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TEMPORARY “MOBILE” PRE-HOSPITAL RURAL CLINICS IN SUDAN EDUCATION, CHARITY AND BEYOND: A SCIENTIFIC APPROACH TO AN OLD MODEL

ABSTRACT

BACKGROUND

The health care access is very limited of people living in low-income countries. Medical students studying in these countries are deprived of the experienced medical educationalists as a result of emigration. State-wide strategies are needed to solve these problems; However, individual efforts from local medical institutions (and foreign help) play a major role. Temporary rural (free-of-charge) clinics were set up by national and international charities, which often represent the only source of healthcare in many deprived rural communities in Sudan.

METHODS

Determined to use the model of old rural clinics, models have been implemented in educational and charitable programmes in the form of a cohesive medical camp targeting six deprived areas in North Sudan in January 2019, with the collaborative approach between the Medical School at the University of Khartoum (Med-UofK) and Cambridge University Hospital Foundation Trust (CUHFT).

A structured medical education programme was performed for the benefit of the participating medical students. In addition, the village patients were reviewed as part of a comprehensive mobile clinic pathway, all free of charge.



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RESULTS

More than 115 medical personnel have participated in a 3-day students-led camp where approximately 680 patients were examined and treated. Medical education, delivered by senior staff, received a global positive feedback and measurable outcome was confirmed in the improvement of students' confidence in conducting various bedside clinical skills.

CONCLUSION

Combining charity and education in this implemented (student-led) project, with the benefits and experience of an international collaboration, received positive feedback by all involved personnel (medical students, educationalists and local patients). This sustainable and reproducible model that can be applied across many areas, particularly for countries those have deprived communities (e.g. refugee camps) and rural villages with low-income.

Sudan, a country located at the north-eastern aspect of Africa just to the south of Egypt, has once been the largest country in Africa before it split in 2011 into North and South independent states. Despite its wealth of assets and richness in resources, it continues, to be one of the low-income countries, that struggle to help its local people. This is mainly due to the lack of strategic planning, together with the increasing prevalence of civil conflicts (Tam et al., 2004). As a result, local people often suffer on many fronts, and needless to say, healthcare facets which undoubtedly suffer the most (Macfarlane et al., 2000 and Peters et al., 2008). The lack of strategic investment in healthcare systems is linked to the increased rates of morbidity and mortality in low-income countries (Kruk et al., 2018), and of which Sudan is a perfect example.

Laterally, undergraduate medical education in countries like Sudan often suffers a fate. Like the “mass-exodus” of healthcare professionals is on the rise, which adds to the burden of the existing struggling system (Medakkar et al., 2018). This leaves medical institutions with reduced numbers of experienced educational staff, which adversely affects the process of undergraduate medical education (Rigby and Gururaja, 2017).

While we realise that state-level solutions are needed to address the roots of these problems, we should not underestimate the roles and efforts of local individuals and institutions, together with support provided by foreign non-governmental organisations (NGOs). Good examples of local projects run to improve healthcare in Sudan are the rural medical missions conducted by the Faculty of Medicine at the University of Khartoum (Med-UofK). These missions, which date back to 1960s, are predominantly run by local medical students who are fresh medical graduates. They are considered a significant contribution to the public healthcare front and are usually well received by the targeted rural areas. A large team of medical students and fresh graduates visit a rural area and camp for a few days, where they deliver free health care and medical education. However, measurement of success of such proj-

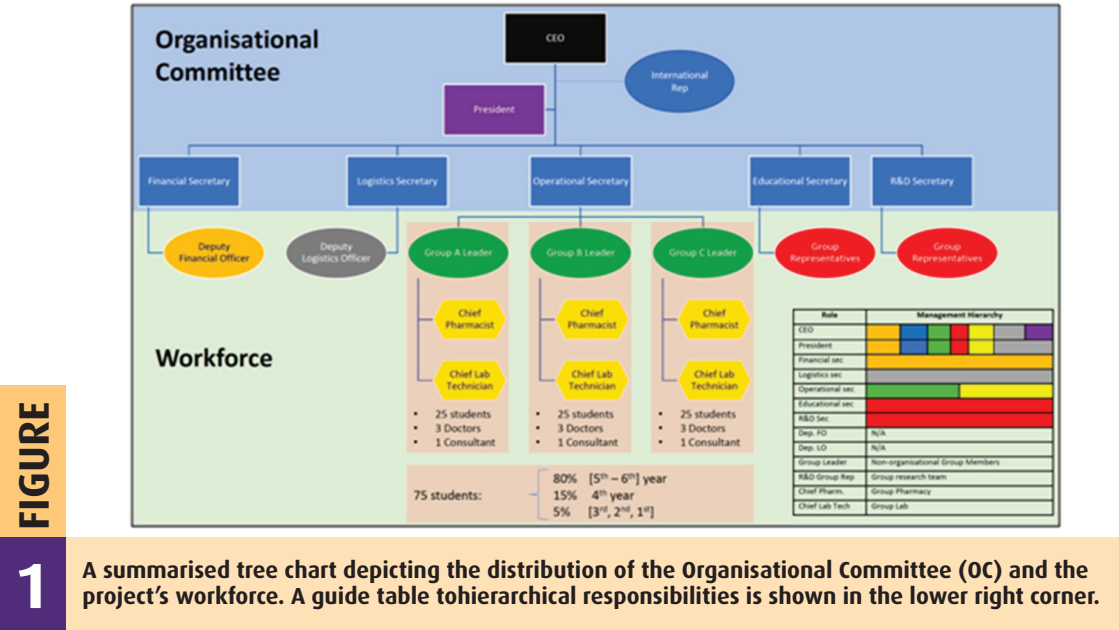
ects had not been previously standardised. As a result, no major implementation had taken place to improve their execution. This article describes a project similar to these missions, however, with a revolutionised delivery of medical education, healthcare and charity. It was performed in a way that allows continuity, sustainability and reproducibility, if a different area is targeted in future, either in Sudan or in other similar countries.

METHODOLOGY

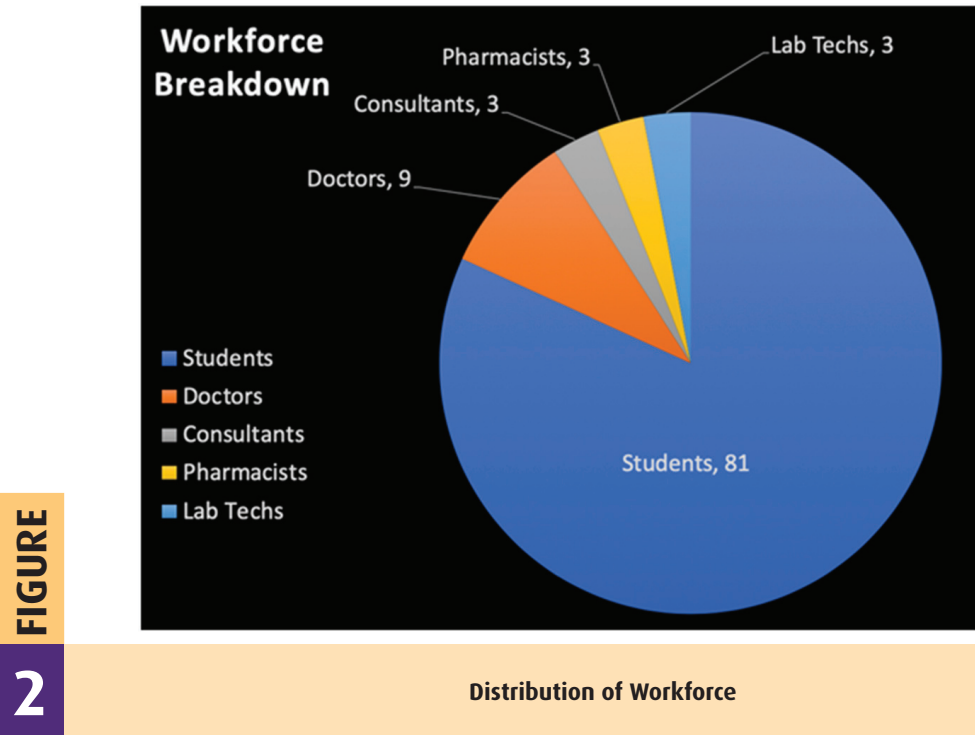
A group of medical students from the University of Khartoum, Khartoum – Sudan (n=81), in collaboration with medical

Medical education; healthcare; low-income countries; pre-hospital clinics

doctors from the Cambridge University Hospital, Cambridge – UK, have worked together to deliver this project, titled: the Meroe Medical and Educational Mission MMEM_2019. A workforce team of 115 medical personnel (medical students, doctors, pharmacists, laboratory technicians) and local entrepreneurs were recruited (Figures 1 and 2). The team (divided into three groups) camped for three days in Meroe, a historic city in the north of Sudan



A summarised tree chart depicting the distribution of the Organisational Committee (OC) and the project’s workforce. A guide table to hierarchical responsibilities is shown in the lower right corner.



Distribution of Workforce

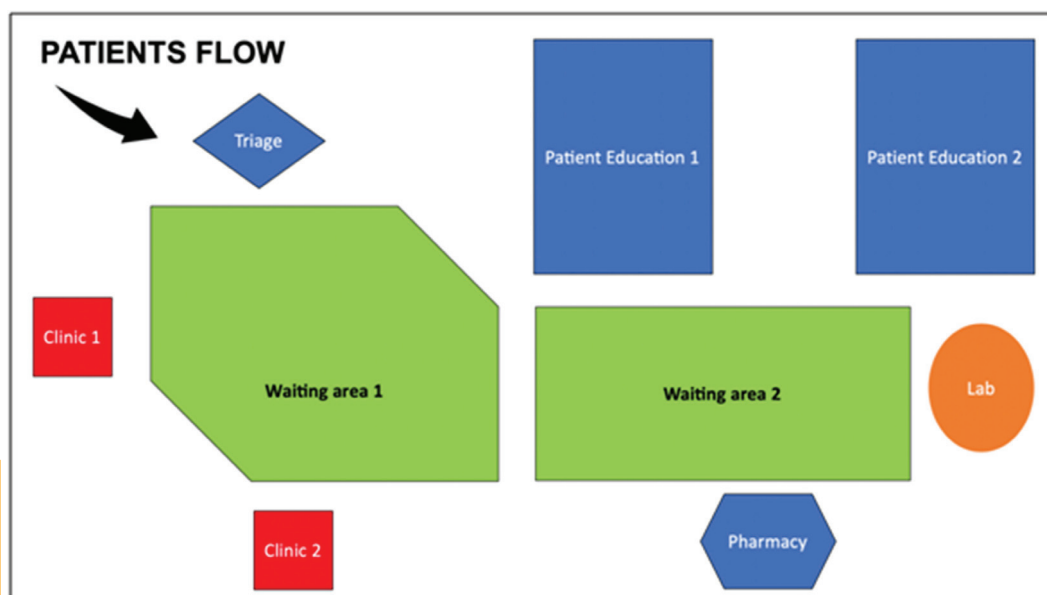
(Figure 3). Over two days, each group travelled from the centre (the city of Meroe) to a rural village (Figure 3) to deliver a full medical day camp. These medical camps involved in the setup of medical consultation clinics, a basic laboratory for routine medical investigations, basic pharmacy and structured medical education sessions for the local inhabitants. During each of the medical camp, students were actively involved in patients' assessments. They were exposed to the essentials of how to operate a medical clinic participated in bench-side laboratory work and learned the etiquette of prescribing and safe dispensing of medications.

Organising Committee (OC) and Participants

The OC (composed mainly of local medical students) were selected by the University of Khartoum Medical School (Med-UofK). Doctors, pharmacists and laboratory technicians were selected based on an individual's teaching interests and teaching track-records. It was favorable to individuals who were passionate about medical education and had experience in teaching medical students. With regards to the students who wished to participate, an application form was made available in various Med-UofK online platforms. Out of 700 applicants, randomisation was performed to select 75 students [60 students from years 5 and 6 (30 from each year), 12 students from year 4 and one student from each of the other levels (years 1, 2 and 3)], Figures 1 and 2.

Area Selection

Sudan was selected because of the authors' links to the country. However, the model was made to be applicable to any country/area with reduced access to healthcare. The North-



FIGURE

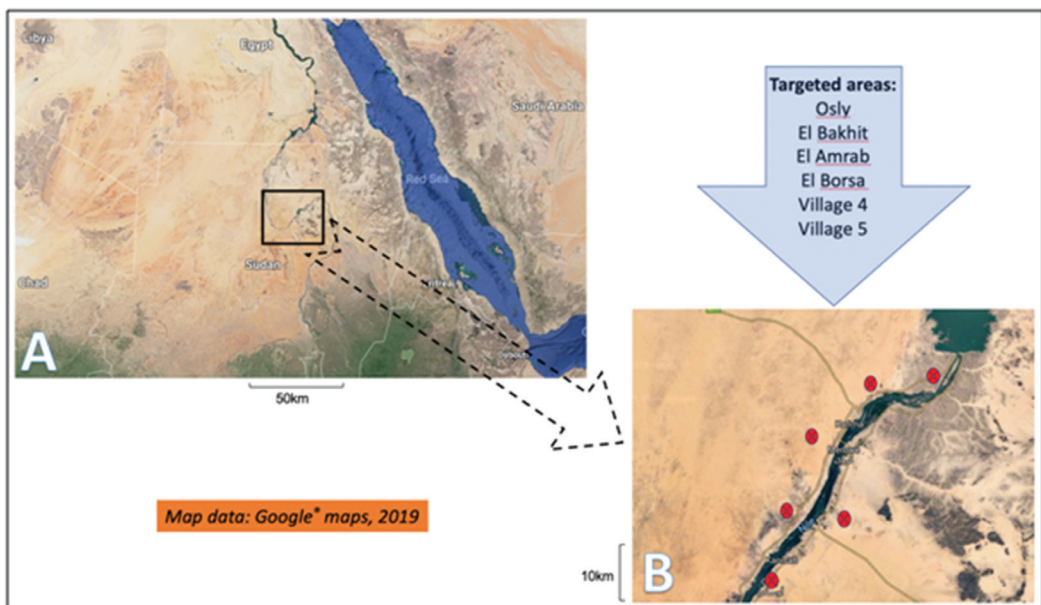
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Schematic representation of the mobile clinic setup. All patients would attend the triage room first, from which they are transferred to the respective areas.

ern state of Sudan (Meroe in particular) was selected following a structured voting exercise (conducted by members of the organisational committee and the visiting doctors). The villages around the Meroe region were selected according to the demand. This was assessed by the data of the local population made available by the local government. Factors that were used to select a particular village included the population of each village, the prevalence of chronic diseases, distance to healthcare centres and the socioeconomic status, Figure 4.

Work Structure

The team ($n=115$) was divided into three groups (A, B and C). Transportation from Khartoum to Meroe took place the day before the commencement of the programme. Associating students and teachers in the same transport vehicles and offering them similar accommodation areas that paved way for good integration and convenient icebreaking, which is essential for the educational process (Abdulrahman, 2005). In Meroe, the accommodation was arranged, and meals were provided daily. Living standards, transport and work environments were made as comfortable as possible, to create a good medium for learning and education, in order to increase the productivity (Hardeman et al., 2015). Over two days, the three groups visited six villages, where they conducted full medical days. During each medical day, the group reviewed patients, conducted medical assessments, performed routine laboratory investigations and dispensed medications (all free of charge). Concurrently health education sessions for the locals were performed regularly.



FIGURE

4

Geographical location of the six targeted villages. Data taken from Googlemaps® 2019.

Educational Programme Setup

Students of Year 5 and 6 were provided with an MMEM_2019 logbook, analogous to the standard logbooks that were developed by medical schools for clinical education (Schüttpeitz-Brauns et al., 2016). Students were encouraged to fill their logbooks during the medical days and were regularly reviewed by the representative group's educational secretary. Pre and post-mission 5-pointed confidence "Likert" scales were performed by students from years 5 and 6. Areas targeted on this assessment were essential clinical assessment skills (e.g. history taking, clinical examination and communication skills), Figure 5.

RESULTS

Participants

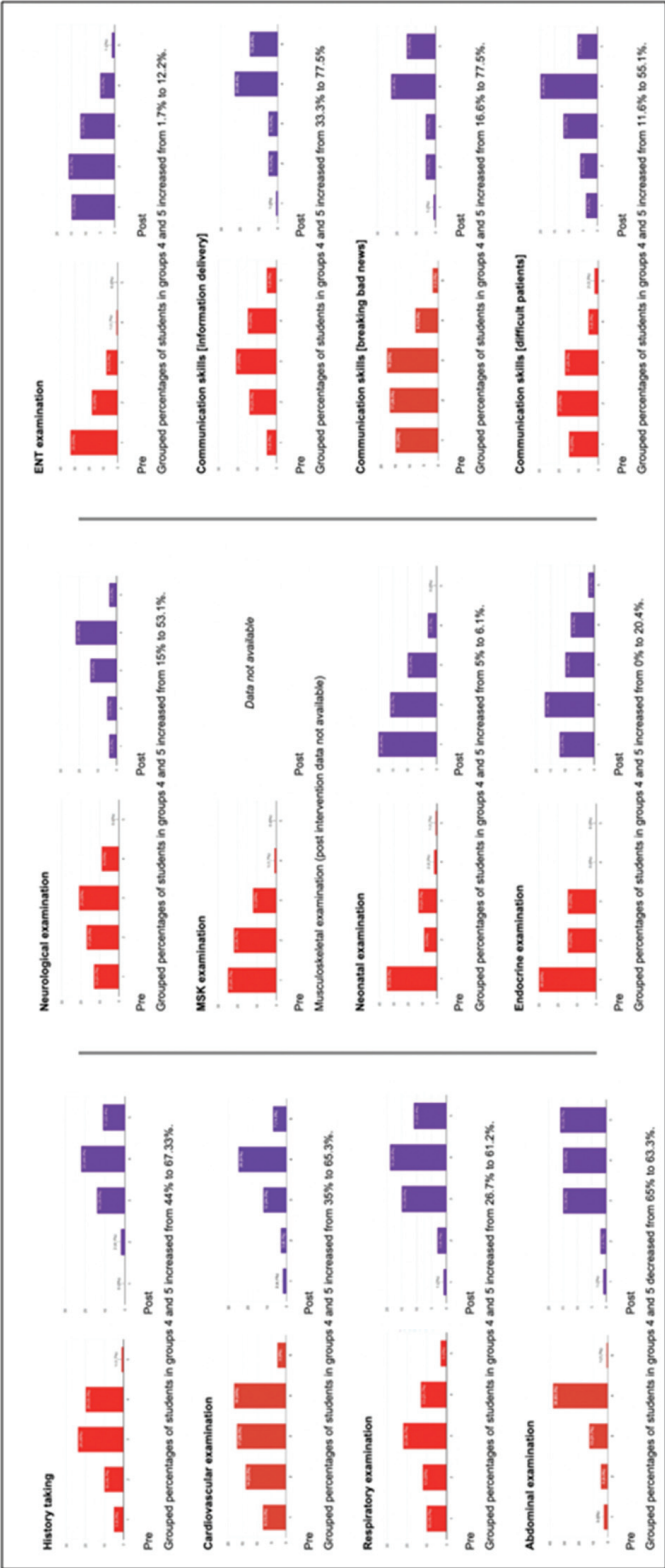
Eighty-one students (of whom 80% were females) have participated in this project (75 randomly selected and 6 OC members). The assessment of students' educational needs was measured by planned questionnaires, of which 100% were returned. Common educational needs identified by students' include training in history taking, bedside clinical examination skills and improvement in doctor-patient communication.

Educational Results

Responses received from the Questionnaire were collected from students of year 5 and 6 in the form of a confidence scale assessments and are shown in Figure 5. Students reported an overall improvement in confidence level while performing history taking, clinical examination and communication skills. Areas of modest improvement were neonatal and Ear, Nose and Throat (ENT) systems examination. Students and educationalists have conveyed positive feedback in multiple formats (comments on feedback stickers, social media texts, gift cards and verbal communications). A strong will to repeat the project on a larger scale involving other areas of Sudan was expressed by students, staff from Med-UofK and the participating educationalists.

Clinical Results

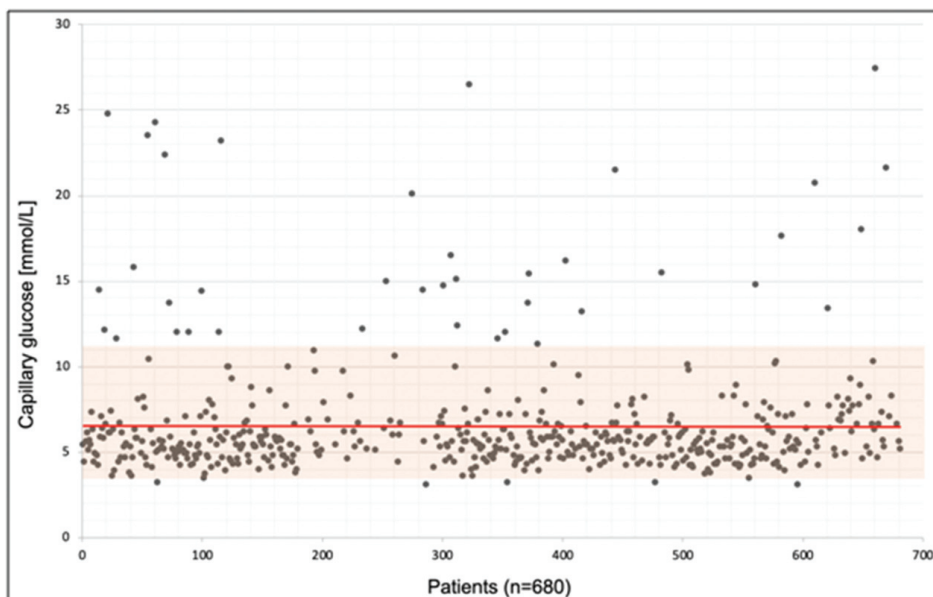
More than 681 patients were examined over two days. Numerous clinical statistics were collected using the project's triage form (demographics, pulse, blood pressure, BMI, medical history, routine investigations, diagnoses and treatment plans). Illustrative examples of capillary blood glucose measurements and blood pressure data were collected from all patients and are shown in Figures 6A and 6B, respectively. Diseases encountered included numerous chronic medical conditions (e.g. essential hypertension and diabetes), tropical diseases such as malaria, rabies, kala-azar, schistosomiasis, mycetoma and strongyloidiasis (Figure 6C, one case), and rare conditions such as Multiple Endocrine Neoplasia (MEN).



FIGURE

5

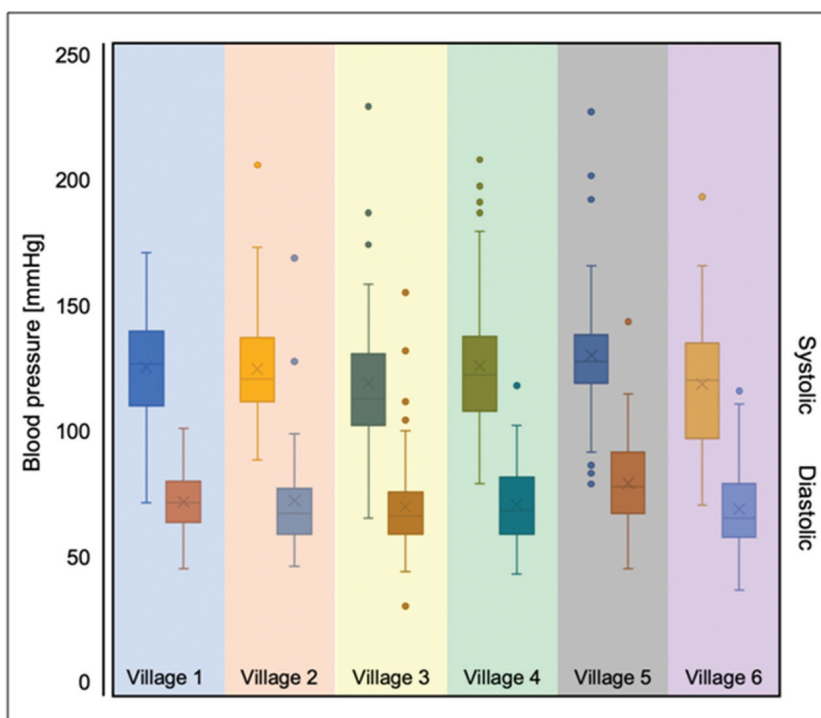
Schematic representation of the mobile clinic setup. All patients would attend the triage room first, from which they are transferred to the respective areas.



FIGURE

6A

Random capillary blood glucose (CBG) measurements. 39 patients were shown to have hyperglycaemia, of whom, 32 were known diabetics on treatment. Seven patients were diagnosed with hyperglycaemia [random CBG > 11.1 mmol/L] and therefore referred for formal assessment.



FIGURE

6B

Blood pressure (BP) data recorded in the 6 visited villages. This data is shared with the Northern State Ministry of Health

**FIGURE****6C**

Direct light microscopy image of a stool sample showing a *Strongyloides stercoralis* (thread-worm) egg (arrowed). The patient (a 3-year-old child) and his 5 siblings were treated with a course of Albendazole. Focused health education sessions (involving food hygiene and hand-washing techniques) were given to the family, to prevent cross contamination/ recurrence.

DISCUSSION

Medical students at Med-UofK found it beneficial to participate in the Meroe Medical and Educational Mission (MMEM_2019) and have gained a considerable exposure to a wide range of clinical skills, more than they expected. Despite the heavy work involved in conducting this project, students reported that the skills they acquired in such a short period were better than those acquired while spending weeks on hospital ward rounds, where a single patient can sometimes be used to educate a large group of students. Although the project design was expected to help students prepare for their final clinical exams and at the same to deliver charity to the local inhabitants, there has been positive feedback from students with regards to the opportunities they received in developing their skills in organisation, leadership, case presentation/discussion, scientific thinking and evidence-based clinical practice.

The decline in bedside clinical skills amongst medical students is an increasingly noticed phenomenon (Faustinella and Jacobs, 2018). This is thought to be a multifactorial, with the main factor being the wide availability of advanced laboratory investigations and imaging

modalities, which allows easy access to reach a diagnosis, in many cases without the need to perform a single bedside clinical examination. As such, healthcare providers in low-income countries have less access to advanced investigations and therefore depend primarily on their bedside clinical skills in reaching a diagnosis (Ngoya et al., 2016). Figure 5 shows clear evidence of improvement in the students' confidence in taking a detailed medical history, performing systems clinical examination and in communication skills. To our knowledge, this is the first model that allows the implementation of a rural medical educational and charitable camp, organised by students, in collaboration with foreign educationalists who contributes with organisational experience and medical education.

Senior healthcare individuals working in high-income countries, who have graduated from medical institutions in low-income countries, are likely to see this model as an opportunity to help their local community, without the need to relocate or spend huge sums of money in charity. In this project, more than 680 patients were examined in 2 days. All patients provided verbal consent for students to be present during their review, which increased the students' exposure to opportunities for conducting bedside assessments. The positive spirits and the high morale in this project contributed to the success in the aspects of education and charity. This was evident from the positive feedback received by participants and patients during and after the feedback from the project.

Student-led learning is a very effective way of delivering education, mainly if supported by senior educators (Merridew and Wilkinson, 2010). In MMEM_2019, students felt that had have ownership of their project and worked with such a passion that permitted excellent results, under the supervision and guidance of the senior staff. For such a challenging project, the success is directly related to the teamwork skills exhibited by medical students working on the ground, which (in our experience) was boosted by the fact that students were involved in every detail of the programme setup. There is evidence supporting this argument (Klug and Bagrow, 2016). Another positive approach that contributed to the success of this project was the meticulous organisational skills and the regular OC meetings.

There is growing evidence that mobile rural clinics constitute an efficient, cost-effective and a smart way to deliver medical care for a large population (Yu et al., 2017, Kojima et al., 2017, Chen et al., 2015, Aljasir and Alghamdi, 2018, Lindgren et al., 2011). Many patients did not have access to any form of medical care and have chosen to live with their untreated chronic illnesses (e.g. toxic multinodular goitre, resistant hypertension, severe anaemia, poorly controlled diabetes and mental health disorders). The main reasons for this include their poor socio-economic status in a country where medical care is not free, together with their inability to travel to main cities to visit a hospital. The project allowed these patients to have free medical assessment and treatment, close to home. For the challenging illnesses that required access to secondary care, referrals to Khartoum Teaching Hospital (the University unit) were organised. This was collaboratively agreed with the University ahead of the project's commencement. Patients were given detailed referral letters and were seen in the hospital free of charge. In addition to clinical care, this project delivered structured

education sessions to patients in large numbers who were local villagers. Educating the patient has long been set as one of the most useful tools in the prevention of disease (Eckman et al., 2012, Street et al., 2009). They provided several educational sessions to the patients targeting common diseases and health issues such as childhood vaccinations, prevention of communicable diseases, awareness about sexually transmitted illnesses, the importance of consuming balanced meals and the importance of preventing improper practices (e.g. female genital mutilation (FGM) surgeries).

The foreign educationalists who visited the medical clinics experienced less access to the advanced investigations. As such, they delivered excellent quality clinical education that was purely based on bedside skills. Exposure to tropical disease has been phenomenal, in comparison to a daily doctor’s work at a secondary hospital in non-tropical countries. This setting allowed the team to spend more time with patients, which improved the doctor-patient rapport.

CONCLUSION

This project is likely to set the foundation for a sustainable and reproducible model of undergraduate medical education and charity. Areas that can benefit from such a model are low-income countries (where healthcare is paid for), distant rural villages with poor access to healthcare and refugee camps. It can be a boost to International medical graduates working in foreign countries can be enticed to return to their original countries for a short period to perform similar projects. Through this model, a quality contribution to the community and local medical institutions is made evident.

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Conflicts of Interest

Authors declare no conflict of interest

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REFERENCES

- Abdulrahman, K.A. Bin (2005) Med M. Medical Education Students' Views On Student-Teacher Relationship: A Questionnaire-Based Study, pp.81–7.
- Aljasir, B. and Alghamdi, M.S. (2018) Patient satisfaction with mobile clinic services in a remote rural area of Saudi Arabia. *Eastern Mediterranean Health Journal*.
- Chen, N., Hsieh, H.P., Tsai, R.K. and Sheu, M.M. (2015) Eye care services for the populations of remote districts in eastern Taiwan: A practical framework using a Mobile Vision Van Unit. *Rural Remote Health*.
- Eckman, M.H., Wise, R., Leonard, A.C., Dixon, E., Burrows, C., Khan, F. et al. (2012) Impact of health literacy on outcomes and effectiveness of an educational intervention in patients with chronic diseases. *Patient Education and Counseling*.
- Faustinella, F. and Jacobs, R.J. (2018) The decline of clinical skills: A challenge for medical schools. *International Journal of Medical Education*, Vol. 9, pp.195–7.
- Hardeman, R.R., Burgess, D., Phelan, S., Yeazel, M., Nelson, D. and van Ryn, M. (2015) Medical student socio-demographic characteristics and attitudes toward patient centered care: Do race, socioeconomic status and gender matter? A report from the Medical Student changes study. *Patient Education and Counseling*.
- Klug, M. and Bagrow, J.P. (2016) Understanding the group dynamics and success of teams Subject Category : Subject Areas : Author for correspondence
- Kojima, N., Krupp, K., Ravi, K., Gowda, S., Jaykrishna, P., Leonardson-Placek, C. et al. (2017) Implementing and sustaining a mobile medical clinic for prenatal care and sexually transmitted infection prevention in rural Mysore, India. *BMC Infectious Diseases*.
- Kruk, M.E., Gage, A.D., Joseph, N.T., Danaei, G., García-Saisó, S. and Salomon, J.A. (2018) Mortality due to low-quality health systems in the universal health coverage era: A systematic analysis of amenable deaths in 137 countries, Lancet.
- Lindgren, T.G., Deutsch, K., Schell, E., Bvumbwe, A., Hart, K.B., Laviwa, J. et al. (2011) Using mobile clinics to deliver HIV testing and other basic health services in rural Malawi. *Rural Remote Health*.
- Macfarlane, S., Racelis, M. and Muli-Musiime, F. (2000) Public health in developing countries, Lancet.
- Medakkar, P., Akinawo, E., Stewart-Pyne, A., Owusu, Y. and Ashu, E. (2018) Emigration of Skilled Healthcare Workers from Developing Countries: Can Team-based Healthcare Practice Fill the Gaps in Maternal, Newborn and Child Healthcare Delivery? *International Journal of MCH and AIDS*, Vol. 6, No. 2, pp.121–9.
- Merridew, N. and Wilkinson, D. (2010) Expanded partnerships between medical faculty and medical students: Developing a global health curriculum as an example of “student-led learning” at the University of Queensland, Australia. *Med Teach*, Vol. 32, No. 11, pp.919–25.
- Ngoya, P.S., Muhogora, W.E. and Pitcher, R.D. (2016) Defining the diagnostic divide: An analysis of registered radiological equipment resources in a low-income African country. *Pan African Medical Journal*, Vol. 25, pp.1–7.
- Peters, D.H., Garg, A., Bloom, G., Walker, D.G., Brieger, W.R. and Hafizur Rahman, M. (2008) Poverty and access to health care in developing countries. *Annals of the New York Academy of Sciences*.
- Rigby, P.G. and Gururaja, R.P. (2017) World medical schools: The sum also rises. *JRSM Open*, Vol. 8, No. 6:205427041769863.
- Schüttelz-Brauns, K., Narciss, E., Schneyinck, C., Böhme, K., Brüstle, P., Mau-Holzmann, U. et al. (2016) Twelve tips for successfully implementing logbooks in clinical training. *Med Teach*, Vol. 38, No. 6, pp. 564–9.
- Street, R.L., Makoul, G., Arora, N.K. and Epstein, R.M. (2009) How does communication heal? Pathways linking clinician-patient communication to health outcomes. *Patient Education Counseling*.
- Tam, C.C., Lopman, B.A., Bornemisza, O. and Sondorp, E. (2004) Epidemiology in conflict - A call to arms. *Emerging Themes in Epidemiology*, Vol. 1, pp. 3–5.
- Yu, S.W.Y., Hill, C., Ricks, M.L., Bennet, J. and Oriol, N.E. (2017) The scope and impact of mobile health clinics in the United States: A literature review. *International Journal for Equity in Health*, Vol. 16, No. 1, pp.1–12.

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