

Introduction

An insufficient global surgical workforce is a major barrier to accessing safe surgery for billions of people worldwide [1]. The numbers of fully trained surgeons, anaesthetists, and obstetricians (SAO) are insufficient and unequally distributed, between and within countries [1]. Rural populations in many low- and middle-income countries (LMICs) are particularly affected due to the low workforce density outside of urban centres. Malawi, where 84% of the population lives in rural areas, faces such challenges [2]. Its specialist surgical workforce is 0.43 per 100 000 population [3], well below the WHO recommended target of 20 per 100 000 population by 2030 [4] and primarily located at the four tertiary hospitals in the cities of Blantyre, Lilongwe, Zomba and Mzuzu. District hospitals (DHs) are the main providers of essential surgical care in rural areas. Due to the shortage of specialists, they are mostly staffed with Clinical Officers (COs), a type of non-physician clinician who undergoes a 3-year training in clinical medicine. As part of their qualifications, COs are formally trained to perform basic surgical and obstetric procedures, along with providing other clinical services [5]. Studies have highlighted the need to support these health workers in their role by strengthening their competences and confidence through enhanced training, mentorship, and supervision [5, 6], enabling them to effectively deliver a broad range of essential surgical services and refer patients for specialist care, where indicated [1, 7].

The increasingly widespread use of mobile communication technologies, such as WhatsApp, in clinical settings [8–10] offers an opportunity to enhance district hospital capacity by allowing remote rural clinicians have real-time access to specialist advice

and supervisory support [10]. Studies, including from sub-Saharan Africa, recommend smartphone-based technologies as useful tools for supervision [9, 11, 12], training [8, 9]; and for relationship building between local non-specialist staff and distant experts [8]. Such links can help non-specialists overcome geographical and resource barriers to accessing expert advice when needed, and contribute to more timely and efficient consultations, better clinical decision-making [9, 13, 14] and patient management [10]. Smartphone communication may also improve the quality and safety of surgical care delivery [9] and referrals [8].

In 2018, the implementation research project ‘Scaling Up Safe Surgery for District and Rural Populations in Africa (SURG-Africa)’ established a remote managed consultation network (MCN) based on WhatsApp to connect district hospitals in Southern Malawi with Queen Elizabeth Central Hospital (QECH) and Zomba Central Hospital (ZCH), the main referral centres for this region. The objective was to strengthen the delivery of safe and timely surgical care in rural areas , thereby improving equitable access to and quality of health service delivery for underserved populations, a Malawi Health Sector Strategic Plan II priority [15]. A description of the initiative and the implementation research approach employed, are reported elsewhere [16].

Material and Methods

We conducted a prospective review of all clinical consultations made through the SURG-Africa MCN over the eight-month period May to December 2018. The presentation of our study follows the Strengthening the Reporting of Observational

Studies in Epidemiology (STROBE) reporting guidelines [17]. In May 2018, the SURG-Africa MCN was established to facilitate communication between mentors and mentees, allowing real-time consultation and exchange of information within a controlled and safe environment. The mentors were surgeons and anaesthesiologists based at QECH and ZCH. Mentees were surgical clinical officers (COs) and anaesthesia providers based at participating district hospitals (DHs). The group initially comprised 55 district-level clinicians from the 9 DHs, and 16 specialists from QECH and ZCH. WhatsApp messenger platform was chosen because it is widely used by Malawians; hence, the MCN system was virtually cost-free for the project and participants, contributing to future sustainability. It also allowed rapid sharing of images, videos, and audio clips, not possible with traditional communications. The SURG-Africa Country Coordinator (GM) was MCN manager and moderator. The MCN was designed to enhance but not replace the existing referral communication system, where DH clinicians complete a referral form with essential clinical information which accompanies patients transferred to the CH.

While recognising potential ethical concerns over sharing patient data on WhatsApp platforms, studies have reported this method to be low risk in respect to breaching patient data confidentiality [14]. To alleviate potential risks, the MCN moderator strictly controlled membership, in consultation with relevant heads of surgery and anaesthesia departments at participating DHs and CHs, ensuring that only staff involved in managing patients with surgical conditions were members. A written protocol on procedures to be followed on the MCN was developed, shared and discussed with all members before entry. The protocol included guidelines to obtain consent from patients or their guardians and ensure anonymity to protect people's privacy. No

patient identifying information was posted to the MCN. The study was approved by the Research Ethics Committee (REC) of the Royal College of Surgeons in Ireland (REC 1417) and the College of Medicine Research Ethics Committee in Malawi (approval no. P.05/17/2179).

Anonymised information posted on the MCN during the study period was extracted by two project staff and captured on an Excel database, under the following headings: i) Patient's sex, age, case summary; ii) Details of requests for specialist advice including: date, time of posting and type of communication (text, image or both); and iii) performance indicators: time to first response to the request for advice; number of clinicians (specialists and others) and expert opinions received; time when final decision on patient management made; and outcome (refer patient immediately, postpone referral or manage locally).

A descriptive analysis was performed for all key variables using Microsoft Excel. Aggregated results quantified network utilisation and perceived benefits in clinical decision-making at the participating DHs, comparing the MCN with previous standard practices. To estimate cost savings through averted referrals of patients to CHs, crude estimates of costs of patient transfer to QECH were calculated for each of the nine study DHs based on cost of allowances for a driver and accompanying clinician and/or nurse, and fuel for the ambulance for a return trip to QECH. Official government overnight allowance for a CO, nurse and driver escorting patient were \$20, \$20, and \$16 respectively. For day trips the staff received a lunch allowance of \$4. Fuel cost was calculated at 1 litre/6km at \$1.12/km (based on official monthly rates established by the Malawi Energy Regulatory Authority for the study period [18]). Costs did not

include staff salaries, ambulance purchase and depreciation, or costs associated with guardians and patients leaving their homes.

Results

During the study period, 249 surgical cases were posted by district clinicians on the SURG-Africa MCN, an average of one case per day from the start of the forum. Half of consultations (52%) related to paediatric cases, which in Malawi are defined as patients below 15 years of age – see Table I. There were more males than females (114 vs 79), though sex was under-reported in children.

Table I - Age and sex distribution of consulted cases

Age	Sex			Total	
	Male	Female	<i>Unreported</i>	N	%
0-28 days	16	14	24	54	22%
29 days to <1 Yr	8	5	8	21	8%
1-4 Yrs	4	7	6	17	7%
5-14 Yrs	14	13	10	37	15%
15-24 Yrs	12	6	2	20	8%
25-34 Yrs	12	9	0	21	8%
35-44 Yrs	12	6	1	19	8%
45-54 Yrs	12	9	1	22	9%
55+ Yrs	21	8	3	32	13%
<i>Unreported</i>	3	2	1	6	2%
Total	114	79	56	249	100%

Requests for advice came from all nine district hospitals, with Nsanje and Mulanje DHs the most active (Table II). On average 6 (4-9) DH clinicians in each hospital posted at least one case.

Table II - Number of surgical cases posted on the MCN by district hospitals

District hospital	Cases posted	Number of clinicians posting cases
Nsanje	50	8
Mulanje	45	6
Chikwawa	36	9
Chiradzulu	30	5
Thyolo	25	9
Balaka	21	6
Mangochi	20	5
Machinga	11	7
Mwanza	10	4
<i>Unknown</i>	<i>1</i>	<i>1</i>
Total	249	60

The top three cases consulted were gastroschisis (a birth defect characterised by intestines lying outside of the abdominal cavity), head injury and bowel obstruction, followed by wounds for grafting, oncological and orthopaedic cases. Just over half of the consultations (129/249; 52%) included patient photographs, X-rays, laboratory

results, clinical notes, and/or other reports by referring clinician or on specialist request.

Of cases that received a response from specialists (n=238, 96%), three quarters (74%) received a first response and 68% received the deciding clinical advice within 1 hour, with no significant difference in time interval between cases with and without images provided by the sending clinician ($p=0.76$). Mean (and median) times to first response and to decision made by specialist were 74 (18) minutes and 94 (29) minutes respectively, with a mode of 2 minutes for both indicators.

Table III - Time from posting a case on the MCN to receiving a response

Time	First response from specialist	Decision by specialist
Within 1 hour	177 (74%)	161 (68%)
After 1 hour or more	61 (26%)	77 (32%)
Total	238* (100%)	238 (100%)
* an additional 11 posted cases received no response		

Of the 238 cases who received advice from specialists in the MCN about a quarter (61 cases; 26%), which could have been referred had there not been any consultation, were managed at the DH with specialist remote support – see Table IV. In 11% of consultations the specialists advised to postpone patient referral, for example when a paediatric patient would not benefit from specialist attention at such a young age. Each case was discussed by a median of two district hospital clinicians and two specialists. In 32 (22%) of the 144 cases referred, the specialists followed up later, posting

feedback through the MCN to the referring district clinician on how the patient was managed at central level.

Table IV - Advice provided by specialists

Advice on referral	N	%
Refer immediately	144	60%
Refer at later stage	25	11%
Don't refer	61	26%
Non-surgical intervention	8	3%
Total	238	100%

We calculated a crude estimate of the potential cost savings from avoided referrals to QECH from the nine district hospitals in the Southern region, based on fuel consumption by ambulances transporting patients and allowances paid to accompanying staff. These costs averaged \$62 per referral trip, ranging from a minimum of \$44 (for a day transfer with driver only) to a maximum of \$96 (night transfer with nurse and CO accompanying the patient). An average of 7.5 unnecessary referrals per month had been avoided because of the SURG-Africa MCN, amounting to a combined potential cost saving of \$ 5,580 per year for the nine district hospitals. Between May and December 2018, the MCN membership more than doubled, including senior Ministry of Health (MoH) officials and critical central level bodies, as well as additional district and central hospital clinicians (Table V). This is reflected in the MCN content, which shows the national MoH directorates unblocking obstacles to district level surgery, e.g. by speeding repairs of non-functional operating theaters.

Table V - Distribution of MCN membership at the beginning and the end of the study period

Institutional base of MCN members	Number in May 2018	Number in December 2018
District level clinicians (surgery and anaesthesia)	55	118
Central hospital clinicians (surgery and anaesthesia)	16	22
Central hospital A&E clinicians	0	3
Ministry of Health officials	0	3
Central Medical Stores Trust officials	0	3
Malawi Blood Transfusion Services	0	3
Total	71	152

Discussion

The aim of this study was to evaluate the SURG-Africa Managed Consultation Network (MCN) by assessing its utilisation, performance and effects on clinical decision-making and referral practices of DLHs in Southern Malawi. The timeliness and responsiveness of surgical specialists were remarkably high (Table III). Specialists provided much more detailed explanations for their advice than would have been possible in written responses to referrals; and by answering questions, they translated consultations into opportunities for continuing professional education of the wider group of district clinicians with access to the MCN. Given the scarcity of surgically trained workforce in rural areas [19], remote consultations are an affordable and sustainable substitute for supervisory visits, as well as an affordable mechanism for ensuring timely referrals, or cost-saving decisions not to refer patients. These benefits have also been observed

in other settings [20]. As such, the communication is more efficient than traditional paper-based systems [21], which have been relatively ineffective in Malawi and other African countries [22].

Other studies report mobile phone application-based communication to be more efficient than verbal communication via phone calls [23], because they provide a permanent record of the presenting case and the specialist advice offered, which district staff can then interrogate. They also support diagnostic investigations and overall better quality of care [24]. The 37% of unnecessary referrals avoided contributed to better utilisation of public health resources, as specialist time and Central Hospital beds were freed up for cases needing advanced care [15]. The estimated cost savings of 5,580\$ per year on transport costs at the nine district hospitals is an important cost-saving in a resource-poor country. A study in a Burns Unit in South Africa similarly reported improved quality of referrals and better resource allocation from the use of social media communications [20].

In many LMICs, reliance on feedback through the specialist completing a dedicated section of the patient referral forms is usually ineffective, as discharged patients rarely return to the sending hospital [25]. The MCN provided district clinicians with immediate advice and a comparatively better way of getting later feedback, although utilisation of the forum for providing feedback was low (22% of cases). Where provided, CH specialists gave broad feedback, including how the referring clinicians managed the case pre- and during referral and how the case was managed at the receiving end, which is an improvement proposed previously by others researching surgical referrals in LMICs [21].

The SURG-Africa MCN has now been integrated into standard practice for all surgical referrals to QECH and ZCH, including referrals from other DLHs, not part of the study. Additional work is needed to develop and test discipline-specific mobile phone applications. Such apps should allow easy identification of cases not responded to, those that received no feedback; and be able to easily extract the data from the group for rapid analysis. For example, the 11 cases that received no response were posted at the same time or very close in time to other posts. In such instances, the specialists often prioritised the cases that appeared more critical or where they could make a helpful contribution (i.e. cases pertaining to the specialty of the surgeon on the network at that time). Some posts might simply have been overlooked due to competing priorities. In the case of the low level of later feedback on cases, there was sometimes no means of assigning responsibility to a specific central hospital specialist. Usually feedback would come if the district clinician pressed to know what happened with the referred patient. Lessons learned from this study also suggest that the development of a set of guidelines on the most commonly discussed cases, similar to Frequently Asked Questions (FAQs), might help minimise delays in consultants advising on patient management, as well as reducing the frequency of repeated requests for advice on common cases.

Limitations

Our study has some limitations. Firstly, our cost analysis was based only on crude estimates of fuel and allowances for a referral to QECH as it was not the main focus of our study. Further research would be beneficial to examine more in-depth cost savings associated with avoidance of unnecessary referral from the point of view of

both district hospitals and referral hospitals, as treating more patients locally has considerable implications on resource utilisation at both ends of the referral pathway. Also, in Malawi families often accompany patients to the central hospital, so the reductions in referrals have important cost implications (potential savings) for households, which were not captured by our study. Secondly, we did not examine patient outcomes in the cases discussed on the MCN; and there was no attempt to measure the counterfactual – what would have been the outcomes if cases were not consulted on the MCN. However, while not measured and quantified, it would be reasonable to assume that the improved communication and access to specialist surgical advice would have resulted in better health outcomes for patients. Thirdly, we collected data that covers only the initial period of the MCN, further research is needed to assess the sustainability of the proposed solution and the long-term effects of using social media to enhance the quality of surgical care in Malawi. Qualitative research on the experience of providers involved in the MCN is planned.

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