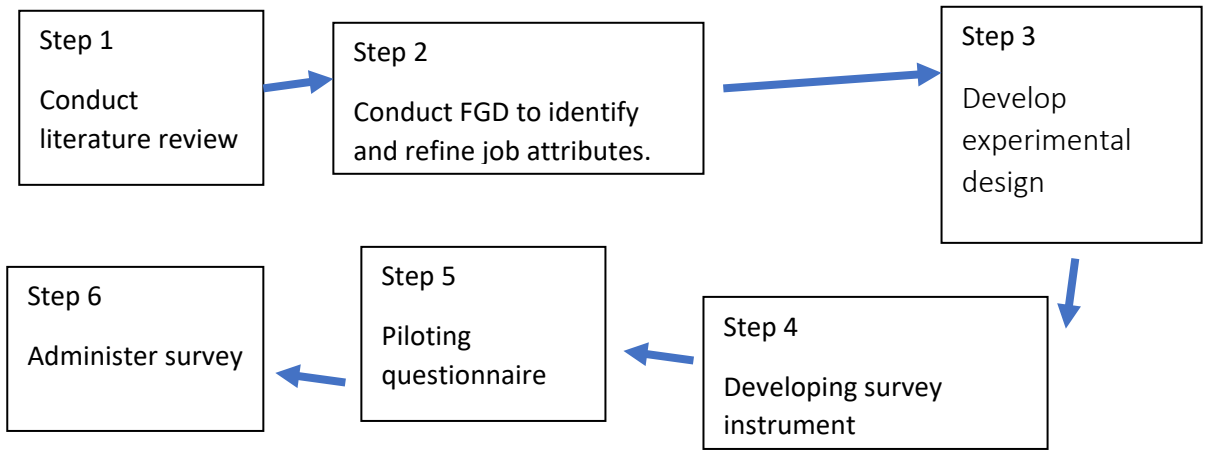

Figure 5 Step wise approach to Design of DCE.[63]

Table 1: Sampling Matrix

PROPOSED SAMPLING MATRIX Total sample = 18 participants (3 x FGD with 6 participants each)		
CHARACTERISTIC	CRITERIA	Number of participants (%)
GENDER	MALE FEMALE	9 (50%) 9 (50%)
PROVINCE OF ORIGIN	WESTERN CAPE	2 (10%)
	GAUTENG	2 (10%)
	KWAZULU NATAL	2 (10%)
	MPUMALANGA	2 (10%)
	NORTHERN CAPE	2 (10%)
	FREE STATE	2 (10%)
	NORTH WEST	2 (10%)
	LIMPOPO	2 (10%)
SUB GROUPS	CUBAN TRAINED STUDENT	2 (10%)

5.3 Data collection procedures (refer to Figure 5)

5.3.1 Conduct literature review (Step 1)

This step includes reviewing literature on DCEs conducted in other low and middle income countries (LMIC), health worker motivation and job satisfaction. This is done to identify the job attributes that were relevant in countries worldwide and in the local context. This information is then used to inform the questions on job attributes that would be used in the FGD. Job attribute levels refer to the specific ordinal values that describe the job attribute.[63]

5.3.2 Conduct FGD to identify and refine job attributes. (Step 2)
A FGD will be used for this study as the topic of job attributes was deemed not to be a sensitive topic requiring one-on-one interviews, and it lends itself well to group discussion among students.

After approval from the Human Research Ethics Committee (HREC) and UCT student affairs department, FGD's will be held with students from the target group to gain input from them about where or not the job attributes identified in the literature are relevant and feasible to their local context.

Prior to this, the class representatives and the convenors of the final year MBChB class will be contacted to arrange a suitable date for the FGD, and to advertise this to the class. The researcher will post the information pamphlet (APPENDIX B) onto the class VULA site to encourage participants to contact her to participate in the FGD. Volunteers will be included based on the sampling matrix (Table 1). The researcher will co-ordinate the data collection sessions with the students' timetable, to minimise interruption of their course commitments. Three FGD sessions will be held, the size of each FGD will be 6 participants per session, and each session will be of 1- 1.5hours duration. Participants will be purposively recruited from the final year class to ensure representation across race and genders.

Each session will start with an introduction of the researcher to participants, following which the researcher will present an overview of the purpose of the study. After this, participants will be given an informed consent form to read and sign, which will then be collected. The sessions will be audio recorded and transcribed by the researcher with the participants identity protected by an assigned number. A focus group discussion guide (Appendix A) will be used to gather information from participants. Follow up questions will be asked to elicit and clarify job attributes and their levels. At the end of the session participants will be provided with light refreshments to appreciate their time and effort in the study. The timing of the session will accord due regard to student's time and semester schedules, so as to have minimal impact on their study commitments. The data from the FGD will be analysed thematically to identify job attributes and levels.

The FGD will inform the levels for each attribute to ensure that they are acceptable and feasible, this is especially important in the case of attributes such as housing and rural allowance. Example of attributes and levels are illustrated in Table 2. The minimum number of levels is two as in the case of educational opportunities, whilst other attributes may have three attributes, such as in the case of housing provision.

5.3.3 Develop experimental design (Step 3)

Once the attributes and their levels have been selected, they are combined to form the hypothetical job postings using experimental design techniques. When all possible combinations of attributes and their levels are presented to elicit preferences, it is known as a full factorial design, this may be challenging as it results in a large number of choice sets for the survey respondent to complete.[64] Therefore an experimental design method is required which will create a more manageable, smaller set of choice.[64] The experimental design is constructed by selecting a set of choices which enable determination of main effects and interactions, as well as factoring in the attributes, their levels, the question format for choices and the analytical framework to be used.[56,64] The term "main effect" refers to the influence of an independent variable on the dependent variable. For example the provision of a housing allowance (independent variable) may lead to a doubling of the probability of taking up a job at Hospital A (dependant variable). Main effects is identified by analysing the choices that the participants have made using choice modelling techniques in statistical software. The term "interaction" refers to the extent to which the preferences an individual has for one attribute depends on the level of preference for another attribute[64]. There are two main types of experimental designs, orthogonal and efficient/optimal designs.[56]

In an orthogonal main-effects plan (OMEP), all main effects are uncorrelated with each other.[56] The disadvantages is that the main effects can be correlated with interactions rendering the orthogonal design inappropriate for most combinations of attributes, levels, and numbers of profiles.[56] In such situations, software is employed to produce a D-optimal design to fulfil study requirements.[56] Orthogonal designs, using orthogonal arrays require attributes to be statistically independent of one another, attribute levels should be present an equal number of times in order to be level balanced.[64]

The more recently developed and computationally simpler, d-efficient design is increasingly used as it aims to minimise the determinant of the covariance matrix with the assumption that parameters are zero.[64] Optimal design is created to illustrate a realistic range of possible options an individual may encounter.[60] No more than six job attributes , are to be used as when there are too many, respondents may fall back on simple-decision making based on financial incentives alone.[63] For example, if a participant is faced with a choice set containing eight job attributes, they may be overwhelmed with the decision-making and resort to choosing the alternative which pays the highest salary. The design choice sets will be unlabelled (i.e. it will not be named Frere Hospital, Vredenberg Hospital), instead choice sets will be generically named (Job A, Job B etc.), because labels have been shown to distract respondents from job attributes and thus may diminish the reliability of estimates of attribute preferences.[64] Ngene software will be used to generate the DCE choice sets with hypothetical scenarios according to the experimental design chosen- optimal design. The characteristics of each alternative are randomly determined by the computer software and each respondent views a set number of preference pairs.[63]

5.3.4 Developing survey instrument (Step 4)

Each hypothetical scenario (choice set) will comprise two anonymous job postings, i.e. Job A and Job B, also known as a preference pair. Demographic questions (e.g. age, gender, marital

status) are included in the questionnaire to elicit interactions between respondent's demographic characteristics and their job attribute preferences. The survey instrument will be a self-administered, online questionnaire on Google forms which will have two sections (Appendix F). The first part consists of pairs of hypothetical job listings from which participants must choose an option in order to reveal their job attribute preferences. The choice questions will be binary (for example choosing between two rural jobs with different job attributes) and there will be an opt-out option. The second part of the questionnaire elicits the exposure variables of interest; demographic characteristics and social background (Table 3), to provide insights into socio-economic background interacts with respondents' job attribute preferences.

Opt-out options are used to prevent respondents being forced to choose a job that they would not take in reality which would result in an inaccurate overestimation of a job attributes utility.[64] One should bear in mind that when a decision is difficult, respondents may choose the opt-out option as a simple-decision technique which could then leads to less information about preferences in the hypothetical scenarios.[64] Medical students in reality do also make use of the option to delay or forego internship, if the selection available to them is unsatisfactory.

5.3.5 Piloting questionnaire (Step 5)

The piloting of the DCE is considered an important quality checkpoint in gauging respondent understanding of the language used as well as the structure of the DCE.[61] The FGD process would inform the attributes used in the pilot DCE questionnaire, and the pilot DCE questionnaire will be given to student participants from the final year class to test the tool and improve its reliability before the final questionnaire is administered in the final survey. The sample size of the pilot survey will be 10 participants; they will be selected by convenience sampling as students in the same rotation. If less than 10 participants from a rotation volunteer to participate in the pilot, the researcher will post the information pamphlet (APPENDIX B) onto the class VULA site to encourage participants to contact her to participate in the pilot. The pilot DCE questionnaire will be anonymous and administered on a mobile device, and the survey will take approximately 30 minutes to complete.

The pilot session will start with an introduction of the researcher, an overview of the purpose of the study and an explanation of how to complete the pilot questionnaire. After this, participants will be given an informed consent form to read and sign, which will then be collected by the researcher. The researcher will provide participants with a website link that will direct them to the online questionnaire. Participants will then complete the questionnaire and submit it online. Once all participants have completed and submitted their questionnaire the researcher will engage with the participants to gain feedback from them of their experience completing the survey, clarify whether any terms were unclear and enquire how long it took participants to complete the pilot questionnaire. At the end of the session participants will be provided with light refreshments to appreciate their time and effort in the study. The timing of the session will accord due regard to student's time and semester schedules, so as to have minimal impact on their study commitments. A summary of the pilot

findings will be compiled, indicating the validity of attributes, lessons learnt from the pilot for improving the main DCE survey, and possible changes required for the main survey.

5.3.6 Administer final DCE survey (Step 6)

The pilot DCE questionnaire will inform the final DCE survey. The final DCE survey will be sent to the UCT Human Research Ethics Committee as an addendum for approval, before it is offered to all students in the final year MBCHB class. The sample size of the final survey is expected to be 224 participants. The pilot DCE questionnaire will be anonymous and administered on devices (laptop/tablet/mobile), the survey will take approximately 30 minutes to complete.

The researcher will co-ordinate the data collection sessions with the students' timetable to minimise interruption of their course commitments. The class is already randomly allocated into ten clinical rotation groups. The researcher will meet each group, introduce herself, and explain the purpose of the study, then provide printed information pamphlets and an example of a completed DCE questionnaire and answer any questions that students may have. After this, every student will be asked to access the web link to the Google form on their device, if they do not have a device (laptop/tablet/mobile phone) with them, the researcher will lend devices to students to complete the questionnaire. This online questionnaire will provide information about the study, the researcher's contact details as well as the opportunity for the student respondent to consent to participate in the study. Participants who decline participation will be thanked for their time, and no further questionnaire questions will be made visible to them.

Only if the participant provides consent to the study on the Google form will the questionnaire be made visible to them. Participants will then complete the questionnaire and submit it online. Participants have access to free Wi-Fi internet on UCT campus in order to complete the online questionnaire. Participants will not be remunerated for participating in the final DCE survey.

If there are less than 50 participants for the DCE questionnaire, follow up recruitment procedures will include extending the time period of data collection and advertising the study on the class' VULA site.

Table 2: Example of job attributes and their levels to be included in the DCE questionnaire.

Job attribute	No. of levels	Attribute Levels
Degree of Supervision at facility	3	Poor Average Good
Proximity to family (exclude partner and dependants)	3	Far >8 hours away family Within 2 hours of family In the same area as family
Rural Allowance	3	R37000 per month (with no rural allowance) R43660 per month (includes rural allowance R6660) R45140 per month (includes Deep rural allowance R8140)

Perceived chance of being *2nd rounded* (not getting one's first choice of placement location)	3	Low Medium High
Doctors Accommodation	3	Not Available Available (single room with kitchenette, shared bathroom) Available (3 bedroom house, swimming pool, safe parking)
Proximity to schools and employment opportunities for partner	3	Far >8 hours away from schools & employment opportunities for family Within 2 hours of schools and employment opportunities for family In the same area as schools and employment opportunities for family
Education opportunities	2	No education opportunities provided Some education opportunities available (e.g. life support courses) with study leave provided.
Equipment at facilities	3	Very few of the necessary equipment is available Some necessary equipment is available All necessary equipment is available

Table 3: Description of demographic variables to be included in DCE questionnaire.

Factors	Description of exposure variables			
Demographic Factors	Age (discrete numeric)	Gender (categorical)	Province of origin (categorical)	Rural origin (categorical)
Personal Factors	Marital status (categorical)	Child Dependants (binary)		
Undergraduate Training Factors	Cuban trained (binary)	Bursary holder (binary)	Career intention (categorical)	Rural training (binary)

5.4 Data Analysis Procedure

Participants will enter their responses onto the online Google form questionnaire, this data is automatically captured into a Microsoft Excel spreadsheet and the job attribute variables are then coded by the researcher according to a previously determined dummy variable coding system. The collected data will then be exported for analysis to STATA v.14 Software to perform data cleaning, descriptive statistics and logistic regression.

5.4.1 Model specification

Univariate analysis will be conducted on the demographic variables. The coefficients of the job attributes will be compared to each other to determine the relative preferences of attributes. The magnitude of the coefficients are the relative valuation of the level for an attribute compared to the reference level. Microsoft Excel 2013 will be used to present

tables of the summarised data and results. Data will be password protected on a laptop that is in the researcher's locked office, itself in an access-controlled area.

The choice of statistical model to be used depends on the number of alternatives that are presented to respondents in each choice set as well as the assumptions of the distribution of the unobservable component of utility (error term). When the choice set in the DCE is binary (i.e. hospital A or hospital B), one can use binary probit or logit models.[64] If one is including 'opt-out' options or more than two alternatives, then one would use the multinomial logit model (MNL).[64]

MNL has three assumptions, firstly independence of irrelevant alternatives (IIA), secondly that the error terms are independent and identically distributed across observations (IID), thirdly that there is homogenous preferences across respondents.[64] Criticism of this model is that these assumptions do not reflect real-world decision making, are too restrictive and therefore that the results of this model may produce results which are not valid for policy formulation. However, it is possible to construct models which relax the restrictions of MNL. Alternatives to the MNL model include multinomial probit models and nested logit models, which relax the IIA assumption; heteroscedastic models which relax the IID assumption and use flexible error variance; and mixed logit models which relax the assumption of taste homogeneity and allow for random taste variation.[64]

Therefore, this study will use a mixed logit model, as it allows for violations of the assumptions of MNL and allows for model estimates that vary across respondents. The analysis of DCE data involves regression models that are used to estimate the willingness-to-be-compensated/ willingness to accept (WTA) for a unit change in each attribute estimated.[60] The WTA is the ratio of the coefficient of a non-financial job attribute to the negative of the coefficient of the rural allowance attribute.[46]

WTA= $-\frac{\beta_m}{\beta_{rural}}$ ……(4)

Where βm coefficient of job attribute *m*

$\beta rural$ coefficient of rural allowance attribute

Predicted rates of probability of uptake of rural jobs with particular job attributes will also be calculated. The probability (p_{ij}) of medical student *i* choosing internship placement *j* can be expressed as follows[32]:

$$p_{ij} = \frac{e^{\beta_0+\beta_1 X_{ij}+\beta_2 Z_{ij}+U_{0j}}}{1+ e^{\beta_0+\beta_1 X_{ij}+\beta_2 Z_{ij}+U_{0j}}}$$

Where

X_{ij} Represent the vector of job attributes-levels.
Z_{ij} Represent the vector of individual characteristics.
β_1 Regression coefficients of job attribute level
β_2 Regression coefficients of individual characteristics.
U_{0j} is the random component of utility which is a function of unobserved job attributes as well as individual-level variation in tastes, this is assumed to be normally distributed.

5.4.2 Data dissemination plan

The results of the study will be presented as a mini-thesis for the researcher's Masters in Public Health. The results will be in the format of a journal article as well as a policy brief. The policy brief will be shared with the trade union Junior Doctor's Association of South Africa (JUDASA) who represent the interests of junior doctors in South Africa. The results of the research journal article and policy brief will also be shared with the final year medical students on their VULA website to which they have life-long access even upon graduation.

6. Ethical considerations

6.1 Study authorisation

In addition to UCT Human Research Ethics Committee approval, the researcher will seek permission from the UCT Student Affairs Departments in order to conduct research involving students enrolled at the University.

6.2 Selection of participants

This research is appropriate with this particular proposed group of respondents as they are final year medical students who will soon be entering into the workforce of the South African public healthcare system as interns. There is a demonstrated lack of rural doctors in South Africa[9]. It is for this reason that researching their job preferences is important as they constitute the future health workforce of the country and this DCE will inform facility managers on how to attract interns to their facilities.

Research should be fairly distributed amongst individuals to whom the research is relevant in order to be socially just. In this case, participants are university students; future medical doctors, who are also at risk of coercion and undue influence. Participants may fear victimization or stigma from the university with respect to their participation in the study. The study researcher was previously a UCT staff member, however, she is now a full-time postgraduate student and plays no role in the study population student's academic results at the University, nor does she play a role in the Department of Health's internship placement

process. These disclaimers will be communicated to potential participants ahead of their participation in either of the FGDs, pilot testing of questionnaire or the main survey. This is so that they are not unduly influenced to participate in the study under a false impression of garnering favour from faculty members -either to influence their academic results or their internship placements. The following steps will be taken in order to minimize these risks. The study researcher will liaison with the final year medical student's class representatives and to outline the purpose of the study and the potential risks and benefits of participation. Students will be asked to volunteer to participate in the FGDs and the pilot testing of the questionnaire.

6.3 Informed consent process

For the final questionnaire, the researcher will provide potential participants with printed information pamphlets (Appendix B), this is done to provide participants with the opportunity to consider whether to participate. Participants who are interested in joining the study would be advised to provide their consent (Appendix C) on the Google form to be able to participate in the study. Participants who decide not to participate in the study or who withdraw from the study once enrolled, will not suffer any adverse repercussions, nor will they be prejudiced against in any way.

6.4 Study risks and benefits

The benefits of this study are expected to accrue at both individual as well as societal levels. This study may help respondents clarify their own thought processes, and interrogate their values regarding which job attributes they are willing to compromise on when choosing their internship placements. It will help them make their own choices explicit and may introduce variables they had previously not thought about. At a population level, the results will be useful in helping policy makers set incentives that are responsive to the values and desirable job attributes of new graduates, to effectively recruit them to underserved areas for the improvement of healthcare service delivery. The risks of participation include stigmatisation of participants by other students during the FGD. It will be reaffirmed to participants that the data collected at the FGD will be anonymised and that participant's involvement in the study will not be discussed with their academic convenors or peers, in order to minimise any possible bias against them. This study thus holds low risk to individual participants.

6.5 Privacy and Confidentiality

Confidentiality of participants is a priority, and the pilot and final questionnaire will be anonymised, with only a study number allocated to protect participant's identity. Participant's personal identifying information will not be linked to the study number. The study researcher will be the only person to have access to the stored, anonymised, electronically-captured data, which will be kept on a password-protected laptop, in a locked room, in an access-controlled area.

6.6 Reimbursement for participation

Participants will not be directly compensated for participation, instead they will be offered light refreshments after the FGD and pilot survey sessions. Participants who complete the online main survey will not be directly compensated for participation.

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APPENDIX A: FOCUS GROUP DISCUSSION GUIDE

Introduction

Welcome to this discussion group. We appreciate your time and effort in being here. We are researching the factors that are important to you when you are deciding which internship placements to apply for. This group discussion will take approximately 1-1.5hours.

Your responses in this session will help us produce a questionnaire that will be administered to your class as part of this research project. You have each been given an information pack and an informed consent form. Please read the information pack and informed consent form thoroughly, before signing it. This session will be audio-recorded and transcribed, your identity will be protected using your assigned study number.

Open ended questions:

1. When you are considering which hospital to apply for your internship for next year, what are some of the factors which you take into consideration?
   For each factor mentioned the researcher will probe deeper:
   1.1 What are the possible options available to you to choose from when considering that factor (e.g if the participant mentioned "housing" as a factor, the participant may have the option of living in doctor's quarters at the hospital or finding their own accommodation off-site).
2. What would make work in a rural area more attractive to you?

If participants do not name any of the following factors in their responses to the above mentioned questions, the researcher will specifically ask about them:

3. How important is the availability of equipment in health facilities when deciding where you want to work?
4. How important is safety of the workplace in deciding where you want to work?
5. How important is supervision at facilities in you decision of where to work?
6. How important is in-service training at facilities in your decision of where to work?
7. Is the certainty of getting your first choice of internship important to you when deciding where to work?

Financial incentives

8. What salary increase would motivate you to take up rural postings?

Living conditions (non-financial incentives)

9. Would you prefer housing to be provided for you, or a housing subsidy?
10. Is opportunities for social activities with your colleagues important to you?
11. Is opportunities for social activities with your community important to you?
12. Are there any other factors which have not yet been mentioned, that are important to you when deciding where you will work?

We have discussed several factors that can influence your decision on where you choose to work. Please rank which four of these job factors is most important to you. Number them 1-4 in order of importance on the form that has been given to you (Appendix D).

APPENDIX B: INFORMATION PAMPHLET

Rural internship job attribute preferences of final year medical students in South Africa: a discrete choice experiment

Good day, my name is Maria Jose from the University of Cape Town.
I am conducting a study to investigate medical student's preferences for job attributes when considering internship placement. I invite you to participate in this study, please read this information pamphlet prior to joining the study, feel free to ask the researcher any questions you may have. Thank you for your time we appreciate your contribution to this study.

Why is this study being done?

The purpose of the research is to determine the job attribute preferences of final year medical students at UCT when considering internship placement choices. The results will be used to form a policy brief and a mini-thesis for the researcher's Master in Public Health. You will be asked to provide written informed consent before participating in the study.

What do study participants need to do?

This study has three phases of participation, the focus group discussion, the piloting of the questionnaire and the final questionnaire.

- If you are asked to participate in a Focus Group Discussion, this will require you to join a group of six students for 1-1, 5 hours to discuss questions that the researcher will put to the group. There will be three such session conducted with different groups of students each time. Each session will be audio recorded and transcribed. Participants of the FGD sessions will be provided with refreshments.

- If you are invited to participate in a pilot testing of a questionnaire this will require you to use your device (laptop/tablet/mobile) to complete an anonymous online questionnaire, you will then be asked by the researcher to provide feedback on the questionnaire in order to improve its clarity and ease of use. It is expected to take approximately 30 minutes to complete. Participants of the pilot testing session will be provided with refreshments.

- If you are invited to complete the final questionnaire you will be provided with a web-link to an anonymous online questionnaire to be completed on your device. It is expected to take 30 minutes to complete.

What are the benefits to me to participate in this study?

Participation in this study in either of the three groups will provide you with an opportunity to think about what job attributes are important to you to guide you as you decide on your internship placement choices. A policy brief with the study results will be prepared and distributed. The results of the research will be shared with the class on your VULA site.

What are the risks to me if I choose to participate in this study?

There are minimal risks expected as a result of this study. Participants may be concerned about risk of stigmatization by faculty as a result of study participation. The study researcher was previously a staff member of UCT but is currently a full-time postgraduate student. Please note that participation in this study will not influence your academic results, nor will it influence your final internship placement. Participation is voluntary and participants have the right to refuse or withdraw from the study at any time without facing repercussions.

How will my information be kept private?

Regardless of which group you are allocated to, your identity will be kept anonymous as you will allocated a study number to be used when collecting your responses. If you are participating in the FGD, please note the session will be audio recorded. If you participation in the questionnaire, your questionnaire will only have a study number, so that your responses will not be linked to your identity. All responses will be captured electronically and this database will protected with password encryption.

How will I be compensated for my participation in the study?

Regardless of which group you are allocated to you will not be reimbursed for your participation. If you participate in the focus group discussion or the pilot questionnaire you will be offered light refreshments to compensate you for your time and effort.

What is a Research Ethics Committee?
The research ethics committee ensures the safety, rights and welfare of people participating in research. Their contact details are:
- Website:
www.health.uct.ac.za/fhs/research/humanethics/about#sthash.oqkqwJ61.dpuf
- Telephone Number: 021 406 6338
- E-mail: sumayah.ariefdien@uct.ac.za

In case of any questions regarding the study and participants' rights please contact the researcher as follows:
Researcher contact details:
Dr Maria Jose
Email: maria.jose@uct.ac.za
Tel: 0214066562
Falmouth Building Level 1, Entrance 1, Room 1.02.2

APPENDIX C: EXAMPLE OF INFORMED CONSENT FORMS

Rural internship job attribute preferences of final year medical students in South Africa: a discrete choice experiment: Focus group discussion

The following is a consent form for the above-mentioned research being conducted at the University of Cape Town.

Name: _____

Surname: _____

Please put a cross in the box of the option you choose:

	YES	NO
Do you agree to participate in a Focus Group discussion?		
Do you understand that participation in this study is voluntary and that you may decide to pull out at any time without facing repercussions?		
Do you understand that you will not be reimbursed for you participation in this study?		
Do you understand that this study has minimal risks and benefits to you as an individual?		

Rural internship job attribute preferences of final year medical students in South Africa: a discrete choice experiment: Pilot testing

The following is a consent form for the above-mentioned research being conducted at the University of Cape Town.

Name: _____

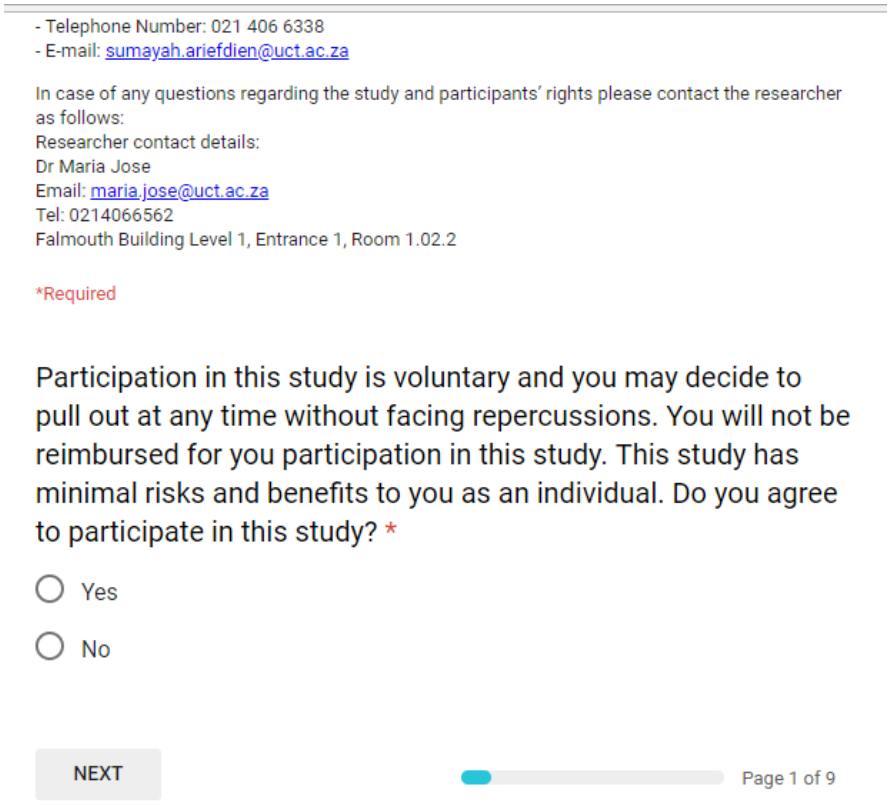
Surname: _____

Please put a cross in the box of the option you choose:

	YES	NO
Do you agree to participate in testing a pilot questionnaire?		
Do you understand that participation in this study is voluntary and that you may decide to pull out at any time without facing repercussions?		
Do you understand that you will not be reimbursed for you participation in this study?		
Do you understand that this study has minimal risks and benefits to you as an individual?		

SAMPLE OF INFORMED CONSENT GOOGLE FORM FOR FINAL DCE QUESTIONNAIRE

(Final questionnaire to be sent to HREC as an addendum)


- Telephone Number: 021 406 6338
- E-mail: sumayah.ariefdien@uct.ac.za

In case of any questions regarding the study and participants' rights please contact the researcher as follows:
Researcher contact details:
Dr Maria Jose
Email: maria.jose@uct.ac.za
Tel: 0214066562
Falmouth Building Level 1, Entrance 1, Room 1.02.2

*Required

Participation in this study is voluntary and you may decide to pull out at any time without facing repercussions. You will not be reimbursed for you participation in this study. This study has minimal risks and benefits to you as an individual. Do you agree to participate in this study? *

- ○ Yes
- ○ No

NEXT

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APPENDIX D: FOCUS GROUP DISCUSSION - JOB RANKING FORM

We have discussed several factors that can influence your decision on where you choose to work.

From the list below, please choose the top four of these job factors that is most important to you and rank them using numbers 1-4 in order of importance.

(1=most important, 2=second most important, 3=third most important, 4=fourth most important).

FACTOR	RANKING #1-4
Degree of supervision	
Housing/housing allowance	
Proximity to schools	
Proximity to employment opportunity for partner	
Safety at facility	
Opportunities for socialisation with community	
Rural allowance	
In service training	
Opportunities for socialisation with colleagues	
Proximity to family	
Chance of being 2nd rounded	

Study Number 001

APPENDIX E: STUDY TIMETABLE

TASK	MARCH 2018	APRIL 2018	MAY 2018	JUNE 2018	JULY 2018	AUG 2018	SEPT 2018	OCT 2018	NOV 2018	DEC 2018
SUBMIT PROPOSAL FOR ETHICS APPROVAL										
APPLY FOR PERMISSION FROM UCT STUDENT AFFAIRS DEPARTMENT										
MEET STUDENT CLASS REPRESENTATIVES										
MEET COURSE CONVENORS										
HOLD THREE FOCUS GROUP DISCUSSIONS WITH PARTICIPANTS										
DEVELOP AND PILOT DCE QUESTIONNAIRE										
DEVELOP AND ADMINISTER FINAL DCE QUESTIONNAIRE										
PERFORM DATA CLEANING AND ANALYSIS										
WRITE UP RESULTS AS JOURNAL ARTICLE AND DEVELOP POLICY BRIEF										
DISSEMINATE RESULTS TO STAKEHOLDERS										

APPENDIX F: EXAMPLE OF DCE QUESTIONNAIRE
(FINAL QUESTIONNAIRE TO BE SUBMITTED TO HREC AS ADDENDUM)

PART A

Consider the following scenario in detail (Hospital E and Hospital F). Based on the description of the job attributes of each hospital, choose the option of the hospital that you would prefer to work at for your internship. Please answer every question.

<table>
<tr><th colspan="3">Scenario</th></tr>
<tr><td colspan="2">Hospital E
• Salary R37000 per month (No Rural allowance)
• Supervision at facility is good
• On site doctors accommodation is available and have many amenities(3 bedroom house, swimming pool, safe parking)
• Low chance of being 2nd rounded
• 2 hours away from school and employment opportunities for partner and dependants.
• Many opportunities for socialisation with colleagues</td><td>Hospital F
• Salary R57000 per month (includes Deep Rural allowance R20000)
• Supervision at facility is poor
• On site doctors accommodation is available and have many amenities(3 bedroom house, swimming pool, safe parking)
• Low chance of being 2nd rounded
• Far (>8hours) away from school and employment opportunities for partner and dependants.
• Some opportunities for socialisation with colleagues</td></tr>
<tr><td colspan="3">WHICH JOB OFFER WOULD YOU CHOOSE?
PLACE AN X UNDER THE OPTION YOU CHOOSE</td></tr>
<tr><td>HOSPITAL E</td><td>HOSPITAL F</td><td>NEITHER</td></tr>
</table>

PART B

The following questions ask you for information about your personal life and background. For each question please choose the option that is applicable to you. Please complete all questions.

1. Which gender do you identify as?
   _____ Male
   _____ Female
   _____ Gender Non-conforming

2. How old were you at your most recent birthday?
   _____Years

3. What is your current relationship status?
   _____Single
   _____In a committed relationship, not married
   _____ Married
   _____Divorced/Separated
   _____Widowed

4. Do you have any children [adopted, fostered, biological or step-children)?
   _____ Yes
   _____ No

6. What kind of area did you grow-up (spend high school years) in?
   _____ Rural Area (villages and farms)

   _____Informal settlement (informal structures within or around town/cities)

   _____ Urban settlement (formal structures in suburbs/ townships)

7. In which province of South Africa is your “home” situated?

___Western Cape

___Gauteng

___Eastern Cape

___Limpopo

___North West

___Mpumalanga

___Kwazulu Natal

___Northern Cape

____My home is not situated in South Africa

8. Have you received a provincial bursary?

___YES
___NO

9. Did you receive any exposure to rural medicine during your undergraduate training thus far? This can include the Eden district placement, a rural elective, a faculty-organised field trip or self-initiated rural exposure to a health facility outside of a city or town.

___YES
___NO

10. Are you a Cuban-trained student?

____YES
____NO

11. Do you intend to complete internship and community service in South Africa?

____YES (continue to question 12)
____NO (continue to question 13 end of questionnaire)

12. Which career path are you interested in pursuing after your internship and community service?

___General practice
___Specialisation
___I don’t know/ undecided

13. End of Questionnaire

APPENDIX G: STUDY BUDGET

LINE ITEM	**UNIT COST**	**QUANTITY**	**TOTAL**
Refreshments (FGD)	R50.00	18	R900.00
Refreshments (PILOT)	R50.00	10	R500.00
Printing info pamphlet and consent form (FGD)	R1.50	18	R27.00
Printing info pamphlet and consent form (PILOT)	R1.50	10	R15.00
TOTAL			**R1442.00**

PART 2:

LITERATURE REVIEW

Abbreviations used

HRH: Human Resources for Health

WHO: World Health Organisation

SSA: Sub-Saharan Africa

DCE: Discrete Choice Experiment

HIV: Human Immunodeficiency Virus

AIDS: Acquired Immunodeficiency Syndrome

HRM: Human Resource Management

LMIC: Low-middle Income Country

TB: Tuberculosis

CVM: Contingent Valuation Method

RUT: Random Utility Theory

FGD: Focus group discussion

OMEP: Orthogonal Main Effects Plan

ASC: Alternative Specific Constant

WTP: Willingness To Pay

MNL: Multinomial logit model

IIA: Independence of irrelevant alternatives

IID: Independent and identically distributed

1. Introduction

This review introduces the multifaceted challenges of Human Resources for Health (HRH) in three broach review sections. Firstly, a theoretical review explores three established frameworks of health care worker job placement choice and develops a hybrid fourth model relevant to South Africa. Secondly, an empirical review defines key terms used and evaluates current literature on policy incentives that attract HRH into rural areas. Thirdly, a methodological review is presented for preference elicitation methods with an emphasis on the theoretical underpinnings of the chosen methodology, discrete choice experiments.

1.1 Search strategy

Search terms used the following terms in combinations: “DCE” OR “discrete-choice experiment” OR “choice modelling” OR “stated preference” OR “conjoint analysis” AND “rural” AND “health care worker” OR “human resources for health” OR “medical student” AND “motivation” OR “recruitment” OR “placement choice” OR “job attribute”.

Search engines used were PUBMED and Google Scholar. Additionally, national and internationally relevant healthcare worker reports, legislation and working papers were reviewed.

Search parameters used a 20-year time period from January 1990- January 2018 and included literature globally as no geographical limitations were applied however only English language articles were reviewed. A total of 70 pieces of literature were found of which 25 were DCE- related articles.

1.2 Definition of terms

South African population census data recognises four settlement types namely; formal urban areas, informal urban areas, commercial farms, tribal areas and rural informal settlements[1] Definitions of “rural areas” vary amongst countries but are commonly based on population density, availability of economic structures and distance from an urban area.[2] Burch et al. [3], derived the definition of rural as “an area more than two hours’ travel by road from the nearest urban centre”, with “urban” defined as “a centre with a population of more than 250000 people”. Rural medical practice is challenging due to social isolation, extreme weather conditions, lack of transport and infrastructure and restricted access to goods and services.[4] Given this, there are a myriad of factors which influence a medical student’s

decision-making process when choosing a rural internship placement site, these will now be explored through conceptual frameworks.

2. Background

The World Health Organisation (WHO) has identified the health workforce as a critical building block of a functional health system and highlighted the importance of equitably deploying health workers to under-resourced areas where the need for health care is the greatest[2]. The WHO recognises that the struggle for health equity is faced by policy makers globally, with the delivery of healthcare to those living in remote and rural areas identified as a pressing challenge.[2] It is disconcerting that although Africa bears 24% of the global disease burden, it has access to only 3% of the global health work force.[5]

The majority of Sub-Saharan African (SSA) countries do not meet the WHO recommended minimum doctor-population ratio.[6] The World Bank assessment shows that a middle income country such as South Africa would need to have a minimum of 180 doctors per 100000 population to be on par with Brazil and Mexico which are middle income countries, however SA's ratio is more on par with low income countries (50:100000).[7] Moreover, HIV/AIDS, emigration, crime and unstable macroeconomic climates are contributing to "brain drain" from these developing countries.[6] A human-capital analysis quantifying the cost of doctors emigrating from Sub-Saharan Africa found the estimated loss on investment to be $58700 per South African medical graduate that left the country.[6] Approximately half of the 2400 South African medical graduates of 2006 and 2007 are predicted to emigrate, with those remaining split between the public and private sector 25% and 75% respectively.[8] Furthermore, only 2.9% of those in the public sector would be practising medicine at rural facilities in the country.[8] The doctor shortage is both an absolute as well as relative issue, as there is unequal division of doctors along public-private lines, provincial lines, rural-urban lines, poor-wealthy lines and state dependant-medically insured lines.[5]

The economic perspective of Human Resource Management (HRM) views the labour market as constructed of supply, demand, wage and market forces.[9] SA medical school positions are limited and highly competitive, thereby limiting entrance to the profession, driving up wages due to a scarcity that is compounded by emigration, and inequitable distribution of doctors.[9] The supply of medical doctors is also constrained by few medical schools and a long process

of training. South African medical doctors are trained in medical school for six years, followed by a two-year compulsory internship at an approved government hospital and additional one-year mandatory community service before they can be certified for independent practice. Although higher wages are associated with lower rates of worker attrition, it is important to note that this relationship is inelastic at higher salary levels (as in the case of doctors), in that instance other job attributes become a more important influence on attrition of doctors.[9]

The health care labour market cannot be left to the mercy of market forces as medical doctors gravitate to employment opportunities that pay more which are in urban areas, this occurs at the expense of the provision of health services in rural areas.[9] It is for this reason that there is a need for external regulation in the form of government interventions. Interventions may take several forms; mandatory rural practise for health workers, bonded training schemes, regulations restricting entry to over serviced areas and compulsory exposure to rural practise.[9] These will be expanded upon in Section 2.5. Preference studies shed light on health professional's job attribute preferences to inform the development of responsive government interventions and these will be described in detail in Section 5.3. Apart from personal factors, many of which may be out of policy-maker's control, institutional factors remain an influential aspect of doctor's practice location decisions, this will now be discussed in detail in an empirical review.

3. Empirical review

3.1 Organisational factors

Organisational factors include recruitment policies, structure of remuneration packages, administrative capacity to pay salaries timeously and the implementation of operational policies.[10] This is further illustrated in a systematic review of medical students from LMIC countries citing weak health system referral structures and mismanaged health facilities as significant demotivating factors for them when considering rural practise.[11] Improved communication channels between doctors and hospital management has been recommended as vital to the success of rural health facilities.[12] A systematic review of the motivations of health personnel highlighted the importance of skilled managers to lobby for the best interests of their staff especially in the context of resource-constrained environments.[13] HRM need to improve in order to boost staff morale and welcome a diverse array of health workers. An open-ended questionnaire given to SA doctors identified "being

paid salaries on time" as the most important human resource practice.[10] These criticisms of HRM extend to the organisational bureaucracy doctors have experienced when applying for promotions as well as the insufficient advertising of vacant posts.[12]

3.2 Facility factors

Facility factors include availability of necessary equipment at facilities, extent of supervision, opportunities for career development, hospital management, socialisation opportunities with colleagues, perceived safety, proximity to family or place of origin, availability of on-site accommodation and perceived workload.[14,15]

3.2.1 Resource availability at facilities

The availability of functional, quality equipment and resources at rural health facilities is well documented incentive for health workers.[11,12,16–21] For nurses considering a rural health facility placement, Penn Kekana et al.[22] found that efficient hospital management, coupled with well-equipped facilities were as influential as a 15% pay increase in motivating them to choose to work in a rural area. This speaks to the extent to which holistic, health system wide improvements have positive effect on HRM. Budhathoki et al.[11] conducted a systematic review of factor that motivate medical students from LMIC to work in rural areas and found that a lack of infrastructure, equipment, medication and telecommunication discouraged students from working at rural health facilities. This extends to medical student's perception of their safety as rural facilities are considered less safe.[11] Using semi-structured interviews with doctors in rural areas, Kotzee & Couper[12] shed light on the effects of a lack of equipment; limited number of blood pressure machines and blood glucose monitors meant patient care was delayed and this led to frustration among doctors. Medical students in particular have been disappointed by the discrepancy between the tertiary, urban hospitals where they were trained and the sparsely equipped rural health facilities where they are placed upon their graduation.[17,23,24]

3.2.2 Supervision and opportunities for career development

The perception that work at a rural facility will result in fewer opportunities for career progression impeded medical students from considering rural health placements.[11] Further

study opportunities and fast-tracking specialisation remain a priority for nurses, midwives and doctors alike [12,21,25–28] Nurses and mid-wives in Peru were willing to take up a rural job if they were offered a 75% salary increase combined with a scholarship for specialization.[26] SA doctors who enjoyed professional development opportunities during their community service year were twice as likely to report intentions to remain in rural, underserved communities.[29] Doctors who worked at rural facilities that had regular supervision from senior specialists report their experience to be beneficial to both their job satisfaction and the quality of patient care they were able to provide.[12] Work environments which offered workers autonomy, role-clarity and team cohesion are linked to greater job satisfaction and retention rates.[30] Although early specialisation is an effective incentive for recruitment it has been found to be inefficient as it is cumbersome to administrate and expensive[31].

3.2.3 Availability of on-site housing

The provision of accommodation on the hospital premises or a housing allowance has, in general, been found to be a favourable rural practise recruitment strategy by a number of studies. [12,16,18–20,27] This is thought to be due to its ability to reduce travel expenses, thereby lowering the living expenses associated with living in a rural area.[10] In contrast Vujicic et al. [21], did not find housing to be effective and denounced the cost-effectiveness of housing provision as a recruitment strategy. The perception that living on hospital premises puts one at risk of unexpectedly being called to work when there are staffing shortages has also been documented as a cause of resistance to housing provision.[10] Choosing to reside off-site from one's workplace instead of accommodation on site was seen as a means of separating work life from one's private life.[32] The lower preference for housing provision among practising nurses compared to student nurses was postulated to be due to practising nurses being on average older, therefore more likely to have families compared to nursing students, who are thought to be less confident in organising their own accommodation.[33] There is a need to study whether that interaction between age and housing allowance on choice of job placement is relevant in other contexts amongst other cadres of health workers such as medical doctors with a longer training period and therefore an older average graduation age compared to nursing.

3.2.4 Occupational safety concerns

Occupational safety broadly refers to a range of threats including physical safety from intentional and unintentional injuries, harassment and occupational exposure to infectious diseases[34]. South Africa's high-burden of tuberculosis (TB), incidence rate of 1000/100000 population, is fuelled by the HIV epidemic as many patients are co-infected [35]. There is a 5-6 fold increased incidence of hospital admission for drug-resistant tuberculosis among healthcare workers in South Africa, which is compounded by low cure rates, high mortality and the risk of transmission to other staff and patients [34]. Infection control practises to limit TB exposure include adequate ventilation, hand washing and personal protective equipment, in the form of respirators/face masks, which act by filtering the air and preventing tuberculosis bacteria from being inhaled by the wearer but must be correctly fitted to prevent leaks of the seal. A risk assessment study of 51 primary health clinics in South Africa found that respiratory masks were available in 41 clinics of which 30% of these were paper masks which do not offer effective protection against tuberculosis, only 22% of clinics had N95 masks with none offering fit testing[36]. In contrast a qualitative study of TB infection and control practises at a South African tertiary academic hospital had N95 masks widely available[37]. In spite of availability of N95 masks, a survey of healthcare workers at three hospitals in South Africa found that 54.8% did not wear N95 respirators when needed and this finding was correlated with mistrust among doctors that their hospital management are unable to uphold workplace safety standards [35].

At rural facilities crime has been a threat to staff and patients with news reports of criminals targeting doctors and nurses stealing their personal items and attacking them at on-site staff accomodation[38]. Historical conflicts in and between tribal communities periodically lead to deadly violence in rural areas, this is compounded by poor road conditions with resulting delays in police responding to instances of crimes[39]. Unavailability of transport, electricity and poor lighting also pose safety challenges forcing residents, especially women, to travel alone between remote areas in the dark where they are at increased risk of being assaulted or robbed[39].

3.3 Personal factors

What follows in an exploration of the personal, facility and organisational factors which act as influencers on medical students' decision-making processes as evidenced in the literature.

Personal factors include, gender, being of rural origin, marital status, having dependent children and intrinsic motivation.[40] These factors will now be discussed in detail.

3.3.1 Gender differences

A number of studies have demonstrated the influence of social gender norms in a medical graduates' choice of practice location as well as training opportunities. [32,41-42] Although men and women may equally value opportunities for career progression, leadership roles, professional development support, impact on wider society, and opportunities to travel, their career choices often reflect decision making influenced by societal gender norms.[41] Male healthcare workers tend to have more training and promotion opportunities and choose their practise location based on economic consideration, in contrast, females tend to be unable to capitalise on these opportunities due to family responsibilities.[32] Female doctors consider flexibility of work conditions and its impact on childcare responsibilities when choosing to specialise or not.[43] Female doctors are more likely to choose urban practise locations for the sake of children's education and employment opportunities of their spouse.[44-45]

An Australian survey of doctors found that respondents who practiced in rural areas had rural origins, were predominantly female, married, had a spouse with rural origins, and were in general practise.[42] The same study described urban medical practitioners as having urban origins, were predominantly married males, who had decided to specialise and found rural facilities limiting in that respect but failed to explore how these differences contribute to job placement choices.[42]. Further studies have found gender to also be influential on the effectiveness of recruitment policies.

Female healthcare workers in Burkino Faso were twice more likely to choose a job offer with free housing than their male counterparts.[18] Similarly, female final year medical students were more sensitive to the recruitment effect of rural allowance compared to their male counterparts males.[31] Female health care workers were more sensitive to the provision of equipment at facilities as a motivating factor for rural practise.[20] There is contrasting evidence from Rockers et al. [24], showing that preferences for working in rural clinics among trainee health professionals in Uganda was not significantly modified by gender. Therefore, the literature strongly supports the need to interrogate the local, gendered, nature of the

practice of medicine in order to inform targeted policy incentives to influence choices around practise location, speciality and career progression.

3.3.2 Rural origins

Recruiting medical students based on their rural origins has been correlated with greater retention rates in rural practice.[11,21,31,46] The key influencers of future rural practise include; a medical graduate's rural origin, a spouse with rural origin, and rural exposure during undergraduate training.[42] This effect is not universal however, as amongst Indian doctors and nurses, having rural origin had no significance on uptake of rural job postings.[28] The importance of the interaction between rural origin and other factors was highlighted by a longitudinal cohort study of SA nurses where rural origin coupled with the provision of work supervision contributed to nurses having increased work resilience, similarly, rural origin coupled with older age was predictive of rural practise amongst nurses.[47] A cross-sectional study of the life cycle of doctors in SA indicated that doctors who work in rural public health facilities do so during the early phase of their careers, then move to the private sector as their children reach school-going age, the authors suggest the need for longitudinal analysis of person-years in rural versus urban practise locations.[48] This lack of longitudinal panel data tracking the career progression and practise locations of SA medical graduates over time should be addressed in order to inform local policy on medical school admission criteria.

3.3.3 Marital status and dependants

Being physically close to one's family, being supported by colleagues and having a commitment to serve others are known to be positive coping mechanisms to deal with work stress.[32] Marital status has been found to be influential in informing health worker priorities as well as work placement choices. Married doctors value a job in an urban centre twice as highly as single doctors, due to the need for work opportunities for their spouse as well as children's need for schooling.[44] Perceived proximity to family when working in rural areas was a motivating factor for medical students to practise in rural areas.[11] A study involving final year midwifery students demonstrated that most did not yet have children, and that the value of future children' well-being did not factor heavily compared to an individual's well-being when making practice location decisions.[16] Married Indonesian final year female medical students with children are less likely to go to rural areas, the cultural expectation of being married and having children deters women from choosing rural areas despite

mandatory community service being a pre-requisite for independent practise certification.[31] It has been argued that this policy, meant to bolster rural healthcare, is in fact inequitable as it forces female graduates to be unemployed, practise illegally or leave the medical profession.[31] Female graduates are willing to trade a large sum to be able to complete their compulsory medical service in urban areas.[31]

An SA study of community service doctors concluded that unmarried community service officers were less likely to receive their first choice facility placement; rural placement was more likely among unmarried, male practitioners.[29] These results may not be a true reflection of participant's preferences, instead they may reflect the value the allocation process places on married applicants' requests above those of unmarried applicants. Actual job placement statistics alone do not fully explain the choices made by doctors about their practise locations, their final practise locations may be a result of externalities beyond their control as well as bureaucratic processes. It is for this reason that stated preferences experiments, which use hypothetical job postings, are valuable at eliciting individuals' preferences unhindered by constraints that may be present in their real life.

3.3.4 Intrinsic motivation

Motivation has been described as a state of perceiving a task's importance, believing one is capable of fulfilling the task and then expecting a personal reward.[49] Motivation may be intrinsic i.e. inherent in an individual, or extrinsic i.e. driven by incentives. Intrinsic motivation has been linked to preference for rural work placement. A study measuring altruism among nurses noted that those with higher levels of altruism were more likely to choose rural job placements.[47] Furthermore, altruistic persons are less inclined to respond to extrinsic incentives, and are more likely to self-select into jobs that are less lucrative for the sake of helping others.[4] Studies describe altruistic workers as having selfless devotion to work in communities with the most need.[50] Intrinsic motivation remains a neglected aspect in research, with some researchers arguing that extrinsic incentives, such as financial incentives, should be rejected as a commodification of healthcare.[51]

3.4 Policy incentives to improve attraction and retention of doctors in rural areas

In response to the aforementioned HRM challenges, the WHO has developed specific recommendations to attract and retain healthcare workers and these can be categorised into five areas namely, educational, financial, personal and professional support and regulation.[2] A systematic review of the motivation and retention of health workers in developing countries concluded that financial incentives alone are not sufficient, and that community appreciation, adequate resources and infrastructure are influential in doctor retention.[13] Most countries use a bundle of financial and non-financial initiatives to improve recruitment and retention of doctors. What follows is a detailed review of rural practise recruitment and retention policy incentives.

3.4.1 Recruitment of rural origin students.

Numerous countries have instituted active recruitment of medical students who hail from rural origins following studies which have demonstrated that rural-origin students are more likely to choose to practise in rural areas upon graduation[11]. The Mandela – Castro program recruits rural-origin students from South Africa to be trained in medicine in Cuban medical schools on condition of mandatory rural service in their home country upon graduation. Similarly, Thailand sponsors rural-origin medical students' training on the condition that upon graduation these students will complete a mandatory rural placement, these programmes have been credited with strengthening the practise of rural medicine in the country.[45]

3.4.2 Mandatory rural placement

In contrast, SA has instituted a mandatory 1 year community service for all medical graduates in order to be certified for independent medical practise in South Africa.[5] However, in terms of this policy's implications, it is argued that mandatory community service ultimately motivates young doctors to emigrate and that few community service doctors remain in the public sector after their mandated time.[5] This practise thus is a short-sighted solution which is associated with high staff turnover rates that further destabilise a fragile rural health care system.

3.4.3 Rural allowance

A study of doctors and nurses in a rural region of South Africa found that rural allowance is effective at attracting workers to rural areas in the short term but was divisive as not all cadres of staff received rural allowance and furthermore there was no clarity on what

constituted a rural placement.[52] Interviewees reported spending their rural allowance on transport to urban areas for shopping and recreational activities.[52] A multicounty study revealed that the provision of a rural allowance equivalent to 30% of their base salary encouraged South African and Kenyan nurses to be 12.4 times more likely to choose a rural job, whereas their Thai counterparts were only 2.0 times more likely to choose the rural job for the same proportion of rural allowance, this demonstrates the differential effects of the same incentives in different locations.[46] Studies done on physician assistants and midwives, noted that financial incentives were effective to some degree but that it is the combination with non-financial incentives that provides the largest rural facility recruitment effect.[19,25] Consultation with health workers prior to the introduction of incentives and appropriately evaluating the effect of incentives have been identified as gaps in the current HRM functioning in African countries.[49].

4. Theoretical Review

Three conceptual frameworks were evaluated for their relevance to the research question namely the Consumer Choice Process, the Bland model and the Health Worker Retention Framework. A fourth framework, South African internship placement decision model is then developed as a locally relevant and integrated hybrid of the three frameworks.

4.1 Consumer Choice Process

Louviere et al.[53] proposes a series of stages outlining the consumer's decision process when faced with a choice of goods to purchase (Figure 1). This model assumes that once a consumer becomes aware of their need, they would then search for possible products that can fulfil that need. The consumer would then weigh up the attributes of each alternate product and take into consideration budget and other constraints to form the utility/preferences which inform their choice. The consumer also has the option to not choose, or to delay their choice. Once a choice is made, the consumer can then evaluate their satisfaction with their choice and this in turn may influence future decision making about consuming this product or other alternatives.

This conceptual framework is limited in its application to medical students' choice of internship placement, in that the medical student is not purchasing a product i.e. there is no budget and they must make a decision based on incomplete information as often the job

attributes of different internship sites are not well advertised. The Consumer Choice Process framework although a helpful guide to generic consumer decision-making behaviour, does not elaborate on the factors that may influence a medical student's practise location decision.

4.2 Adapted Bland Model

In contrast, the Bland Model is a conceptual framework used for analysing medical student specialisation choice in the United States.[54] In their systematic review of factors influencing medical students motivation to work in rural areas, Budhathoki et al.[11] adapted the Bland Model to position medical students' motivation to work in rural areas as a dependant variable influenced by health facility factors, personal & lifestyle factors, medical training & curriculum factors, medical school related factors and policy factors (Figure 2). Health facility factors are relevant as they represent the job attributes that would influence medical student's preferences. Medical training and medical school although influential, are not within the scope of this study's research question as they do not represent job attributes that HRM policy makers can influence through policy interventions.

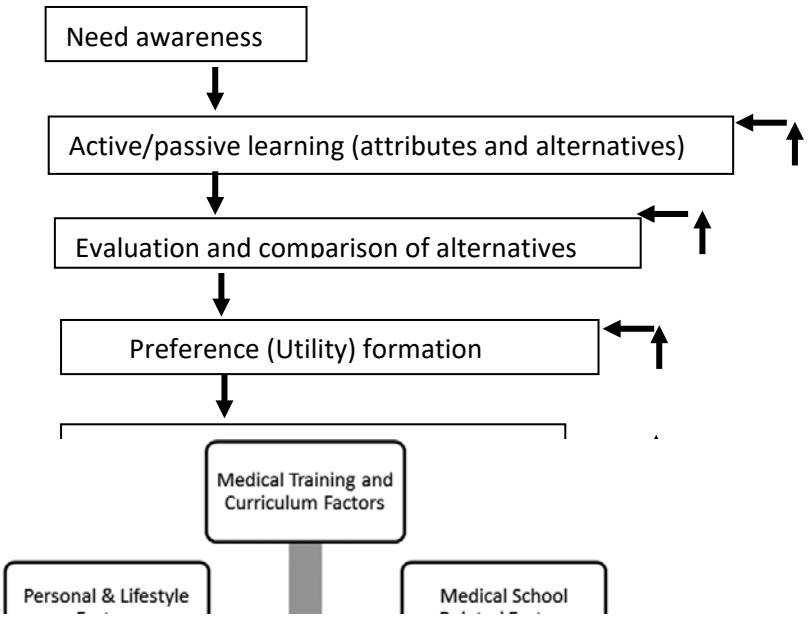

Figure 1: Consumer Choice Process [53]

Figure 2: Adapted Bland model by Budhathoki et al.[11]

4.3 Framework for Health Worker Retention

The third conceptual framework reviewed is the Framework for Health Worker Retention. Kiwanuka et al. [32], adapted the Health Worker Retention Framework (Figure 3) originally developed by Schaefer and Moos.[55] This framework describes three broad categories of factors that influence a health worker's intention to stay or leave their work environment, namely, organizational factors, facility factors and personal factors.[32] This framework is intended for use amongst health care workers already employed at a facility with health worker retention viewed as the main outcome. This model therefore does not consider medical students decision making processes when choosing an internship placement. This model is valuable however in terms of the level of detail it provides with respect to organizational factors, facility factors and personal factors.

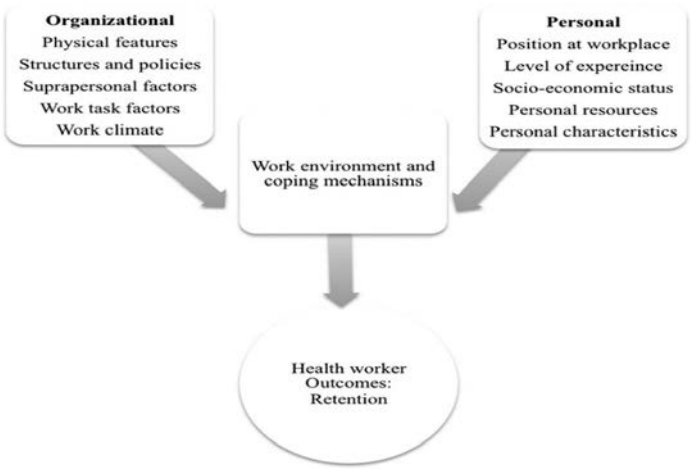

Figure 3: Health worker retention framework by Kiwanuka et al. [32]

4.4. South African internship placement decision model

A South African internship placement decision model has been developed for this study (Figure 4). It is an adaptation of the Consumer Choice Process conceptual framework, adapted Bland Model and Framework for Health Worker Retention. It aims to outline the decision-making process of a final year medical student faced with the decision of their internship practise location.

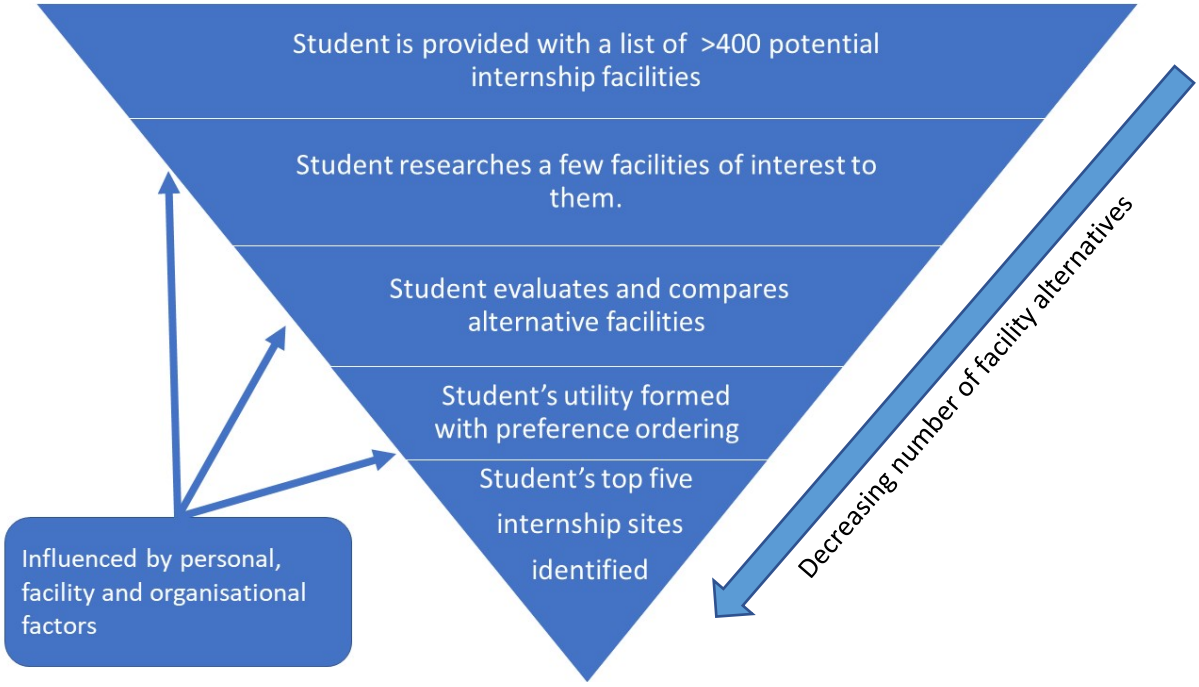

Figure 4: South African internship placement decision model by the author

Step 1, the final-year medical student will be contacted by the National Department of Health (NDOH) requiring them to apply online for their internship placement for the following year. The list of available sites, how many posts are allocated to each site and the deadline for application is communicated to the student via an online portal.

Step 2, at this point the student may choose to rely on their experience at hospital sites to inform their decision, or they may choose to gather further information about internship placement sites that are of interest to them. This may take the form of word-of-mouth or social media contact with fellow students, family members and more senior medical colleagues in their social circles. The student may also visit potential sites, speak to current staff members at a site, or get information on the internet about certain internship sites before deciding. This research informs the student's set of beliefs regarding the job attributes possessed by each internship site (e.g. based on feedback from a fellow student, the supervision at a hospital is reputed to be very good).

Step 3, the student would then evaluate the list of alternatives available to them and the job attributes of interest to them. This evaluation would be influenced by personal, facility and

organisational factors. The student would then formulate a decision rule which is based on trade-offs of job attributes; this results in Step 4, the student developing a preference ordering of internship sites (i.e. 1st choice, 2nd choice, 3rd choice etc.). Considerations that may influence their decision, personal, organisational and facility factors (e.g. family commitments, hobbies, career intentions). Finally, in Step 5 the applicant chooses their top five internship sites on the online application portal.

As per the Internship and Community Service Placement guidelines[56], the NDOH receives applications and allocates posts. Those with special considerations (e.g. married students or those with medical conditions requiring placement at specific areas) would be prioritised for allocation followed by South African nationals and thereafter foreign medical graduates. Appeals made by applicants or requests for exchanges between facilities are considered by NDOH before the final appointment decisions are made by the Provincial Department of Health and communicated to applicants.

5. Methodological review

A trial and error approach to health care worker recruitment is costly for low/middle income countries and therefore evidence based methods are required.[24] Contemporary studies on health worker recruitment and retention have made use of a range of qualitative and quantitative methods a review of these methodologies follow, with an emphasis on the limitations of each.

5.1 Qualitative studies

Qualitative methods provide rich information about experiences, thought and feelings towards current recruitment policies. Methods of qualitative data collection include semi-structured interviews (the most popular method), focus group discussions and meta-ethnography.[57] In-depth interviews allows one to explore sensitive topics in private settings however it requires a higher degree of qualitative research skills.[57] Focus group discussions are, on average, less time intensive compared to interviews and holds the advantage of encouraging group discussion that may offer new information to the researcher.[57] Meta-ethnography is considered the least time intensive but is variable in terms of quality of the data.[57]

These methods are highly reliant on the researcher's ability to conduct focus groups and establish rapport with respondents, furthermore it does not measure participant's "trade-offs" with respect to the identified job attributes[12]. Qualitative methods is prone to over-simplifying individual's complex preferences.[57]Although qualitative methods provide a spring-board for further research into identified themes, their results alone have limited generalisability and real-world applicability in contexts where policy-makers prioritise evidence-based, validated recommendations to achieve maximum impact.

5.2 Quantitative methods

The collection of numerical data to represent medical students and interns job attribute preferences by means of surveys ask them to choose from a list of job attributes those which are important to them and rate it on a linear scale[49]. This measures the proportions of the sample which picked a specific attribute but does not capture the trade-offs that participants would make, does not provide a relative ranking nor can it directly advise policy-makers on which attributes to prioritise for interventions. Authors of such studies also concede that such methods are sensitive to the emotional status of the respondent at the time of administration.[58]

5.3 Preference elicitation methods

Preference elicitation is a powerful tool to inform HRM policy and is primarily divided into revealed preference (RP) and stated preference (SP).[59]

5.3.1 Revealed Preference studies

RP is the term used to describe an individual's actual choice behaviour in real-world situations, these may be reported by the individual or based on observation by the researcher across a specific time period.[59] RP data is advantageous due to its external validity as reflects actual choices made by respondents; however it is limited to alternatives that are already present in the market and therefore fails to predict respondents' reactions to new alternatives.[59] It is unable to estimate trade-offs across the features (known as attributes) of a new product or service, additionally, the threat of attribute multicollinearity makes it challenging to isolate each attribute's contribution to utility.[31]

5.3.2 Stated preference studies

In contrast, stated preference refers to one's choice behaviour in hypothetical situations, this may be elicited in the form of a survey.[59] SP evaluation techniques study individuals' preferences for products or services that are available at present or that may be forthcoming, it makes use of a method of estimating trade-off of the product's attributes to predict future demand.[59,60] Stated preference elicitation allows the researcher to construct hypothetical choice sets free from multicollinearity.[31] The disadvantage of SP is that the results gained in hypothetical scenarios may not correlate with how individuals behave in the actual market. Alternative forms of preference elicitation such as Likert scales, possess systematic bias as respondents tend to cluster their answers or remain neutral, whilst such ordinal scales may convey order, they are unable to measure magnitude of preferences.[14,58] Forms of stated preference elicitation include contingent valuation and choice modelling.

5.3.2.1 Contingent valuation method (CVM)

CVM has been used in environmental economics and asks respondents about their willingness to accept (WTA) monetary compensation for a good.[61,62] WTA makes use of a monetary value to represent a good as a whole as opposed to the value of the individual attributes of which the good is comprised.[19] In the case of health care workers job attributes, CVM may ask a participant how much salary he/she would be willing to accept to work in a rural area. CVM may be designed as open-ended, dichotomous or bidding game.[63] Contingent valuation method is criticised for its questionable reliability and validity of estimates and requirement for large sample sizes.[61,63] Dichotomous Choice CVM and DCE are both underpinned by random utility theory[62].

5.3.2.2 Choice modelling methodology

DCE is an attribute based measure of utility that is underpinned by a number of economic theories; Lancaster's theory of demand, consumer theory and random utility theory.[64,65] Consumer theory assumes that rational individuals aim to maximize utility and therefore when stating a preference for an alternative such as job placement site, the person is assumed to choose the alternative that yields his/her highest individual utility.[20,58]

Robyn et al. [17] argue that the hypothetical scenarios presented in a DCE present attributes of each alternative well described whereas in in reality there would be minimal information available about the attributes of each alternative, this leads job-seekers to base their

decisions on rumours of facility reputation. In the context of healthcare jobs, most of the internship placement hospitals do not advertise their job attributes, therefore it can be argued that a final year medical student's choice of internship placement can be based on incomplete information.

An advantage of DCE is that the choices are presented exogenously and so avoids the challenges associated with identifying causal effect of job characteristics.[9] Another advantage being DCE's ability to elicit the ranking of preferences in comparison to one another.[9] It is suggested that a DCE's results be validated by revealed preference studies by conducting policy experiments.[23]

In conclusion despite the apparent validity of revealed preference data, the versatility of discrete choice experiments (DCE) takes into account choice behaviour and inter-linked behaviours and has been applied in a variety of industries including transportation, agriculture and healthcare.[64] This is the reasoning behind the use of DCE methodology for this study.

6. DCE methodology and applications

6.1 Theoretical foundations of DCE

Lancaster's economic theory of demand assumes that customers are rational, their preferences consistent and stable over time to the extent that they can be measured on a numerical scale by the benefit/utility they produce[67]. Utility is not merely derived from consumption of a good, but instead it is a function of the attributes that constitute that good and that an individual's choices reveal their rank ordering of preferences for those attributes.[13,53,58] Choices that consumers make between alternatives are as a result of a combination of their preferences, affordability and access.[64] To this end, goods may be consumed either individually or jointly to produce the combination of properties that deliver utility to the consumer.[53] Furthermore, discrete choice theory limits an individual's choice to a set list of alternatives not the infinite possibilities of choices.[65]

Discrete choice theory introduces the idea that individual choice behaviour is intrinsically probabilistic, hence random.[65] Random Utility Theory is underpinned by the assumption that an individual's utility function cannot be observed by researchers and that the utility function is represented by a systematic component and a random component.[19] The researcher is

able to estimate the systematic component in order to provide quantifiable information on the relative importance of job attributes. The random component of the utility function determines which framework is used to analyse the data which then predicts how an individual's choice is influenced by variation in job attributes.[19]

In a random utility context presented with a limited set of *J* alternative discrete choices, the utility U_{jnt} of medical student *n* in choice situation *t* for internship placement *j* can be expressed as:

$$U_{jnt} = V_{jnt} + \varepsilon_{jnt} \quad (1)$$

where V_{jnt} is the deterministic component of utility, and ε_{jnt} the error terms, which are a function of unobserved internship placement attributes as well as individual-level variation in preferences and are assumed to be independent and identically distributed (IID). The utility represents the appeal of internship site *j* as a function of the estimated sensitivities and observed demographic characteristics of the respondent and the attributes of the choice options. The deterministic part of the utility (V_{jnt}) is influenced by the levels taken by the *m* attributes X_{mjnt} and their marginal utility, or preference, coefficients β_{mj}:

$$V_{jnt} = \sum_{m} \beta_{mj} X_{mjnt} \quad (2)$$

There are four possible sources of randomness including measurement errors, proxy variables, unobserved attributes and unobserved taste variation or heterogeneity in preferences among individuals which limits the researcher's ability to perfectly predict individual's choices[67].

6.2 Role of qualitative methods in DCE

Qualitative methods contribute to DCE in two phases, firstly, the conceptual development and selection and validation of attributes and attribute levels, secondly, the refinement of language, terminology and descriptions used.[57] Conceptual development refers to the acknowledgement that the nature of qualitative research is such that it results in complex, rich data that can provide comprehensive, mutually exclusive, set of attributes.[57] Language refinement is an important aspect of a DCE as it ensures that meaning is conveyed accurately by using terms which will not be misconstrued by the respondents when answering choice sets.[57] In the absence of qualitative data, researchers may rely on policy to inform attribute

development; however, this runs the risk of important attributes being omitted, similarly literature review may be used in attribute formation but locally relevant literature on job attributes may be insufficient and literature alone is unable to contribute to language refinement[57].

Reviews of qualitative methods used in healthcare DCEs show a range of informants were used including carers, patients, professionals, adults, and the general population, often qualitative research was conducted in the same population as the DCE was conducted in.[68] There is great variation with regards to the numbers of informants used in qualitative data collection, between 16 and 40 persons has been cited in the literature.[57,68] The types of analytical methods available for qualitative data included meta-ethnography, framework & constant comparison.[57,68] Coast et al.[57] argue that iterative qualitative methods, constant comparative approaches, are more cost-effective at refining attributes in an inclusive manner as opposed to the use of psychometric methods. It is suggested that purposive sampling is used to gain a wide range of perspectives on attributes to minimise mis-specifying attributes.[57]

To ensure the assumptions of the DCE conceptual framework are not violated, attributes must fulfil the following criteria: include all attributes of importance to respondents, attributes should not include the underlying construct to avoid dominating other attributes, attributes should be such that there is a nonzero probability for the selection of each choice option[57]. The attributes should be able to be manipulated through policy interventions and should not be dependent on personal characteristics.[57] Many published DCE's do not report the qualitative methods used to inform their attribute development and although guidelines exists for analysis of DCE, there is still a lack of guidelines when reporting the use of qualitative methods for DCE.[68]

6.3 Design of a DCE

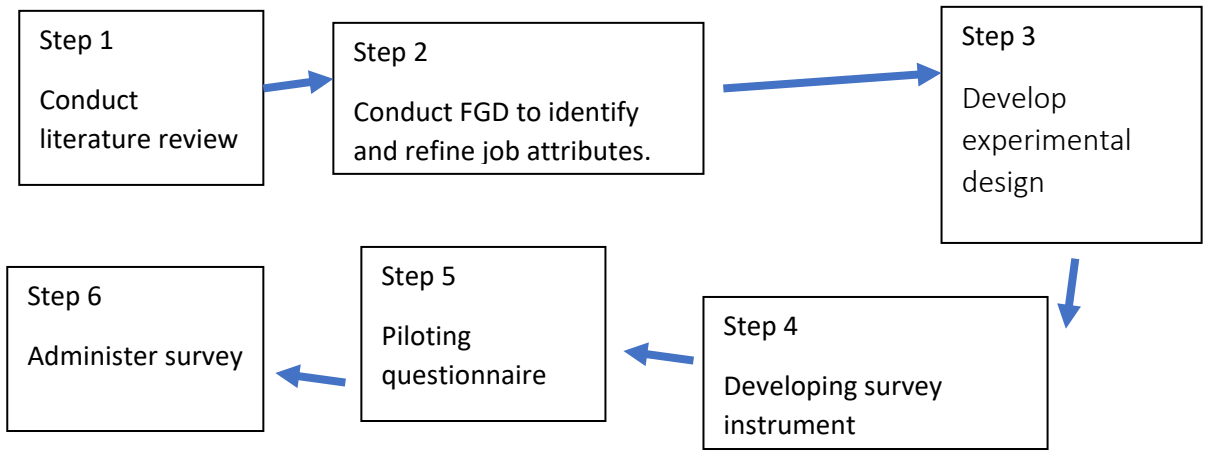

Figure 5 Step wise approach to Design of DCE.[69]

6.3.1. Conduct literature review (Step 1)

Figure 5 outlines the stepwise process of designing and conducting a DCE. This step includes reviewing literature on DCEs conducted in other low- and middle-income countries (LMIC), health worker motivation and job satisfaction. This is done to identify the job attributes that were relevant in countries worldwide and in the local context. This information is then used to inform the questions on job attributes that would be used in the FGD. Job attribute levels refer to the specific ordinal values that describe the job attribute.[69]

6.3.2 Conduct FGD to identify and refine job attributes. (Step 2)

Data from an FGD would then be analysed thematically to identify job attributes and levels and would inform the levels for each attribute to ensure that they are acceptable and feasible in the local context, this is especially important in the case of attributes such as housing and rural allowance.

6.3.3 Develop experimental design (Step 3)

Once the attributes and their levels have been selected, they form hypothetical job postings by way of experimental design techniques. When all possible combinations of attributes and their levels are presented to elicit preferences, it is known as a full factorial design, but this may be challenging as it results in a large number of choice sets for the survey respondent to complete.[70] Therefore an experimental design method is required which will create a more manageable, smaller set of choice.[70] The experimental design is constructed by selecting a

set of choices which enable determination of main effects and interactions, as well as factoring in the attributes, their levels, the question format for choices and the analytical framework to be used.[60,70] The term "main effect" refers to the influence of an independent variable on the dependent variable, whilst the term "interaction" refers to the extent to which the preferences an individual has for one attribute depends on the level of preference for another attribute[70]. There are two main types of experimental designs, orthogonal and efficient/optimal designs.[60]

In an orthogonal main-effects plan (OMEP), all main effects are uncorrelated with each other.[60] The disadvantages is that the main effects can be correlated with interactions rendering the orthogonal design inappropriate for most combinations of attributes, levels, and numbers of profiles.[60] In such situations, software is employed to produce a D-optimal design to fulfil study requirements.[60] Orthogonal designs, using orthogonal arrays require attributes to be statistically independent of one another, attribute levels should be present an equal number of times in order to be level balanced.[70]

The more recently developed and computationally simpler, d-efficient design is increasingly used as it aims to minimise the determinant of the covariance matrix with the assumption that parameters are zero.[70] Optimal design is created to illustrate a realistic range of possible options an individual may encounter.[66] Generally it is recommended that no more than six job attributes are used with too many, respondents may fall back on simple-decision making based on financial incentives alone.[69] Unlabelled choice sets (e.g. Job A, Job B), have been shown to be less distracting for respondents which contributes to higher reliability of estimates of attribute preferences.[70] The questionnaire is created by computer software such as Sawtooth or Ngene which create the specified number of preference pairs.[69]

6.3.4 Developing survey instrument (Step 4)

Demographic questions (e.g. age, gender, marital status) are included in the questionnaire to elicit interactions between respondent's demographic characteristics and their job attribute preferences. Opt-out options may be used to prevent respondents being forced to choose a job that they would not take in reality which would result in an inaccurate overestimation of a job attributes utility.[70] One should bear in mind that when a decision is difficult, respondents may choose the opt-out option as a simple-decision technique which could then

leads to less information about preferences in the hypothetical scenarios, hence why opt-outs were not always used.[70]

6.3.5 Piloting questionnaire (Step 5)

The piloting of the DCE is considered an important quality checkpoint in gauging respondent understanding of the language used as well as the structure of the DCE.[57] This data is collected using a combination methods, the respondent is sent the online questionnaire to be self-administered, this is then followed up with a face to face interview with the respondent to get qualitative feedback on the user-friendliness of the DCE, clarity of terms used and the length of the questionnaire. This feedback is then used to make amendments to the questionnaire to improve it before final questionnaire administration.

6.3.6 Administer final DCE survey (Step 6)

The DCE is administered to all participants in the sample group by the researcher for their responses to be captured on either a paper or computer-based questionnaire at which point bias may be unintendedly introduced if participants favour one side of the page/screen over the other. This "left-right" bias can be identified by the researcher through the addition of a constant to the model that captures the average effect on utility of all factors that are not included in the model.[67] An unlabelled DCE with generic alternative should ideally have an insignificant constant, otherwise one would conclude that there was a tendency to favour one side of the page/screen over the other.[67] Participants can also become fatigued during lengthy DCEs and then may revert to simple choice heuristics i.e. mental shortcuts.[67] This can be avoided through efficient DCE design, however not entirely eliminated, therefore validity testing during the modelling phase is essential[67].

6.4 Modelling DCE

The captured data must be coded for use in the statistical modelling process and the choice of coding can be dummy or effects coding. Dummy coding integrates the reference level of the attribute into the intercept, therefore not possible to estimate its parameter[67]. In contrast, effects coding allows for the estimation of the reference level of the attribute which is equal to the negative sum of the parameter values for the other levels of the attribute[67].

The choice of statistical model to be used depends on the number of alternatives that are presented to respondents in each choice set as well as the assumptions of the distribution of the unobservable component of utility (error term). When the choice set in the DCE is binary (i.e. hospital A or hospital B), one can use binary probit or logit models.[70] If one is including 'opt-out' options or more than two alternatives, then one could use the multinomial logit model (MNL) or mixed logit models.[70]

MNL has three assumptions, firstly independence of irrelevant alternatives (IIA), secondly that the error terms are independent and identically distributed across observations (IID), thirdly that there is homogenous preferences across respondents.[70]

This can be express in parameters as a multinomial logit model:

$$Uij = \alpha_1 + \beta_1 x_{1ij} + \beta_2 x_{2ij} \ldots \beta_m x_{mij} + \varepsilon_{ij} \ldots$$

(3)

Where

U_{ij} Is the utility of person *i* for alternative *j*,

α_1 Represents the intercept/ alternative specific constant (ASC)

$x_1, x_2..x_m$ Represent the observable component of utility as a function of m attributes These attributes could be cost, colour, product features etc.

$B_1, \beta_2..\beta_m$ These coefficients represent the "weight" or "preferences" for each attribute.

ε_{ij} Is the random component of utility which is a function of unobserved attributes as well as individual-level variation in tastes.

IIA assumes that the random disturbance term ε_{ij} is uncorrelated between alternatives.[31] Therefore the unobservable factors affecting a medical student's preference for internship placement *j* is uncorrelated with the unobservable factors affecting the student's preference for internship placement *k*.[31] Medical students are assumed to have a ranking of internship placement sites with varying attribute levels based on their preferences for job attributes and their levels.[20] For example, medical student *i* will choose internship site *j* over internship site *k* because they prefer to get a rural allowance which is only available at internship site *i*

and not available at internship site *k*. The probability (p_{ij}) of medical student *i* choosing internship placement *j* can be expressed as follows[28]:

$$p_{ij} = \frac{e^{\beta_0+\beta_1 X_{ij}+\beta_2 Z_{ij}+U_{0j}}}{1+ e^{\beta_0+\beta_1 X_{ij}+\beta_2 Z_{ij}+U_{0j}}} \quad (4)$$

Where

X_{ij} Represent the vector of job attributes-levels.

Z_{ij} Represent the vector of individual characteristics.

β_1 Regression coefficients of job attribute level

β_2 Regression coefficients of individual characteristics.

U_{0j} is the random component of utility which is a function of unobserved job attributes as well as individual-level variation in tastes, this is assumed to be normally distributed.

Criticism of multinomial logit model is that these assumptions do not reflect real-world decision making, are too restrictive and therefore that the results of this model may produce results which are not valid for policy formulation. However, it is possible to construct models which relax the restrictions of MNL. Alternatives to the MNL model include multinomial probit models and nested logit models, which relax the IIA assumption; heteroscedastic models which relax the IID assumption and use flexible error variance; and mixed logit models which relax the assumption of taste homogeneity and allow for random taste variation.[70]

A mixed logit model allows for violations of the assumptions of MNL and allows for model estimates that vary across respondents. The modification in mixed logit is that the researcher does not know the value of the coefficient or the error term. The solution of the equation requires integrating *Ln* over all the possible values of *β* weighted by the density selected, usually the standard normal distribution such that the error term is assumed to be correlated over choice sets and the coefficients are assumed to vary over respondents[23].

$$L_n = \int_{\xi} \prod_{t=1}^{15} P_{j^*nt}(\beta)\, \phi(\xi) \mathrm{d}\xi \quad (6)$$

A simulated maximum likelihood estimator is used to estimate the probabilities. Mean coefficients μ_β are the output of a mixed logit model and they represent the relative utility of each attribute compared to its reference level of that attribute with the standard deviations σ_β reflecting the degree of heterogeneity among participants. For continuous variable the parameter estimates refer to the mean utility increase/ decrease associated with each a one unit increase in the continuous variable.

Willingness to pay (WTP) represents the respondent's preferences for rural health facility attributes in monetary is the ratio of the coefficient of a non-financial job attribute to the negative of the coefficient of the rural allowance attribute.[19] It is interpreted as how much money respondent is willing to pay to work at a rural health facility which offers that attribute level in comparison to a facility with the reference attribute level, this is then expressed in monetary terms.

$$\text{WTP} = -\frac{\beta_m}{\beta_{rural}} \quad (6)$$

Where βm coefficient of job attribute *m*

$\beta rural$ coefficient of rural allowance attribute

6.5 Discrete choice experiments in the literature

Literature reviews of health care worker DCEs reveal that doctors and medical students are the most studied cadre of health worker.[19] A DCE conducted on Ghanaian medical students found provision of on-site housing, rural allowance, hospital infrastructure, supportive management and shorter contracts before study leave to be influential job attributes when considering a rural placement.[23] A DCE in Ethiopia found that in order to motivate half of doctors to relocate to rural areas, a rural bonus of approximately 89% of their base salary is required with the probability of accepting a rural job increasing from 27% to 84%.[44] Similar studies have yet to be conducted at SA medical schools to elicit job attribute preferences from future medical graduates.

A DCE conducted in India on final year medical and nursing students, primary-care doctors and nurses identified eight job attributes and used a D-efficient fractional factorial design to construct choice pairs. [28] There was a differential effect of job attributes on acceptance of rural jobs according to cadre of healthcare workers; a substantial salary increase had small

effect on doctors, but large effect on nurses' acceptance of rural jobs where as specialist training in exchange for rural service had a positive effect on job acceptance among all cadres studied. [28] The study concluded that for medical students moderate salary incentives, the provision of housing and hospital infrastructure were not as effective for recruitment as substantial salary increases with improved living, working environment, and educational incentives.[28] Such expensive packages of incentives are out-of-reach for most developing countries, which further highlights the critical role of nurse-clinicians or non-physician clinicians as suitable alternatives in rural areas[28].

Amongst Cameroonian health care workers and students, a DCE concluded that health workforce retention policies should include a combination of both monetary and non-financial incentives in order to be most effective.[17] More than 90% of doctors and medical students surveyed preferred an inclusive package of benefits which included a substantial rural retention bonus (of 50% or more of base salary) with better facilities and equipment over their current job. [17] The authors of that study suggested that health facilities be classified according to their degree of remoteness and that a transparent job market would positively influence health care worker recruitment and retention by making public the favourable job attributes of each health facility to enable informed decision making by the healthcare worker. [17]

7. Conclusion

To begin to address the lack of medical doctors practising in rural facilities, one needs to acknowledge both the challenges of rural practise as well as the personal, facility and organisational factors that are influential in a doctor's choice of practise location. The South African internship placement decision model was developed to clarify the decision-making process of South African medical students when faced with the choice of internship placement location. The literature has highlighted the importance of understanding the local practice of medicine, however the lack of longitudinal panel data tracking the career progression of medical graduates undermines efforts to develop effective recruitment policies.

Marital status, rural origin and gender have all been found to be influential in informing health worker priorities as well as work placement choices. Stated choice experiments hold a

key to understanding individuals' preferences. Although extrinsic incentives are seen as a commodification of health care, government regulation of healthcare human resource is required due to market failure in the health care market. Most countries use a bundle of initiatives to improve recruitment and retention of doctors as although financial incentives are effective, at higher salary wages the response is inelastic and therefore other non-financial job attributes are influential. These include the availability of staff accommodation or housing allowance, well equipped facilities, and offering opportunities for further education.

In conclusion, a country such as South Africa, in desperate need to expand and redistribute its cadre of medical doctors, should prioritise research that uncovers the job attribute preferences of its most recent medical graduates. The results of which can provide valuable information to facility managers and the Department of Health, to aid in the design of targeted recruitment and retention packages for doctors whilst acknowledging the influence that personal, facility and organisation factors have on doctor retention.

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PART 3:
JOURNAL MANUSCRIPT

MANUSCRIPT PREPARED FOR JOURNAL OF HEALTH POLICY AND PLANNING

Cover page

Journal Article Title: Rural internship job preferences of final year medical students in South Africa: a discrete choice experiment.

Corresponding Author: Dr Maria Jose MBChB

Email: jsxmar002@myuct.ac.za Institution: University of Cape Town

Address: 7 Hamlet Way Pinelands, 7405, South Africa Telephone: 0836303319

Keywords: Discrete choice experiment; human resources for health; rural medicine; medical student; career intention; health worker recruitment; occupational health.

Abbreviated title: Rural internship job preferences of final year medical students in South Africa

Key Takeaways

- Cost-effective rural healthcare worker recruitment policy requires insight into the rural health facility attribute preferences of final year medical students.
- This DCE study revealed that the most preferred rural health facility attribute was the opportunity to gain advanced practical experience.
- Facility attributes of hospital safety and the availability of personal protective equipment and basic resources were more valued than currently used incentives of rural allowance and housing provision.
- Effective recruitment strategies would be those that are targeted to the expectation of individuals based on their gender, career aspirations and prior rural medical exposure.

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Abstract

To achieve Sustainable Development Goal 3 in developing countries, *Good health and well-being for all*, the health workforce is vital however the unpopularity of rural medical practice results in widening healthcare inequalities between urban and rural areas. This study determined the heterogeneity in valuations for rural facility attributes by final year medical students at one South African public university to inform cost-effective recruitment policy recommendations. Focus groups conducted identified facility attributes, a D-efficient design was generated with 15 choice sets, each with two rural hospital alternatives and no opt-out option. An online, unlabelled discrete choice experiment (DCE) was conducted, the results effects coded, and mixed logit models applied. The final sample size was 193 (86,16% of the class), majority female 130 (66.33%), with urban origins 176 (89.80%), unmarried 183 (93.37%) and without children 193 (98.47%). Most had undergraduate rural medicine exposure 110 (56.12%) and intended to specialise 109 (55.61%). The main-effects mixed logit found advanced practical experience, hospital safety, correctly fitted personal protective equipment (PPE) and availability of basic resources the highest weighted attributes with their mean utilities increasing by 0.82, 0.64, 0.62 and 0.52 respectively (p=0.000). In contrast, increases in rural allowance and the provision of housing provided smaller mean utility increases of 0.001 (p<0.01) and 0.09 (p<0.05) respectively. The interaction terms; female, general practise and prior rural medicine exposure, were associated with higher weighting for hospital safety, mean utility increases 1.59, 1.82, 1.42 respectively (p=0.000). Participants

were willing to pay ZAR 2636.45 monthly (95%CI: 1398.55;3874.355) to gain advanced practical experience (equivalent to 65.91% of current rural allowance). Medical students' facility preferences have been found to be influenced by their gender, career aspirations and prior experienced with rural medicine. Teaching advanced practical skills, securing facilities and providing PPE should be prioritised over rural allowance and housing provision.

Introduction

The World Health Organisation (WHO) has identified the health workforce as a critical building block of a functional health system and highlighted the importance of equitably deploying health workers to under-resourced areas where the need for health care is the greatest (World Health Organization, 2010). The WHO recognises that the struggle for health equity is faced by countries globally- with the delivery of healthcare to those living in remote and rural areas identified as a pressing challenge (World Health Organization, 2010). Most countries worldwide report a far higher density of doctors in urban areas compared to rural areas, this is exacerbated in Africa where the burden of disease is both absolute in numbers and relative in distribution between urban and rural areas, compounded by the few health professionals disproportionately distributed between these areas resulting in poorer health outcomes in rural areas (World Health Organization, 2010).

Definitions of "rural areas" vary amongst countries but are commonly based on population density, availability of economic structures and distance from an urban area (World Health Organization, 2010). Burch *et al.*, (2017) defined rural as "an area more than two hours' travel by road from the nearest urban centre", with urban defined as "a centre with a population of more than 250,000 people". Rural medical practice is often seen to be

challenging due to social and cultural isolation, lack of infrastructure and transport, electricity, telecommunications and restricted access to goods and services (Lagarde and Blaauw, 2014).

South African medical doctors are trained in medical schools (either in South Africa or Cuba), followed by a two-year compulsory internship at an approved government hospital and additional one-year mandatory community service before they can be certified for independent practice, a practise associated with high staff turnover rates that further destabilise a fragile rural health care system (Dambisya, 2007). The South African National Department of Health's strategies for rural doctor recruitment includes recruiting rural-origin students to be trained in Cuba on condition of fixed-term mandatory rural service and the provision of on-site housing on-site which is both expensive and time-consuming to maintain (Dambisya, 2007).

Although there is data available to describe health worker's practise location intentions, there is currently a dearth of knowledge on the job preferences of medical students despite the important differences that exist between their job preferences and that of active health workers (Vujicic *et al.*, 2011; Rockers *et al.*, 2012).

Discrete choice theory introduces the idea that individual choice behaviour is intrinsically probabilistic, hence random (Ryan *et al.*, 2007). Random Utility Theory (RUT) assumes that humans are rational individuals who aim to maximize utility. For medical students the corollary would therefore be that they wish to choose an internship placement site that yields his/her highest individual utility (Kolstad, 2011). RUT is underpinned by the assumption

that an individual's utility function cannot be directly observed by researchers and that the utility function is represented by a systematic component and a random component (Honda and Vio, 2015). The systematic component is estimated in order to provide quantifiable information on the relative importance of health facility attributes (hence forth referred to as job attributes). The random component of the utility function determines which framework is used to analyse the data which then predicts how an individual's choice is influenced by variation in job attributes (Honda and Vio, 2015).

The literature strongly supports the need to interrogate the local, gendered, nature of the practice of medicine. This study therefore seeks to uncover the job attribute preferences of final-year medical student to provide valuable information for the design of targeted rural health facility recruitment and retention packages.

Materials and methods

Population and Sampling

The study population were all final-year medical (MBCHB) students at the University of Cape Town (UCT), who will be applying for internship placement in 2019 for commencement of work in 2020 (N= 224 students). This study population includes South African medical students who have been trained in Cuba who will commence their internship in the latter half of 2019. The final sample size was 86,16% of the study population (n=193). They were sampled through purposive sampling as every eligible student was invited to participate in the study.

Identify and refine job attributes

Literature was reviewed of discrete choice experiments conducted in low- and middle-income countries (LMIC), mostly regarding health worker motivation and job satisfaction. Job attribute levels refer to the specific ordinal values that describe the job attribute (Rockers *et al.*, 2012). Job attributes that were relevant in countries worldwide and in the local context were identified and validated by a series of focus group discussions (FGDs) conducted with final year medical students.

Qualitative methods contribute to discrete choice experiments in two phases, firstly, the conceptual development and selection and validation of attributes and attribute levels, secondly, the refinement of language, terminology and descriptions used (Coast *et al*., 2012). Conceptual development here refers to the acknowledgement that the nature of qualitative research is such that it results in complex, rich data that can provide a comprehensive, mutually exclusive, set of attributes (Coast *et al*., 2012). Language refinement is an important aspect of discrete choice experiments as it ensures that meaning is conveyed accurately by using terms which will not be misconstrued by the respondents when answering choice sets (Coast *et al*., 2012).

Three FGD sessions were held with a total of 15 medical students representing the gender and provincial distribution of the class. The attribute "Rural allowance" was defined as having three levels; the reference category, ZAR4000 per month[1] was based on existing literature which noted rural allowance as 20% of monthly base salary in the South African public service context (Mburu and George, 2017). The second level (8% increase) was based on historical wage increases which are consumer price index +2% (South African Medical Association,

2017) and the third level (20% increase on current rural allowance) was based on qualitative data from FGD participants as being preferred by them.

The attribute “Supervision” was defined by three levels based on the seniority of the staff member who would be available at the facility to provide guidance to the intern. The reference level “Medical Officer” is the junior doctor that must have completed internship and community service and is authorised to practise general practise independently. The second level “Registrar” refers to a more experienced doctor who is a specialist-in-training for a specific discipline. The third level “Consultant” refers to a very experienced medical specialist who has completed his/her further training.

Attributes that were mentioned in the literature and then again reiterated in the FGD were rural allowance, housing provision, physical safety and the availability of equipment at facilities. Attributes that were mentioned in the literature but excluded as attributes from this study include proximity of health facility to children’s schools and work opportunities for spouses, these were excluded as they are personal factors not amenable to policy recommendations as opposed to facility attributes. Attributes that were added from the FGD with unanimous support from participants include provision of personal protective equipment (N95 respirator masks) to protect against occupational tuberculosis exposure, extent of practical experience at the facility and seniority of supervisor, these attributes were not tested in other DCE literature.

Attributes that were briefly mentioned in FGDs include: access to Wi-Fi, in-service training and socialisation opportunities among colleagues however, these attributes were excluded from the DCE as they were not well supported by FGD participants.

Experimental design

The selected attributes and levels were used to form hypothetical job postings using experimental design techniques. Sawtooth Software (Sawtooth Software Inc., Sequim, WA, USA) was used to generate the experimental design. Each hypothetical scenario (choice set) comprised two unlabelled job postings, i.e. Job A and Job B, also known as a preference pair. For this discrete choice experiment, 15 choice sets were generated, and the same version of the questionnaire was completed by all participants.

There are two main types of experimental designs, orthogonal and efficient/optimal designs(Johnson *et al.*, 2013). Orthogonal design was deemed inappropriate for the required combinations of attributes, levels, and numbers of profiles therefore a D-efficient design was used as it aims to minimise the determinant of the covariance matrix with the assumption that parameters are zero (De Bekker-Grob, Ryan and Gerard, 2012). The design choice sets were unlabelled with choice sets generically named Rural Hospital A, Rural Hospital B , as labels have been shown to distract respondents from job attributes and thus may diminish the reliability of estimates of attribute preferences for example naming a village or district in which the hospital was situated (De Bekker-Grob, Ryan and Gerard, 2012). There was no opt-out option provided which reflects the mandatory nature of the internship process for accreditation.

Piloting questionnaire

The discrete choice experiment was piloted with 25 final year medical students from the preceding graduating class, this was an important quality checkpoint in gauging respondent's ability to understand the terms and language used in the questionnaire as well as the structure and instructions in completing it (Coast *et al*., 2012). Piloting was used to test the

tool and improve its reliability before the final questionnaire was administered to the final sample. The feedback from piloting resulted in changes to the attribute levels of "Occupational Hazard" to clarify that some facilities may offer N95 masks but without correctly fit-testing them, they are prone to air-leaks which undermine their effectiveness (Sissolak *et al*., 2000). "Practical experience" was defined as either "limited" to indicate mostly administrative skills and basic clinical skills, or "advanced" which included a wider variety of clinical skills and invasive procedures. The final list of investigated attributes is given in Table 1.

Questionnaire and Data collection

The final discrete choice experiment questionnaire comprised of 15 choice sets and 12 socio-demographic questions including rural medicine experience and future career plans and was administered on Sawtooth Software. The questionnaire link was sent to the final year medical class of University of Cape Town via email. It was anonymous and administered on devices (laptop/tablet/mobile), took on average 20 minutes to complete (Figure 1). All students have access to computers on campus at computer laboratories as well as Wi-Fi access. Research personnel were also present in person at class lectures to encourage participation among students, provide refreshments and answer questions. The collected data were further processed in Microsoft Excel, including the removal of incomplete questionnaires. The dataset was then exported to STATA v.14 Software to perform effects coding, descriptive statistics, and estimation of the mixed logit model and validity testing. Univariate analysis was conducted on the demographic variables, Microsoft Excel 2013 was used to generate tables of the summarised data and results.

Ethical clearance

In addition to University of Cape Town Human Research Ethics Committee approval, the study was approved by the University of Cape Town Student Affairs Departments in order to conduct research involving students enrolled at the University.

Data Analysis

Model specification

In a random utility context presented with a limited set of *J* alternative discrete choices (Ryan et al., 2012), the utility U_{jnt} of medical student *n* in choice situation *t* for internship placement *j* can be expressed as:

$$U_{jnt} = V_{jnt} + \varepsilon_{jnt} \quad (1)$$

where V_{jnt} is the deterministic component of utility, and ε_{jnt} the error terms, which are a function of unobserved internship placement attributes as well as individual-level variation in preferences and are assumed to be independent and identically distributed (IID). The utility represents the appeal of internship site *j* as a function of the estimated sensitivities and observed demographic characteristics of the respondent and the attributes of the choice options. The deterministic part of the utility (V_{jnt}) is influenced by the levels taken by the *m* attributes X_{mjnt} and their marginal utility, or preference, coefficients β_{mj}:

$$V_{jnt} = \sum_{m} \beta_{mj} X_{mjnt} \quad (2)$$

Considering the attributes identified, the deterministic part of the utility is now given by:

$$V_{jnt} = \beta_1 \text{supervision}_{nt} + \beta_2 \text{rural allowance}_{nt} + \beta_3 \text{accommodation}_{nt} \quad (3)$$

$$+\beta_4 \text{resources}_{nt} + \beta_5 \text{practical experience}_{nt} + \beta_6 \text{hospital safety}_{nt} + \beta_7 \text{occupational hazard}_{nt}$$

Assuming that the error terms ε_{jnt} are distributed independently and identically across individuals (Chomitz *et al.*, 1998), choices and alternatives using a type I extreme value distribution, the probability of respondent *n* choosing site *j* in choice situation *t* is given by the conditional logit model:

$$P_{int}(\beta) = \frac{\exp(V_{int})}{\sum_j \exp(V_{jnt})} \quad (4)$$

which is a function of the vector of marginal utility coefficients *β* for the different attributes. The likelihood of the sequence of choices *t* for respondent *n* is then given by:

$$L_n = \prod_{t=1}^{15} P_{j_{nt}^* nt}(\beta) \quad (5)$$

where j_{nt}^* represents the alternative chosen by respondent *n* in choice situation *t* (out of 15 choice situations). This implies that unobservable factors affecting a medical student's preference for internship placement *j* are uncorrelated with the unobservable factors affecting the student's preference for internship placement *j* (Vujicic *et al.*, 2010). Although choice data can be analysed with the conditional logit equation 4 above, mixed logit models have the advantage of accommodating violations of IID, improving model fit and behavioural realism of the results (Vujicic *et al.*, 2010;Kruk *et al.*, 2010). The modification in mixed logit is that the researcher does not know the value of the coefficient or the error term. The solution of the equation requires integrating L_n over all the possible values of *β* weighted by the

density function $\phi(\xi)$ selected, in our case assuming a standard normal distribution, following (Dada *et al.*, 2019) as in equation 6:

$$L_n = \int_{\xi} \prod_{t=1}^{15} P_{j^*nt}(\beta)\, \phi(\xi) \mathrm{d}\xi \tag{6}$$

A simulated maximum likelihood estimator is used to estimate the probabilities. Mean coefficients μ_β are the output of a mixed logit model and they represent the relative utility of each attribute compared to its reference level of that attribute with the standard deviations σ_β reflecting the degree of heterogeneity among participants (Dada *et al.*, 2019). For continuous variables the parameter estimates refer to the mean utility increase/ decrease associated with each one unit increase in the continuous variable. All parameters estimated are expected to be positive except for the effect of a poorly fitted N95 mask, as it is assumed to be less valued compared to no N95 mask. *Stata v14* was used to first estimate a conditional logit model, which was then improved upon by the main-effects mixed logit model. This model was then used as the base model for interacting socio-demographic terms and generating the willingness to pay (WTP) estimates.

Sub-group Analysis

Mixed logit models can account for the demographic characteristics of respondents through the inclusion of interaction terms between a demographic variable and an attribute(Kruk *et al.*, 2010). Socio-economic interaction terms were introduced to the mixed logit model, these were gender, career aspiration (specialisation or general practise (GP)) and prior rural medicine exposure (Ruralexperience, NoRuralexperience) as illustrated in Appendix A equations 7.1 - 7.6. Although a model was run to investigate the effect of rural origin compared to urban origin of respondents as an interaction with their preferences, this model

was rejected due to the small sample of rural origin participants. Similarly, the province of origin of participants was interacted with their preferences and found to not yield heterogeneity in preferences and therefore was omitted.

Willingness To Pay

Willingness to pay (WTP) represents the respondent's preferences for rural health facility attributes in monetary terms and is the ratio of the coefficient of a non-financial job attribute to the negative of the coefficient of the rural allowance attribute dividing each attribute coefficient by the rural allowance coefficient (Jaskiewicz *et al.*, 2014). It is interpreted as how much money a final year medical student is willing to pay to work at a rural health facility which has that attribute level in comparison to a facility with the reference attribute level, this is then expressed in ZAR (South African Rands) and as a percentage of current rural allowance.

$$\text{WTA} = -\frac{\beta_m}{\beta_{rural}} \quad (8)$$

where *ϐm* is the coefficient of the job attributes *m*, and *ϐrural* the coefficient of rural allowance attribute.

Results

Demographics

The final sample size was 193 (86,16%) of 224 final-year medical students, there was a non-response rate of 13,84% which are students who were sent the questionnaire but did not complete it. With regards to participant demographic results (Table 2), the mean age was 23.7 years (95% CI 23.65; 23.75), this is in keeping with the norm of a 6-year medical degree

which most students enter medical school immediately after high school at age 18 and graduate at an age of 23 years. Most of the sample were females, 130 (66.33%) versus 63 males (31.63%), with 4 participants (2.04%) reporting to be gender non-conforming. Of the nine provinces that constitute South Africa, Western Cape, Gauteng and Kwa-Zulu Natal contributed most of the participants at 72 (36.73%), 47 (23.98%) and 38 (19.39%) of the sample respectively with no participant hailing from Free State province. Majority of participants came from urban areas 176 (89.80%), were not married 183 (93.37%) and did not have child dependants 193 (98.47%). Majority of respondents had some exposure to rural medicine during their undergraduate training 110 (56.12%) with opt-in rural electives 43 (32.09%) and other forms of rural medicine exposure such as family medicine rotations being the most popular type of exposure 51 (38.06%). The minority of the participants were provincial bursary holders 45 (22.96%) or completed their training in Cuba 7 (3.57%). Encouragingly 192 (97.96%) of participants intended to complete their internship in South Africa with the majority opting to specialise instead of entering general practise upon completion 109 (55.61%) versus 9 (4.59%) respectively.

Main effects model and validity testing

Table 3 illustrates the main effects models that were conducted with the mixed logit model 2 improving on the conditional logit (model 1) by randomising those attributes that were found to be significant in the conditional logit model. Model 2 was then used for validity testing of left-right bias through the introduction of a Rural Hospital A constant. Left-right bias refers to participants favouring the alternative that was displayed on the left side of the screen compared to the right side of the screen. If there was no left/right bias one would expect the Rural Hospital A constant to be zero, however it was 0.49 (p value=0.012) therefore at the 5% level it can be concluded that there was a level of left-right bias present in this sample. To

validate the results for participant fatigue, the 15 choice sets were divided into three groups: the first five choice sets, the second five choice sets and the last five choice sets. The model (Table 5) compare the second and third set of choice tasks with the first set of five choice tasks used as a reference group. A heteroscedastic conditional logit model was run to model outcomes based on the alternative-specific regressors (Lancsar et al., 2017), this demonstrated the second and third group variables were not significant (p=0.37, p=0.81) respectively therefore it can be concluded that the later choices are not significantly different from earlier choices; i.e. participant fatigue is unlikely.

Job attribute preference results

With regards to the relative utilities estimated, a larger relative utility translates into a greater preference for an attribute, compared to one with a lower relative utility. An advanced practical experience was the most valued attribute followed by the provision of correctly sized N95 masks, limited physical threats in the facility and availability of basic resources (Table 3). Importantly the provision of subsidised doctor's quarter and rural allowance were among the least valued attributes. Having doctor's quarters supplied was valued above renting private accommodation and this result is statistically significant (p=0.027). There was a minimal preference for the provision of rural allowance as a ZAR1 increase in rural allowance had a 0.001 relative increase in utility and this was statistically significant (p=0.00). When compared to having no N95 mask available, having a poorly-fitting mask was less valued however these results were not statistically significant (p=0.39). Supervision by a consultant was weighted over supervision from a medical officer with these results statistically significant (p=0.018). Similarly, supervision by a registrar was valued over that of a medical officer, however these results were not statistically significant (p=0.630).

Sub-group analysis

Mixed logit model 2 was then interacted by gender and the results (Table 3 Model 3.1 & 3.2) indicate heterogeneity of preferences by gender. Males had an aversion to rural allowance increases which was statistically significant (p=0.000). Females preferred being supervised by medical officers compared to registrars, while the opposite was true for males. Both males and females valued hospital safety as their highest weighted attribute, this was more so for females. Females had a higher preference for housing, resource availability and a correctly fitting mask in comparison with males. Interestingly, females would prefer having no mask instead of an ill-fitting mask whereas males would prefer the opposite. Career aspirations contributed to the heterogeneity in preferences as those who intended to specialise gained more utility from being supervised by a consultant and gaining practical experience, whereas their colleagues who intended to join general practice who valued hospital safety and the provision of basic resources higher (Table 3 Model 3.3 & 3.4). Undergraduate rural medicine exposure was investigated as an interaction term (Table 3 Model 3.5 & 3.6). Those without undergraduate rural medicine exposure had a higher preference for practical experience and access to basic resources but did not value hospital safety as highly as those who did have rural medicine exposure.

Willingness to pay estimates

Table 4 illustrates that participants were willing to forego ZAR1672.02 (41,8% of current rural allowance) for a daily availability of basic resources, this was statistically significant. Participants were willing to sacrifice only ZAR282.27 (7.06% of current rural allowance) for the provision of housing but ZAR2068.63 (51.72% of current rural allowance) for a safe hospital environment both of which were statistically significant. For the highest valued attribute, advanced practical experience respondents were willing to forego

ZAR2636.45(65.91% of current rural allowance) compared to a site with limited practical experience, this was statistically significant. Participants were willing to forego ZAR1944.13 (48.60% of current rural allowance) for correctly fitted N95 masks over no masks, this was statistically significant. Participants were willing to trade-off ZAR892.53(22.31% of current rural allowance) for N95 masks even if they are ill-fitting.

Discussion

This study's objective was to explore the heterogeneity in job attribute preferences of final-year medical students for rural health facility internships to inform recruitment policy.

Practical Experience

Participants showed the strongest preference for facilities which would provide them with extensive practical experience, this is a natural selling point of rural health facilities as many of them do require intern doctors to perform advanced procedures due to being understaffed and situated far from referral hospitals. Therefore, it would be advantageous for facility managers of such facilities to make known to prospective staff that they stand to gain valuable "hands-on" experience when working at such facilities.

Facility Safety

The preference of medical students, especially females, to work at a safe facility with limited physical threats is relevant in the context of rural facilities which are often geographically isolated. These findings support those of Walker and Gilson (2004) who described the experiences of female South African nurses who were victims of crime while working at local clinics. The perception of security is necessary for effective recruitment of staff to rural facilities; therefore, an integrated approach is needed to co-ordinate facility management, local law-enforcement and community structures efforts to provide staff and users of rural

health facilities with a peaceful environment to work and recuperate. Investing in the securing of facilities against criminal activities and civil unrest would prove to have far-reaching benefits in terms of the reduction in the theft of infrastructure and limiting injury to staff and patients alike. Such security could include, but not limited to, physical presence of trained security personnel, fencing and other barriers, access control to various sections of the facility as well as adequate lighting of the facility and surrounding areas e.g. parking areas & external walk ways that are often used by staff at night.

Access to basic resources

Access to basic resources such as gloves, syringes and needles was a preference that emerged from this study. This is an area of investment which moves beyond recruitment incentives and directly impacts patient care and health outcomes at facilities. In rural facilities which are situated far from medical supply depots, the budgeting and timely procurement of these resources is vital for the provision of quality healthcare and training of recently graduated doctors.

Protection from occupational hazards

Occupational tuberculosis exposure is a unique attribute not identified in other DCE studies and was a chief concern of medial students and proved to be so influential that students were willing to forgo almost half of their current rural allowance to protect themselves from contracting tuberculosis. This is a pertinent risk that rural health facilities need to be aware of and prioritise this as an area of investment not only for the protection of staff health but also as a recruitment tool and means of limiting the spread of airborne diseases. Considering that an N95 mask costs approximately ZAR7.76 each and can be used for up to 2 weeks with proper care (BeSafe Paramedical Suppliers, 2019). Interestingly, a poorly fitting N95 mask

was less preferred to no mask and this further highlights the priority with which medical students value their health and their understanding that a poorly fitting N95 mask is just as ineffective at protecting them against airborne disease as having no mask at all. That occupational TB exposure was found to be a chief concern of medical students is supported by Westhuizen *et al.* (2000) survey findings that medical and physiotherapy students rated themselves at a 4.4 times increased risk of contracting TB compared to the general population with 49% reporting not access to N95 respirators at the health facilities where they were training.

Seniority of supervisor

That the seniority of the supervisor was found to be of such importance to medical students that they preferred to be supervised by a consultant is concerning in the context of rural facilities which are often manned by junior staff with few or no consultants. This lack of senior staff alone may deter medical students, especially those intent on specialising, from applying for their internship at rural facilities. Furthermore, it would be worthwhile for facilities that have consultants to provide them with more responsibility of the supervision of intern doctors as this is a noted draw-card for junior doctors who seek greater guidance during their first years of medical practise. These findings support earlier research which found that South African doctors who worked at rural facilities that had regular supervision from senior specialists report their experience to be beneficial to both their job satisfaction and the quality of patient care they were able to provide(Kotzee and Couper, 2006).

Rural allowance and housing

The popularity of rural allowance and housing provision as a recruitment strategy by a number of studies is thought to be due to its ability to offset travel expenses, thereby

lowering the living expenses associated with living in a rural area (Kotzee and Couper, 2006; Mangham and Hanson, 2008; Kruk *et al.*, 2010; Kolstad *et al.*, 2011; Ageyi-baffour *et al.*, 2013; Bocoum *et al.*, 2014; Longmore *et al.*, 2014; Honda and Vio, 2015). This study however found the opposite as both rural allowance and housing provision was minimally preferred which supports the findings of Vujicic *et al*. (2011) who denounced the cost-effectiveness of housing provision as a recruitment strategy in Vietnam. Therefore, this is a note-worthy finding as this remains an ongoing, expensive practise by the Department of Health (DOH) which needs further research to determine its effectiveness as a recruitment tool for rural placements. Although generally higher wages are associated with lower rates of worker attrition, it is important to note that this relationship is inelastic at higher salary levels (as in the case of doctors), in that instance other job attributes become a more important influence on attrition of doctors.(McPake *et al*., 2014). Pending further research, the DOH should reconsider the implementation of its rural allowance policy for doctors as systematic alternatives, which have been mentioned above, may prove to be impactful and cost-efficient in the long-term.

Interaction effects of gender

This study confirms the findings of other studies of the influence of gender on medical graduates' choice of practice location as well as training opportunities (Kiwanuka *et al.*,2017; PricewaterhouseCoopers, 2011; Stagg *et al.*, 2009). The finding that female medical students were more sensitive to rural allowance and housing provision is supported by studies in Burkino Faso and Indonesia which found that females were twice more likely to choose a job offer with free housing and were more sensitive to the recruitment effect of rural allowance compared to their male counterparts respectively (Chomitz *et al.*, 1998; Bocoum *et al.*, 2014).

Interaction effects of career intention

Career intentions of medical students is an area that has been studied in qualitative and quantitative studies(Stagg *et al.*,2009; Mofolo and Botes, 2013; El Koussa *et al.*, 2016). This study contributes to this knowledge with the first attempt at interacting self-stated career intention with rural health facility attribute preference valuations. The results of which provide insight into how rural health facilities can offer new graduates what they are looking for regardless of their career aspirations. For the graduate who intends to specialise, rural health facilities can provide the advance practical skills they seek to learn. As rural health facilities are usually staffed by generalists, medical students who prefers to remain in general practise should be encouraged by the facility's provision of a safe hospital environment and availability of basic resources to meet their expectations in order to attract them.

Interaction effects of prior exposure to rural medicine

The preferences of medical students without undergraduate rural medicine exposure for basic resources, practical experience and housing contrasts with the literature which reports that those with rural medicine exposure valued these attributes more than their inexperienced colleagues (Vujicic *et al.*, 2010) In the South Africa context, this could be due to the rural hospital accommodation not meeting their expectations or those who have been to rural health facilities feeling more confident to organise their own accommodation. That medical students with rural medicine exposure valued hospital safety highly reflects the safety concerns they may have encountered personally or heard about from others during their time at the facility.

Limitations of study

Limitations of the study include the small sample size, left-right bias and the fixed questionnaire administration which meant that participants who dropped out of the questionnaire would have missed the last few choices set questions and their contribution would not be included in the study which could result in bias results. Whilst the attributes included in this study were informed by local FGDs this limits the comparability across DCEs conducted with medical students from other countries and contexts where a different set of attributes were considered. The discrete choice experiment results should be validated by revealed preference data by conducting policy experiments (Kruk *et al.*, 2010). Robyn et al. (2015) argue that there should be greater transparency regarding job listings, compared to a discrete choice experiment where job attributes of each alternative are well described, in reality there would be minimal information available about the attributes of a facility, this leads job-seekers to base their decisions on rumours of facility reputation. Most of the internship placement hospitals do not advertise their job attributes explicitly, therefore the final year medical students' revealed choice of internship placement can be based on incomplete information.

Conclusion

In the context of limited budgets and resource constraints, policy makers and rural health facility managers are advised to pay heed to the implications of this study's findings to assist in priority-setting targeted recruitment initiatives to attract underrepresented medical graduates especially females and those with intention to remain in general practise through transparent and informative rural facility descriptions. This discrete choice experiment identified the range of preferences for rural health facility attributes valued by a diverse

sample of final-year medical students at a public university. The authors are confident that the results are representative for South African-trained- medical graduates' expectations for a meaningful rural internship placement experience, one that would offer them a supervised learning environment, safety from physical and occupational hazards and the provision of basic resources to complete their clinical responsibilities. It is hoped that these cost-effective facility-based incentives would have healthcare system-wide benefits to both staff and rural health facility users alike.

Endnotes 1. Exchange rate as at 8 March 2019 ZAR14.50=1USD

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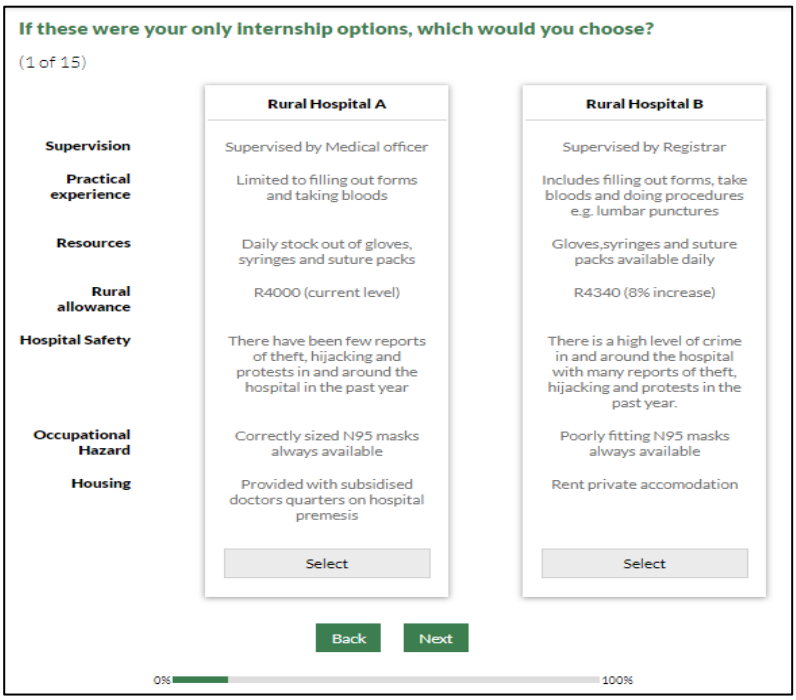

Figure 1: Screenshot of discrete choice experiment choice set presented to participant

Table 1: Job attributes and levels in the discrete choice experiment.

Job attribute	Coefficient	Variable	Effects coding	Attribute Level description
Supervision	β1	Categorical	-1	Supervised by Medical Officer [Ref]
			0	Supervised by Registrar
			1	Supervised by Consultant
Rural Allowance	β2	Continuous	-	R4,000 per month [Ref]
				R4,340 per month (8% increase)
				R4,800 per month (20% increase)
Accommodation	β3	Categorical	-1	Rent private accommodation [Ref]
			1	Provided with subsidised doctors quarters on hospital premises
Resources	β4	Categorical	-1	Daily stock out of gloves, syringes and suture packs [Ref]
			1	Gloves, syringes and suture packs available daily
Practical Experience	β5	Categorical	-1	Limited to filling out forms and taking bloods [Ref]
			1	Includes filling out forms, take bloods and doing procedures e.g. lumbar punctures
Hospital Safety	β6	Categorical	1	There have been few reports of theft, hijacking and protests in and around the hospital in the past year
			-1	There is a high level of crime in and around the hospital with many reports of theft, hijacking and protests in the past year. [Ref]
Occupational Hazard	β7	Categorical	-1	No N95 masks available in the hospital [Ref]
			0	Poorly fitting N95 masks always available
			1	Correctly sized N95 masks always available

Table 2: Demographic results (n=193)

Demographic Factors		Number (%)
Age	Mean 23.7 years	
Gender	Male	63 (31.63)
	Female	130 (66.33)
	Non-Conforming	4 (2.04)
Province of origin	Western Cape	72 (36.73)
	Gauteng	47 (23.98)
	Free State	0.00
	North West	3 (1.53)
	Eastern Cape	19 (9.69)
	Kwa-Zulu Natal	38 (19.39)
	Mpumalanga	7 (3.57)
	Limpopo	7 (3.57)
	Northern Cape	3 (1.53)
Area of origin	Rural (village/farm)	14 (7.14)
	Informal settlement (informal structures around town/city)	6 (3.06)
	Urban (formal structure in suburb/township)	176 (89.80)
Marital status	Single, never married	183 (93.37)
	Married	13 (6.63)
	Widowed	0.00
	Divorced/separated	0.00
Child dependants	Yes	3 (1.53)
	No	193 (98.47)
Undergraduate exposure to rural medicine	Yes	110 (56.12)
	No	86 (43.88)
Rural medicine exposure type	Eden district placement	8 (5.97)
	An elective at a rural facility	43 (32.09)
	Student-society organised rural-medicine exposure	32 (23.88)
	Other	51 (38.06)
Provincial bursary holder	Yes	45 (22.96)
	No	151 (77.04)
Cuban trained student	Yes	7 (3.57)
	No	189 (96.43)
Intention to intern	Yes	192 (97.96)
	No	4 (2.04)
Career intention	General Practise	9 (4.59)
	Specialisation	109 (55.61)
	I don’t know/ undecided	70 (35.71)
	Other	4 (2.04)
	Did not intend to complete internship	4 (2.04)

Table 3: Main effects Model results

Reference	Attribute	Model 1: Conditional Logit Model β (SE)	Model 2: Mixed Logit Model β (SE)	Model 2: Mixed Logit Model SD	Model 3.1 Females β (SE)	Model 3.2 Males β (SE)	Model 3.3 Specialise β (SE)	Model 3.4 General Practise β (SE)	Model 3.5 Undergraduate rural medicine exposure β (SE)	Model 3.6 Without undergraduate rural medicine exposure β (SE)
Supervision Medical Officer	Supervision Registrar	0.007 (0.038)	0.027 (0.051)	-	-0.033 (0.069)	0.058 (0.062)	-0.014 (0.067)	-0.024 (0.085)	0.002 (0.071)	0.0537 (0.070)
	Supervision Consultant	0.070 (0.041)*	0.133 (0.059)**	-	0.123 (0.071)*	0.133 (0.074)*	0.233 (0.071)**	0.101 (0.106)	0.207 (0.070)***	0.041 (0.094)
	Rural allowance	0.000 (0.000)***	0.001 (0.000)***	-0.001 (0.000)***	0.001 (0.000)***	-0.0002 (0.000)	0.001 (0.000)***	0.001 (0.000)**	0.001 (0.0002)***	0.0004 (0.000)**
Private housing	Housing provided	0.058 (0.023)**	0.088 (0.038)**	-	0.089 (0.0459)*	0.035 (0.051)***	0.093 (0.049)*	0.066 (0.063)	0.017 (0.047)	0.172 (0.057)***
Basic resources not available	Basic Resources available	0.316 (0.025)***	0.519 (0.058)***	0.486 (0.062)***	0.582 (0.073)***	0.366 (0.075)***	0.435 (0.068)***	0.674 (0.132)***	0.468 (0.076)***	0.566 (0.085)***
Limited Practical experience	Advanced Practical experience	0.485 (0.025)***	0.819 (0.076)***	0.693 (0.070)***	0.852 (0.096)***	0.612 (0.099)***	0.882 (0.102)***	0.673 (0.126)***	0.778 (0.091)***	0.815 (0.120)***
Hospital unsafe	Hospital safe	0.376 (0.026)***	0.642 (0.075)***	0.654 (0.077)***	1.588 (0.194)***	0.698 (0.089)***	0.970 (0.148)***	1.819 (0.365)***	1.421 (0.193)***	0.979 (0.199)***
No N95 Facemask	Poorly fitting N95 mask	0.021 (0.038)	-0.033 (0.047)	-	-0.091 (0.064)	0.032 (0.060)	-0.024 (0.059)	-0.074 (0.082)	-0.057 (0.062)	-0.019 (0.071)
	Correctly fitting N95 mask	0.380 (0.043)***	0.620 (0.063)***	0.443 (0.070)***	0.679 (0.082)***	0.273 (0.071)***	0.676 (0.085)***	0.546 (0.108)***	0.600 (0.080)***	0.650 (0.103)***
No of Observations		5790	5790	5790	5790	5790	5790	5790	5790	5790
Log Likelihood		-1559.063	-1357.8716	-1357.8716	-1539.0443	-1749.1605	-1642.9905	-1754.7903	-1624.9288	-1733.2398
Wald chi-square		895.20	205.27	205.27	180.48	115.04	135.48	59.83	142.79	85.76
Prob > chi-square		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pseudo R-squared		0.223	-	-	-	-	-	-	-	-

*significant at 10%level p<0.10 ** significant at 5%level p<0.05 *** significant at 1%level p<0.01

Table 4: Willingness to Pay estimates (based on Mixed Logit Model 2)

Attribute	β (SE)	WTP ZAR relative to base (95%CI)
Supervision by registrar	0.027 (0.051)	303.46 (-40.23; 647.15)
Supervision by consultant	0.133 (0.059)**	475.16 (110.74; 839.57)
Provision of housing	0.088 (0.038)**	282.27 (19.28; 545.26)
Daily availability of basic resources	0.519(0.058)***	1672.02 (889.88; 2454.17)
Advanced practical experience	0.819(0.076)***	2636.45 (1398.55;3874.355)
Limited physical threats in and around facility.	0.642(0.075)***	2068.63 (1166.88; 2970.38)
Poorly fitting N95 mask	-0.033 (0.047)	892.53 (393.93; 1391.14)
Correctly fitting N95 mask	0.620(0.063)***	1944.13 (1089.36; 2798.90)

Table 5: Heteroscedastic logistic regression for participant fatigue

Variable	Coef.	Std. Err.	P>z	[95% CI]
First set of five choice tasks [Ref]				
Second set of five choice tasks	-0.11	0.12	0.37	-0.35; 0.13
Third set of five choice tasks	-0.04	0.15	0.81	-0.33; 0.26

Appendix A: Sub-group analysis equations

$$V_{jnt} = \beta_8 \text{female x supervision}_{nt} + \beta_9 \text{female xrural allowance}_{nt} + \beta_{10} \text{female x accommodation}_{nt} + \beta_{11} \text{female x resources}_{nt} + \beta_{12} \text{female x practical experience}_{nt} + \beta_{13} \text{female x hospital safety}_{nt} + \beta_{14} \text{female x occupational hazard}_{nt} \quad (7.1)$$

$$V_{jnt} = \beta_8 \text{male x supervision}_{nt} + \beta_9 \text{male x rural allowance}_{nt} + \beta_{10} \text{male x accommodation}_{nt} + \beta_{11} \text{male x resources}_{nt} + \beta_{12} \text{male x practical experience}_{nt} + \beta_{13} \text{male x hospital safety}_{nt} + \beta_{14} \text{male x occupational hazard}_{nt} \quad (7.2)$$

$$V_{jnt} = \beta_8 \text{gp x supervision}_{nt} + \beta_9 \text{gp x rural allowance}_{nt} + \beta_{10} \text{gp x accommodation}_{nt} + \beta_{11} \text{gp x resources}_{nt} + \beta_{12} \text{gp x practical experience}_{nt} + \beta_{13} \text{gp x hospital safety}_{nt} + \beta_{14} \text{gp x occupational hazard}_{nt} \quad (7.3)$$

$$V_{jnt} = \beta_8 \text{specialisation x supervision}_{nt} + \beta_9 \text{specialisation x rural allowance}_{nt} + \beta_{10} \text{specialisation x accommodation}_{nt} + \beta_{11} \text{specialisation x resources}_{nt} + \beta_{12} \text{specialisation x practical experience}_{nt} + \beta_{13} \text{specialisation x hospital safety}_{nt} + \beta_{14} \text{specialisation x occupational hazard}_{nt} \quad (7.4)$$

$$V_{jnt} = \beta_8 \text{rural\_experience x supervision}_{nt} + \beta_9 \text{rural\_experience x rural allowance}_{nt} + \beta_{10} \text{rural\_experience x accommodation}_{nt} + \beta_{11} \text{rural\_experience x resources}_{nt} + \beta_{12} \text{rural\_experience x practical experience}_{nt} + \beta_{13} \text{rural\_experience x hospital safety}_{nt} + \beta_{14} \text{rural\_experience x occupational hazard}_{nt} \quad (7.5)$$

$$V_{jnt} = \beta_8 \text{no\_rural\_experience x supervision}_{nt} + \beta_9 \text{no\_rural\_experience x rural allowance}_{nt} + \beta_{10} \text{no\_rural\_experience x accommodation}_{nt} + \beta_{11} \text{no\_rural\_experience x resources}_{nt} + \beta_{12} \text{no\_rural\_experience x practical experience}_{nt} + \beta_{13} \text{no\_rural\_experience x hospital safety}_{nt} + \beta_{14} \text{no\_rural\_experience x occupational hazard}_{nt} \quad (7.6)$$

PART 4:

POLICY BRIEF

Recruitment tools for medical graduates to rural facilities
Policy Brief Compiled by Dr Maria Jose

Executive Summary

This policy brief presents evidence of non-financial rural healthcare recruitment tools for medical graduates. An internship experience which offers safety from physical and occupational hazards, the provision of basic resources and opportunity to gain practical skills are key attributes valued by final year medical students to the extent that they are willing to forego current available rural allowance in favour of these attributes.

Context of the problem

Rural medical practice remains an unpopular choice amongst health professionals which results in widening inequalities in healthcare access between urban and rural areas. Healthcare needs of rural communities must be carefully weighed against the individual preferences of healthcare workers in order to develop effective recruitment strategies. South Africa uses several strategies for rural doctor recruitment including the training of rural-origin students in South Africa and Cuba on condition of mandatory rural service upon graduation, mandatory one-year community service for all South African medical graduates and the provision of rural allowance and subsidised housing at rural facilities during the two-year internship period.

Critique of policy options

The above mentioned solutions are costly to the fiscus and are associated with high staff turnover rates that further destabilise a fragile rural health care system.[1] Research at The University of Cape Town concluded a 2 year study into the rural health facility attributes that influence final year medical students to choose a rural healthcare facility for their internship placement found that neither subsidised housing provision nor increases in rural allowance were found to be associated with rural job preference.

Policy Recommendations

- Publicise rural health facility “draw-cards” such as the opportunity to gain practical experience.
- Improve physical safety at rural health facilities.

- Provide staff in healthcare facilities with personal protective equipment (PPE) to prevent occupational exposure to tuberculosis (e.g. correctly fitted facemasks) and basic resources (e.g. gloves & syringes).
- Reconsider rural allowance as a rural recruitment tool.
- There is a need for greater transparency regarding rural healthcare facility attributes as there is currently minimal information available which this leads medical graduates to base their career decisions on anecdotal evidence and media's coverage of rural facilities.

Based on the above-mentioned research, medical students valued access to practical experience, hospital safety and availability of PPE as attractive rural health facility features. Extensive practical experience is a natural selling point of rural health facilities as many do require intern doctors to perform advanced procedures due to being understaffed and situated far from referral hospitals. Medical students preferred to work at a facility with advanced practical experience even if it offered 34.1% of current rural allowance.

Medical students preferred to work at physically safe rural facilities even if they were only offered 48,3% of current rural allowance. Rural facilities, often geographically isolated, require security to minimise criminal activities, civil unrest and theft of infrastructure. Such security ranges from trained security personnel, fencing and other barriers, access control to various sections of the facility to well-lit parking areas & external walk ways at rural facilities that are often used by staff, patients and families at night.

In comparison to rural allowance, assumed to be R4000 per person/month in 2018, a facemask costs approximately R15.52 per person monthly and medical students would rather work at a rural facility which provided only 51,4% of current rural allowance but had correctly-fitting facemasks stocked. Medical students preferred to work in facilities that only offered 58.2% of current rural allowance but at least had basic resources (syringes & gloves). In rural facilities which are situated far from medical supply depots, the budgeting and timely procurement of basic resources and PPE should be prioritised.

Next Steps

- Health worker preference research including discrete choice modelling and revealed preference studies must be funded and expanded to be conducted across all South African

universities. Such research would be valuable to inform Human Resource for Health Strategy that is person-centred and promotes “positive practise environment”.

- The rural allowance policy should be reconsidered as a stand-alone and the alternatives, which have been mentioned above, may prove to be impactful and cost-efficient in the long-term.

Sources consulted

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ADDENDUM 1:
AUTHOR GUIDELINES

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- Corresponding author's name, address, telephone/fax numbers and e-mail address
- Each author's affiliation and qualifications
- Keywords and an abbreviated running title
- 2-4 Key Messages, detailing concisely the main points made in the paper
- Acknowledgements
- A word count of the full article

In the **acknowledgements**, all sources of funding for research must be explicitly stated, including grant numbers if appropriate. Other financial and material support, specifying the nature of the support, should be acknowledged as well.

Figures should be designed using a well-known software package for standard personal computers. If a figure has been published earlier, acknowledge the original source and submit written permission from the copyright holder to reproduce the material. Colour figures are permitted but authors will be required to pay the cost of reproduction: this is currently £350 per figure.

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For useful information on preparing your figures for publication, go to http://cpc.cadmus.com/da.

All **measures** should be reported in SI units, followed (where necessary) by the traditional units in parentheses. There are two exceptions: blood pressure should be expressed in mmHg and haemoglobin in g/dl. For general guidance on the International System of Units, and some useful conversion factors, see 'The SI for the Health Professions' (WHO 1977).

Manuscript file must include text body. Title Page, Figures and Tables should be uploaded separately.

Prior Publication Policy

[Based on a statement developed by a group of editors of journals that publish articles on health, health services, and health policy. Journals currently using this statement include: Health Affairs, Health Services Research, Inquiry, Journal of Health Politics, Policy and Law, Journal of Health Services Research & Policy, Medical Care, and the Milbank Quarterly.]

Background

The policy of the journals subscribing to this statement is to consider for publication only original work that has not previously been published. Questions about what constitutes previous publication are arising with increasing frequency because of the growth of electronic publishing and the increasing number of reports and papers being produced by organizations and agencies. This statement provides guidance on this issue.

There are legitimate reasons why research may be disseminated before submission to a journal. Active communication among researchers about preliminary findings or the circulation of draft reports for discussion and critique contributes to the eventual quality of published work. In addition, organizations that support or carry our research have an understandable interest in disseminating their work. From the perspective of journals, these reasons for dissemination must be balanced against two considerations. The first is the value of the peer review process. The rules against prior publication are intended to add some assurance of the credibility of published research.

Papers are often improved during the peer review process, with findings, conclusions, and recommendations sometimes changed in response to reviewers' comments. The public and policymakers might be confused or misled if there were multiple versions of a paper in the public domain. Second, from a more parochial viewpoint, journal space is limited, and much time and expense are involved in the evaluation, publication, and distribution of journal articles. Journals must make difficult choices about what to include; there is less value in publishing papers that have already been disseminated to their target audiences.

We discuss here several types of dissemination and provide guidelines with respect to the prior publication question. This discussion is essentially an elaboration of two rules, the first emphasizing previous dissemination of the material, the second stressing disclosure.

• Rule One: If the material in a paper has already been disseminated to a journal's audience, particularly in a format that appears to be a final product, then it is unlikely that a second version will be worth publishing in the journal.

• Rule Two: It is the responsibility of authors to let editors know at the time of submission whether a paper's contents

have been previously disseminated in any manner so that the editors can determine whether to proceed with the review process.

Previous Presentations at Meetings

Presentation of a paper at conferences or seminars usually does not jeopardize the possibility of publication.

Working Papers

Dissemination of "working papers" to a limited audience will not ordinarily jeopardize publication. Working paper series are used by many organizations as a means of enabling researchers to obtain critiques from fellow researchers. Working papers covered by this policy are those that are released by the author or an organization rather than by a publisher, are not advertised to the public, and are marked as drafts that are subject to future revision. HPP will not publish papers for which a similar working paper is already available in the public domain.

Internet Postings

Release via the Internet may jeopardize journal publication under some circumstances. Presentation of the work as a final report is a marker of an attempt to reach a wide audience, particularly when combined with efforts to direct traffic to the work (e.g., via links on other sites) and efforts to attract attention (e.g., press releases). In contrast, if a document is posted on the Internet only to facilitate communication among colleagues with the aim of getting feedback, and if there has been no attempt to otherwise attract the attention of journalists, the public, or the broader research community to the document, then this is unlikely to preclude journal publication.
In general, when posting on the Internet serves similar functions as presentation at professional meetings - facilitating the development of papers and the improvement of the research, influencing future revisions, and not constituting a "finished" product - it would not be considered prior publication. On the other hand, when the Web site posting functions as a virtual version of a conventional publication, which may even be copyrighted by the posting organization, the benefit of an additional publication in the journal will be scrutinized carefully.

In cases where there has been little to no exposure at the time that a paper has been submitted to the journal, but the circumstances surrounding the posting make it likely that a high level of exposure (press coverage, etc.) might occur, then the author should remove a posting as a condition for further consideration of the manuscript.
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The dissemination efforts of foundations, government agencies, research institutes, and other organizations that

support or carry out research can complement publication in peer-reviewed journals. If publication in one of our peer-reviewed journals is desired, organizational publications should be timed to coincide with or follow journal publication, with appropriate copyright permissions having been obtained. This sequence ensures that the peer-review process will have an opportunity to correct deficiencies of method or presentation.
Formal, published reports that have gone through an editorial process, that have been intended to reach a wide audience, and that are publicized and available to any interested party (whether free or not) usually will not be considered for journal publication. A paper that is based on such a report might be considered for publication if it were sufficiently different in emphasis or intent. In such instances, the author should explain at the time of submission (or before) how the paper differs from the previously released report and why its publication would represent a distinct and important contribution beyond that version.

Policy briefs

If the findings of a piece of research have been published locally (i.e. in a specific country) with the aim of influencing policy debates in that country then even if the brief is available on the web we may consider publishing an article so long as (i) the brief has not had wide circulation outside the country and (ii) the brief is clearly targeted at policy-making audiences, and hence does not include the detailed discussion of methods and perhaps findings that one might expect in a journal article.

Media Publicity

If results reported in a working paper have become widely known as a result of media exposure (or even if the potential for widespread exposure remains during review), and that working paper is readily available to interested readers (e.g., through a Web site), an editorial judgment will be made whether journal publication would be appropriate. Authors can help protect their work from unwanted media exposure by making clear on working drafts, copies presented at conferences, and other versions that it is a draft that has not yet undergone peer review for publication and that findings and conclusions are subject to change. Authors also should request that any "stories" derived from interviews with the media be embargoed until the work is published or released by the publisher (see, for example, Fontanarosa, P.B., and C.D. DeAngelis. 2002. The Importance of the Journal Embargo. Journal of the American Medical Association 288: 748-750). Any accepted manuscript released to the media should contain the statement: "A revised final version of this paper will appear in (Journal Name), volume, issue." Journal policies involving author contact with members of the media may vary, depending on the issue or journal. Thus, authors should check with the editor before speaking with or distributing papers to members of the media.

Importance of Disclosure

In contrast to the editors' decision whether a certain paper has been disseminated too widely to warrant journal publication, there is very little judgment involved in whether an author should disclose previous dissemination. Prior to, or at the time of, submission of a paper that has been disseminated in any of the ways discussed previously, authors should bring this to the attention of the editor so that a determination can be made before the paper goes into the peer-

review process. In so doing, authors should describe in what form and how the work was previously disseminated and how the submitted manuscript differs from previously disseminated versions. Editors might be receptive to a modified version of a paper that has been widely disseminated if the submitted version has a different focus (e.g., more emphasis on methods, more sophisticated analytic approach, or discussion of developments that have transpired since the initial dissemination). The key point is to let editors know about any dissemination that will have, or is likely to have, occurred before the journal article is published rather than have it discovered during or after the review or editorial process. As part of the submittal, authors should include copies of other related papers that might be seen as covering the same material.

Failure to disclose could preclude publication in the journal or, if already published, could result in a notice in the journal about the failure and may result in a retraction of the article.

Manuscript Preparation

Page 1: **Title Page** – as above.

Page 2: **Abstract**. The abstract should be prepared in one paragraph, no headings are required. It should describe the purpose, materials and methods, results, and conclusion in a single paragraph no longer than 300 words without line feeds.

Page 3: **Introduction**. The Introduction should state the purpose of the investigation and give a short review of the pertinent literature, and be followed by:

Materials and methods. The Materials and methods section should follow the Introduction and should provide enough information to permit repetition of the experimental work. For particular chemicals or equipment, the name and location of the supplier should be given in parentheses.

Results. The Results section should describe the outcome of the study. Data should be presented as concisely as possible, if appropriate in the form of tables or figures, although very large tables should be avoided.

Discussion. The Discussion should be an interpretation of the results and their significance with reference to work by other authors.

Abbreviations. Non-standard abbreviations should be defined at the first occurrence and introduced only where multiple use is made. Authors should not use abbreviations in headings.

All **measures** should be reported in SI units, followed (where necessary) by the traditional units in parentheses. There are two exceptions: blood pressure should be expressed in mmHg and haemoglobin in g/dl. For general guidance on the International System of Units, and some useful conversion factors, see 'The SI for the Health Professions' (WHO 1977).

References. References must follow the Harvard system and must be cited as follows:

Baker and Watts (1993) found...

In an earlier study (Baker and Watts 1993), it...

Where works by more than two authors are cited, only the first author is named followed by 'et al.' and the year. The reference list must be typed double-spaced in alphabetical order and include the full title of both paper (or chapter) and journal (or book), thus:

Baker S, Watts P. 1993. Paper/chapter title in normal script. Journal/book title in italics **Volume number in bold** : page numbers.

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Tables All tables should be on separate pages and accompanied by a title - and footnotes where necessary. The tables should be numbered consecutively using Arabic numerals. Units in which results are expressed should be given in parentheses at the top of each column and not repeated in each line of the table. Ditto signs are not used. Avoid overcrowding the tables and the excessive use of words. The format of tables should be in keeping with that normally used by the journal; in particular, vertical lines, coloured text and shading should not be used. Please be certain that the data given in tables are correct. Tables should be provided as Word or Excel files.

Types of papers

Health Policy and Planning welcomes submissions of the following article types:

- Original research
- Review articles
- Methodological musings
- Innovation and practice reports
- Commentaries
- 'How to do (or not to do)...' [for example, see Hutton & Baltussen, HPP, 20(4): 252-9] and
- '10 best resources' [for example, see David & Haberlen, HPP, 20(4): 260-3].

ORIGINAL RESEARCH

Manuscripts should preferably be a **maximum** of **6,000** words, excluding tables and figures/diagrams.

The manuscript will generally follow through sections: Title page (as above), Abstract (no more than 300 words), Introduction, Methods, Results, Discussion, Conclusion, Acknowledgements, References. However, it may be appropriate to combine the results and discussion sections in some papers. Tables and Figures should not be placed

within the text, rather provided in separate file/s.

For the reporting of statistical analyses please consider the following additional points:

- Focus the statistical analysis at the research question.
- Provide information about participation and missing data.
- As much as possible, describe results using meaningful phrases (e.g., do not say "beta" or "regression coefficient", but "mean change in Y per unit of X"). Provide 95% confidence intervals for estimates.
- Report the proportions as *N* (%), not just %.
- Report *P* values with 2 digits after the decimal, 3 if <0.01 or near 0.05 (e.g., 0.54, 0.03, 0.007, <0.001, 0.048). Do not report *P* values greater than 0.05 as "NS".
- Always include a leading zero before the decimal point (e.g., 0.32 not .32).
- Do not report tests statistics (such as chi-2, T, F, etc.)."

For acknowledgements, figures and measures see above.

REVIEW ARTICLES

Manuscripts should preferably be a **maximum** of **10,000 words**, excluding tables, figures/diagrams and references.

Reviews may be invited. They generally address recent advances in health policy, health systems and implementation. **Systematic reviews are particularly welcomed**, but may not be appropriate for every topic. If authors are submitting a review article that is not a systematic review then the paper should explain why a systematic review was not feasible/desirable, and the review methods should be described in a way that is as clear and as replicable as possible.

The manuscript will generally follow through sections: Abstract (no more than 300 words), Introduction, Methods, Results, Discussion, Conclusion, References. However, it may be appropriate to combine the results and discussion sections in some papers. Tables and Figures should not be placed within the text, rather provided in separate file/s.

Checklists have been developed for a number of study designs, including randomized controlled trials (CONSORT), systematic reviews (PRISMA), observational studies (STROBE), diagnostic accuracy studies (STARD) and qualitative studies (COREQ, RATS). We recommend authors refer to the EQUATOR Network website (http://www.equator-network.org) for further information on the available reporting guidelines for health research, and the MIBBI Portal for prescriptive checklists for reporting biological and biomedical research where applicable. Authors are requested to make use of these when drafting their manuscript and peer reviewers will also be asked to refer to these checklists when evaluating these studies.

COMMENTARIES

Short commentaries on topical issues in health systems are welcomed - please email the editorial office prior to submission. Most such commentaries are commissioned by the editors, but the journal will also consider unsolicited submissions. Commentaries should of broad interest to readers of *Health Policy and Planning*, and while they are not research papers, they should be well substantiated. Manuscripts should preferably be a **maximum** of **1,200 words**, excluding tables, figures/diagrams and references.

The manuscript will generally contain a short set of key take-home messages. Tables and Figures should not be placed within the text, rather provided in separate file/s.

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This series is meant to explain how to use a particular research or analytical method (e.g. social network analysis, discrete choice experiment etc.). The research or analytical methods discussed should be well accepted and clearly defined: this category of paper is not meant to address methodological debates but rather to help disseminate and promote the use of well-accepted methodologies.

Manuscripts should preferably be a **maximum** of **3,000 words** excluding tables, figures/diagrams and references.

The sections must be arranged as follows: i) Title page (as above), ii) Abstract, iii) Introduction, iv) Body of the paper, and v) References. Main sections should be coordinated by the author, and inserted between Introduction and Reference sessions. Please contact our office before submitting a manuscript in this category.

Tables and Figures should not be placed within the text, rather provided in separate file/s.

10 BEST RESOURCES

This 10 best is a series of articles that identify and outline the 10 most useful resources from a range of sources to help facilitate a better understanding of a particular issue in global health.

We often commission these articles but we also hear unsolicited suggestions.

For acknowledgements, figures and measures see above.

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This series is meant to address methodological issues in health policy and systems research, where there is currently a lack of clarity about accepted research methods. This series is intended to support the development of the health policy and systems research field, through supporting methodological discussion.

Manuscripts should preferably be a **maximum** of **3,000 words**, excluding tables, figures/diagrams and references.

The sections must be arranged as follows: i) Title page (as above), ii) Abstract, iii) Introduction, iv) Body of the paper,

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These short reports are narratives from the perspective of health managers operating at the national or sub-national level which focus on innovative approaches to strengthen health systems. Papers should highlight the practical experience of health managers or practitioners involved in taking action to strengthen health systems through innovative activities and new practices. The new activities and practices should preferably have been implemented for a sufficiently long time to allow authors to demonstrate the potential for sustained improvement or change in the health system. Examples might include practices to build capacity, develop new partnerships or restructure relationships within health systems. Papers should identify 2-4 key messages or lessons for consideration in other settings. We will not consider clinical and pharmaceutical innovations and practices. Manuscripts should be a **maximum** of **2,000 words**.

The manuscript will generally follow through sections: Key Messages, Abstract (no more than 300 words), Introduction, Methods, Results, Discussion, Conclusion, References. However, it may be appropriate to combine the results and discussion sections in some papers. Tables and Figures should not be placed within the text, rather provided in separate file/s. In the main body of the paper, sub-headings may be useful to signal key elements of the experience reported. Reports must be led by local practitioners, managers or policy-makers.

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- Pre-submission language editing
- Authorship
- Originality
- Online submission

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In order to meet your funding requirements authors are required to name their funding sources, or state if there are none, during the submission process. For further information on this process or to find out more about the CHORUS initiative please click here.

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ADDENDUM 2:
DCE QUESTIONNAIRE

Rural internship job attribute preferences of final year medical students in South Africa: a discrete choice experiment.

Good day, my name is Dr Maria Jose. I graduated in Medicine from UCT in 2011, and am currently completing my Master's here. I am conducting a study to understand how medical students make their decision of which hospital to apply for internship. The results will be used to inform a policy brief and a mini-thesis. The policy brief will be shared with your class on the Vula site.

Your participation in this questionnaire will require you to use your device (laptop/tablet/mobile) to complete an **anonymous online questionnaire**. This questionnaire is expected to take approximately **10 minutes** to complete. Your identity will be kept anonymous, all responses will be captured electronically and this database will be protected with password encryption.

There are **minimal risks** expected as a result of this study. The study researcher is not a staff member of UCT nor Department of Health. Your participation in this study **will not influence your academic results, nor will it influence your final internship placement**.

The benefit of participation for yourself is **greater clarity regarding the qualities you care about for your internship hospital**. There are no financial benefits to participation, you will be provided light refreshments at your orientation session on the 1st February 2019. Participation is voluntary and participants have the right to refuse or withdraw from the study at any time without facing repercussions.

In case of any questions regarding the study and participants' rights please contact the researcher as follows: Dr Maria Jose
Email: jsxmar002@myuct.ac.za Tel: 0836303319

The research ethics committee ensures the safety, rights and welfare of people participating in research.
Website **www.health.uct.ac.za/fhs/research/humanethics/about#sthash.oqkqwJ61.dpuf**
Number: 0214066338 E-mail: sumayah.ariefdien@uct.ac.za
The researcher (Dr Maria Jose) can be contacted on jsxmar002@myuct.ac.za or 0836303319

Do you consent to participate in this study?

- ◯ YES
- ◯ NO

Next

This questionnaire has two parts, Part A & Part B. Complete both Part A and Part B of this questionnaire.

Part A is a sequence of 15 hypothetical scenarios.
For each scenario imagine that you had to choose between these two rural hospitals for your internship and you had no other options. For each scenario, choose which hospital (A or B) you would most prefer to work at for your internship based on the description of its attributes.

Part B of this questionnaire asks questions about your education and background.

Please note the following definitions of the terms used in each scenario:

"**Supervision**": refers to the supervision which interns can expect to receive at that hospital from their clinical seniors.

"**Practical experience**": refers to the typical work that interns would be exposed to at that hospital.

"**Resources**": refers to the type of equipment that interns can expect to find at that hospital.

"**Rural allowance**": refers to the monthly additional income that interns can expect to receive for working at a rural hospital, this is over and above their salary. Baseline rural allowance is assumed to be R4000 per month (per 2018 guidelines).

"**Occupational Hazard**": refers to the risk of contracting tuberculosis following exposure at the hospital.

"**N95 mask**": also known as a respirator, refers to a personal protective equipment mask which covers the nose and mouth to prevent transmission of air-borne diseases such as tuberculosis.

"**Hospital Safety**": refers to the perceived physical safety of the hospital and immediate surroundings as measured by recent incidents of crime and civil unrest.

"**Housing**": refers to the type of accommodation that interns can expect at a hospital.

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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 premesis	Rent private accomodation
	Select	Select

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0% 100%

If these were your only internship options, which would you choose?

(2 of 15)

	Rural Hospital A	Rural Hospital B
Supervision	Supervised by Medical officer	Supervised by Consultant
Practical experience	Includes filling out forms, take bloods and doing procedures e.g. lumbar punctures	Limited to filling out forms and taking bloods
Resources	Gloves,syringes and suture packs available daily	Daily stock out of gloves, syringes and suture packs
Rural allowance	R4000 (current level)	R4800 (20% 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	Poorly fitting N95 masks always available	No N95 masks available in the hospital
Housing	Provided with subsidised doctors quarters on hospital premesis	Rent private accomodation
	Select	Select

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If these were your only internship options, which would you choose?

(3 of 15)

	Rural Hospital A	Rural Hospital B
Supervision	Supervised by Registrar	Supervised by Consultant
Practical experience	Limited to filling out forms and taking bloods	Includes filling out forms, take bloods and doing procedures e.g. lumbar punctures
Resources	Gloves,syringes and suture packs available daily	Daily stock out of gloves, syringes and suture packs
Rural allowance	R4340 (8% increase)	R4800 (20% 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	No N95 masks available in the hospital	Correctly sized N95 masks always available
Housing	Provided with subsidised doctors quarters on hospital premesis	Rent private accomodation
	Select	Select

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If these were your only internship options, which would you choose?

(4 of 15)

	Rural Hospital A	Rural Hospital B
Supervision	Supervised by Medical officer	Supervised by Consultant
Practical experience	Includes filling out forms, take bloods and doing procedures e.g. lumbar punctures	Limited to filling out forms and taking bloods
Resources	Daily stock out of gloves, syringes and suture packs	Gloves,syringes and suture packs available daily
Rural allowance	R4340 (8% increase)	R4000 (current level)
Hospital Safety	There is a high level of crime in and around the hospital with many reports of theft, hijacking and protests in the past year.	There have been few reports of theft, hijacking and protests in and around the hospital in the past year
Occupational Hazard	No N95 masks available in the hospital	Poorly fitting N95 masks always available
Housing	Provided with subsidised doctors quarters on hospital premesis	Rent private accomodation
	Select	Select

Back Next

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If these were your only internship options, which would you choose?

(5 of 15)

	Rural Hospital A	Rural Hospital B
Supervision	Supervised by Registrar	Supervised by Consultant
Practical experience	Limited to filling out forms and taking bloods	Includes filling out forms, take bloods and doing procedures e.g. lumbar punctures
Resources	Gloves,syringes and suture packs available daily	Daily stock out of gloves, syringes and suture packs
Rural allowance	R4800 (20% increase)	R4340 (8% increase)
Hospital Safety	There is a high level of crime in and around the hospital with many reports of theft, hijacking and protests in the past year.	There have been few reports of theft, hijacking and protests in and around the hospital in the past year
Occupational Hazard	Correctly sized N95 masks always available	No N95 masks available in the hospital
Housing	Provided with subsidised doctors quarters on hospital premesis	Rent private accomodation
	Select	Select

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If these were your only internship options, which would you choose?

(6 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	Gloves,syringes and suture packs available daily	Daily stock out of gloves, syringes and suture packs
Rural allowance	R4000 (current level)	R4800 (20% increase)
Hospital Safety	There is a high level of crime in and around the hospital with many reports of theft, hijacking and protests in the past year.	There have been few reports of theft, hijacking and protests in and around the hospital in the past year
Occupational Hazard	Correctly sized N95 masks always available	Poorly fitting N95 masks always available
Housing	Rent private accomodation	Provided with subsidised doctors quarters on hospital premesis
	Select	Select

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If these were your only internship options, which would you choose?

(7 of 15)

	Rural Hospital A	Rural Hospital B
Supervision	Supervised by Consultant	Supervised by Medical officer
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	R4340 (8% increase)	R4800 (20% increase)
Hospital Safety	There is a high level of crime in and around the hospital with many reports of theft, hijacking and protests in the past year.	There have been few reports of theft, hijacking and protests in and around the hospital in the past year
Occupational Hazard	Poorly fitting N95 masks always available	No N95 masks available in the hospital
Housing	Provided with subsidised doctors quarters on hospital premesis	Rent private accomodation
	Select	Select

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If these were your only internship options, which would you choose?

(8 of 15)

	Rural Hospital A	Rural Hospital B
Supervision	Supervised by Consultant	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	Gloves,syringes and suture packs available daily	Daily stock out of gloves, syringes and suture packs
Rural allowance	R4800 (20% increase)	R4000 (current level)
Hospital Safety	There is a high level of crime in and around the hospital with many reports of theft, hijacking and protests in the past year.	There have been few reports of theft, hijacking and protests in and around the hospital in the past year
Occupational Hazard	No N95 masks available in the hospital	Correctly sized N95 masks always available
Housing	Provided with subsidised doctors quarters on hospital premesis	Rent private accomodation
	Select	Select

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If these were your only internship options, which would you choose?

(9 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	R4340 (8% increase)	R4000 (current level)
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	Poorly fitting N95 masks always available	Correctly sized N95 masks always available
Housing	Rent private accomodation	Provided with subsidised doctors quarters on hospital premesis
	Select	Select

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If these were your only internship options, which would you choose?

(10 of 15)

	Rural Hospital A	Rural Hospital B
Supervision	Supervised by Consultant	Supervised by Registrar
Practical experience	Includes filling out forms, take bloods and doing procedures e.g. lumbar punctures	Limited to filling out forms and taking bloods
Resources	Gloves,syringes and suture packs available daily	Daily stock out of gloves, syringes and suture packs
Rural allowance	R4340 (8% increase)	R4000 (current level)
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	No N95 masks available in the hospital
Housing	Provided with subsidised doctors quarters on hospital premesis	Rent private accomodation
	Select	Select

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If these were your only internship options, which would you choose?

(11 of 15)

	Rural Hospital A	Rural Hospital B
Supervision	Supervised by Medical officer	Supervised by Registrar
Practical experience	Includes filling out forms, take bloods and doing procedures e.g. lumbar punctures	Limited to filling out forms and taking bloods
Resources	Daily stock out of gloves, syringes and suture packs	Gloves,syringes and suture packs available daily
Rural allowance	R4800 (20% increase)	R4340 (8% increase)
Hospital Safety	There is a high level of crime in and around the hospital with many reports of theft, hijacking and protests in the past year.	There have been few reports of theft, hijacking and protests in and around the hospital in the past year
Occupational Hazard	Poorly fitting N95 masks always available	Correctly sized N95 masks always available
Housing	Provided with subsidised doctors quarters on hospital premesis	Rent private accomodation
	Select	Select

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If these were your only internship options, which would you choose?

(12 of 15)

	Rural Hospital A	Rural Hospital B
Supervision	Supervised by Medical officer	Supervised by Consultant
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	R4800 (20% increase)	R4000 (current level)
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	No N95 masks available in the hospital	Poorly fitting N95 masks always available
Housing	Provided with subsidised doctors quarters on hospital premesis	Rent private accomodation
	Select	Select

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If these were your only internship options, which would you choose?

(13 of 15)

	Rural Hospital A	Rural Hospital B
Supervision	Supervised by Medical officer	Supervised by Consultant
Practical experience	Limited to filling out forms and taking bloods	Includes filling out forms, take bloods and doing procedures e.g. lumbar punctures
Resources	Gloves,syringes and suture packs available daily	Daily stock out of gloves, syringes and suture packs
Rural allowance	R4800 (20% increase)	R4000 (current level)
Hospital Safety	There is a high level of crime in and around the hospital with many reports of theft, hijacking and protests in the past year.	There have been few reports of theft, hijacking and protests in and around the hospital in the past year
Occupational Hazard	Poorly fitting N95 masks always available	No N95 masks available in the hospital
Housing	Rent private accomodation	Provided with subsidised doctors quarters on hospital premesis
	Select	Select

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If these were your only internship options, which would you choose?

(14 of 15)

	Rural Hospital A	Rural Hospital B
Supervision	Supervised by Medical officer	Supervised by Registrar
Practical experience	Includes filling out forms, take bloods and doing procedures e.g. lumbar punctures	Limited to filling out forms and taking bloods
Resources	Gloves,syringes and suture packs available daily	Daily stock out of gloves, syringes and suture packs
Rural allowance	R4800 (20% increase)	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	No N95 masks available in the hospital	Correctly sized N95 masks always available
Housing	Rent private accomodation	Provided with subsidised doctors quarters on hospital premesis
	Select	Select

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If these were your only internship options, which would you choose?

(15 of 15)

	Rural Hospital A	Rural Hospital B
Supervision	Supervised by Consultant	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	Gloves,syringes and suture packs available daily	Daily stock out of gloves, syringes and suture packs
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	Poorly fitting N95 masks always available	Correctly sized N95 masks always available
Housing	Provided with subsidised doctors quarters on hospital premesis	Rent private accomodation
	Select	Select

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PART B
For each of the following questions please choose the option that is applicable to you.

What is your gender?

- ◯ Male
- ◯ Female
- ◯ Gender non-conforming

What is your age, in years?

[ ] Years

What is your marital status?

- ◯ Single, never married
- ◯ Married
- ◯ Widowed
- ◯ Divorced/Separated

Do you have any children (adopted, fostered, biological or step-children)?

- ◯ YES
- ◯ NO

What kind of area did you grow up and spend your high school years in?

- ◯ Rural Area (villages and farms)
- ◯ Informal settlement (informal structures around town/cities)
- ◯ Urban settlement (formal structures in suburbs/ townships)

In which province of South Africa is your "home" situated?

- ◯ Western Cape
- ◯ Gauteng
- ◯ Free State
- ◯ North West
- ◯ Eastern Cape
- ◯ Kwazulu Natal
- ◯ Mpumalanga
- ◯ Limpopo

◯ Northern Cape

Have you received a provincial bursary to study at university?

◯ YES
◯ NO

Are you a Cuban-trained student?

◯ YES
◯ NO

Did you receive any exposure to rural medicine during your undergraduate training thus far?

◯ YES
◯ NO

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Which of the following rural medicine activities did you participate in? (choose all that apply)

- [ ] Eden district placement
- [ ] An elective at a rural facility
- [ ] Student-society organised rural-medicine exposure
- [ ] Other

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Do you intend to complete internship and community service in South Africa?

- ◯ YES
- ◯ NO

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Which career path are you interested in pursuing after your internship and community service?

- ◯ General Practise
- ◯ Specialisation
- ◯ I don’t know/ undecided
- ◯ Other

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Thank you for your time, the questionnaire is now complete

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ADDENDUM 3:

HUMAN RESEARCH ETHICS COMMITTEE APPROVAL

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E53-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 649?
Email: sumayah.arlefdien@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

01 June 2018

HREC REF:212/2018

Dr O Alaba
Public Health & Family Medicine
Health Economics Unit
Falmouth Building

Dear Dr Alaba

PROJECT TITLE: RURAL INTERNSHIP JOB ATTRIBUTE PREFERENCES OF FINAL YEAR MEDICAL STUDENTS IN SOUTH AFRICA: A DISCREET CHOICE EXPERIMENT (MASTERS CANDIDATE - DR M JOSE)

Thank you for your response letter dated 07 May 2018, addressing the issues raised by the Human Research Ethics Committee (HREC).

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30 June 2019.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

We acknowledge that the student: Dr Maria Jose will also be involved in this study.

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

Yours sincerely

signature removed to avoid exposure online

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP), South African Good Clinical Practice Guidelines (DoH 2006), based on the Association of the British Pharmaceutical Industry Guidelines (ABPI),and Declaration of Helsinki (2013) guidelines.
The Human Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

ADDENDUM 4:

UNIVERSITY OF CAPE TOWN DEPARTMENT OF STUDENT AFFAIRS RESEARCH APPROVAL

RESEARCH ACCESS TO STUDENTS

DSA 100

NOTES

1. This form must be **FULLY** completed by all applicants who want to access UCT students for the purpose of research or surveys.
2. Return the fully completed **(a) DSA 100** application form **by email,** in **the same word format,** together with **your: (b) research proposal inclusive of your survey, (c) copy of your ethics approval letter / proof (d) informed consent letter** to: Moonira.Khan@uct.ac.za. You application will be attended to by the Executive Director, Department of Student Affairs (DSA), UCT.
3. The turnaround time for a reply is **approximately 10 working days.**
4. NB: It is the responsibility of the researcher/s to apply for and to obtain **ethics approval and to comply with amendments that may be requested;** as well as **to obtain** approval to access UCT staff and/or UCT students, from the following, at UCT, respectively: (a) **Ethics**: Chairperson, Faculty Research Ethics Committee' (FREC) for ethics approval, (b) **Staff access:** Executive Director: HR for approval to access UCT staff, and (c) **Student access:** Executive Director: Student Affairs for approval to access UCT students.
5. **Note:** UCT Senate Research Protocols requires compliance to the above, **even if prior approval has been obtained from any other institution/agency. UCT's research protocol requirements applies to *all* persons, institutions and agencies from UCT and external to UCT who want to conduct research on human subjects for academic, marketing or service related reasons at UCT.**
6. **Should approval be granted to access UCT students for this research study, such approval is effective for a period of one year from the date of approval (as stated in Section D of this form), and the approval expires automatically on the last day.**
7. **The approving authority reserves the right to revoke an approval based on reasonable grounds and/or new information.**

SECTION A: RESEARCH APPLICANT/S DETAILS

Position	Staff / Student No	Title and Name	Contact Details (Email / Cell / land line)
A.1 Student Number	JSXMAR002	Dr Maria Jose	jsxmar002@myuct.ac.za/ 0836303319
A.2 Academic / PASS Staff No.			
A.3 Visitor/ Researcher ID No.			
A.4 University at which a student or employee	UCT	Address if *not* UCT:	
A.5 Faculty/ Department/School	Faculty of Health Science/ School of Publich Health and Family Medicine		

A.6 APPLICANTS DETAILS If different from above	Title and Name	Tel.	Email

SECTION B: RESEARCHER/S SUPERVISOR/S DETAILS

Position	Title and Name	Tel.	Email
B.1 Supervisor	Dr Olufunke Alaba	0214066576	olufunke.alaba@uct.ac.za
B.2 Co-Supervisor/s	Dr Amarech Obse, Assoc Prof Mark Zuidgeest	0214066576/ 0216504756	Amarech.Obse@uct.ac.za / mark.zuidgeest@uct.ac.za

SECTION C: APPLICANT'S RESEARCH STUDY FIELD AND APPROVAL STATUS

C.1 Degree – if applicable	Master's in Public Health
C.2 Research Project Title	Rural internship job attribute preferences of final year medical students in South Africa: A Discrete Choice Experiment
C.3 Research Proposal	Attached: Yes ■ No ☐
C.4 Target population	6th year MBCHB students at UCT health science faculty
C.5 Lead Researcher details	If different from applicant: 01423276, Dr Olufunke Alaba, 0214066576, olufunke.alaba@uct.ac.za
C6. Will use research assistant/s	Yes ☐ No ■ If yes- provide a list of names, contact details :
C.7 Research Methodology and Informed consent	**Research methodology**: Discrete choice experiment, focus group discussion (fFGD) and questionnaire **Informed consent:** Yes, advised for online questionnaire, choice experiment and group discussions
C.8 Ethics clearance status from UCT's Faculty Ethics in Research Committee /Chair (EiRC)	Approved by the UCT EiRC: Yes ■ With amendments: Yes ■ No ☐ (a) Attach copy of your UCT ethics approval. Attached: Yes ■ No ☐ (b) State date / Ref. No / Faculty of your UCT ethics approval: 1/06/2018 Ref. /Faculty.: 212/2018

SECTION D: APPLICANT/S APPROVAL STATUS FOR ACCESS TO STUDENTS FOR RESEARCH PURPOSE

(To be completed by the UCT - ED, DSA or Nominee)

	Approved / With Terms / Not	* Conditional approval with terms	Applicant/s Ref. No.:
D.1 APPROVAL STATUS	(i) Approved ■ ~~(ii) With terms~~ ~~(iii) Not approved~~	a) Access to students for this research study must only be undertaken after written ethics approval has been obtained. *b)* In event any ethics conditions are attached, these must be complied with before access to students.	JSXMAR002 / Dr Maria Jose

D.2 APPROVED BY:	Designation	Name	Signature	Date of Approval
	Executive Director Department of Student Affairs	*Dr Moonira Khan*	signature removed to avoid exposure online	*27 June 2018*