

## Equipping medical graduates to address health systems challenges in South Africa: An expressed need for curriculum change

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**Background.** Stellenbosch University Rural Medical Education Partnership Initiative (SURMEPI) aims to enhance health systems knowledge and skills to empower medical graduates to address health systems challenges especially in rural and underserved areas.

**Objectives.** To assess the content of health systems research (HSR) and strengthening, and understand perceptions of medical graduates and faculty about HSR in the undergraduate medical curriculum at Stellenbosch University.

**Methods.** We defined HSR and strengthening competencies for medical graduates through a literature review and expert consultations. Learning outcomes in terms of knowledge, skill or attitude in the 64 module guides of the curriculum were compared with the competencies required. A survey of recent medical graduates assessed whether their training equipped them to address health systems challenges. Interviews with faculty assessed their views on teaching health systems competencies.

**Results.** HSR foundational competencies were covered at a basic knowledge level, with little progression of learning levels, and several key competencies were not taught at all. Teaching was not integrated throughout the curriculum. Of 189 graduates, 63 (33.3%) agreed while 67 (35.4%) disagreed that their training prepared them to address health system challenges; 128 (67.7%) agreed on the importance of learning health systems competencies as undergraduates, and proposed learning areas of health system knowledge, leadership and management, problem solving, community service, evaluation methods and health economics. They wanted more practical, problem-oriented HSR training. Faculty supported the relevance and inclusion of HSR and strengthening in the curriculum.

**Conclusion.** The curriculum needs adaptation to better equip students with HSR and strengthening competencies.

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There is a growing recognition of the need for medical curricula to address health systems changes and challenges faced by health professionals. In particular, the focus has been on developing a competency-based curriculum to ensure graduates are able to address the needs and context of countries' health systems.<sup>[1]</sup>

Celletti *et al.*<sup>[2]</sup> reported that 'insufficient collaboration between the health and education sectors creates a gap between professional education and the realities of health service delivery'. As a result, graduates are faced by a number of health systems challenges mostly related to lack of taught competencies to address them. Consequently, some graduates are migrating to where opportunities to grow are offered, resulting in maldistribution of health professionals, especially in low- and middle-income countries (LMIC).<sup>[3-5]</sup>

A transformative approach to education is therefore essential to align educational institutions and health systems through curriculum reform to address neglected topics and local relevance in an integrated way.<sup>[6]</sup> This can be enhanced by placing contextually relevant training sites in, and recruiting medical students from, areas where doctors are most needed.<sup>[2]</sup> Studies have suggested that change in medical curriculum content (e.g. incorporating key competencies such as system-based and team-based approaches) may result not only in improved quality of healthcare but also in an improved healthcare system.<sup>[7-11]</sup>

The Faculty of Medicine and Health Sciences (FMHS) of Stellenbosch University (SU) has adapted the CanMeds framework<sup>[12]</sup> as a foundation

for the development of the 'graduate attributes' framework which was adopted in 2013.<sup>[13]</sup> The adoption of the graduate attributes has called for a change of the current medical curriculum through review and alignment to the graduate attributes and implementation of a community-based education (CBE) approach for medical graduate training to fulfil not only the role of medical expert, but also of scholar, health advocate, manager, collaborator, communicator and professional.<sup>[12]</sup> Towards supporting this approach, the SU Rural Medical Education Partnership Initiative (SURMEPI) undertook to review the content related to health systems research (HSR) (Box 1 below) and health systems strengthening in the undergraduate medical curriculum; to assess the perception of recent graduates about their preparedness to address health systems problems in their practice; and to obtain faculty perceptions about the teaching of HSR in the curriculum. All of this aimed to inform curriculum renewal to empower graduates to address challenges experienced while working, especially in rural and underserved areas.

**Definition:** Health (systems and) services research (HSR) is a 'multidisciplinary field of scientific investigation that studies how social factors, financing systems, organisational structures and processes, health technologies, and personal behaviours affect access to health care, the quality and cost of health care, and ultimately our health and well-being. Its research domains are individuals, families, organisations, institutions, communities, and populations.'<sup>[14]</sup>

## Methods

### Design

This study had four distinct stages. Firstly, HSR competencies for undergraduate medical training were defined through a literature review and aligned with the proposed SU graduate attributes for undergraduate medical teaching. SU faculty members and HSR experts were consulted to discuss, refine and validate the desired core competencies for SU training.

Secondly, a descriptive document review of all theoretical and clinical module guides was conducted to assess the current HSR content and teaching approach in the MB,ChB curriculum, and to analyse it against the validated core competencies. Using a standardised piloted data extraction form, we extracted learning outcomes relating to foundational and area-specific, pre-specified competencies. The level of learning was assessed using Bloom's taxonomy of cognitive functioning,<sup>[15]</sup> by matching the verb contained in the learning outcome to the appropriate level of the taxonomy. The study guides contain the details of module objectives, outcomes, relevant course outlines and assessment methods for the whole 6-year medical curriculum.

Thirdly, an internet-based survey of recent graduates was conducted, using a standardised, piloted questionnaire, to assess their perception of how well they were equipped to address health systems issues in their clinical practice. Likert scale questions were used, along with open-ended qualitative questions.

Finally, an interview was conducted with key faculty staff, mostly module convenors, to establish their perception of the need to integrate teaching and learning opportunities to strengthen the health systems competencies of medical graduates.

### Study setting, sample and data collection

For the document review, the following information was extracted from all faculty module guides ( $N=64$ ): name of module; year and phase of study; department or division responsible; specific learning outcomes relevant to HSR were classified with the corresponding level of cognitive functioning according to Bloom's taxonomy. Two authors independently extracted the relevant learning outcomes. Judgements were made for cognitive/knowledge outcomes by matching the verbs contained in the learning outcome to verbs used to describe each level of Bloom's taxonomy. Two other authors reviewed and validated the extracted data and disagreements were resolved through discussion and consensus.

The survey of graduates was conducted using the SU online survey tool (SUN-Survey). A total of 980 medical students had graduated between 2004 and 2010. Contact details were available for 842 (86%). Between January and July 2012, eight email invitations and one cell phone reminder message were sent out to the 842 identified participants. A financial incentive was subsequently added as a lucky draw for participants who completed the whole questionnaire. Answers from the internet-based questionnaire were extracted using the SUN-Survey export function into an Excel spreadsheet.

A purposive sample of 30 key faculty staff (heads of divisions and module convenors) was selected for interviews and focus group discussions, which were conducted by trained qualitative researchers. The interviews and focus groups were recorded, transcribed, and analysed by three members of the team separately. All transcripts were analysed through coding and category development using

**Table 1. Identified and validated undergraduate HSR competencies**

#### Foundational attributes of a lifelong learner

*Clear communicator:* Able to communicate important aspects of theory, research findings clearly and effectively, in ways appropriate to various audiences; able to give, receive and incorporate feedback relevant to research and professional work

*Ethically and socially responsible:* Aware of, and committed to, ethical action and social responsibility in all research and professional activities, including respect for context and diversity, e.g. along lines of ethnicity, sex and gender, geography, education, income, occupation and others

*Critical thinker:* Able to critically appraise theory and evidence and to use independent judgement to synthesise information and place it in a broader context

*Problem-solver:* Able to conceptualise problems and use theory, evidence, context and reasoning to identify a range of possible solutions and make recommendations from among them

*Effective worker:* Able to work effectively, independently and collaboratively within teams; able to plan and manage projects through to completion on time and on budget

*Interdisciplinary:* Have capacity for, and orientation towards, working with and integrating the knowledge of people with different academic training, professional roles and sociocultural backgrounds

#### Breadth and depth of knowledge related to health and healthcare systems

*Disciplinary depth:* Possess detailed knowledge and skills from a specific discipline or field related to health services and policy research (e.g. epidemiology, medicine, nursing, sociology, economics, political science or management)

*Health systems:* Able to describe the main features of the SA healthcare system and to comparatively situate the SA system within the international context

*Determinants of health:* Able to define and work with concepts of health and identify the relative importance of broad determinants of health at the individual, group, community and population level

*Health research methods* (including basic epidemiology and statistics): Able to explain how health and disease are measured and how relationships between determinants (e.g. environmental, behavioural or treatment) and health are established

*Health economic theory:* Able to explain how health and healthcare differ from ordinary unique economic goods and describe core concepts in health economics (e.g. cost-effectiveness, health insurance, moral hazard)

*Organisational theory:* Able to understand a variety of theories concerning how people interact within and between organisations and to place such theories in the context of healthcare systems

*Evaluation methods:* Able to identify appropriate ways in which health services can be evaluated using tools of programme evaluation, health technology assessment and/or health economics

thematic analysis; and emerging themes were identified. Comparisons and disagreements were solved through discussion and consultation.

## Statistical analysis

Microsoft Office Excel 10.0 (Microsoft, USA) software was used for quantitative data from the paper review and quantitative survey data (background, demography and Likert scale data). Proportions were estimated for the quantitative results. ATLAS.ti 6.2 software was used to manage data from the qualitative survey and interview data.

## Ethical considerations

Ethical approval for the study was obtained from the SU Faculty of Medicine and Health Sciences Health Research Ethics Committee (Ref No N11/07/205 and S11/10/004). The study was funded by SURMEPI.

## Results

### Identification of HSR competencies

Table 1 provides the core HSR and strengthening competencies identified and validated by the curriculum review committee for the SU undergraduate medical curriculum. These competencies include foundational attributes of a lifelong learner, as well as breadth and depth of knowledge related to health and healthcare systems. These competencies are also described respectively as enabling and key competencies in the graduate attributes.<sup>[13]</sup>

### Document review of all theoretical and clinical module guides

The curriculum is divided into 3 phases. Phase 1 covers the first 6 months of the first year and provides a pre-clinical, interprofessional training phase. Phase II starts in the second half of the first year, providing largely theoretical clinical learning in year 2, and continuing to the middle of the fifth year as the main clinical training phase. Clinical rotations in Phase II have been further divided into early (year 3) and middle (years 4 - 5) clinical rotations. Phase III represents late clinical rotations commencing in the latter part of year 5 and extending to year 6.

Overall, the review found that competencies that are included in the curriculum consist of 'disciplinary depth' (in the medical sciences), 'health research methods' (mainly epidemiology and statistics) and 'determinants of health'. 'Health systems' appear mainly in late phase II and phase III (years 4 - 6), which is quite late in the curriculum to introduce undergraduates to the context in which they will be working.

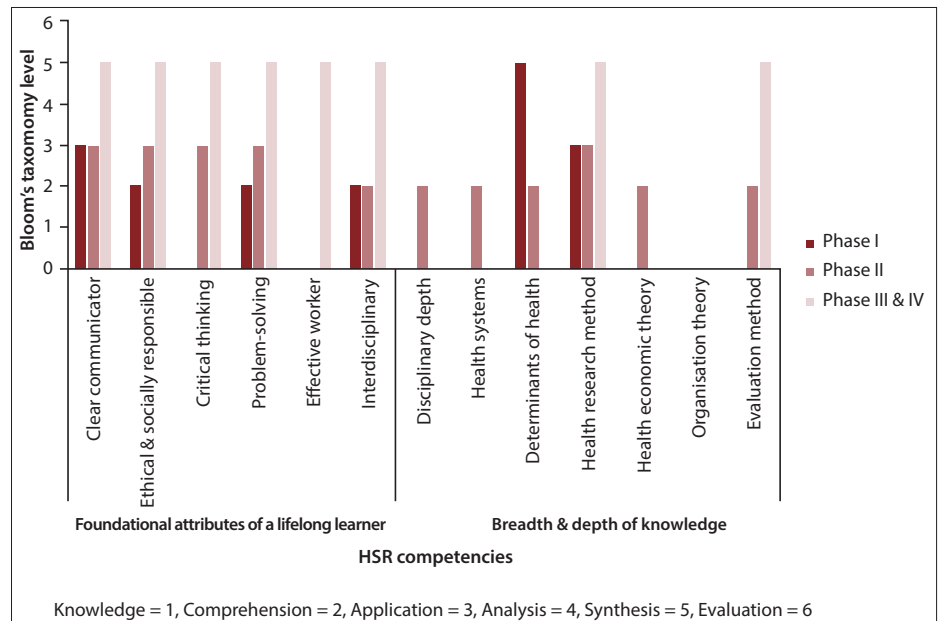


Fig. 1. HSR competencies delivered by phase and level of Bloom's taxonomy.

In phase I all foundational HSR competencies, except 'effective worker' and 'critical thinking', are included in two module outlines for this phase. Two of the HSR breadth and depth competencies are also introduced in this phase. Health research methods, particularly basic epidemiology and statistics are covered in two modules. In-depth competencies that are not covered at all in phase I include health systems (South Africa (SA) and global health systems), health economic theory, organisational theory and evaluation methods (Fig. 1).

During early phase II (third year), several of the foundational competencies are covered. Aspects of communication, problem-solving and ethical and social responsibility are covered in 3 modules. Critical thinking and interdisciplinary functioning also receive attention in one module.

In the middle phase II, the HSR teaching is concentrated entirely in two modules of the medical curriculum: the health and disease in communities module (fourth year) and the health management module (fifth year). Health systems are formally introduced for the first time in the curriculum in the health management module. Health research methods and evaluation methods are not formally taught in this phase, although students are expected to conduct 'projects' which may include research or evaluation on aspects of healthcare. These 'projects' are part of their clinical exposure and no clear generic outcomes and guidelines were documented in the study guide.

Students are also introduced to basic concepts in health financing. Some concepts of organisational theory are introduced as well, focusing both on the management of public sector primary health care (PHC) services and private medical practices.

The teaching approach consists mostly of didactic lectures, but includes the use of the university's online learning management system for self-directed learning. Clinical rotations in PHC services provide opportunities for students to be involved in various practical sessions and group work.

Assessment throughout the curriculum, as identified through the document review, includes formative assessments (continuous tutor assessment, research project, self-assessments, and oral presentations) and summative assessments (written tests, multiple-choice question (MCQ) tests, and a final examination which can be a practical or consist of long questions). Methods of assessment of the foundational competencies are based on class tests and written examinations only. This enables the assessment of knowledge and understanding, but has a limited ability to assess higher levels of learning.

### Survey of recent graduates

The response rate to the survey was 320/842 (38%). Tables 2 and 3 summarise the responses of graduates regarding their perception on HSR training.

From the 189 respondents who completed these questions, 128 (67.7%) agreed that it is important to learn about HSR in the undergraduate curriculum,

**Table 2. Graduates' responses regarding HSR training at SU**

	Agree totally <i>n</i> (%)	Agree strongly <i>n</i> (%)	Agree <i>n</i> (%)	Disagree <i>n</i> (%)	Disagree strongly <i>n</i> (%)	Disagree totally <i>n</i> (%)
It is important to learn HSR in the undergraduate curriculum	0 (0.0)	47 (25.0)	81(43.1)	10 (5.3)	1 (0.5)	3 (1.6)
Medical school training at SU prepared me well for practising HSR in the SA healthcare system	6 (3.2)	33 (17.5)	63 (33.3)	67 (35.4)	14 (7.4)	6 (3.2)

**Table 3. Graduates' responses regarding HSR competencies at SU**

To what extent were the following HSR components covered in the curriculum?	Not at all <i>n</i> (%)	Inadequate Basic <i>n</i> (%)	Adequate <i>n</i> (%)	Comprehensive <i>n</i> (%)
An understanding of the structure of the SA healthcare system	7 (3.7)	42 (22.2)	78 (41.3)	13 (6.9)
Knowledge of how the SA healthcare system relates to the rest of the world	27 (14.4)	60 (31.9)	66 (35.1)	5 (2.7)
Knowing whom problems should be reported to and how to elevate problems if needed	29 (15.5)	67 (35.8)	55 (29.4)	5 (2.7)
The ability to identify the most critical area in the healthcare system causing a specific health intervention to fail	19 (10.3)	62 (33.7)	54 (29.3)	3 (1.6)
Understanding the determinants of health	4 (2.1)	28 (15.0)	66 (35.3)	10 (5.3)
Understand how health and disease are measured	3 (1.6)	17 (9.0)	81 (42.9)	17 (9.0)
Comprehension of health economics and how it influences treatment you were able to give at your hospital	15 (8.0)	49 (26.1)	72 (38.3)	5 (2.7)
Understanding the complexity of interactions of people/patients between organisations	9 (4.8)	44 (23.4)	73 (38.8)	5 (2.7)
Ability to effectively evaluate the healthcare system or the service you are giving as a doctor	9 (4.9)	44 (24.0)	71 (38.8)	3 (1.6)
Ability to give feedback to decision-makers to allow them to make practical and necessary medical decisions	17 (9.1)	44 (23.5)	58 (31.0)	3 (1.6)

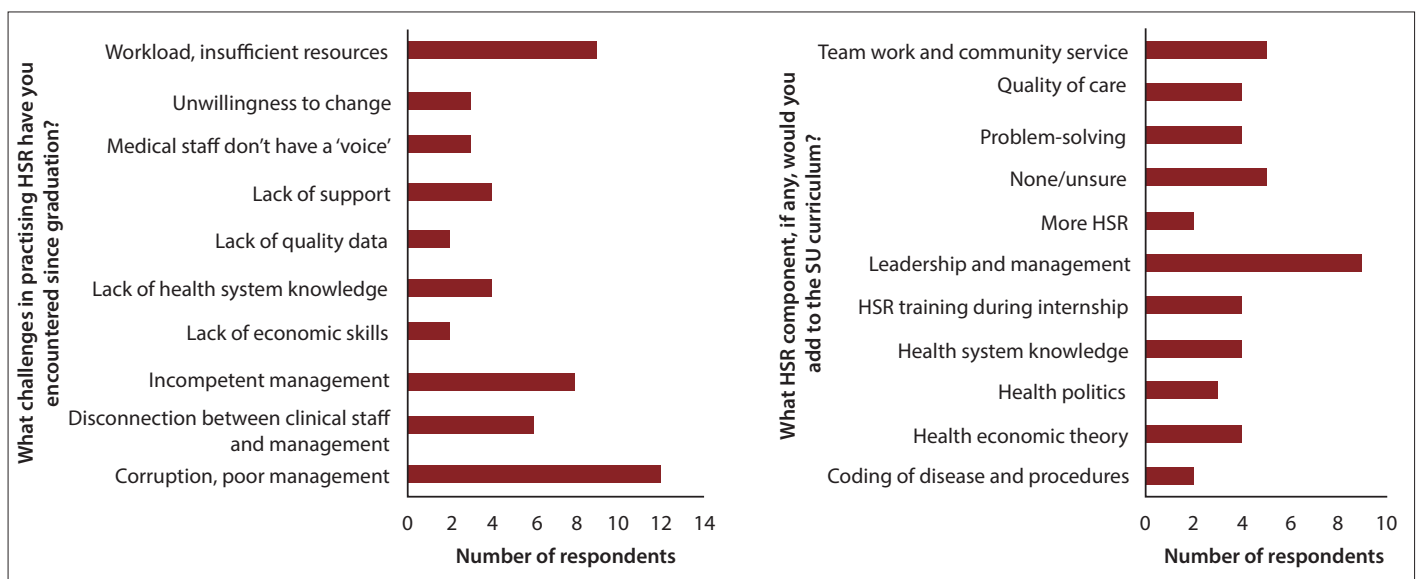


Fig. 2. Challenges and HSR needs from graduates' perspective.

given the challenges faced in practice; but 67 (35.4%) respondents indicated that the training did not prepare them to address HSR issues (Table 2 and Fig. 2).

They argued:

'I can't recall that we were taught anything on the health care system, so I would add as much as possible management skill training diplomacy.'

'This should be an obligatory module that extends throughout the course.'

## Faculty interviews

A total of 20 faculty members participated in five focus groups and ten individual interviews. The following themes emerged: understanding of HSR and the core competencies; relevance to medicine and the participant's department; teaching in the faculty and departments; measures of HSR assessment. Overall, the results show the need to incorporate more HSR teaching in the curriculum, despite many challenges faced by convenors; concerns were expressed about teaching capacity, and most of the interviewees indicated a lack of a clear understanding of HSR. They responded as follows:

'I think there's a big, big gap in the students' knowledge about health systems.'

'I think we do prepare our students for it but I don't think it's enough...'

'...they (students) must have quite a clear understanding of how the system functions ... because they work within the system.'

'Yah, maybe I don't understand exactly what you mean by health systems education.'

## Discussion

The review of study guides found that the teaching of the foundational and key HSR competencies was fragmented across the MB,ChB curriculum. HSR-specific (breadth and depth) competencies receive very little attention in the current curriculum. Those included are covered at a basic knowledge level, and there is little evidence of progression to higher levels of knowledge or application.

The graduates' lack of, and expressed need for, more HSR teaching in the qualitative answers is supportive of the quantitative results from the paper-based review. Previous studies have found that improvements in the quality of healthcare and continuity of healthcare system require adaptations in the medical curriculum.<sup>[7-9,11]</sup> The curriculum should be adapted so as to prepare students for the health system context and environment where they are expected to work.

Graduates suggested that several HSR themes be integrated or reinforced in the curriculum, including leadership and management, health system knowledge, problem-solving, team work and community service, quality of care and health economic theory. Evidence has shown that integrating HSR learning increases knowledge and skills in this field.<sup>[6]</sup> This requires enhancement of current teaching approaches so that explicit and specific teaching of HSR could be delivered across all phases within the MB,ChB curriculum.

This also aligns with needs identified by Patel *et al.*,<sup>[16]</sup> and supports the argument that curriculum transformation is needed towards increased academic excellence and health services delivery through training of students in the healthcare models that best serve population health needs.<sup>[2]</sup>

Despite the challenges identified in addressing HSR, faculty members were aware of the importance of HSR in the curriculum. If this neglected topic in the medical curriculum needs more attention, the approach should

be to make it practical, problem-based and relevant to the local and regional context as suggested by graduates.

The document review was limited in that it was based on the written information contained in the module guides of the MB,ChB curriculum. Assessments of the actual teaching and acquisition of HSR competencies, as well as the alignment of assessments to the learning outcomes could not be evaluated comprehensively through the document review. The findings were however triangulated with the survey of recent graduates and the interviews of module convenors, which validated the key findings from the document review. The opinions of health consumers were not obtained as part of this study. It is recommended that this should be considered for future research. Furthermore, the purposive sampling of faculty members and the lower response rate to the graduate survey despite SMS (text message) and email reminders, could have introduced a selection bias. However, from the open-ended questions we realised that the responses and number of new topics brought up in the responses became saturated. This study, which focused on SU, cannot be generalised to teaching and learning of medical graduates throughout SA, although there may be similarities. The approach to curriculum understanding, and then enhancement, is however robust and could be used in other medical schools and settings.

## Conclusions

We describe the teaching and learning of HSR in the SU undergraduate curriculum. Most of the foundational competencies for HSR are covered throughout the curriculum, but in a fragmented manner with limited evidence of continuity and progression in the learning. Very little attention is paid to HSR-specific competencies which are introduced late in the curriculum, or not at all. If medical graduates are to understand and be able to work in the context of the SA health system, they need to be introduced to health systems much earlier, and it should be an important component of their ongoing learning.

A significant proportion of recent graduates felt they were not equipped with competencies to address health systems challenges in their work situations. Furthermore, the document review suggests that there are insufficient teaching, learning and assessment opportunities for HSR in order to develop medical graduates who can critically engage within the health system. This was supported by the module convenors.

The four components of this review provide evidence for improvements in HSR teaching and learning in the undergraduate medical curriculum. The review involves and elicits the views of key role-players in the research process. The review has clarified which health systems competencies are important for undergraduates, has identified gaps in the current curriculum and opportunities for developing these competencies. This research component has played an important role in the curriculum renewal process at SU, and is contributing to the development of a transformative curriculum, through which health graduates can acquire competencies that will contribute to evaluating, problem-solving and strengthening the health system within which they function. Changes to the curriculum have been implemented, based on gaps identified in the study.

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## References

1. Frenk J, Chen L, Bhutta ZA, et al. Health professionals for a new century: Transforming education to strengthen health systems in an interdependent world. *Lancet* 2010;376(9756):1923-1958. [[http://dx.doi.org/10.1016/S0140-6736\(10\)61854-5](http://dx.doi.org/10.1016/S0140-6736(10)61854-5)]
2. Celletti F, Reynolds TA, Wright A, Stoertz A, Dayrit M. Educating a new generation of doctors to improve the health of populations in low- and middle-income countries. *PLoS Med* 2011;8(10):e1001108. [<http://dx.doi.org/10.1371/journal.pmed.1001108>]
3. Kirigia JM, Gbary AR, Muthuri LK, Nyoni J, Seddoh A. The cost of health professionals' brain drain in Kenya. *BMC Health Services Research*. 2006;6:89. [<http://dx.doi.org/10.1186/1472-6963-6-89>]
4. Greysen SR, Dovlo D, Olapade-Olaopa EO, Jacobs M, Sewankambo N, Mullan F. Medical education in sub-Saharan Africa: A literature review. *Med Educ* 2011;45(10):973-986. [<http://dx.doi.org/10.1111/j.1365-2923.2011.04039.x>]
5. Chen LC. Striking the right balance: Health workforce retention in remote and rural areas. *Bull World Health Organ* 2010;88(5):323. [<http://dx.doi.org/10.2471/BLT.10.078477>]
6. Mandl KD, Lee TH. Integrating medical informatics and health services research. *J Am Med Inform Assoc* 2002;9(2):127-132. [<http://dx.doi.org/10.1197/jamia.M0973>]
7. Solyom AE. Viewpoint: Improving the health of the public requires changes in medical education. *Acad Med* 2005; 80(12):1089-1093. [<http://dx.doi.org/10.1097/00001888-200512000-00004>]
8. Poncelet AN, Mazotti LA, Blumberg B, Wamsley MA, Grennan T, Shore WB. Creating a longitudinal integrated clerkship with mutual benefits for an academic medical center and a community health system. *Perm J* 2014;18(2):50-56. [<http://dx.doi.org/10.7812/TPP/13-137>]
9. Pershing S, Fuchs VR. Restructuring medical education to meet current and future health care needs. *Acad Med* 2013;88(12):1798-1801. [<http://dx.doi.org/doi:10.1097/ACM.000000000000020>]
10. Mullan F, Frehywot S, Omaswa F, et al. Medical schools in sub-Saharan Africa. *Lancet* 2011;377(9771):1113-1121. [[http://dx.doi.org/10.1016/S0140-6736\(10\)61961-7](http://dx.doi.org/10.1016/S0140-6736(10)61961-7)]
11. Armstrong EG, Mackey M, Spear SJ. Medical education as a process management problem. *Acad Med* 2004;79(8):721-728. [<http://dx.doi.org/10.1097/00001888-200408000-00002>]
12. Frank JR. The CanMEDS 2005 Physician Competency Framework The CanMEDS 2005 Physician Competency Framework. Better standards. Better physicians. Better care. Ottawa: The Royal College of Physicians and Surgeons of Canada, 2005.
13. Graduate attributes for undergraduate students in teaching and learning programmes at the Faculty of Medicine and Health Sciences. Stellenbosch University, July 2013. <http://www.sun.ac.za/english/faculty/healthsciences/Documents/Graduate%20attributes%20FMHS%20-%20ENGLISH%20-%201%20July%202013.pdf> (accessed 5 June 2014).
14. Lohr KN, Steinwachs DM. Health services research: An evolving definition of the field. *Health Serv Res* 2001;37(1):2001-2003. [<http://dx.doi.org/10.1111/1475-6773.01020>]
15. Bloom's Taxonomy. The Three Types of Learning. <http://www.nova.edu/hpd/testing/ctl/forms/bloomstaxonomy.pdf> (accessed 13 February 2012).
16. Patel MS, Lypson ML, Davis MM. Medical student perceptions of education in health care systems. *Acad Med* 2009;84(9):1301-1306. [<http://dx.doi.org/10.1097/ACM.0b013e3181b17e3e>]