Research

Predictors of site choice and eventual learning experiences in a decentralised training programme designed to prepare medical students for careers in underserved areas in South Africa

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Background. There is a dire need for medical schools in South Africa to train medical doctors who have the capacity and willingness to work in primary healthcare facilities, particularly in rural areas.
Objectives. To assess the effect of students' gender, race, place of birth and place of high school completion on their choice of training site location and to assess the extent to which the training programme enhanced students' learning experiences relevant to primary care across training sites.
Methods. A survey design involving six cohorts of 4th-year undergraduate medical students (N=187) who were part of the 2013 Family Medicine rotation at the Nelson R Mandela School of Medicine. Self-administered questionnaires were completed by students at the end of each rotation. Data analyses involved descriptive computations and inferential statistical tests, including non-parametric tests for group comparison and generalised polynomial logistic regression.
Results. Students believed that their knowledge and skills relevant to primary care increased after the rotation (p<0.0001). There were statistically significant differences between rural and urban sites on certain measures of perceived programme effectiveness. Male students were less likely to choose urban sites. Black students were less likely to choose rural sites compared with their white and Indian counterparts, as were students who attended rural high schools (odds ratio (OR) 9.3; p<0.001). Students from a rural upbringing were also less likely to choose rural sites (OR 14; p<0.001).
Conclusion. Based on the findings, an objective approach for student allocation that considers students' background and individual-level characteristics is recommended to maximise learning experiences.

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There is a maldistribution of the health workforce in favour of urban areas, with fewer medical doctors practising in geographical areas where the need is greatest in South Africa (SA).[1] Research commissioned by the SA Department of Labour in 2008 showed that the health workforce shortages are not only geographically defined.[2] In addition to rural and urban disparities, there are recruitment and retention difficulties in the public sector compared with the private sector.

Over the past decade, Canada, Australia and the USA have also reported disparities between metropolitan and non-metropolitan areas, despite an increase in the number of medical graduates per capita.[3,4] The shortage of doctors in rural areas has been linked to poor treatment outcomes for diseases such as HIV/AIDS and other complicated illnesses, when compared with urban areas in SA.[2]

The incorporation of primary care or family medicine in the undergraduate medical curriculum and decentralising training outside of large academic complexes are two of 10 evidence-based undergraduate interventions demonstrated to influence medical graduates' decisions to work in rural areas.[5] This 'distributed' approach has become more popular in medical universities with a drive to promote rural health. Students spend some time in decentralised training sites with a view to enhancing their experiential learning and increase their chances of eventual career paths and retention in these areas.[6,7] There is also some evidence to show that students from rural origins are more likely to pursue their medical career in rural settings after graduation, compared with those from non-rural origins.[8]

To maximise the outcomes of such intervention, particularly those related to experiential learning and desire for a future career in rural settings, it is important to understand what factors influence the choice for training site location, as this may dictate whether an objective approach for student allocation may be necessary. In this study, we evaluated a decentralised training programme which was piloted at the University of KwaZulu-Natal (UKZN) in 2013 on 4th-year undergraduate medical students as part of their Family Medicine block. The primary hypothesis was that students' choice for site location was determined by their gender, race, place where they were raised and where they completed high school. Secondly, we tested the hypothesis that learning experiences differed among students depending on the 'rurality' of the site where they completed their rotation.

This formative evaluation was partly conducted to share lessons learned with the medical education community and to generate information to inform the refinement of this pilot intervention.

The UKZN Decentralised Training Programme

The UKZN Decentralised Training Programme was piloted in 2013 in SA through a collaboration between UKZN, the Medical Education Partnership Initiative (MEPI) and the KwaZulu-Natal (KZN) Department of Health. As part of the programme implementation plan, students were allowed to self-select in groups of four to six. The resultant groups of students then chose one of six primary healthcare facilities across KZN, where they were attached for 12 consecutive days. Two of the facilities were rural, two peri-urban and two urban. For this programme, an urban area was defined as a geographical location where there is a high population density and economic functioning, such as the City of Durban. A rural area was defined as a geographical location with very low population density and little to no economic activity. A peri-urban area was considered to be an area between consolidated urban and rural regions.

The students received one week of teaching and skills training prior to the clinical attachment. In the short term, the programme sought to enhance student learning experiences at each of the training sites. The medium-term outcome following directly from this would have been an increased propensity or willingness to return to such areas after undergraduate training.

Methods

Design

This study involved cross-sectional surveys with six successive cohorts of 4th-year medical students who benefited from the MEPI-UKZN Decentralised Training Programme in 2013. Of a total of 187 4th-year students who completed the rotation, 183 consented to participate, giving a response rate of 97%.

At the end of each rotation, students were given a structured quantitative questionnaire to complete. The questionnaire was developed mindful of the need to maximise the response rate and to obtain accurate and relevant information for the survey. Questions were constructed using short and simple sentences asking one piece of information at a time. With the study being exclusively quantitative, only closed questions were used. This allowed for specific information on dependent and independent variables of interest to be gathered. The independent variables of interest were categorical in nature and included students' gender, race, geographical areas that best describe where they completed high school and were born, and geographical location of the site where they completed their rotation. The questionnaire also contained questions that were developed against specific learning objectives set out in the primary care/family medicine curriculum. These constituted the dependent variables and were formulated using a 5-point Likert scale ranging from 1 (no knowledge or skills) to 5 (no need for supervision). The scale was used to rate each learning objective before and after the rotation, as a subjective measure of the change in knowledge/skills on that learning objective. A number of experiential learning variables on the evaluation of clinical placement programmes which are commonly cited in the literature[6,7] were also included in the questionnaire. Students used a 5-point Likert scale to rate their experiences during the rotation period, based on these variables. To maximise accuracy of the information gathered, negative questions were avoided as far as possible and questions

Table 1. Distribution of students *(n)* across cohorts by their demographic characteristics and type of DTC location they selected

Variable	Cohort 1	Cohort 2	Cohort 3	Cohort 4	Cohort 5	Cohort 6	Total	Pearson's χ^2	*p*-value
Sex									
Male	11	10	15	11	10	16	72		
Female	16	19	17	16	22	18	109		
Total	27	29	32	27	32	34	181	14.28	0.501
Ethnicity									
White	3	5	5	2	4	2	21		
Black	14	10	13	14	13	15	79		
Indian	8	15	14	11	15	16	79		
Coloured	2	0	0	0	1	1	4		
Total	27	30	32	27	33	34	183	11.47	0.721
Type of DTC location									
Rural	12	12	20	13	19	26	102		
Urban	8	7	8	8	9	0	40		
Peri-urban	7	6	5	6	4	8	36		
Total	27	25	33	27	32	34	178	15.74	0.112
Area where student completed high school									
Rural	3	8	5	6	8	7	37		
Urban	16	17	25	16	15	20	109		
Peri-urban	8	5	3	5	9	7	37		
Total	27	30	33	27	32	34	183	9.34	0.500
Area where student was born									
Rural	5	8	5	9	9	7	43		
Urban	16	18	21	13	16	21	105		
Peri-urban	5	4	7	5	8	6	35		
Total	26	30	33	27	33	34	183	5.14	0.881

DTC = decentralised training centre.

that were likely to induce bias in responses were minimised. Imprecise questions were avoided to ensure that there were no differences in how respondents understood the questions.

Statistical analysis

The survey data were first entered into Microsoft Excel 2010, then imported into Stata version 13.0 (StataCorp, USA)[9] for cleaning and analyses. Descriptive analyses involved computation of summary statistics and graphical presentations based on students' background characteristics and other survey responses. Pearson's χ^2 test with measures of associations was used to compare student cohorts by gender, race and the decentralised training centres (DTCs) where they completed their rotation.

The data were not normally distributed and therefore non-parametric tests were used for between- and within-group comparisons based on participants' responses. To compare the 'before' and 'after' perceived knowledge and skills scores, Wilcoxon's signed-rank test was used. The Kruskal-Wallis test was used to compare different areas of attachment by the perceived quality of the programme delivery and perceptions about the programme in general. To assess the relationship between students' background characteristics and their choice of location of the DTC where they completed their rotation, a generalised polynomial logistic regression model was used. A *p*-value of <0.05 was considered statistically significant.

Ethics approval

The study was approved by the UKZN Biomedical Research Ethics Committee (Ref. No. BE046/13) before the study commenced.

Results

Of the 183 students surveyed in all six cohorts, 180 satisfactorily completed the questionnaire – a completion rate of 98.3%. Sixty percent of these students were female. Regarding racial distribution, 79 (43%) were Indian, 79 (43%) were black, 20 (11.5%) were white and 4 (2.5%) were coloured. Sixty percent of the students completed their clinical rotation in rural DTCs while the rest were attached to peri-urban or urban DTCs in almost equal proportions. More black students (44.30%) had a rural upbringing than an urban or peri-urban upbringing (29.11% and 26.58%, respectively). Students who attended rural high schools and those who attended urban high schools were equal in proportion (39.24%), with the rest (21.52%) attending high school in peri-urban areas.

There were no statistically significant differences between cohorts in terms of sex, race, and chosen DTC, or in geographical area of high school completion and upbringing (Table 1). Similarly, the differences between cohorts in terms of choice for site location were not statistically significant.

Students felt that their knowledge of and skills in a variety of subject matters increased following exposure to the clinical rotation. All perceived changes were statistically significant ($p<0.001$). On a Likert scale of 1 - 5, the median ratings increased from 3 (some knowledge/skills) to 4 (good knowledge/skills but need supervision/support). The most notable perceived change

Table 2. Students' ratings of their perceived change in knowledge/skills (Wilcoxon signed-rank test)

	Statistic			
Knowledge and skills variable	***n***	**Median**	***z*-value**	***p*-value***
Effective communication skills in carrying out a patient-centred interview				
Before	179	3.00	−9.87	<0.001
After	183	4.00		
Understanding context of the patient				
Before	179	3.00	−10.59	<0.001
After	183	4.00		
Describing the indication and risks with common investigations and procedures				
Before	177	3.00	−10.24	<0.001
After	180	4.00		
Clinical problem-solving skills				
Before	177	3.00	−10.33	<0.001
After	181	4.00		
Formulate a three-stage assessment and management plan				
Before	177	3.00	−10.97	<0.001
After	181	4.00		
Manage undifferentiated problems				
Before	177	2.00	−10.44	<0.001
After	181	4.00		
Manage common chronic illnesses				
Before	178	3.00	−10.79	<0.001
After	181	4.00		
Clinical record keeping				
Before	179	3.00	−10.52	<0.001
After	183	4.00		
Ethical issues in clinical practice such as confidentiality, consent and patient autonomy				
Before	179	3.00	−8.43	<0.001
After	182	4.00		
Health promotion and disease prevention				
Before	179	3.00	−10.75	<0.001
After	184	4.00		
Liaising with other members of the healthcare team				
Before	176	3.00	−10.50	<0.001
After	181	4.00		

*Asymptotic significance (two-tailed).

in knowledge/skills was observed in the management of undifferentiated problems where the median rating increased from 2 (vague knowledge/skills) to 4 (good knowledge/skills but need supervision/support) (Table 2).

Further post-hoc analyses conducted to compare rural, urban and peri-urban sites revealed that there were no site-specific differences in all 11 items for perceived change.

Statistically significant differences between rural, urban and peri-urban DTCs were only observed in relation to students' ratings of their relationship with the clinic staff ($p<0.001$), their access to materials during the rotation ($p<0.05$) and the clinical skills/knowledge they gained ($p<0.05$). Shown in Table 3, students who were in urban DTCs reported, for the most part, better quality of programme delivery than those in rural and peri-urban DTCs. Ratings of other measures such as the relationship with their supervisors, quality of supervision and teaching and the overall content of the training were again better in urban DTCs than in other DTC locations, but these differences were not statistically significant (Table 3). Despite the DTC-specific differences reported here, the median perception ratings were encouraging overall. They ranged between 3 (good) and 5 (excellent) across the board on a Likert scale of 1 (poor) to 5 (excellent).

The perceived effect of the decentralised training programme was, for the most part, also rated higher by students who completed their rotation in urban DTCs (Table 4). However, these differences were only statistically significant for four subjective indicators of the programme's effectiveness. For example, although students in urban DTCs reported to be much more motivated to continue with their medical career following their experience at the urban DTCs, this was not statistically different from that reported by students in rural and peri-urban DTCs ($p>0.05$).

Table 3. Students' rating of the quality of programme by DTC locations (Kruskal-Wallis test)

	Statistic					
Variable	***n***	**Mean rank**	χ^2	**df**	**Median**	***p*-value**
Overall content of the training						
Rural	101	91.08	4.17	2	3.00	0.153
Urban	40	92.97				
Peri-urban	34	73.00				
Clinical skills/knowledge gained						
Rural	102	90.79	5.88	2	3.00	0.042
Urban	39	95.88				
Peri-urban	34	70.59				
Quality of supervision and teaching						
Rural	102	86.25	2.03	2	3.00	0.391
Urban	40	98.00				
Peri-urban	34	84.09				
Relationship with clinic staff						
Rural	102	89.93	12.31	2	4.00	0.000
Urban	40	103.25				
Peri-urban	34	66.87				
Access to necessary materials						
Rural	100	84.53	7.88	2	3.00	0.021
Urban	40	105.19				
Peri-urban	34	75.44				
Relationship with the rotation supervisor						
Rural	102	84.92	2.82	2	4.00	0.241
Urban	40	99.04				
Peri-urban	34	86.84				

df = degrees of freedom.

The same result was found for the perceived effect of the programme in easing students' transition to the clinical environment. However, it was encouraging to learn that on a scale of 1 - 5, the median ratings ranged between 4 and 5 across all indicators of programme effectiveness.

Table 5 shows results from both the univariable and multivariable analyses of four predictors of site choice. At univariable level, most odds ratio (OR) estimates were statistically significant. The model predicted that male students were less likely to choose urban DTCs than their female classmates. With regard to ethnicity, black students were more likely to choose urban DTCs than their white and Indian classmates. The students who attended and completed their high school in rural areas were nine times less likely to select a rural DTC for their rotation compared with those who completed high school in urban and peri-urban areas. The same direction of predictions was also observed for students who were born and raised in rural areas. These students were 14 times less likely to choose the DTCs located in rural areas.

Although the direction of ORs remained similar across all the four predictors after multivariable analyses, the ORs became smaller. Some predictors also became statistically insignificant. For example, only sex and race remained statistically significant predictors of site choice, with males more likely to choose rural DTCs than their female counterparts, and black students less likely to choose rural DTCs than their white and Indian classmates. Students' place of birth and high school completion were not statistically significant predictors of site choice after model adjustment.

Discussion

This pilot study was conducted with a view to documenting some of the factors that influence undergraduate medical students' choice of site location within the context of the UKZN decentralised training programme. The objective of the study was also to find out whether the site location determined students' perceptions about the quality of the programme, as well as their perceived learning experience. The purpose of the study was to generate information for future use by the programme developers to craft an intervention that is more context-sensitive and likely to be well received by the actual end users.

The programme structure and mode of delivery were, in principle, well aligned with

Table 4. Students' rating of the quality of programme effectiveness by DTC locations (Kruskal-Wallis test)

		Statistic				
Variable	***n***	**Mean rank**	**χ^2**	**df**	**Median**	***p*-value**
Will ease my transition to the clinical environment						
Rural	101	90.50	3.88	2	5.00	0.212
Urban	39	93.47				
Peri-urban	35	74.69				
Motivated me to continue with the medical career						
Rural	101	87.78	2.55	2	5.00	0.382
Urban	40	97.01				
Peri-urban	35	80.84				
Orientated me towards the social context of practice						
Rural	101	92.57	6.75	2	5.00	0.031
Urban	39	89.83				
Peri-urban	34	69.76				
Made me more confident to approach patients						
Rural	101	91.02	10.37	2	5.00	<0.001
Urban	40	100.26				
Peri-urban	35	67.77				
Made me more aware of myself and others on the team						
Rural	101	87.87	9.05	2	4.00	0.025
Urban	40	104.26				
Peri-urban	35	72.30				
Strengthened my theoretical knowledge						
Rural	101	90.13	3.65	2	4.00	0.213
Urban	39	94.14				
Peri-urban	35	75.01				
Introduced me to the organisation of the healthcare system and role of various professionals within it						
Rural	100	88.97	9.48	2	4.00	0.022
Urban	39	100.82				
Peri-urban	35	68.46				

novel strategies in medical education,[5-7] which are geared towards enhancing experiential learning among undergraduate medical students during their early years of medical training.

Indeed, there is ongoing discourse around how training in a variety of clinical teaching facilities correlates with eventual practice locations.[10] Some proponents of this approach continue to argue that it results in students entering permanent practice in a location similar to the one in which they trained.[11] This study adds a slightly different but complementary dimension to what already exists in the literature.

As the study participants were only recruited in their 4th year of undergraduate medical training, this study was not able examine the effect of the decentralised training programme on eventual practice location. A follow-up study to examine their career paths and practice location after graduation and whether these are influenced by the individual-level characteristics assessed in this study, would be useful. However, our findings begin to show some intricacies of allowing students to self-select in a model that involves one programme and multiple training sites which vary in resources, infrastructure and location. We advance a view that medical educationists with an interest in the distributed approach ought to be more objective in how they allocate students to training sites away from the traditional medical schools to place the 'right' candidate in the 'right' training location.

The study was able to show that students with rural upbringing and rural high school education were less likely than those from urban areas to select rural training sites as part of their family medicine rotation, when these two predictors were considered independently. When combined with sex and race in a multivariable model, the two predictors produced similar results, but with smaller ORs. Despite the lack of statistical significance in the multivariable model, the direction of predictions reported here should not be overlooked. The univariable analyses tell a story that ought to be explored further in much larger studies within the SA context. A much larger study in SA may use a mixed-effects or multilevel modelling approach to assess the potential effects of additional upstream factors, such as the programme type and name of academic institution, on site choice. This would address the possible influences of curriculum differences within institutions, as well as the kind of students trained at each institution. The same approach can also be used within the context of an international study, by taking into account the country in which the programme was implemented. A large-scale study is therefore recommended, as it is more likely to be able to answer the question around the generalisability of the findings reported here. There is ongoing debate elsewhere that if rural students are selected to enter medical training programmes and are provided with both under- and postgraduate training opportunities in rural areas, they are more likely than those selected from urban areas to return to such areas for medical practice.[12] This has been referred to as the 'pipeline approach' to rural physician resources.[13,14] The disinclination of students with a rural background to select rural sites as part of their decentralised training begs the question as to whether a targeted approach, with sites selected for students based on student characteristics, may more objectively ensure that the pipeline approach works more effectively. A qualitative study would be valuable to further unpack the

Table 5. Relationship between students' background characteristics and their choice of DTCs using a polynomial logistic regression model

		Univariable analysis			Multivariable analysis		
Predictors	**Location of the DTC**	**OR**	**95% CI**	***p*-value**	**OR**	**95% CI**	***p*-value**
Sex							
	Rural	*			*		
Male v. female	Urban	0.29	0.12 - 0.72	0.0076	0.166	0.05 - 0.53	0.002
Male v. female	Peri-urban	1.57	0.73 - 3.41	0.2506	1.337	0.54 - 3.28	0.525
Race							
	Rural	*			*		
White v. black	Urban	0.04	0.01 - 0.33	0.0027	0.047	0.01 - 0.41	0.006
White v. black	Peri-urban	0.22	0.05 - 0.87	0.0315	0.154	0.03 - 0.78	0.024
Indian v. black	Urban	0.03	0.01 - 0.12	<0.0001	0.047	0.01 - 0.19	<0.0001
Indian v. black	Peri-urban	0.22	0.10 - 0.51	0.0005	0.213	0.07 - 0.62	0.004
Area where student completed high school							
	Rural	*			*		
Rural v. urban	Urban	9.40	3.47 - 25.45	<0.0001	3.326	0.60 - 8.30	0.167
Rural v. urban	Peri-urban	5.03	1.81 - 13.94	0.0019	2.734	0.53 - 3.99	0.227
Peri-urban v. urban	Urban	2.80	1.07 - 7.23	0.0358	2.862	0.59 - 13.78	0.189
Peri-urban v. urban	Peri-urban	1.30	0.45 - 3.72	0.6269	2.798	0.62 - 12.45	0.176
Area where student was born							
	Rural	*			*		
Rural v. urban	Urban	14.01	5.08 - 38.67	<0.0001	1.872	0.35 - 10.01	0.463
Rural v. urban	Peri-urban	4.20	1.60 - 10.96	0.0035	0.797	0.15 - 3.98	0.782
Peri-urban v. urban	Urban	5.40	1.97 - 14.79	0.0010	1.373	0.27 - 6.84	0.699
Peri-urban v. urban	Peri-urban	0.85	0.26 - 2.82	0.7955	0.243	0.04 - 1.42	0.117

*Reference value.

underlying constructs of this observation. It may be possible that black students who, within the context of this study, were mostly raised in rural settings, may indeed have chosen to complete their rotation in urban settings but have the desire to go back to rural areas once they have completed their medical training. Therefore, one aspect to explore would be whether there is a short-term desire to experience learning in a more urban setting but a long-term career plan in a rural setting, and the reasons for these choices.

Despite the above findings, it was encouraging to learn that the largest proportion of students, regardless of their sex, ethnicity and background characteristics, selected rural DTCs. This pattern was observed across all six cohorts of students. Although not specifically asked, this may be an indication that these students anticipated better learning opportunities in rural health facilities, which are presumed to be more understaffed and student-friendly than facilities in urban areas.

Our findings also revealed that students in urban areas reported better learning experiences than those in rural areas. This was particularly true with regard to access to necessary hospital resources, their interaction with the clinical team and the clinical skills and knowledge gained. Similarly, compared with rural DTCs, students in urban DTCs felt more confident in approaching patients and became more conscious of the organisation of the healthcare system and the role of various professionals within it. However, students from rural DTCs were better orientated towards the social context of practice, meeting the objective of the programme. The last finding mirrors what has been shown elsewhere.[15] These are important issues to consider if rural DTCs are to contribute to the long-term staffing of rural facilities. Training institutions therefore need to ensure that resources are equitably provided in both rural and urban training sites.

The differences in the students' learning experiences across the DTCs could be attributed to logistical and operational issues that were encountered during the course of the programme. The programme was not implemented wholly as originally intended owing to delays in the mobilisation of resources, particularly in rural DTCs.

This highlights the complexities of the distributed approach in which students are allocated to multiple settings with varying characteristics. The situated learning theory postulates that a training location provides the context within which a student develops his or her professional identity.[16,17] Programmes that utilise a distributed design must ensure that adequate resources, both human and material, are available to enhance the personal learning of students in rural areas. This would more likely encourage these students to return to similar settings for future practice. Universities and other medical training institutions may not achieve this without supportive policies at macro level, particularly from government structures and other relevant civil society organisations.

Finally, our study revealed that the students' knowledge and skills increased across all sites following their exposure to the DTCs. This was based on a number of learning elements posited in the programme. Despite the use of a subjective measure of knowledge and skill gain, this was an encouraging finding which indicates promising effects of the programme in enhancing learning among the students.

Conclusion

Students had positive perceptions and experiences about the primary care curriculum and the decentralised training programme, even though these varied depending on the geographical location of the site. The choice for the location of the DTC was dependant on gender, race, and place where the student grew up and completed high school. Although this study can be considered a pilot, our findings suggest that students should be allocated to sites based on their individual characteristics to maximise their potential for experiential learning and the likelihood of eventual career paths in areas where they are needed the most. Nevertheless, large-scale studies conducted within a much broader context may be required to substantiate the findings reported here.

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