Could improved training opportunities reduce health workforce migration from sub-Saharan Africa? Evidence from a discrete choice experiment among pharmacists

Work-in-progress. HESG Summer 2012. Not for citation.

Gillian Stynes
Department of Global Health and Development, London School of Hygiene and Tropical Medicine,
15-17 Tavistock Place, London WC1H 9SH, UK. Email: *gillian.stynes@lshtm.ac.uk*

Background: Sub-Saharan Africa (SSA) suffers from acute shortages of all types of health workers, partly due to high rates of health workforce migration (HWM) to high-income countries. The role of non-financial incentives in HWM is inadequately defined. This study examined the hypothesis that improved local education opportunities could alter the relative uptakes of local and foreign training, ultimately reducing (education-led) HWM from SSA.

Methods: Pharmacists and pharmacy students, of SSA origin and any migration status, were recruited in Ghana and the UK. Semi-structured interviews confirmed that overseas training is both a leading driver of HWM and a major conduit. Pharmacists described seven key factors affecting their valuation of education opportunities: location (SSA or elsewhere), cost, preferred specialty, learning approach (theoretical or practical), course length, access to learning resources (e.g. equipment) and institutional reputation. A discrete choice experiment (DCE) was employed to value the relative influence of these attributes in education location decisions. A labelled design with 16 hypothetical choice sets was self-administered in either paper or online form. Each choice set consisted of a local education option, a foreign education option and a 'delayed choice' option. The choice data are modelled using variations of the standard logit model.

Policy implications: The findings offer hope that a non-trivial proportion of health workers, who migrate to pursue education abroad, might be persuaded to study at home if policymakers implemented appropriate changes. The study is intended to inform policymakers seeking new and sustainable ways to address the crisis of HWM in low-income countries.

Acknowledgements:
I thank my PhD advisory committee, Prof. Richard Smith (LSHTM), Prof. Felicity Smith (UCL School of Pharmacy), Dr. Moses Oketch (IoE), Dr. Mylène Lagarde (LSHTM) and Dr. Frances Owusu-Daaku (KNUST), for their expert guidance and continued support. This research is funded by the Bloomsbury Colleges, London International Development Centre and a Dr. Gordon Smith Travelling Scholarship. The study was approved by ethical research boards in Ghana (KNUST) and the UK (LSHTM). I am very grateful for the generosity and enthusiasm of all study participants.

Introduction

Worldwide shortages and inequitable distribution of human resources for health are trends of great concern [1-3]. The negative impact of health workforce migration (HWM) on the availability and standard of healthcare is disproportionately strong in developing regions with high disease burdens and fragile health systems, such as sub-Saharan Africa (SSA) [4]. The specialised, labour-intensive nature of healthcare provision requires not only a large trained health workforce, but also a balance of health cadres, in order to achieve better health outcomes [5, 6]. Attrition continues apace: between 1995-2002, nearly 20% of nurses, 27% of dentists and 43% of pharmacists emigrated from Ghana [7].

Pharmacists are integral, with physicians and nurses, to the core health delivery team [8]. In SSA, where sparse resources are often concentrated in secondary care facilities, pharmacists can fulfil a key primary care role, offering accessible and affordable services, particularly in rural areas. Poorer countries are also most in need of pharmacists' skills to effectively rationalise drug use and manage budgets. Shortages force pharmacists to retreat to core functions, like dispensing. In Uganda, there is one pharmacist per 140,000 people, compared to one per 1,300 in the UK [9]. This can lead to low job satisfaction, irrelevancy of further education and attrition from public sector to private, or overseas [10]. Half of final-year pharmacy students in nine developing countries intended to migrate within five years [11]. Nevertheless, pharmacist workforce issues remain conspicuously neglected [10].

The various personal, professional and environmental aspects influencing HWM decisions are often categorised into 'push' and 'pull' factors. 'Push' factors are inadequacies or defects in the home country. Conversely, 'pull' factors are features of the foreign country which are attractive to health workers, including reverse 'push' factors. Economic models of migration predict that migration could be controlled through wage-setting and also mechanisms affecting the probability and conditions of employment, such as increased skills [12]. Studies have confirmed the expected dominance of financial considerations (salary, bonuses and allowances) in HWM decisions while consistently demonstrating that other factors, like training opportunities, are also very important [13, 14]. Direct financial incentives, though the most common policy interventions, may not always be the most effective or cost-effective way to manage recruitment and retention problems [15]. The health workforce crisis dictates that new policy levers are urgently required. Important non-financial factors in HWM, such as education, can no longer be overlooked.

Empirical data are highly fractured, but the desire for foreign training appears widespread among SSA health workforces [16]. Most students do not intend to return home immediately after their foreign study [17, 18]. There is evidence of ability screening at entry, whereby the applicants with the highest qualifications or aptitude are more likely to be accepted, together with skill sorting on exit, whereby the less qualified or less employable students are more likely to return home [19, 20]. If the availability and quality of education opportunities influence HWM decisions, then educational interventions could comprise an important, credible alternative to purely pecuniary interventions.

Potential solutions must take into account effects on HWM patterns and long-term sustainability. The primary policy thrust of many ministries, aid agencies and WHO remains the rapid expansion of the number and capacities of health worker training institutions [2, 21]. In the absence of effective complementary policies addressing retention, there is a danger that more graduates will merely

increase the exit flow of health workers. With massive investment in education by developing and aid-donating countries, it is critical to weigh the impact on HWM. Such evaluations are lacking [22, 23].

It is necessary to scrutinise the role of education in HWM for complexities which are often obscured in broader discussions, but have consequences for attempts to manage HWM via education policy. Firstly, there are endogeneity issues of timing and causality. It is possible that individuals choose health careers because of the associated migration prospects [24]. Indeed, obtaining education may be the purpose of HWM (a goal), or *vice versa* (a conduit)... or both. To successfully target HWM via education, it is vital that some foreign students decide to remain abroad only *after* first moving abroad. It is in this gap that increased uptake of 'better' local education could divert potential migrants. It is therefore essential to measure the importance of location in education decisions.

Secondly, HWM studies tend to ignore the heterogeneity underlying terms like 'education', for tractability, though health professional education is neither a simple nor uniform product. If HWM-targeting education policy is to be evidence-based, it is critical to expose the process and factors with which students evaluate education offers from institutions in SSA and outside. Low availability and perceived low quality of training may induce many students to seek training overseas [25-30]. Others may encounter an academic culture where foreign training and practice demonstrate excellence and achievement [31-34].

This study hypothesises that the availability and characteristics of international education opportunities influence pharmacists' migration decisions; and that improving the quality of home-based education opportunities could reduce education-led migration. An underlying assumption is that undertaking overseas education increases their probability of becoming longer-term migrants. Education policies thus represent viable, available, but hitherto overlooked, levers in HWM management [35]. Informed action requires systematic comparative information about the features of education which most influence health workers' education location choices. Poor research coverage of non-physician cadres in SSA settings shaped specific research questions:

(1) Which characteristics of local (SSA) and overseas pharmacy education are most valued by SSA pharmacists when choosing where to undertake education?

(2) Which policy interventions, designed to improve local (SSA) pharmacy education, are most likely to increase its uptake relative to overseas education and, ultimately, to reduce education-led pharmacist migration from SSA?

Methods

In order to quantitatively characterise SSA pharmacists' preferences for local versus foreign professional education, a discrete choice experiment (DCE) was conducted. The DCE formed part of a migration survey distributed face-to-face, by post and online via a commercial platform (Survey Monkey). Token incentives were offered for completion. Ghana was originally selected as a case study, because of high rates of HWM, research links and English language. However, low migrant recruitment required the inclusion of participants of other SSA origin and the adoption of mixed sampling strategies, including chain-referral, convenience and self-selection, to overcome incomplete sample frames and feasibility issues. Data collection took place between July 2011 and February 2012. Appropriate sample size depended on the unknown true values of the choice model

parameters [36]. Assuming choice proportions of 33% SSA and 67% overseas, estimated sample size was 195 [37].

DCE validity is fundamentally reliant on accurate and comprehensive specification of relevant choices, attributes and levels [38, 39]. In each choice set, respondents were asked to choose between two postgraduate pharmacy education opportunities, one labelled as based some or all of the time in SSA, and another labelled as based entirely overseas. A labelled design was important because it permitted estimation of alternative-specific parameters, capturing known, real differences between training-related attributes in the two settings [40]. This 'forced-choice' DCE permitted 'pure' estimation of the effects of varying attribute levels on choice. However, allowing respondents to 'opt out' or choose *status quo* options is recommended [41]. Respondents were secondly asked whether they would prefer a new, third, option of delaying their choice. This 'unforced-choice' DCE simulated market demand for alternatives within the constraints of the experiment.

47 individual semi-structured interviews were recorded by the researcher with 18 UK-based respondents and 29 Ghana-based respondents (including 8 returned migrants), between November 2010 and March 2011. The sample targeted maximal variation in presumed economic and taste variables: migration status, qualification status, employment sector, age and gender. Incomplete sample frames, low UK response rates and feasibility issues dictated mixed sampling strategies. Interviewees described their decision to study pharmacy, their education and careers, and professional training and practice in SSA and elsewhere. Data were transcribed by the researcher and four assistants, for content analysis in NVivo (v9). 29 preliminary concepts were identified and iteratively transformed into seven comprehensive and mutually exclusive attributes: "course availability"; "tools for learning"; "exposure to international pharmacy practice"; "university quality"; "approach to learning"; "funding"; and "course length".

The choice of realistic, meaningful attribute levels increases the precision of coefficient estimates [42]. Alternative-specific attribute levels incorporated prevailing standards in postgraduate pharmacy education, minimised implausible combinations, and evaluated potential improvements to the SSA *status quo*. To ensure that choices were informative, a 'zero' level for the overseas-specific cost attribute, "funding", was avoided. One or two qualitative levels per attribute per alternative were defined. The exception was the critical location-related attribute, "exposure to international pharmacy practice", henceforth "exposure". The appeal of split-site programmes was explored by estimating a non-linear location effect using four SSA-specific levels (25%, 50%, 75% or 100% of time spent studying in SSA).

A 'full factorial' design (2,048 combinations) is unfeasible, but a 'fractional factorial' subset can estimate the desired effects, balancing efficiency (statistical precision for a given sample size) with identification (independent effect estimation). A 96% *D*-efficient design was generated using SAS (v9.2) [43]. The SAS procedure simultaneously chose alternatives and paired them into 16 choice sets, an acceptable cognitive burden [44]. Choice sets were ordered in two ways; versions were randomly administered to control for order bias.

Adaptive piloting in the UK and Ghana suggested minor wording revisions. The final design drew heavily on the qualitative interviews (Table 1, Figure 1).

Table 1 DCE design characteristics

Labelled alternatives →	**A** **You will school, at least some of the time, in your home country**	**B** **You will school abroad, outside Africa**
Attributes ↓	**Alternative-specific levels ↓**	**Alternative-specific levels ↓**
Course availability *Whether your preferred pharmacy course is offered at the university.*	Different course *You are offered a <u>different</u> pharmacy specialism or qualification level.*	Different course *You are offered a <u>different</u> pharmacy specialism or qualification level.*
	Exact course *You are offered the <u>exact</u> pharmacy specialism and qualification you prefer.*	Exact course *You are offered the <u>exact</u> pharmacy specialism and qualification you prefer.*
Tools for learning *The university facilities, e.g. library, internet, materials and equipment.*	Incomplete/delayed access *Often, you must queue or try to get them elsewhere.*	Complete access
	Complete access	
Exposure to international pharmacy practice *The amount of course time you spend studying pharmacy at an institution outside Africa.*	100% at home	100% abroad
	25% time spent abroad *Split-site programme*	
	50% time spent abroad *Split-site programme*	
	75% time spent abroad *Split-site programme*	
University quality *The international reputation of the university/universities providing the course and awarding the qualification.*	Low international rank	Medium international rank
	Medium international rank	High international rank
Approach to learning *The teaching and learning style emphasised by staff at the university.*	Theory focus *Book-based lectures and self-study, focusing on theoretical knowledge.*	Application focus *Clinical or laboratory-based, focusing on problem-solving and practical application.*
	Application focus *Clinical or laboratory-based, focusing on problem-solving and practical application.*	
Funding *Whether you have sponsorship.* *N.B. Assume the split-site programmes incur the <u>same</u> school fees as programmes located 100% at home.*	No scholarship	Partial scholarship (school fees only)
	Partial scholarship (school fees only)	Full scholarship (school fees and living costs)
Course length *The expected time until you complete the course might be affected by university closures, for example.*	Uncertain; possible delays *Past students have finished within 2-3 years (Master's), 5-6 years (PhD), or more.*	Standard; no delays *Past students have finished within 1 year (Master's) or 3-4 years (PhD).*
	Standard; no delays *Past students have finished within 1 year (Master's) or 3-4 years (PhD).*	

Figure 1 DCE choice set example

You have just graduated from your first pharmacy degree. You have decided to take further pharmacy education and you have been offered two alternative programmes.

Alternative programmes → **Features ↓**	**A** **You will school, at least some of the time, in your home country**	**B** **You will school abroad, outside Africa**
Course availability	Exact course	Different course
Tools for learning	Complete access	Complete access
Exposure to international pharmacy practice	75% time spent abroad	100% time spent abroad
University quality	Medium international rank	High international rank
Approach to learning	Theory focus	Application focus
Funding	Partial scholarship (school fees only)	Full scholarship (school fees and living costs)
Course length	Uncertain; possible delays	Standard; no delays

i) Which programme will you choose?

Mark **X** under your preference:	**A**	**B**

ii) If you have the option to state "No preference for A or B", will you keep your first answer?

Mark **X** under your preference:	**Keep my answer**	**No preference for A or B**

Model specification

Data were modelled in NLOGIT (v4.0). All attributes were effects-coded [37, 45]. In a likelihood model, the utility of any alternative is a linear additive function of a systematic component, comprising the characteristics of the alternative ($\beta_i X_{ij}$) and the individual ($\gamma_i Z_i$), and a random unobserved component (ε_{ij}), conditioned on the availability and attributes of all alternatives.

Equation 1 Expected utility for individual i from choosing j

$$U_{ij} = V_{ij} + \epsilon_{ij}$$

$$V_{ij} = X'_{ij}\beta + Z'_i\gamma \qquad j = 1...J$$

Where: X'_{ij} is a vector of attributes of choice *j* as perceived by individual *i*

Z'_i is a vector of characteristics of individual *i*

β and γ are vectors of coefficients

ε_{ij} is a vector of random errors

The probability that a rational individual *i* will choose an alternative *j* (from a set *J*) depends on its utility (U_{ij}) being higher than other alternatives [46]. Here, *J*=2 for the 'forced choice' DCE and *J*=3 for the 'unforced choice' DCE. Individuals seek to maximise their utility and, while doing so, trade off attributes. Assigning independent, identical, extreme value type 1 errors, the resulting specification is the standard conditional logit (CL) model (also called multinomial logit) used in this study.

Equation 2 Probability that individual *i* chooses alternative 1 of *J* (conditional logit)

$$\begin{aligned} P(Y_i = 1) &= P(U_{i1} > U_{ij}) \\ &= P((V_{i1} + \varepsilon_{i1}) > (V_{ij} + \varepsilon_{ij}) \\ &= P((V_{i1} - V_{ij}) > (\varepsilon_{i1} - \varepsilon_{ij})) \qquad \forall\, j \neq 1 \end{aligned}$$

$$P(Y_i = 1) = \frac{e^{\mu V_{i1}}}{\sum_j e^{\mu V_{ij}}} \qquad j = 1...J$$

Where: Y_i is a random variable representing the choice outcome

μ is a scale parameter inversely proportional to the variance of the error distribution, σ_ε, and usually set equal to one

It seemed reasonable that tastes might be influenced by migration status, qualification status, age, gender or having a family. Application of more complex models should be based on hypotheses, supported by theory, concerning *a priori* expectations of respondents' behaviour [47]. It was anticipated that respondents willing to choose SSA might vary in their preferences for receiving more or less "exposure". This variation was expected to be somewhat unrelated to observed, or even observable, personal characteristics. Advanced models relax the CL assumption of independence of irrelevant alternatives, thus allowing latent taste heterogeneity (without having to specify interaction terms) and unrestricted substitution patterns, while recognising that DCE

respondents perform a sequence of repeated (related) choices (Equation XXX). Accordingly, extensions to CL were expected to increase the behavioural realism of analysis.

Equation 3 Expected utility for individual *i* from making choice *j* (advanced models)

$$U_{ijt} = V_{ijt} + \epsilon_{ijt}$$

$$V_{ijt} = X'_{ijt}\beta_i + Z'_i X'_{ijt}\gamma \qquad j = 1...J$$

Where:
- X'_{ijt} is a vector of attributes of choice *j* as perceived by individual *i* over time, i.e. choice situations
- Z'_i is a vector of characteristics of individual *i*
- β_i and γ are vectors of coefficients, β_i being individual-specific
- ε_{ijt} is a vector of random errors

The distribution of β_i in Equation 3 – continuous (e.g. normal) or discrete – determines the model type. If the taste distribution for one or more attributes is multimodal, this denotes the presence of different subgroups, or latent classes [48]. Latent class models (LCM), though relatively uncommon in health economics, permit individual-specific tastes to follow discrete, unspecified distributions and implicitly allow coefficient correlations [49]. LCM can be summarised as follows:

Equation 4 Probability that individual *i* chooses alternative *j* (latent class model)

$$P_i(j) = \sum_{q=1}^{Q} P_i(j|q)\, R_i(q)$$

Where:
- $P_i(j)$ is the probability individual *i* chooses alternative *j*
- $R_i(q)$ is the probability individual *i* belongs to class *q*
- $P_i(j|q)$ is the probability individual *i* chooses *j*, given *i* belongs to class *q*
- *Q* is the number of latent classes

Class assignment and the number of classes are unobservable (the latter being a qualitative judgement), but calculation of the probability of choosing alternative *j*, given individual *i* belongs to class *q*, is no different to standard CL, resulting in a fixed parameter vector for class *q*. The overall mean is a function of how the parameters are mixed by class probabilities. Individual characteristics enter the model for class membership. Likelihood ratio tests and assessments of model stability were used to 'test down' from a higher number of classes [50].

Mixed logit (MXL) models specify continuous coefficients and use simulation methods, requiring assumptions about which parameters to randomise and which distributions to impose [47, 51-53]. "Exposure" was assigned a random normal distribution. Other parameters were kept fixed, because the qualitative research suggested respondents prefer exact courses, better access to learning resources, higher-ranking universities, a practical approach, more funding and no delays. Imposing random normal coefficients on all attributes was also investigated. LCM and MXL were compared using Akaike and Bayesian Information Criteria.

Researchers disagree regarding the appropriate treatment of missing choices: some analysts include all available data [51], others seek to avoid multicollinearity by excluding respondents with missing data [37]. Researchers also disagree regarding the treatment of dominant preferences, cases where individuals' preferences are discontinuous and rely on lexicographical ordering or target-setting, rather than compensatory trade-offs [52-54]. All preferences are important from a policy perspective and exclusion of dominant preferences may reduce efficiency and introduce selection bias. Since choice models are robust to violations of compensatory decision-making and to errors made by individuals in forming and revealing preferences, respondents providing at least 8 (50%) choices and respondents with dominant preferences were included in base-case analysis.

Results

424 qualified and trainee SSA pharmacists, 71% Ghanaian, participated (Table 2). Combined, migration and qualification status created five "decision status" groups: trainees studying at home (24%); trainees studying elsewhere (14%); and qualified non-migrants (31%), migrants (13%) and returned migrants (9%). Migration and qualification status could not be determined in 30 (7%) and 15 cases (4%), respectively. Males slightly outnumbered females. Most participants were young (20-29 years old) and single, with no children. Most practising pharmacists (60%) had a postgraduate qualification; most trainees (78%) planned to obtain one. Over half (53%) worked in retail and one third (34%) in hospitals or clinics, while academia was probably over-represented (20%).

Missing choices were recorded for 27 (6%) respondents, of whom 22 (5%) were missing at least half and were subsequently excluded from analysis. Respondents displaying dominant preferences for one alternative were not excluded. Of 398 respondents providing all 16 answers under 'forced-choice' conditions, 8 (2%) and 103 (26%) always preferred the SSA or overseas alternative, respectively. Of 397 respondents providing all 16 responses under 'unforced-choice' conditions, 6 (2%), 68 (17%) and 4 (1%) consistently preferred the SSA, overseas or 'delayed choice' alternative, respectively. Such responses may represent protests against omitted attributes, inference of additional (absent) information, very high valuations for particular attributes, or other rationales. Nevertheless, it was encouraging to note that at least two-thirds of respondents were willing to trade off and to choose SSA in certain circumstances. The profile of respondents showing dominant preferences did not raise concerns (Table 2).

Interestingly, very few participants (4%) ranked the labels as the most influential factor when directly questioned about their attribute processing strategy. "Funding" was most cited (19%), followed by "approach to learning" and "course availability" (both 17%). "Exposure" (13%) trailed in fourth. Most respondents ranked "course length" as least important (28%), probably reflecting the youth of the sample, followed by the labels (15%). It will be seen how these answers contrast with indirect evaluations of attribute impact extracted by the DCE.

Table 2 Socio-demographic characteristics

Variable	Description	Full sample		Respondents displaying dominant preferences					
				SSA		Overseas		'Opt-out'	
		n	*(%)*[a]	*n*	*(%)*[a]	*n*	*(%)*[a]	*n*	*(%)*[a]
N; n[a]	Total	424		6	*(1%)*	68	*(16%)*	4	*(<1%)*
Nationality	Ghana	303	*(71%)*	6	*(100%)*	51	*(75%)*	4	*(100%)*
	Other SSA	113	*(27%)*	-	-	15	*(22%)*	-	-
Gender	Male	230	*(54%)*	3	*(50%)*	41	*(60%)*	1	*(25%)*
Age	<30 years	243	*(57%)*	3	*(50%)*	42	*(62%)*	2	*(50%)*
	30-39 years	104	*(25%)*	1	*(17%)*	14	*(21%)*	2	*(50%)*
	40-49 years	45	*(11%)*	1	*(17%)*	9	*(13%)*	-	-
	>50 years	23	*(5%)*	1	*(17%)*	1	*(1%)*	-	-
Marital status	Married	159	*(38%)*	3	*(50%)*	20	*(29%)*	2	*(50%)*
Children[b]	Yes, dependent	115	*(27%)*	2	*(33%)*	17	*(25%)*	2	*(50%)*
	No	278	*(66%)*	3	*(50%)*	46	*(68%)*	2	*(50%)*
	Yes, not dependent	21	*(5%)*	1	*(17%)*	3	*(4%)*	-	-
Migration status	Non-migrant	236	*(56%)*	4	*(67%)*	46	*(68%)*	3	*(75%)*
	Migrant	114	*(27%)*	-	-	18	*(26%)*	-	-
	Returned migrant	44	*(10%)*	2	*(33%)*	2	*(3%)*	1	*(25%)*
Qualification status	Qualified	244	*(58%)*	6	*(100%)*	34	*(50%)*	4	*(100%)*
	Trainee	165	*(39%)*	-	-	31	*(46%)*	-	-
Employment[c]	Retail	129	*(53%)*	1	*(17%)*	22	*(65%)*	3	*(75%)*
	Hospital/ clinic	84	*(34%)*	4	*(67%)*	11	*(32%)*	2	*(50%)*
	Academia	49	*(20%)*	-	-	4	*(12%)*	1	*(25%)*
	Industry	27	*(8%)*	1	*(17%)*	2	*(6%)*	-	-
	Other	21	*(9%)*	-	-	6	*(18%)*	-	-
Postgraduate qualification	Yes[c]	146	*(60%)*	3	*(50%)*	17	*(50%)*	2	*(50%)*
	Planned[d]	128	*(78%)*	-	-	25	*(81%)*	-	-

[a] *Figures may not sum, due to missing data, rounding and multiple answers (employment only).*

[b] *Children aged under 18 years were considered dependent.*

[c] *Qualified pharmacists only.*

[d] *Trainee pharmacists only.*

Main-effects CL models

Both 'forced-choice' and 'unforced-choice' CL models were statistically significant and the parameter estimates were very similar (Table 3). Significant constant terms demonstrated that SSA pharmacists generally prefer to be educated overseas, rather than in SSA. Nearly all attribute coefficients had positive signs and were significant, meaning that pharmacists prefer to undertake a favoured course, have comprehensive access to learning resources, attend an institution with a high international reputation, apply a practical learning approach, receive more funding and avoid delays in course completion. These expected results confirm the theoretical validity of the technique.

Coefficient signs and significance varied for "exposure". The reference category was 0%, i.e. 100% of training conducted in SSA. Significant positive 50% "exposure" indicated that pharmacists would prefer a split-site programme where 50% of training was based overseas. 75% "exposure" was also positive, but insignificant. In contrast, the negative, though insignificant, 25% "exposure" suggested that pharmacists prefer to be fully based in SSA than to spend 25% of course time on an overseas campus. One interpretation is that pharmacists expect disproportionately high personal or career upheaval from a relatively short foreign sojourn. Insignificance may imply differing tastes, or that pharmacists had difficulty accepting or valuing these levels, perhaps unconvinced of feasibility or differentiation from the extremes of 0% and 100%. A Wald test ($\chi^2(3)=12.000$, $p=0.007$) showed that the impact of "exposure" was sufficiently explained by simple linear coding, but information about the pattern of preferences would be lost. Likelihood ratio tests confirmed the models' improved explanatory power over constant-only models ($p=0.000$) and predictive validity was high. On excluding dominant preferences for alternatives, coefficients increased in magnitude and 25% "exposure" became significant.

Table 3 Results of main-effects conditional logit (CL) models, 'forced-choice' and 'unforced-choice'

Alternative	Variable	'Forced-choice' main-effects CL			'Unforced-choice' main-effects CL		
		Coefficient	Std. error	*p*-value	Coefficient	Std. error	*p*-value
SSA	*Alternative-specific constant*	**-1.907**	**0.041**	**0.000**	**-0.244**	**0.054**	**0.000**
	Course availability	**0.451**	**0.041**	**0.000**	**0.451**	**0.045**	**0.000**
	Tools for learning	**0.365**	**0.041**	**0.000**	**0.328**	**0.045**	**0.000**
	25% international exposure	-0.104	0.070	0.138	-0.039	0.074	0.603
	50% international exposure	**0.164**	**0.071**	**0.020**	**0.252**	**0.073**	**0.001**
	75% international exposure	0.074	0.068	0.274	0.069	0.074	0.354
	University quality	**0.167**	**0.041**	**0.000**	**0.164**	**0.044**	**0.000**
	Approach to learning	**0.284**	**0.041**	**0.000**	**0.341**	**0.045**	**0.000**
	Funding	**0.231**	**0.041**	**0.000**	**0.227**	**0.044**	**0.000**
	Course length	**0.257**	**0.040**	**0.000**	**0.272**	**0.044**	**0.000**
Overseas	*Alternative-specific constant*				**1.740**	**0.038**	**0.000**
	Course availability	**0.338**	**0.041**	**0.000**	**0.455**	**0.031**	**0.000**
	University quality	**0.157**	**0.040**	**0.000**	**0.073**	**0.031**	**0.018**
	Funding	**0.189**	**0.041**	**0.000**	**0.163**	**0.031**	**0.000**
Number of observations		6,427			6,425		
LogL; restricted logL (ASC only); LR χ^2		-2405.954; -2798.541; $\chi^2(12)=785.175$ ($p=0.000$)			-4459.321; -4914.567; $\chi^2(12)=910.492$ ($p=0.000$)		
Adjusted pseudo-R^2 (ASC only)		0.14			0.09		
Proportion of responses correctly predicted		77%			61%		

Note: Both models converged in 6 iterations.

Advanced models

MXL and LCM investigated how tastes for foreign exposure varied across respondents. MXL offered no improvement on CL and reported that the log-likelihood was flat, perhaps implying that the data contained insufficient variation. LCM with two latent classes was superior (Table 4). Increased number of classes slightly improved explanatory power, but resulted in very small class probabilities.

Class 2 (35% probability) closely mimicked CL results. Almost all coefficients were positive and significant, as expected, illustrating that these respondents traded off most attributes. Again, only 50% "exposure" was significant, though overall preference for overseas was reduced. In contrast, the class 1 (65% probability) overseas constant was much larger, while only the 75% "exposure" level was significant. This subgroup seemed so strongly motivated by the possibility of time abroad that a minimum of 75% "exposure" was required to influence them in favour of SSA. They were not concerned about "university quality" or overseas "funding". "Course availability" provided them most utility. LCM suggests that SSA pharmacists can be classified into two types, according to their strength of preference for overseas rather than local education.

Table 4 Results of the main-effects latent class model (LCM), 'unforced-choice' only

Alternative	Variable	Main-effects LCM (class 1)			Main-effects LCM (class 2)		
		Coefficient	**Std. error**	***p*-value**	**Coefficient**	**Std. error**	***p*-value**
SSA	*Alternative-specific constant*	-0.122	0.163	0.156	**-0.364**	**0.025**	**0.000**
	Course availability	**0.781**	**0.130**	**0.000**	**0.317**	**0.038**	**0.000**
	Tools for learning	**0.611**	**0.111**	**0.000**	**0.160**	**0.044**	**0.000**
	25% international exposure [a]	0.229	0.176	0.193	0.005	0.075	0.9459
	50% international exposure [a]	0.062	0.182	0.733	**0.269**	**0.079**	**0.001**
	75% international exposure [a]	**0.503**	**0.193**	**0.009**	-0.061	0.078	0.4343
	University quality	0.153	0.110	0.163	**0.142**	**0.045**	**0.002**
	Approach to learning	**0.516**	**0.122**	**0.000**	**0.319**	**0.043**	**0.000**
	Funding	**0.266**	**0.114**	**0.020**	**0.194**	**0.042**	**0.000**
	Course length	**0.529**	**0.112**	**0.000**	**0.223**	**0.043**	**0.000**
Overseas	*Alternative-specific constant*	**3.261**	**0.114**	**0.000**	**0.352**	**0.028**	**0.000**
	Course availability	**0.774**	**0.090**	**0.000**	**0.520**	**0.025**	**0.000**
	University quality	-0.022	0.076	0.774	**0.237**	**0.035**	**0.000**
	Funding	0.056	0.079	0.481	**0.363**	**0.032**	**0.000**
Latent class probabilities		**0.647**	**0.002**	**0.000**	**0.348**	**0.026**	**0.000**
Number of observations		6,425					
LogL; restricted logL (ASC only); LR χ^2		-3864.744; -4914.567; $\chi^2(27)=2099.646$ ($p=0.000$)					
Adjusted pseudo-R^2 (ASC only)		0.21; 0.45 (no coefficients)					
Proportion of responses correctly predicted		71%					

Note: The model converged in 34 iterations.

CL and LCM were re-estimated with important socio-demographic characteristics, namely: "decision status" (a combined migration/qualification status variable, for which the reference category was a qualified non-migrant), age, gender and presence of a spouse or dependent child (Table 5). Imposing interactions between "exposure" and "decision status" in the CL model produced insignificant coefficients, implying that "decision status" did not affect valuation of this attribute, so planned individual subgroup models, by "decision status", were not estimated.

Under CL modelling, qualified non-migrants, migrants, and home trainees gained significantly less utility from SSA, while qualified returned migrants gained significantly more. The trainee abroad coefficient was not significant for SSA, but was significantly positive for overseas. Perhaps surprisingly, home trainees gained significantly less utility from overseas, though the magnitude was small. This suggests that home trainees have somewhat weaker preferences for studying overseas than qualified non-migrants. This might be because they have fewer resources and put less career investment at risk when undertaking further studies and are therefore more willing to accept (inferior) local education. The signs of the overseas coefficients for qualified migrants and returned migrants were as predicted, but not significant. Age was associated with increased utility in both alternatives. It was anticipated that female gender and families would strengthen preferences for SSA and weaken those for overseas: the results bore correct signs, though not all were significant.

As before, LCM class 2 (probability 36%) showed similar results to CL. Family (SSA) became significant. Importantly, the overseas constant was not significant, along with age and gender (overseas). This suggests that pharmacists in class 2 traded off most attributes and they were less dominated by "exposure". These pharmacists were interested in 50%/50% split-site programmes but did not value 25% or 75% sojourns, probably for the reasons proposed previously. Older female returned migrants with families gained the most utility from SSA and the least from overseas. Class 1 (probability 65%) contained those who prioritised "exposure". In this group, fewer SSA coefficients were significant (and only 75% "exposure") and the magnitudes of the two constants were greater. All "decision status" variables were insignificant in the SSA alternative, indicating preferences crossed all combinations of migration and qualification status. Interestingly, females gained more utility than males from both alternatives. Family was insignificant and age was only important for SSA. Formal examination of determinants of class membership is possible, although the practical implications of such socio-demographic analyses for education and migration policy are uncertain.

Changes in sign and significance occurred on excluding dominant preferences. CL showed significant positive effects for family (SSA) and "university quality", returned migrant and female gender (overseas). Trainee abroad (overseas) became insignificant. For LCM class 2, age (SSA) and home trainee, trainee abroad and family (overseas) became insignificant. Trainee abroad (SSA) became negative significant and the overseas constant became positive significant. In class 1, positive coefficients for 25% and 50% "exposure", "funding" and trainee abroad (SSA) became significant, along with negative coefficients for migrant (SSA) and home trainee (both alternatives). Returned migrant and trainee abroad (overseas) became insignificant. Class 1 valued and traded all attributes except "university quality" (both alternatives) and "funding" (overseas). In class 2, the attribute roles did not change. In both classes, the role of "decision status" in the explanation of choice changed.

The apparently poor fit (pseudo-R^2) of the statistical models is not comparable to ordinary R^2, but is in fact adequate. The high proportions of responses correctly predicted should be noted.

Table 5 Results of the full conditional logit (CL) and latent class (LCM) models, 'unforced-choice' only

Alternative	Variable	Full CL			Full LCM (class 1)			Full LCM (class 2)		
		Coefficient	Std. error	*p*-value	Coefficient	Std. error	*p*-value	Coefficient	Std. error	*p*-value
SSA	*Alternative-specific constant*	**-1.137**	**0.259**	**0.000**	**-1.311**	**0.495**	**0.008**	**-0.853**	**0.147**	**0.000**
	Course availability	**0.478**	**0.049**	**0.000**	**0.784**	**0.131**	**0.000**	**0.355**	**0.043**	**0.000**
	Tools for learning	**0.337**	**0.048**	**0.000**	**0.612**	**0.114**	**0.000**	**0.192**	**0.049**	**0.000**
	25% international exposure	-0.028	0.079	0.727	0.353	0.182	0.053	-0.018	0.086	0.839
	50% international exposure	**0.310**	**0.078**	**0.000**	0.157	0.186	0.396	**0.316**	**0.087**	**0.000**
	75% international exposure	0.051	0.080	0.524	**0.541**	**0.199**	**0.007**	-0.037	0.086	0.671
	University quality	**0.168**	**0.048**	**0.000**	0.159	0.110	0.148	**0.142**	**0.050**	**0.005**
	Approach to learning	**0.343**	**0.048**	**0.000**	**0.508**	**0.125**	**0.000**	**0.330**	**0.048**	**0.000**
	Funding	**0.259**	**0.047**	**0.000**	0.176	0.116	0.129	**0.277**	**0.047**	**0.000**
	Course length	**0.295**	**0.047**	**0.000**	**0.621**	**0.120**	**0.000**	**0.244**	**0.048**	**0.000**
	Qualified migrant	**-0.504**	**0.145**	**0.001**	-0.513	0.285	0.072	**-0.555**	**0.090**	**0.000**
	Qualified returned migrant	**0.763**	**0.147**	**0.000**	-0.108	0.255	0.672	**1.237**	**0.063**	**0.000**
	Trainee in home country	**-0.562**	**0.120**	**0.000**	-0.379	0.227	0.095	**-0.699**	**0.069**	**0.000**
	Trainee abroad	0.084	0.150	0.576	0.613	0.331	0.064	-0.061	0.080	0.443
	Female	**0.236**	**0.056**	**0.000**	**0.298**	**0.117**	**0.011**	**0.197**	**0.029**	**0.000**
	Age	**0.027**	**0.008**	**0.001**	**0.035**	**0.015**	**0.017**	**0.017**	**0.005**	**0.000**
	Spouse/dependent child	0.066	0.074	0.370	0.160	0.141	0.258	**0.099**	**0.039**	**0.013**

Alternative	Variable	Full CL			Full LCM (class 1)			Full LCM (class 2)		
		Coefficient	Std. error	*p*-value	Coefficient	Std. error	*p*-value	Coefficient	Std. error	*p*-value
Overseas	*Alternative-specific constant*	**0.788**	**0.205**	**0.000**	**2.874**	**0.395**	**0.000**	-0.070	0.075	0.351
	Course availability	**0.488**	**0.033**	**0.000**	**0.837**	**0.093**	**0.000**	**0.587**	**0.027**	**0.000**
	University quality	0.062	0.032	0.054	-0.059	0.078	0.450	**0.209**	**0.038**	**0.000**
	Funding	**0.174**	**0.033**	**0.000**	0.105	0.079	0.181	**0.372**	**0.036**	**0.000**
	Qualified migrant	0.168	0.100	0.093	0.055	0.231	0.813	**0.639**	**0.087**	**0.000**
	Qualified returned migrant	-0.013	0.120	0.913	**-0.826**	**0.201**	**0.000**	**-2.158**	**0.180**	**0.000**
	Trainee in home country	**-0.175**	**0.079**	**0.026**	-0.202	0.171	0.237	**0.598**	**0.083**	**0.000**
	Trainee abroad	**0.273**	**0.109**	**0.012**	**0.590**	**0.275**	**0.032**	**0.837**	**0.095**	**0.000**
	Female	0.053	0.041	0.199	**0.254**	**0.092**	**0.006**	-0.046	0.031	0.142
	Age	**0.033**	**0.007**	**0.000**	0.014	0.012	0.258	0.000	0.002	0.986
	Spouse/dependent child	**-0.167**	**0.056**	**0.003**	0.115	0.105	0.274	**0.114**	**0.036**	**0.002**
Latent class probabilities					**0.645**	**0.004**	**0.000**	**0.356**	**0.026**	**0.000**
Number of observations		5,965			5,965					
LogL; restricted logL (ASC only); LR χ^2		-4040.504; -4589.288; $\chi^2(26)=1097.567$ (p=0.000)			-3420.492; -4589.288; $\chi^2(55)=2337.592$ (p=0.000)					
Adjusted pseudo-R^2 (ASC only)		0.12			0.25; 0.48 (no coefficients)					
Proportion of responses correctly predicted		62%			73%					

Note: CL and LCM models converged in 6 and 79 iterations, respectively.

Policy impact analysis

Strictly speaking, the relative importance of attributes cannot be determined from parameter size and significance alone, as these are confounded with differing utility scales [55]. The marginal effects of changes to SSA attributes, i.e. the potential impact of education-related SSA policies on choice, were simulated for particular scenarios, using parameter estimates from the full LCM, including dominant preferences. Results represent hypothetical changes based on the sample's experimental choices. Both these estimates and the actual uptakes of alternatives recorded across the experiment (13% SSA; 73% overseas; 14% 'delayed choice') differ to an unknown extent from real-life market shares in the true SSA pharmacist population. Nevertheless, changes predicted within the experiment are reasonable indicators of the relative power of potential policies.

Given the typical local and overseas training decision currently offered to SSA pharmacists (Figure 2), predicted uptake of SSA and overseas education by this sample is 1% and 91%, respectively (8% would be unsure). This means that SSA pharmacists, freed of financial and entry constraints, exhibit 91% probability of choosing foreign studies under *status quo* conditions. Concerns regarding education-led migration are thus justified. This result reveals the magnitude of the task facing policymakers and educators seeking to manage human resources for health in SSA.

Figure 2 Baseline scenario for the policy impact simulations (typical prevailing conditions)

Attributes	Levels	
	SSA	**Overseas**
Course availability	Different course	Exact course
Tools for learning	Incomplete/delayed access	Complete access
Exposure to international pharmacy practice	None; 100% time spent at home	100% time spent abroad
University quality	Low international rank	High international rank
Approach to learning	Theory focus	Application focus
Funding	No scholarship	Full scholarship (school fees and living costs)
Course length	Uncertain; possible delays	Standard; no delays

Simulations showed that uptake of SSA education could be increased by up to 84% by policies targeting improvements in single aspects (Table 6). Unfortunately, initial absolute uptake of 1% means that actual increases are trivial. Unexplained preferences for foreign education were strong enough to outweigh individual local improvements, given freedom to choose. Only when several factors were jointly improved did relative uptake significantly shift. Upgrading all factors under local control, i.e. all except "exposure", increased predicted uptake of SSA education by a factor of 12. Simultaneously improving every attribute predictably increased predicted uptake of SSA education by more than 25 times. In absolute terms, comprehensive policies and investment could swing SSA uptake from just 1% to 30%, meaning that nearly one in three pharmacists would actively choose to study at home and potentially be conserved in the local workforce.

Table 6 Policy impact simulations: modelled market share effects of hypothetical changes to SSA postgraduate pharmacy education

Scenario	Examples of potential policies	Attribute(s) affected	New level	Choice probability (% uptake)		
				SSA	Overseas	'Opt-out'
Baseline	Typical prevailing conditions in SSA (Figure XXX)			1.2%	90.8%	8.0%
Individual policy changes						
"Availability"	Increase variety of specialised courses and qualifications available	*Course availability*	Exact course	2.1%	90.5%	7.4%
"Resources"	Improve the quantity and quality of university facilities, e.g. library, internet access, laboratory equipment and materials	*Tools for learning*	Complete access	1.7%	90.7%	7.6%
"International links"	Engage in collaborative programmes with overseas institutions, offer students the chance to spend part of their course on a foreign campus	*International exposure*	50% time spent abroad	1.9%	90.6%	7.6%
"Reputation"	Develop local institutions' reputations, particularly in research, e.g. by investing in staff, hosting conferences, funding open-access publishing	*University quality*	Medium international rank	1.5%	90.7%	7.8%
"Modern learning"	Modernise curricula and train staff to provide practically-oriented basic training, offer more practical experience at clinical and retail sites	*Approach to learning*	Application focus	2.0%	90.5%	7.5%
"Local funding"	Introduce scholarships covering local university fees, provide maintenance grants, support employers to offer study leave	*Funding*	Partial scholarship (school fees only)	1.8%	90.5%	7.7%
"Completion rates"	Actively target high and fast course completion rates, e.g. by improving and standardising progress monitoring, or introducing staff incentives	*Course length*	Standard (no delays)	1.8%	90.6%	7.6%
Policy packages						
"Course development"	"Availability" + "Resources" + "Modern learning"	*Course availability; tools for learning; approach to learning*	Exact course; complete access; application focus	5.2%	88.7%	6.1%
"Student support"	"Local funding" + "Completion rates"	*Funding; course length*	Partial scholarship; standard (no delays)	2.6%	90.2%	7.2%
"International outlook"	"International links" + "Reputation"	*International exposure; university quality*	50% abroad; medium international rank	2.3%	90.3%	7.3%
Local attributes	Superior standards for attributes under local control	All except *international exposure*	At higher level	14.9%	80.8%	4.3%
All attributes	Comprehensive education policy	All attributes	At higher level	30.1%	66.5%	3.4%

The results suggest that pharmacists currently study for further qualifications in SSA primarily because of financial hardship or other barriers, rather than personal choice. Selection processes for overseas sponsorship tend to be based on aptitude and academic achievement, meaning that those lost to migration are likely to be the 'brightest and best'. Crucially, improvements to individual education-related factors would not substantially affect pharmacists' overall preferences for overseas education, when it is available. SSA policymakers and educators, together with aid donators and collaborating institutions, therefore need to ensure that the societal benefits of offering foreign scholarships to healthcare students are fully evaluated against the ensuing migration risk. Increased regulation (especially, effective 'bonding') is probably required to safeguard return on outlay for SSA. Investment in the quantity and quality of SSA education must also be assessed in light of these results. If it is acknowledged that pharmacists studying in SSA at postgraduate level do so by default, then limited resources should be effectively tailored to the needs of this population. If, on the other hand, substantial sums are made available for postgraduate education, this study suggests that a targeted, multi-faceted approach could generate substantially increased student retention.

Discussion

The importance, to health workers, of financial considerations and access to continued education has been highlighted in other DCEs [56-59]. This paper presents results from a labelled DCE, which examined location preferences for further education among qualified and trainee SSA pharmacists. . The analysis showed that preferences for overseas study among SSA pharmacists are very strong and difficult to overcome. These are predictably influenced by key characteristics of education in each setting, but are not fully explained by them. These findings may signal the role of subsequent opportunities, such as employment and migration. Results may be transferable across developing settings, but are likely to be unique to pharmacists [60].

This study faced several limitations in data collection and analysis. Selection bias arose from lack of resources, incomplete sample frames and voluntary participation. Migrants were extremely hard to locate, while survey length may have put off potential participants. Conclusions may be extrapolated from the (mainly Ghanaian) sample only with extreme caution. The survey was administered in multiple modes, which may have affected consistency [61]. Although research in DCEs is lacking, some evidence shows that mixed-mode surveys are efficient while producing valid measurements [62]. Missing data, while not extensive, reduced available information and may have affected accurate determination of migration status.

Biases relating to the DCE technique itself may have occurred. If the hypothetical nature of the task was undermined, because participants did not fully understand or accept the brief, they may not have made choices consistent with their real preferences and behaviour [63]. The prevalence of dominant preferences could cause concern; participants may have disagreed with the selection of attributes or levels, considering the choices to be personally irrelevant. However, piloting and face-to-face feedback suggested that the DCE was well understood by most participants.

Only a limited scale of improvements to SSA education was examined by the DCE. This was justified by the policy perspective, which requires realism. Even the limited changes that were hypothetically applied would incur massive planning and implementation costs. It was expected that such changes were already at the limit of what might reasonably be achieved within a 5-10-year period, aligned with most planning frameworks.

This research contributes to various literatures: health workforce management, health workers' preferences, economics of education and migration, SSA development and methodological DCE issues. It is difficult to compare the results with those of other studies, as this study is believed to pioneer the assessment of professional education as a potential policy lever in HWM. The findings confirmed the importance of education in HWM and demonstrated that concerted improvements to local education may possess greater effectiveness in deterring HWM than competing policies, albeit only in relative terms and only when education is the sole migration conduit [64]. Importantly, SSA pharmacists' overwhelming preferences for overseas study appear to be considerably dependent on unknown, non-education-related factors. Finally, although this study did not appraise planning and implementation costs for hypothetical education policies, they can be assumed to be high and sustained. Nevertheless, the cost-effectiveness of education policies for reducing HWM could yet be comparable to that of the direct pecuniary incentives traditionally considered [13, 65].

Conclusion

A better understanding of pharmacists' decision-making behaviour is vital for policymakers concerned with ensuring an appropriate distribution of types, as well as numbers, of health workers in SSA. Education-led migration is thought to be responsible for a substantial proportion of health workforce losses from this region. This study examined the preferences of SSA pharmacists for home- versus overseas-based postgraduate education by means of a discrete choice experiment and demonstrated the utility of the DCE approach in this important policy arena.

The results have important consequences for health workforce planning in SSA. Firstly, the findings emphasised that SSA pharmacists, if offered the chance to undertake foreign study, are almost certain to accept. However, LCM methods indicated that two subgroups existed: approximately one third were less concerned about "international exposure" than their peers. Secondly, more than two thirds of SSA pharmacists were willing to choose local education in at least one hypothetical scenario. Meaningful increases in local uptake require the introduction of expensive and comprehensive improvements. In the short-term, policymakers and educators must acknowledge that postgraduate pharmacy students choose SSA courses chiefly by default and, therefore, escalate migration-related controls on foreign scholarships and shape local education offerings to match the requirements of local employment.

It appears that preferences for overseas education are driven not by education-related factors *per se*, but by other, perhaps systemic, factors, such as labour market imperfections and inadequate working conditions. It remains incumbent upon researchers to establish the most cost-effective combination of public policies for managing HWM from SSA.

HESG feedback on model specification would be helpful, e.g.

- *LCM use and interpretation.*
- *Is lack of improvement with MXL plausible?*
- *Treatment of dominant preferences and missing data.*
- *Choice of covariates, e.g. "decision status" versus migration/qualification interaction terms.*
- *Recommended further analysis, e.g. modelling class membership.*
- *Fairness of conclusions regarding the usefulness of education policy as a migration lever.*

References

1. Connell, J., et al., *Sub-Saharan Africa: beyond the health worker migration crisis?* Social Science and Medicine, 2007. **64**(9): p. 1876-1891.
2. World Health Organization, *Working Together for Health*, in *World Health Report*. 2006, WHO: Geneva.
3. World Health Organization, *WHO Global Code of Practice on the International Recruitment of Health Personnel*. 2010, World Health Organization: Geneva. p. 8.
4. Huddart, J. and O.F. Picazo, *The Health Sector Human Resource Crisis in Africa: An Issues Paper*. 2003, Unites States Agency for International Development, Bureau for Africa, Office of Sustainable Development: Washington, D.C.
5. Buchan, J., J. Ball, and F. O'May, *Determining skill mix: practical guidelines for managers and health professionals.* Human Resources Development Journal, 2000. **4**(2).
6. Speybroek, N., et al., *Reassessing the relationship between human resources for health, intervention coverage and health outcomes*. 2006, Evidence and Information for Policy, World Health Organization: Geneva. p. 14.
7. Agyei, J., *Joining the Bandwagon: Emigration Expectation Among Trainee Health Personnel in Ghana*. 2007, Development Research Center on Migration, Globalization and Poverty. p. 25.
8. World Health Organization, *The Role of the Pharmacist in the Health Care System*, in *Report of a WHO Consultative Group, New Delhi, India, 13-16 December 1988 and Report of a WHO Meeting, Tokyo, Japan, 31 August-3 September 1993*. 1994, World Health Organization: Geneva.
9. International Pharmaceutical Federation, *2009 FIP Global Pharmacy Workforce Report*. 2009, Federation Internationale Pharmaceutique (FIP): The Hague.
10. Hawthorne, N. and C. Anderson, *The global pharmacy workforce: a systematic review of the literature.* Human Resources for Health, 2009. **7**(1): p. 48.
11. Wuliji, T., S. Carter, and I. Bates, *Migration as a form of workforce attrition: a nine-country study of pharmacists.* Human Resources for Health, 2009. **7**.
12. Commander, S., M. Kangasniemi, and L.A. Winters, *The Brain Drain: Curse or Boon? A survey of the literature*, in *Challenges to Globalization: Analyzing the Economics*, R.E. Baldwin and L.A. Winters, Editors. 2004, Chicago University Press for NBER: Chicago. p. 235-278.
13. Willis-Shattuck, M., et al., *Motivation and retention of health workers in developing countries: a systematic review.* BMC Health Services Research, 2008. **8**(1): p. 247.
14. Issac, A. and N. Syam, *Migration of healthcare professionals from India - a case study of nurses*. 2009, Centad and the World Health Organization: New Delhi.
15. Vujicic, M., et al., *The role of wages in the migration of health care professionals from developing countries.* Human Resources for Health, 2004. **2**(1): p. 3.
16. Awases, M., et al., *Migration of health professionals in six countries : a synthesis report*. 2004, WHO Regional Office for Africa: Brazzaville.
17. Baruch, Y., P.S. Budhwar, and N. Khatri, *Brain drain: Inclination to stay abroad after studies.* Journal of World Business, 2007. **42**(1): p. 99-112.
18. Ndetei, D.M., et al., *The challenges of human resources in mental health in Kenya.* African Journal of Psychiatry, 2007. **10**(1): p. 33-36.
19. Kangasniemi, M., L.A. Winters, and S. Commander, *Is the medical brain drain beneficial? Evidence from overseas doctors in the UK.* Social Science & Medicine, 2007. **65**(5): p. 915-923.
20. Kaushik, M., et al., *High-end physician migration from India.* Bulletin of the World Health Organization, 2008. **86**(1): p. 40-45.
21. Crisp, N., B. Gawanas, and I. Sharp, *Training the health workforce: scaling up, saving lives.* The Lancet, 2008. **371**(9613): p. 689-691.

22. Peñaloza, B., et al. (2009) *Interventions for controlling emigration of health professionals from low and middle-income countries*. Cochrane Database of Systematic Reviews **Volume**, DOI: 10.1002/14651858.CD007673
23. Grobler, L., et al. (2009) *Interventions for increasing the proportion of health professionals practising in rural and other underserved areas*. Cochrane Database of Systematic Reviews **Volume**, DOI: 10.1002/14651858.CD005314.pub2
24. Orenuga, O.O. and O.O. da Costa, *Characteristics and study motivation of clinical dental students in Nigerian universities.* Journal of Dental Education, 2006. **70**(9): p. 996-1003.
25. Socransky, S.J., G. Obst, and G. Swart, *A survey of Canadians enrolled in American Emergency Medicine residencies.* Journal of Emergency Medicine, 2000. **18**(4): p. 473-6.
26. Connell, J., *At the end of the world: holding on to health workers in Niue.* Asian and Pacific Migration Journal, 2007. **16**(2): p. 179-197.
27. Mullan, F., *Doctors for the world: Indian physician emigration.* Health Affairs, 2006. **25**(2): p. 380-393.
28. McEntee, E., et al., *Career Tracking Study: Factors affecting career choices and retention of Irish medical graduates*, in *Published in conjunction with the Final Report of the Postgraduate Medical Education and Training Group*. 2005, Department of Public Health Medicine and Epidemiology, University College Dublin: Dublin.
29. Syed, N.A., et al., *Reasons for migration among medical students from Karachi.* Medical Education, 2008. **42**(1): p. 61-68.
30. Marshall, J., et al., *The UK education of overseas students in speech and language therapy.* International Journal of Language and Communication Disorders, 2001. **36**(SUPPL.): p. 339-344.
31. Hagopian, A., et al., *The flight of physicians from West Africa: views of African physicians and implications for policy.* Soc Sci Med, 2005. **61**(8): p. 1750-60.
32. Akl, E.A., et al., *Post-graduation migration intentions of students of Lebanese medical schools: a survey study.* BMC Public Health, 2008. **8**: p. 191-191.
33. Akl, E.A., et al., *Why are you draining your brain? Factors underlying decisions of graduating Lebanese medical students to migrate.* Social Science & Medicine, 2007. **64**(6): p. 1278-1284.
34. Astor, A., et al., *Physician migration: Views from professionals in Colombia, Nigeria, India, Pakistan and the Philippines.* Social Science and Medicine, 2005. **61**(12): p. 2492-2500.
35. Matowe, L., M. Duwiejua, and P. Norris, *Is there a solution to the pharmacist brain drain from poor to rich countries?* Pharmaceutical Journal, 2004. **272**(7283): p. 98-99.
36. Louviere, J., D. Hensher, and J. Swait, *Stated Choice Methods: Analysis and Applications*. 2000, Cambridge: Cambridge University Press.
37. Hensher, D., J. Rose, and W. Greene, *Applied choice analysis: a primer*. 2005, Cambridge: Cambridge University Press.
38. Coast, J., et al., *Using qualitative methods for attribute development for discrete choice experiments: issues and recommendations.* Health Economics, 2011. **20**(n/a).
39. Coast, J. and S. Horrocks, *Developing attributes and levels for discrete choice experiments using qualitative methods.* Journal of Health Services & Research Policy, 2007. **12**(1): p. 25-30.
40. de Bekker-Grob, E.W., et al., *Labeled versus Unlabeled Discrete Choice Experiments in Health Economics: An Application to Colorectal Cancer Screening.* Value in Health, 2010. **13**(2): p. 315-323.
41. Lancsar, E. and J. Louviere, *Conducting Discrete Choice Experiments to Inform Healthcare Decision Making: A User's Guide.* PharmacoEconomics, 2008. **26**(8): p. 661-677.
42. Hall, J., et al., *What influences participation in genetic carrier testing?: Results from a discrete choice experiment.* Journal of Health Economics, 2006. **25**(3): p. 520-537.
43. Kuhfeld, W., *Marketing Research Methods in SAS: Experimental Design, Choice, Conjoint and Graphical Techniques*. 2009: SAS Institute, Inc.

44. Bech, M., T. Kjaer, and J. Lauridsen, *Does the number of choice sets matter? Results from a web survey applying a discrete choice experiment.* Health Economics, 2011. **20**(3): p. 273-286.
45. Bech, M. and D. Gyrd-Hansen, *Effects coding in discrete choice experiments.* Health Economics, 2005. **14**(10): p. 1079-1083.
46. McFadden, D., *The measurement of urban travel demand.* Journal of Public Economics, 1974. **3**: p. 303-328.
47. Kjær, T. and D. Gyrd-Hansen, *Preference heterogeneity and choice of cardiac rehabilitation program: Results from a discrete choice experiment.* Health Policy, 2008. **85**(1): p. 124-132.
48. Train, K. and G. Sonnier, *Mixed Logit with Bounded Distributions of Correlated Partworths*, in *Applications of Simulation Methods in Environmental and Resource Economics*, R. Scarpa and A. Alberini, Editors. 2005, Springer-Verlag. p. 117-134.
49. Hole, A.R., *Modelling heterogeneity in patients' preferences for the attributes of a general practitioner appointment.* Journal of Health Economics, 2008. **27**(4): p. 1078-1094.
50. Greene, W.H. and D.A. Hensher, *A latent class model for discrete choice analysis: contrasts with mixed logit.* Transportation Research Part B: Methodological, 2003. **37**(8): p. 681-698.
51. Ryan, M., K. Gerard, and M. Amaya-Amaya, eds. *Using Discrete Choice Experiments to Value Health and Health Care*. The Economics of Non-Market Goods and Resources, ed. I.J. Bateman. Vol. 11. 2008, Springer: Dordrecht.
52. Lancsar, E. and J. Louviere, *Deleting 'irrational' responses from discrete choice experiments: a case of investigating or imposing preferences?* Health Economics, 2006. **15**(8): p. 797-811.
53. Ryan, M., V. Watson, and V. Entwistle, *Rationalising the 'irrational': a think aloud study of discrete choice experiment responses.* Health Economics, 2009. **18**(3): p. 321-336.
54. Scott, A., *Identifying and analysing dominant preferences in discrete choice experiments: An application in health care.* Journal of Economic Psychology, 2002. **23**(3): p. 383-398.
55. Lancsar, E., J. Louviere, and T. Flynn, *Several methods to investigate relative attribute impact in stated preference experiments.* Social Science & Medicine, 2007. **64**(8): p. 1738-1753.
56. Kruk, M.E., et al., *Rural practice preferences among medical students in Ghana: a discrete choice experiment.* Bulletin of the World Health Organization, 2010. **88**(5): p. 333-341.
57. Snow, R., et al., *Key factors leading to reduced recruitment and retention of health professionals in remote areas of Ghana: a qualitative study and proposed policy solutions.* Human Resources for Health, 2011. **9**(13).
58. Kolstad, J.R., *How to make rural jobs more attractive to health workers. Findings from a discrete choice experiment in Tanzania.* Health Economics, 2011. **20**(2): p. 196-211.
59. Mangham, L.J. and K. Hanson, *Employment preferences of public sector nurses in Malawi: results from a discrete choice experiment.* Tropical Medicine & International Health, 2008. **13**(12): p. 1433-1441.
60. Lagarde, M. and D. Blaauw, *A review of the application and contribution of discrete choice experiments to inform human resources policy interventions.* Human Resources for Health, 2009. **7**(1): p. 62.
61. Dillman, D.A. and L.M. Christian, *Survey Mode as a Source of Instability in Responses across Surveys.* Field Methods, 2005. **17**(1): p. 30-52.
62. Marta-Pedroso, C., H. Freitas, and T. Domingos, *Testing for the survey mode effect on contingent valuation data quality: A case study of web based versus in-person interviews.* Ecological Economics, 2007. **62**(3–4): p. 388-398.
63. Hensher, D.A., *Hypothetical bias, choice experiments and willingness to pay.* Transportation Research Part B: Methodological, 2010. **44**(6): p. 735-752.
64. Blaauw, D., et al., *Policy interventions that attract nurses to rural areas: a multicountry discrete choice experiment.* Bulletin of the World Health Organization, 2010. **88**(5): p. 350-356.
65. McCoy, D., et al., *Salaries and incomes of health workers in sub-Saharan Africa.* The Lancet, 2008. **371**(9613): p. 675-681.