

Role of Mobile Health on Patient Enrollment for Cleft Lip-Palate Surgery: A Comparative Study Using SMS Blast Text Messaging in Zimbabwe

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Background: Patients' lack of awareness of available services is a significant barrier to delivering surgical care in resource-limited settings. Short message service (SMS) text messaging is a potential means to disseminate this information in resource-limited settings, where rates of mobile phone usage are high.

Methods: A blast SMS text informing local populations of upcoming cleft lip-palate (CLP) surgical services was distributed to 25% of the subscriber base 1 week prior to arrival of a (CLP) surgical team in Zimbabwe. A retrospective cohort analysis comparing characteristics of patients presenting to the CLP clinic in the year prior to (2016) and 2 years following (2017–2018) the implementation of the blast SMS text messaging system is performed to assess its impact.

Results: Patients presenting to a single Zimbabwean CLP surgical program in the years with SMS messaging notifications were significantly more likely (52 [64%] vs. 5 [17%], $P < .001$) to have been informed of surgical services through their mobile phones. The average distance traveled per patient was not significantly different prior to implementation of mass text messaging (180.4 km [SD114.8] vs. 167.4 km [SD105.9], $P = .580$). The average patient age was significantly higher following the implementation of mass text messaging (7.4 [SD8.7] vs. 3.0 [SD2.8] years, $P = .010$).

Conclusions: SMS messaging is an effective method of informing patients of CLP surgical services in resource-limited settings. After implementation of SMS text notifications, surgical patients were of increased age, but showed no difference in distance traveled.

Key Words: Global health, cleft lip and palate, text messaging, mhealth, mobile health, global surgery.

Level of Evidence: IV

INTRODUCTION

Barriers to surgical care in low resource settings are numerous, requiring research into innovative solutions to address them. Barriers to surgery include the surgical workforce crisis,^{1,2} inadequate infrastructure,^{1,3} prohibitive transportation costs,² and patients lacking awareness that surgical care exists.^{2,4–6} Specifically, cleft lip-palate (CLP) deformities represent a significant burden of disease that is unmet in low- and middle-income countries (LMICs). A majority (58.2%) of CLP patients in sub-Saharan Africa cite “lack of awareness” as a major barrier

to receiving surgical care.⁶ Novel ways of reaching surgical candidates in low resource settings are needed.

Mobile phones may be one such avenue.⁷ According to the World Bank, over the last two decades, LMICs demonstrated a rapid expansion in mobile phone penetration rates (ie, mobile phone subscriptions per 100 people).⁸ For example, in 2013, the mobile phone penetration rate in Zimbabwe was equal to that of the United States (~97%)⁸ (Fig. 1). Using mobile phones to expand communication in the health space is a burgeoning field referred to as mhealth.⁹ Herein, we aim to assess the efficacy of a short message service (SMS) text messaging platform to inform a Zimbabwean population of available CLP surgical services. Patients who presented in the years of SMS notification were compared to prior years when the notification platform was not used. We hypothesize that in comparison to prior years, the addition of an SMS text notification platform produces a surgical patient group that 1) is more likely to learn of surgical services through text messaging and 2) travels from a greater distance to obtain services.

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MATERIALS AND METHODS

Institutional review board approval was obtained from the University of Zimbabwe College of Health Sciences. United States academic institutional IRB review boards were involved in the project and ceded review to the University of Zimbabwe

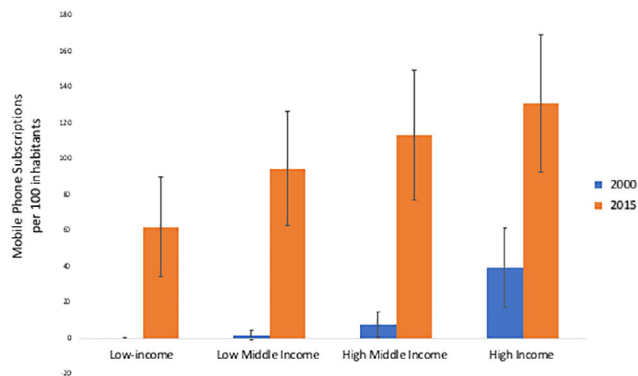


Fig. 1. Mobile phone penetrance by country income classification. Mobile phone penetrance in both low- and high-income countries has drastically increased over the past two decades. Data originally obtained for analysis from The World Bank.

College of Health Sciences. Since 2006, a single visiting surgical team has provided the majority of cleft lip and palate care in Zimbabwe. Patients have traditionally been notified by radio, television, church groups, and word of mouth. In 2017, the SMS notification platform was added with the initiation of a mass SMS delivered 1 week prior to the arrival of the visiting surgical team. The visiting surgical team operated for a 1-month period in May of 2016–2018. A mass SMS text message in English, an official language of Zimbabwe, providing the date, time, and location of CLP surgical services was sent to a randomly selected 25% of the subscriber base of the largest cellular service provider in Zimbabwe. This percentage was determined by the cellular provider, who volunteered to send the text message at their own expense. During surgical screening, intake patients were queried on how they learned about the visiting surgical services, their age, and home city/village using a standardized form that was administered to those undergoing surgery.¹⁰ Data were available only for those who underwent surgery. The hospital at which this study took place is the only tertiary care center for the entire country and is situated in the capital city of Harare, covering a wide population base.

Student's *t* tests were used to compare the pretext messaging and post-text messaging cohorts. *P* values of less than .05 were considered significant. Statistical analysis was performed using STATA 12.0. (STATA Corp, College Station, TX).¹¹ Geospatial mapping of home villages was performed for surgical patients. Home villages for surgical patients were geocoded using Google Earth. 7.1.1.1888 (Google Earth version 5.1.3533.1731, 2009; Google, Mountain View, CA). Home village or province abbreviations and misspellings were reviewed and corrected where possible. Latitude and longitude coordinates in decimal degrees were produced for each home village. Using Google Earth, distance from home village to the surgical screening clinic was calculated in kilometers as the crow flies.

RESULTS

Twenty-nine patients underwent cleft lip and palate surgery in 2016, 53 in 2017, and 29 in 2018. Patients presenting for CLP surgical evaluation when SMS messaging services were in effect were significantly more likely (52/81 [64%] vs. 5/29 [17%], *P* < .001) to have been informed of the program through text messaging. The average distance from the patients' home city/village to Harare Children's

TABLE I.
Comparison of Patient Demographics for Patients Presenting Pre-SMS Text Message Blast (2016) and Post-SMS Text Message Blast (2017–2018).

| | Pre-SMS Texting (N = 29) | Post-SMS Texting (N = 81) | <i>P</i> Value |
|----------------------------------|--------------------------|---------------------------|-----------------|
| Informed via mobile phone, N (%) | 5 (17.2%) | 52 (64.2%) | <.001 |
| Distance traveled (km) | 180.4 (114.8) | 167.4 (105.9) | .580 |
| Age, yr (SD) | 3.0 (2.8) | 7.4 (8.7) | .010 |

SMS = short message service.

Bolded values represent statistically significant *P* values of <0.05.

Hospital was not significantly different in the year prior to implementation of mass text messaging (180.4 km [SD114.8] vs. 167.4 km [SD105.9], *P* = .580). The average patient age was significantly higher following the implementation of mass text messaging (7.4 [SD8.7] vs. 3.0 [SD2.8] years, *P* = .010) (Table I).

DISCUSSION

Text messaging has the potential to be a powerful tool for more efficient delivery of surgical care, allowing for the dissemination of information to large populations and transmission of information from patient to surgeon.^{9,12} Mobile phones are highly prevalent in LMICs, offering a means to create awareness for surgical services. The purpose of this study was to assess the efficacy of a SMS mobile phone text messaging system in informing the local population of an upcoming CLP program and to compare the patient populations presenting for surgical care before and after implementation of this system. We find that following implementation of the SMS notification platform, the majority (64%) of patients presenting for CLP surgery were informed of the services through SMS, despite similar efforts through traditional religious groups, radio announcements, and word of mouth prior and after the implementation of SMS notifications. This demonstrates that this mechanism of information dissemination is highly effective and can be a very valuable tool in overcoming a significant barrier to health care access.

Interestingly, there was no significant difference in the distance patients traveled for service following the implementation of the SMS notification system. We hypothesized that text messaging would reach a wider patient population and that the average distance traveled during the SMS notification year would therefore increase. However, the finding that the average distance traveled by patients did not increase may imply that patients living closer to urban areas (where surgical services are offered) are more likely to own/utilize mobile phones. It may also be a result of other barriers, such as prohibitive transportation costs, that hinder patients from further away to seek care, particularly with only 1 week's notice.^{2,6} Last, it may reflect that there are simply higher numbers of patients closer to urban areas. The greater number of residents living in urban areas meant that the randomized text message would lead to a higher number of residents from urban areas being informed of

the clinic. The statistically significant increase in age could represent that information was more likely to be disseminated to a wider urban population that had less contact with the health care system. Prior to initiation of SMS text, messaging knowledge of the clinic was spread through primarily word of mouth. This could have preferentially led to younger patients and families with more involvement with the health care system being preferentially directed to the clinic. Overall, this study highlights that text messaging is an effective method of spreading information about health care in developing countries, but also shows that reaching rural populations remains a difficulty.

The exponential rise of mobile phones in LMICs allows for the potential to leverage this technology to revolutionize health care delivery and information dissemination. "Leapfrogging" of older technologies has already occurred in Africa in money payment systems. (eg, M-Pesa from Kenya).^{13,14} While high-income countries are currently undergoing a transition from standard "brick and mortar" banking to mobile money, the majority of LMICs in Africa have entirely leapfrogged the brick and mortar phase of banking, moving from a cash-based economy directly to mobile money payment systems.¹³ Mobile technology decreases transportation needs, improves access, and increases communication.¹³⁻¹⁵ The same benefits of mobile money payments systems can also be applied to surgical care. The leveraging potential within surgical services awaits similar transformations. With the shift from simple cellular phones to smart phones in LMICs, integration of this technology for applications in global health including postoperative wound checks, follow-up evaluation, and clinic recruitment is an emerging source of focus in global health.¹⁶

As a result of this study, the use of text messaging is, as expected, shown to be an effective method of informing populations of surgical services in resource-limited settings. While this study captured only the patients that underwent surgical intervention, we aim to analyze the entire cohort of patients presenting to clinic to gain a more accurate representation dissemination of information, rather than just those undergoing surgical intervention. Regardless, however, the demonstration of a significant majority of patients citing text messaging as the method by which they heard of surgical services is important for understanding how health care information is spread in resource-limited settings.

This study has several limitations. As it deals with surgery in LMICs, the ability to gather longitudinal information is limited. Survey data were collected only from patients who underwent surgery; approximately half of patients who were seen in the clinic did not undergo surgery and were not included in this study. Patient characteristics may differ in these two populations. With regards to distance traveled, in using the straight-line distance between the homes of the study population and the clinic, this study ignores the significant transportation difficulties that may arise due to a lack of infrastructure or transportation. Furthermore, income status was not included which may affect means of transportation, though patients with high incomes likely would be able to

afford travel to a health care facility. However, being limited by not being able to accurately identify the traffic and transportation infrastructure from each city from which study participants were recruited mandated that we use the straight-line distance for the purposes of standardization. Identifying all patients interested in surgical services following the blast text could show that SMS messaging casts a much wider net. This study still shows, however, that in a low resource setting, SMS is an effective tool to inform patients about cleft-lip palate surgical services.

Future studies in low resource settings could use SMS messaging platforms to identify which patients are interested in surgery. In addition, mobile health technology could be used for screening of patients, allowing those who are not surgical candidates to avoid unnecessary transportation costs. Other mobile phone-based applications may also be useful and deserve further study. SMS messaging alone does not address other barriers to surgical care beyond patient awareness.¹⁴ Evaluating optimal timing to inform local populations of forthcoming global surgery clinics could also be useful, as traveling to these clinics requires significant planning on the part of the patient and family.

CONCLUSION

SMS text messaging is an effective method of informing patients of CLP surgical services in a resource-limited settings. The efficacy of text messaging in disseminating information of health care access opportunities warrants further study as a primary means to reach prospective patients in need of care.

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