

## Practicing medicine without borders: tele-consultations and tele-mentoring for improving paediatric care in a conflict setting in Somalia?

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### Abstract

**OBJECTIVES** In a district hospital in conflict-torn Somalia, we assessed (i) the impact of introducing telemedicine on the quality of paediatric care, and (ii) the added value as perceived by local clinicians. **METHODS** A 'real-time' audio-visual exchange of information on paediatric cases (Audiosoft Technologies, Quebec, Canada) took place between clinicians in Somalia and a paediatrician in Nairobi. The study involved a retrospective analysis of programme data, and a perception study among the local clinicians.

**RESULTS** Of 3920 paediatric admissions, 346 (9%) were referred for telemedicine. In 222 (64%) children, a significant change was made to initial case management, while in 88 (25%), a life-threatening condition was detected that had been initially missed. There was a progressive improvement in the capacity of clinicians to manage complicated cases as demonstrated by a significant linear decrease in changes to initial case management for meningitis and convulsions (92–29%,  $P = 0.001$ ), lower respiratory tract infection (75–45%,  $P = 0.02$ ) and complicated malnutrition (86–40%,  $P = 0.002$ ). Adverse outcomes (deaths and lost to follow-up) fell from 7.6% in 2010 (without telemedicine) to 5.4% in 2011 with telemedicine (30% reduction, odds ratio 0.70, 95% CI: 0.57–0.88,  $P = -0.001$ ). The number needed to be treated through telemedicine to prevent one adverse outcome was 45. All seven clinicians involved with telemedicine rated it to be of high added value.

**CONCLUSION** The introduction of telemedicine significantly improved quality of paediatric care in a remote conflict setting and was of high added value to distant clinicians.

**keywords** Somalia, conflict, telemedicine, children, quality, outcomes

### Introduction

*A small child is brought into the paediatric emergency room with fits and is attended to by a young doctor. A day later, the child is getting worse, the parents are very worried, and the doctor wonders what to do. There is no senior colleague from whom to seek advice, the only referral hospital is 250 km away, and the road is insecure!*

We are in the war-torn Galgadud region of Somalia, where Médecins Sans Frontières (MSF) runs a district hospital supporting a limited number of Somali clinicians. Expatriate healthcare staff are no longer physically on site as they face high security risks because of kidnappings and

direct threats to life. The national Somali clinicians, through the circumstances of war, have had little or no opportunity for continuing education, have virtually no on-site supervision by senior clinicians, and lack exposure to new medical developments. As MSF is responsible for the hospital, the issue of 'quality of care' in this type of setting is a genuine concern.

To address this issue, MSF introduced tele-consultations and tele-mentoring (telemedicine) (Spooner & Gotlieb 2004; Sood *et al.* 2007; Wootton & Bonnardot 2010) – a 'real-time' exchange of audio-visual information between the clinicians in Somalia and a specialist paediatrician in Nairobi. Literally, telemedicine means 'medicine at a

distance' and the rationale for introducing this is simple – export the expertise but not the experts to Somalia (Wooton & Bonnardot 2010). Experience with such technology for supporting health care in conflict settings like Somalia is limited and is also very new for MSF. Does such support have a positive impact on the quality of care? Using our experience with this technology in a district hospital paediatric ward in Somalia, we assessed (i) the impact of telemedicine on improving quality of care and, (ii) the added value as perceived by the clinicians using the service.

## Methods

### Study design

This was a retrospective analysis of programme data and a semi-structured questionnaire survey among clinicians.

### Study setting

The study was conducted in the paediatric ward of the Guir'el district hospital located in the Galgaduud region of Somalia. The region has a population of about 327 000 inhabitants and, like other areas of the country, has been ravaged by war for over 20 years. There is no functional Ministry of Health, and all existing health services are provided by aid organisations and private (for profit) actors. MSF started supporting this hospital in 2006, and the available services include paediatrics, internal medicine, maternity and emergency surgery. All services are provided free of charge. The hospital has 90 beds of which 36 are allocated to paediatrics – this is the only health facility providing inpatient care for children in a 250-km radius. The paediatric ward was chosen as the pioneering site for piloting telemedicine as this was where we perceived that there were major problems in terms of quality of care. Treatment outcomes of children are also relatively more sensitive to improvements in quality to care.

### Study population

The study population included all children admitted to the paediatric ward during 2010 and 2011. A perception survey on the added value of telemedicine was conducted between March and April 2011 and included all clinicians involved with paediatric care.

### Telemedicine equipment and consultations

Before introducing telemedicine (a new technology in Somali), meetings and discussions were held with individ-

**Box 1** Conditions to be systematically referred for telemedicine, Paediatrics ward, Guir'el hospital, Somalia (January–December 2011)

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Any child with severe malnutrition who requires hospitalisation or is not improving  
 Any child with diarrhoea and/or vomiting and moderate to severe dehydration  
 Any child with respiratory distress indicated by a respiratory rate (under 2 months > 50 breaths/min; 2–12 months >40/min; 1–5 years > 40/min)  
 Any child with convulsions  
 Any unconscious child  
 Any moderate to severely pale or anaemic child  
 Any child with swollen eyelids  
 Any child with septic skin lesions  
 Any child with a suspected surgical problem  
 All ill neonates

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uals and community elders (who are respected by the community as the local authority) to raise awareness and understanding on its relevance to patient care and to the community at large. The equipment was installed in December 2010 in the paediatric consultation room in Guir'el district hospital for the Somalia clinicians and similarly in the MSF–Somalia coordination office in Nairobi for the specialist paediatrician. The equipment in Somalia and Kenya was obtained from Audiosoft Technologies (Quebec, Canada) (Audiosoft 2008) and included a mobile camera, a microphone device and a loud speaker linked up to a computer and screen. The equipment cost about €9000; the VSAT internet broadband subscription added €900/month. The total overall cost for the first year for equipment and broadband was about €20 000.

Figure 1 shows the consultation room in Kenya with the specialist paediatrician during a consultation. All clinical staff were well trained in how to use the technology. The system allowed real-time audio-visual exchange of information on paediatric cases between the clinicians in Somalia and the specialist in Nairobi on a daily basis. Consultations were scheduled from 2:00 pm onwards on each day, to allow the Somali clinicians time to first conduct their daily ward rounds and then organise cases for the telemedicine session. Specific risk-criteria requiring mandatory referrals for telemedicine consultations were defined and clinicians were obliged to systematically refer all children presenting with such conditions for telemedicine (Box 1). In addition to specific consultation, education on identification of risk signs, differential diagnosis, drug dosages, choice of antibiotics and follow-up requirements was provided by the specialist ('Tele-mentoring'). The technology also allowed the specialist paediatrician



**Figure 1** Consultation room and specialist paediatrician in Nairobi, Kenya conducting a telemedicine consultation with colleagues in Guri'el hospital, Somalia.

who spoke the Somali local language to counsel parents of very ill children, thereby fostering a positive relationship between the clinical team and parents. Paediatric management was in line with WHO and MSF clinical guidelines (MSF 2010).

### Impact of telemedicine on quality of care

The impact on quality of paediatric care was assessed in two ways. First, the initial management of each case by the Somali clinicians was compared with the final management by the specialist paediatrician after telemedicine consultation. This comparison determined (i) added or changed diagnoses leading to significant modifications to initial case management (e.g. change in drug dosage or drug regimen), (ii) life-threatening conditions 'missed' by the Somali clinician(s) which would have probably resulted in death or serious morbidity (e.g. meningitis, empyema), and (iii) clear decisions on referral to a higher and distant health facility. Three independent senior clinicians (two general practitioners and one paediatrician based in Europe) with wide clinical experience in Africa performed the comparisons. In case of discordance, consensus was sought by joint review of cases and further discussion.

Second, the impact on adverse paediatric ward outcomes (attrition, deaths and lost to follow-up) was compared for a period with telemedicine (the intervention year, 2011) with the preceding year (the control year, 2010, without telemedicine) – the latter serving as a historical control. All clinicians providing services during 2010 and 2011 were the same, and there were no improvements (or changes) in terms of infrastructure or added services in 2011 apart from telemedicine.

### Added value of telemedicine as perceived by clinicians

The added value, as perceived by the clinicians, was assessed using a pre-tested, semi-structured questionnaire. All clinicians were asked to independently fill out the questionnaire containing information on three aspects: usefulness of telemedicine for clinical management, patient acceptability and use of the technology. Consent was obtained and all responses were anonymous to avoid responder bias.

### Data collection and statistical analysis

Data on morbidity, case management and ward outcomes were systematically gathered from a telemedicine database and a standardised inpatient data monitoring tool (Epicentre tools, Epicentre, Paris, France). The Audiosoft system (Audiosoft 2008) ensured that patient information transferred by camera to the laptop viewer in Kenya was encrypted for data transfer security. Differences between groups of variables were compared using the  $\chi^2$  test for categorical variables and the  $\chi^2$  for trend was used to assess linear relationships. The level of significance was set at  $P = 0.05$  or less and 95% confidence intervals (CI) were used throughout. Data analysis was carried out using the EpiInfo 6.0 software (CDC Atlanta, USA) and Stata software (StataCorp, USA).

### Ethics

Ethics approval was received from the MSF Ethics Review Board, Geneva, Switzerland and the Union Ethics Advisory Group, Paris, France.

### Results

#### Characteristics of the study population

Between January and December 2011, there were 3920 paediatric admissions including 3190 (81%) under 5 years of age. Three hundred and forty-six (9%) children (65% male) were referred for telemedicine and underwent a total of 572 consultations. Time taken for telemedicine consultation at the first visit consultation varied on average between 30 and 45 min depending on the complexity of the case. Table 1 shows the conditions referred to telemedicine as determined by the independent clinicians, mainly lower respiratory tract infection either with respiratory distress or no response to standard treatment (31%), malnutrition with complications (18%), convulsions/suspected meningitis (15%), and diarrhoea and/or vomiting with moderate to severe dehydration (12%).

**Table 1** Conditions referred for telemedicine, Guir'el hospital, Paediatric ward, Somalia (January–December 2011)

Conditions referred for telemedicine	No (%)
Lower respiratory tract infection (not responding to treatment or with respiratory distress)	107 (31)
Malnutrition with complications requiring hospitalisation	62 (18)
Fever with convulsions and suspected meningitis	53 (15)
Diarrhoea and/or vomiting with moderate to severe dehydration	40 (12)
Neonatal septicaemia	17 (5)
Swellings in different parts of the body with or without fever	14 (4)
Urinary tract infection/nephrotic syndrome	6 (2)
Premature Infants	4 (1)
Burns	4 (1)
Trauma and fractures	4 (1)
Pulmonary tuberculosis	4 (1)
Others: unconscious child (3), delayed milestones (3), Kala-azar (3), perinatal asphyxia (3), skin infections (2), intestinal obstruction (2), tetanus (2), jaundice (2), chronic suppurative otitis media (2), drug reactions (2), diabetes (2), snake bite (2), pemphigus (1), liver abscess (1), poisoning (1)	31 (9)
Total	346 (100)

### Impact of telemedicine on paediatric case management

In more than half of all telemedicine consultations, case management was significantly changed, such as a change in drug dosage or treatment (Table 2). In a quarter of consultations, a life-threatening condition that had been initially missed by the Somali clinician(s) was detected because of telemedicine (Table 3). These conditions were wrongly managed in terms of drug regimens and/or dosages. Figure 2 shows the trend in changes to initial case management by Somali clinicians for three major morbidities that were referred to telemedicine. The trend in numbers of cases of these morbidities remained similar over time. The capacity of local clinicians to manage these potentially complicated cases improved progressively, as demonstrated by a significant linear drop in alternations to initial case management for meningitis and convulsions (92–29%,  $\chi^2$  for trend 10.1,  $P = 0.001$ ), lower respiratory tract infection (75–47%,  $\chi^2$  for trend 5.1,  $P = 0.02$ ) and complicated malnutrition (86–40%,  $\chi^2$  from trend, 9.4,  $P = 0.002$ ).

### Impact of telemedicine on adverse paediatric ward outcomes

Table 4 shows the standardised outcomes of 3873 children admitted during 2011 (with telemedicine) compared with

**Table 2** Impact of telemedicine on clinical case management, Guir'el hospital, Somalia (January–December 2011)

	Impact of telemedicine on improving case management		
	Significant changes made to case management*	Life-threatening conditions that were missed†,‡	Clear decisions on referral§
Total telemedicine consultations	No. (%)	No. (%)	No (%)
346	222 (64)	88 (25)	18 (5)

\*Added or changed diagnosis/treatment made through telemedicine which significantly altered case management (e.g. change in drug dosages or treatments).

†Life-threatening conditions that were initially missed and that telemedicine helped to diagnose. Failure to make such diagnoses is likely to have resulted in death (see Table 3).

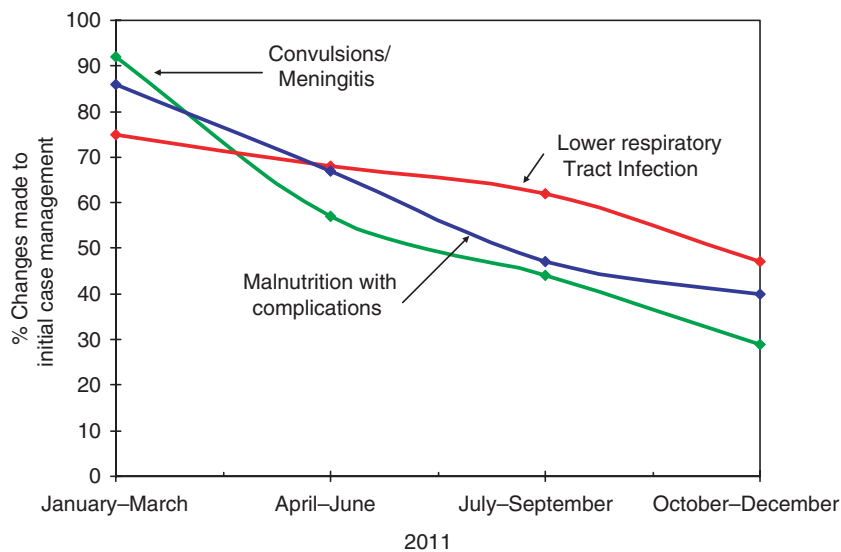
‡Some examples of life-threatening conditions included: meningitis, severe lower respiratory tract infection with respiratory distress, tuberculosis (PTB), Pemphigus, pyothorax with tamponade, congenital hypertrophic pyloric stenosis.

§Mainly for surgical cases such hydrocephalus, trauma, osteomyelitis, etc., referred to the distant Galkao hospital.

**Table 3** Life-threatening conditions that were initially missed and that telemedicine helped to diagnose. Guir'el hospital, Paediatric ward, Somalia (January–December 2011)

Life-threatening conditions diagnosed through telemedicine	No (%)
1. Bacterial meningitis and tuberculosis meningitis	39 (44)
2. Pulmonary tuberculosis with severe pleural and/or pericardial effusions	11 (12.5)
3. Neonatal septicaemia	11 (12.5)
4. Septicaemia/septic shock	6 (7)
5. Congestive cardiac failure	5 (6)
6. Severe Perinatal asphyxia	3 (3)
7. Necrotizing enterocolitis	2 (2)
8. Severe septic arthritis	2 (2)
9. Severe pyelonephritis	2 (2)
10. Others: Anaphylactic drug reaction (1), Measles with severe pneumonia(1), diabetic ketoacidosis/coma (1), infective endocarditis(1), pemphigus(1), hydrocephalus requiring urgent surgical shunting (1), osteomyelitis (1)	7 (8)
Total	88 (100)

the preceding year (2010) without telemedicine. Adverse outcomes (deaths and lost to follow-up) decreased 30% from a total of 7.6% in 2010 to 5.4% in 2011 (odds ratio 0.70, 95% CI: 0.57–0.88,  $P = 0.001$ ). Formal referrals to a higher-level facility also significantly increased from 0.05



**Figure 2** Changes to initial case management of three major morbid conditions made after telemedicine consultations (expressed as a percentage of all cases), Guir'el hospital, Somalia (January–December 2011). Convulsions/meningitis –  $\chi^2$  for trend = 10.1,  $P = 0.001$ ; lower respiratory tract infection –  $\chi^2$  for trend = 5.1,  $P = 0.02$ ; malnutrition with complications –  $\chi^2$  for trend = 9.4,  $P = 0.002$ .

**Table 4** Paediatric ward outcomes in 2010 (without telemedicine support) compared with similar outcomes in 2011 (with telemedicine support), Guir'el hospital, Somalia

	2010 (Without telemedicine) No. (%)	2011 (With telemedicine) No. (%)	$P$ -value*
Total exits	2102	3873	–
Cured	1942 (92.4)	3648 (94.2)	0.006
Adverse outcomes	159 (7.6)	211 (5.4)	0.001
Deaths	81 (3.9)	122 (3.2)	
Lost to follow-up	78 (3.7)	89 (2.3)	
Transferred out	1 (0.05)	14 (0.4)	0.02

\* $\chi^2$  test.

Cured – improved and discharged home, adverse outcomes – combination of deaths and lost to follow-up, death – died from any reason while in the paediatric ward, lost to follow-up – patient who abandoned the paediatric ward without medical advice, transferred out – a formal referral to a higher-level facility in a different city.

to 0.4% (odds ratio 7.6, 95% CI: 1.1–15.5,  $P = 0.02$ ). The number needed to be treated (NNT) through telemedicine to prevent one adverse outcome (death or loss to follow-up) was 45.

#### Added value of telemedicine as perceived by the clinicians

A total of seven Somali clinicians used telemedicine during the study period, all of whom responded to the questionnaire survey. In terms of clinical case management, all seven clinicians found telemedicine useful for improving patient care. The three main reasons given were: it helped

to improve recognition of risk signs (7/7); it improved management protocols and prescription practices (6/7); and it built a relationship of solidarity through direct contact with distant specialist colleagues (5/7). Telemedicine was also accepted by all parents of children and there were no consultation refusals. All clinicians were eventually able to use the technology in an independent manner after training. However, during the first two months after installation, six of seven clinicians encountered temporary disruptions in audio (sound distortion) and video (image streaking) quality and two clinicians ended up cancelling a session because of poor audio and video quality. These problems were resolved after widening the bandwidth of the internet provider (VSAT).

When asked about how to improve the technology, the main suggestions were (i) introducing bi-directional video communication (7/7), (ii) introducing larger and higher resolution flat-screens to permit better visualisation of cases and on-the-job training (7/7), and (iii) introduction of additional applications such as a mobile camera devices, auto-scopes and ultrasound devices (6/7).

#### Discussion

This is one of the first studies from a conflict-torn, district hospital setting in Africa, showing that telemedicine significantly improves quality of paediatric care, enhances the clinical capacity of distant clinicians, and is of high added value to clinicians. The strengths of this study are the considerable number of children included, standardised case management protocols in place, and independent assessment of case management by a separate team of



clinicians. Furthermore, as the data come from a program setting, the findings are likely to reflect the operational reality on the ground. We also adhered to the STROBE guidelines for reporting of observational studies (Von Elm *et al.* 2007).

There are a number of limitations of this study. First, the quality of case management was assessed in a proportion of all paediatric ward admissions (those referred for telemedicine) and as such, we do not know whether the improvements in care had a direct impact on the remaining cases. Second, unlike a randomised controlled trial, the analysis of adverse ward outcomes was based on simple observational data, and there may have been differences between the two periods (before and during telemedicine) that could have confounded the results. However, the clinicians remained the same during the entire study period, there were no particular improvements made to hospital diagnostic facilities and conflict-related insecurity, which influences access-to-care, also remained relatively constant. Although we do not have specific data to support this, we do not think that other differences would explain the significant improvements in case management. We also do not have the true outcomes of patients declared lost to follow-up, which could include 'unascertained deaths'. Community tracing to verify such outcomes in this setting is limited because of security concerns. For this reason, it is most logical to assess 'adverse outcomes' as being the combined value of both deaths and losses to follow-up – which was what was done in this analysis.

These results have wider implications that are of vital importance for non-governmental organisations like MSF, working in difficult and inaccessible settings. First, for every ten children referred to telemedicine, about six ended up with significant improvements made to their initial management. Importantly, a quarter had a life-threatening condition(s), which were detected thanks to this service. Clinical capacity of the distant clinicians also improved with time. It is fair to think that prompt, and sustained specialist support offered through telemedicine would have had a 'life-saving effect' on the latter (Strehle & Shabde 2006). Furthermore, the technology allowed the export of specialist medical advice regardless of the security situation on the ground (Sable *et al.* 2002; Smith 2007; McConnochie *et al.* 2010).

Second, we observed a highly significant 30% reduction in adverse ward outcomes – deaths and loss to follow-up. This is logical as telemedicine is offered to the most severely ill and difficult-to-manage cases and is likely to have had a mortality-reduction effect. The fact that by offering telemedicine to 45 patients, one adverse event in the ward was prevented is also a powerful indicator of its public health value.

Third, the technology was well accepted by clinicians, seemed robust after initial set-up problems, and was relatively easy to use even in the remote setting. The performance of the system depends on the internet bandwidth, and basic audio and video communications were sustained once the bandwidth was increased. However, it is important to realise that if bandwidth is limited or the technical platform is complicated with additional applications (bi-directional video, additional camera devices, etc.), system performance may deteriorate (Geissbuhler *et al.* 2003; Mupela *et al.* 2011).

Fourth, the technology was also well accepted by the community in a setting with varying cultural beliefs which can negate the use of camera devices. We believe this is related to the strong emphasis placed on raising community awareness and seeking prior support of community elders. It is also noteworthy that no parents objected to the use of telemedicine, because paediatric care involves reassuring parents as well as treating the child (Allen & Hayes 1994; Romano *et al.* 2001; Marcin *et al.* 2004). However, acceptability among adults and particularly women may be different and this merits further research.

Fifth, from an economic perspective, prior to telemedicine services becoming available, MSF was obliged to fly a medical team to Guir'el hospital every two months to provide, among other activities, clinical support and training. The overall cost was about €17 000 per trip as only private charter planes fly to Somalia. In this regard, although MSF never implemented telemedicine with an eye to cost-saving, telemedicine could be seen as bringing tangible cost savings and rapid return on the initial €20 000 investment. There is already considerable evidence of socio-economic benefits to patients because of accessibility of services and client satisfaction (Ermer 1999; Karp *et al.* 2000; Jennett *et al.* 2003).

Finally, doctors in Somalia work under some of the most deprived and insecure circumstances in the world, and they strongly felt that telemedicine brought a sense of proximity and solidarity with senior colleagues elsewhere. This feeling that 'we are not left alone' is extremely valuable from a humanitarian perspective and is a strong motivating factor for MSF. This is about practicing 'medicine without borders' by simply exporting the expertise through communications technology (Fraser & Mcgrath 2000; Wootton & Bonnardot 2010). This could be applied elsewhere in areas of conflict and is of high operational interest. MSF field workers had tended to look at the role of new technology such as telemedicine (at least in the beginning) with an 'eye of suspicion', but this experience clearly highlights the need to embrace such tools that are now available, pilot them and if proven beneficial try to use them in a manner that best serves the beneficiaries.

R. Zachariah *et al.* **Practicing medicine without borders**

In conclusion, the introduction of telemedicine in a remote district hospital in conflict-torn Somalia resulted in big improvements in quality of care being offered to children and was found to be of high added value to distant clinicians.

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