

## Original Research Article

# Strengthening district healthcare in rural Africa: a cross-sectional survey assessing difficulties in pulse oximetry use and handoff practices

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**Received:** 04 October 2018

**Revised:** 30 November 2018

**Accepted:** 03 December 2018

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## ABSTRACT

**Background:** Rural hospitals in sub-Saharan Africa suffer from numerous disparities in resources and practices, and subsequently patient care is affected.

**Methods:** In order to assess current practices and opportunities for improvement in pulse oximetry use and patient-care handoffs, a cross-sectional survey was administered to clinicians at a referral level hospital serving a large rural area in Shinyanga, Tanzania.

**Results:** Respondents (n=46) included nurses (50%), medical doctors (48%), and clinical officers (2%). A response rate of 92% was achieved, and 81% of clinicians acknowledged routine difficulties in the use of current devices when obtaining pulse oximetry. Although 83% of respondents reported using a written handoff at shift change, information reporting was inconsistent and rarely included specific management guidance.

**Conclusions:** Further research is needed to elucidate handoff practices in developing settings, but there is a large opportunity for novel point-of-care devices and tools to improve both pulse oximetry use and patient care handoffs in rural Africa.

**Keywords:** Childhood pneumonia, Hospitals, Rural, Patient handoff, Patient safety, Pulse oximetry, Routines, Surveys and questionnaires, Transitions of care

## INTRODUCTION

The bottleneck of improving healthcare in rural Africa is often attributed to several common factors - pervasive corruption disrupting continuous development, poor progress in building robust infrastructure, and a widespread shortage of human resources.<sup>1</sup> Yet on closer inspection of hospital function at a clinical level, a different picture begins to emerge. The inferior outcomes

of patient care seem directly related to three fundamental and intertwined key elements that are often overlooked: poor motivation among healthcare staff, poor training of those staff, and poor treatment of patients.<sup>2,3</sup>

Since 2017, the provincial health ministry in Shinyanga Region, Tanzania has collaborated with the Global Health Track in the Department of Family Medicine and Community Health at University Hospitals Cleveland

Medical Center/Case Western Reserve University (UHCMC/CWRU) to strengthen healthcare capacity through bedside clinical training.<sup>4</sup> The primary site of training and education is Shinyanga Regional Teaching Hospital, located in the capital of the region. The hospital contains 304 beds, with 39 doctors and 4 clinical officers, as well as nurses and nursing students; it is the referral hospital for the entire Shinyanga region and serves a population of approximately 1.5 million. By conducting regular teaching rounds and engaging with frontline care providers, the collaboration has worked to develop novel point-of-care devices to enhance the clinical performance of Tanzanian providers at the bedside. Over time two areas in particular have emerged as critical: one is the poor performance of current models of pulse oximeters, especially in the cases of pediatric and seriously-ill patients; the other is the lack of a reliable handoff tool to ensure safe transitions of care.

Pulse oximetry can substantially reduce the burden of childhood pneumonia in resource-poor settings, and the WHO has advocated for increased access to pulse oximetry for this purpose as well as universal access to reduce surgical deaths.<sup>5</sup> However, the actual application of conventional devices to pediatric patients often proves cumbersome in the field, and can cause needless delays in diagnosis and treatment of childhood respiratory illnesses. Recent studies have demonstrated that inter-observer agreement is less than 50% in pediatric pulse oximetry readings, and cite movement artifact and poor perfusion as common causes of inaccurate measurements.<sup>6</sup> Furthermore, a device which is cheap and ubiquitous in many developed countries remains widely unavailable to save the lives of children with pneumonia in developing countries - an unacceptable disparity. Another frequently encountered disparity is a profound lack of standardized patient handoffs between care providers at shift change. While such practices (and their requisite technology, including apps and integrated EMR solutions) are widespread in the developed setting, they remain scarce in the developing world, though there is a paucity of literature on this topic.<sup>7</sup> With this context in mind, a cross-sectional survey of doctors and nurses was performed in a representative setting in sub-Saharan Africa, to assess current practices and difficulties involved in patient-care handoffs and pulse oximeter use.

Outcomes of the survey would be used to inform the collaborative design and implementation of a novel point-of-care pulse oximetry device as well as a mobile-phone based handoff tool (IHOT), to improve the care of patients in similar communities in rural Africa.

## METHODS

The study was designed as a cross-sectional survey of clinicians – including physicians, housestaff, nurses, and students – at a teaching hospital in a rural setting in sub-Saharan Africa, in order to assess common practices in handoff and pulse oximetry. Institutional Review Board

approval was not sought as the study did not involve patients or patient data; the questionnaire was completely voluntary on the part of participants, who were entirely medical staff; and the survey was carefully designed with full participation of the representatives of those staff, namely the chief medical officer and residents/nurses themselves, to ensure its appropriateness. Therefore, it was determined that the survey was exempt from IRB approval. It was administered via paper questionnaire to all attendees at morning report on May 9<sup>th</sup> 2018, at Shinyanga Regional Teaching Hospital in Shinyanga, Tanzania. Surveyed individuals consisted of all attendees of the meeting, including MDs, interns, assistant medical officers, clinical officers, nurses, and nursing students, with the exception of survey administrators. The survey consisted of seven questions regarding both pulse oximetry and handoff practices. Surveys were anonymous and immediately collected for data collection; statistical analysis was performed using Microsoft Excel version 16.11.1.

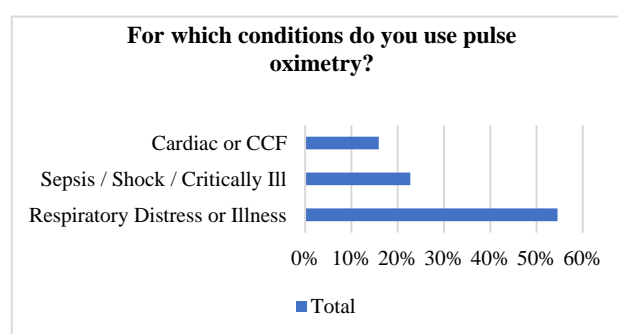
## RESULTS

Forty-six responses were obtained out of fifty questionnaires distributed, for a 92% response rate. Of these, 50% (23) identified as nurses, 48% (22) as medical doctors, and 2% (1) as a clinical officer (Table 1).

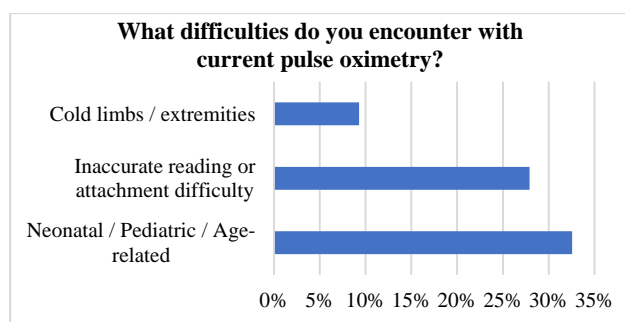
**Table 1: Study respondents.**

Survey participants	N (% of total)
Medical doctors	22 (48)
Nurses	23 (50)
Clinical officer	1 (2)

Regarding pulse oximetry, 81% of respondents acknowledged routine difficulties in the use of current devices when obtaining pulse oximetry. The three most common reasons given were: 1) using the device in pediatric or neonatal patients, 2) difficulty attaching or stabilizing the device on patients, and 3) seriously-ill patients with cold extremities. The most common conditions in which pulse oximetry is used were reported as respiratory distress or illness (55%), septic shock or critical illness (23%), and cardiac illness or failure (16%).

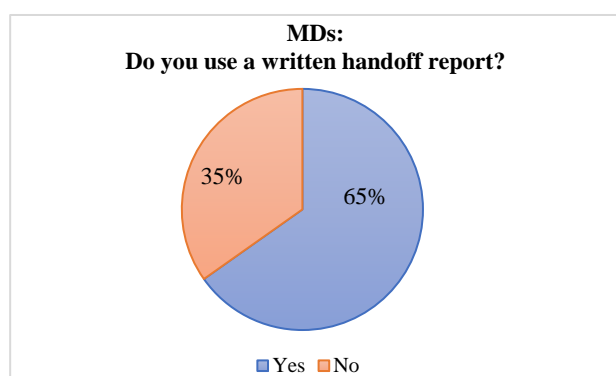


**Figure 1: Indications for pulse oximetry.**

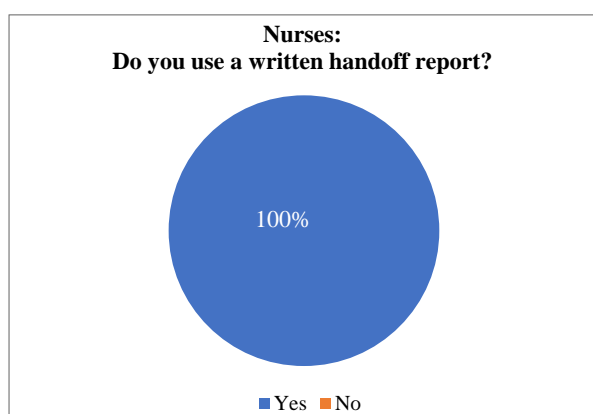


**Figure 2: Difficulties with pulse oximetry.**

For patient handoff, 83% of total respondents noted that they have use some sort of written handoff for patient care at the shift change (65% of MDs vs 100% of nurses). The information most commonly included in current handoffs was vital signs (67%), overall patient condition (53%), management plan (44%), and diagnosis (33%). Only 2 of the 46 respondents (4%) answered that their written handoff report includes a 'to-do-list' for on-call personnel to check.



**Figure 3: Handoff usage by MDs.**



**Figure 4: Handoff usage by RNs.**

## DISCUSSION

Pulse oximetry has been used for more than a decade to measure hypoxemia in critical conditions and has become a quintessential tool in assessing patients in developed

countries.<sup>1,2</sup> However, as evidenced by the survey, in the resource-poor setting clinicians encounter numerous difficulties in effectively applying this technology to the care of critically-ill patients, especially children. Many disposable components of the pulse oximetry sensor could be reusable, to minimize cost and wear on the device. The widely-utilized pincer clip technology rarely fits neonatal or uncooperative patients, and is notoriously fickle in its application. Furthermore, the wire component is vulnerable to break.<sup>8</sup>

This cross-sectional survey among clinical healthcare providers in a regional teaching hospital in a resource-poor setting reaffirmed these difficulties (Figure 2) despite the importance of the device (Figure 1), from the perspective of daily users of conventional technology at the bedside. To remedy these shortcomings the collaboration has spent the last several years conceptualizing and developing a novel point-of-care pulse oximetry device, unique in its design which requires neither a wire nor pincer-clip to apply to patients (Figure 5).



**Figure 5: The novel point-of-care pulse oximetry device.**

Historically, patient handoffs have been poorly studied, and have only come to the forefront of medical education in the developed world in the past several decades. We found a substantial difference in usage of handoff tools between doctors and nurses (Figure 3 and 4). Recent studies in Africa demonstrate that even elective surgery in developing countries is associated with twice the risk of death compared with the developed world.<sup>9</sup> It is interesting to note that no participants in the survey recommended including 'things to watch' or 'things to do' in a theoretical handoff tool. Despite the common use of the handoff shown in this survey, vital signs are rarely repeated after admission in most patients. Creating a 'to do list' that is reviewed in patient handoffs, contains pertinent but brief data, and is easily available to the on-call provider is not a novel concept, but is rare in the developing setting and will undoubtedly be a challenge to implement. But as the survey demonstrates, handoff

practices are currently lacking in nearly third of doctors, and a secure and easy-to-use handoff tool is essential to enhance efficiency, assure patient safety, and ultimately improve the quality of care in rural Africa.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: Not required*

## REFERENCES

1. Kim J, Farmer P, Porter M. Redefining global health-care delivery. *Lancet*. 2013;382:1060-9.
2. Rowe A, de Savigny D, Lanata C, Victora C. How can we achieve and maintain high-quality performance of health workers in low-resource settings? *Lancet*. 2007;366:1026-35.
3. Wilson R, Michel P, Olsen S, Gibberd RW, Vincent C, El-Assady R, et al. Patient safety in developing countries: retrospective estimation of scale and nature of harm to patients in hospital. *BMJ*. 2012;344:e832.
4. Crofts J, Mukuli T, Murove B, Ngwenya S, Mhlanga S, Dube M, et al. Onsite training of doctors, midwives and nurses in obstetric emergencies, Zimbabwe. *Bull WHO*. 2015;93:347-51.
5. Floyd J, Wu L, Burgess D, Izadnegahdar R, Mukanga D, Ghani A. Evaluating the impact of pulse oximetry on childhood pneumonia mortality in resource-poor settings. *Nature*. 2015;528:s53-s59.
6. McCollum E, King C, Deula R, Zadutsa B, Mankhambo L, Nambiar B, et al. Pulse oximetry for children with pneumonia treated as outpatients in rural Malawi. *Bull WHO*. 2016;94:893-902.
7. Lane-Fall M, Collard M, Turnbull A, Halpern S, Shea J. ICU attending handoff practices: Results from a National Survey of Academic Intensivists. *Crit Care Med*. 2016;44(4):690-8.
8. Weber W, Mulholland E. Pulse oxymetry in developing countries. *Lancet*. 1998;351:1589.
9. Biccari B, Madiba E, Kluyts H, Munlemvo DM, Madzimbamuto FD, Basenero A, et al. Perioperative patient outcomes in the African Surgical Outcomes Study: a 7-day prospective observational cohort study. *Lancet*. 2018;391:1589-98.

**Cite this article as:** Masigati HG, Potter GW, Morikawa MJ, Mfaume RS. Strengthening district healthcare in rural Africa: a cross-sectional survey assessing difficulties in pulse oximetry use and handoff practices. *Int J Community Med Public Health* 2019;6:57-60.