Original Article

Telemedicine for Children with Sickle cell Anemia in a Resource-Poor Setting during COVID-19 Pandemic: An Observational Study

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Abstract

Background: The severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) pandemic has continued to disrupt medical care among patients with sickle cell anemia (SCA). The city lockdowns and restrictions to minimize virus transmission in countries have created gaps in the optimal management of children with SCA. **Aim:** The aim of this study was to access the clinical experience in the use of mobile health telemedicine for the care of children with SCA. **Methods:** At the start of national lockdown, text messages were sent to parents of children with SCA who are attending a tertiary hospital in Nigeria. The message included advice to call consultants in the pediatric hemato-oncology unit whenever their wards were sick or due for a routine clinic visit. Information obtained include date of call or text message, complaints, intervention prescribed, and feedback from the parents. **Results:** There were 115 calls and 43 texts from the parents from April through July 2020. The proportion of calls increased from 16.5% to 33.9%, while texts increased from 23.3% to 30.2% over the months. Responses were significant ($P = 0.047$). Respiratory symptoms (40%) were the most common complaints. The most frequent interventions were counseling (59%) and drug prescriptions (31%) with the resolution of most symptoms by day 7 ($P < 0.001$). Parents (60.8%) preferred phone interactions across the months ($P < 0.05$). No confirmed case of SARS-CoV-2 was recorded. **Conclusion:** Mobile health telemedicine is a beneficial tool in the maintenance of care and possibly prevention of SARS-CoV-2 infection among children with SCA in a resource-limited region. Efforts should be made by stakeholders to institute and promulgate telemedicine during this pandemic.

Keywords: Children, COVID-19, low-middle income, mobile, sickle cell anemia, telemedicine

Introduction

The world has been astonished by the infection of a novel severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), also known as COVID-19, since December 2019.[1] In Nigeria, the COVID-19 index case heralded the onset of the scourge on February 27, 2020.[2] Globally, the number of confirmed cases is astronomically rising, 18.9 million as of August 5, 2020, with over 0.7 million deaths.[3] Majority of the reported cases were adults. Children have been shown to have a low risk of developing symptomatic COVID-19 disease, and this may be the reason why they seem to be less affected hence few reportages.[4,5] In Nigeria, little is known of the morbidity and mortality pattern among persons <20 years of age who constitute about 4,000 of the confirmed cases as at the time of writing.[6] However, those with comorbidities, including sickle cell anemia (SCA), tend to have the severe form of the disease.[7-9]

Children with SCA, a chronic hemolytic disease, are predisposed to COVID-19 because it has been suggested that the virus causes the release of iron from hemoglobin which reduces its oxygen-carrying capacity and further worsens the anemic state.[10] Other possible mechanisms of vulnerability to COVID-19 include partly dysfunctional immune system, systemic vasculopathy, risk of thrombosis, and unavailability of blood donors due to social distancing measure against

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COVID-19 infection.[11] These may be the reason the most common presentations among children with SCA who also have COVID-19 are bone pain crises and acute chest syndrome.[12] In general, fever and upper respiratory tract symptoms are the most common presenting symptoms in children with COVID-19 infection.[13] Meanwhile, the virus is transmitted through respiratory droplets while talking, coughing, catarrhal fluid, or sneezing from an infected person who may be symptomatic or not.[14] As of July 31, 2020, there were 284 confirmed COVID-19 cases in SCA globally with one recorded child death.[12] However, there was no recorded case of COVID-19 among children with SCA in sub-Saharan Africa at that time.[12]

The pandemic has caused disruptions in the clinical management of common diseases, which the World Health Organization is trying to ameliorate.[15] The city lockdowns and fear of contracting the disease have made parents not to seek medical care for their wards in time.[16] A multicenter surveillance project in the United Kingdom between April and May 2020, and endorsed by the Royal College of Paediatrics and Child Health, found out that 3% of delayed presentations to the emergency room were due to parental decisions.[17] Overzealous COVID-19 preventive measures among health workers have also led to delayed diagnosis of life-threatening emergencies.[18] This also may not be unconnected with the adverse psychological effects of coming in contact with a case of suspected COVID-19.[19] To mitigate these challenges, health institutions and personnel are now utilizing telemedicine to reach out to their patients.[20]

Telemedicine is defined as the use of electronic information and communication technologies to provide and support health care when distance separates the participants.[21] Its forms of application includes live video conferencing, store-and-forward video conferencing, remote patient monitoring, and mobile health.[22] Mobile health can easily be practiced in low-middle income countries unlike the other forms that require a constant power supply, internet service, availability and affordability of SMART (Self-Monitoring, Analysis and Reporting Technology) phones and gadgets. Mobile health entails the use of mobile devices like handset phones which are available even in rural areas. Information can be exchanged via phone calls and texts between the physician and the patient or patient relative.

From the foregoing, the clinical experience on the use of mobile health telemedicine at the early stages of the COVID-19 pandemic in a hospital unit of a resource-poor tertiary center was assessed.

Methods

The study took place in a tertiary hospital in the Niger-Delta region of Nigeria which serves as a referral center to general and private hospitals and to neighboring states of the region. In the pre-COVID era, its peadiatric hemato-oncology clinic sees 7–15 children with SCA weekly, while the peadiatric emergency room admits 2–3 children with SCA weekly.

Virtual meeting of the four consultants in the peadiatric hemato-oncology unit was held when the national lockdown to reduce COVID-19 transmission started in late March 2020. In order to prevent COVID-19 infection, it was agreed that communication be created between the doctors and the patients' caregivers through phone calls and text messaging.

Names and phone numbers of all parents of the patients with SCA were obtained from the e-registry of the peadiatric hemato-oncology unit. Text messages with advice to call the stated phone lines of any of the four attending peadiatrician before coming to the hospital were sent to 271 parents on March 28, 2020. The Message also had information on what to do when their children are sick. Similar messages were also sent to the Sickle Cell Support Network, an organization that focuses on advocacy and good health of persons with SCA. This cross-sectional project was approved by the Health Research Ethical Committee of the hospital.

Information on the date of the phone call from parents, biodata (name, age and sex) of child, complaints, other necessary clinical interviews, and intervention prescribed were kept by each of the doctors after obtaining informed verbal consent to do so in the first encounter. By the second encounter, on day 7, caregivers were asked to give feedback on whether they prefer physical meeting or mobile health telemedicine for future encounters and the outcome of the child's health. Preference for mobile health telemedicine was taken as favorable because of the SARS-CoV-2 pandemic.

Those with difficulty in breathing, worsening paleness and/or yellowness of eyes, and severe bone and/or abdominal pain not improving with the prescribed intervention were asked to go to the emergency room, and their details were immediately forwarded to the emergency physician on duty to reduce delay in management. Those with COVID-like symptoms were to be isolated and undergo a test for the virus.

Statistical analysis

Information extracted from each physician's book was collated and analyzed with SPSS version 23.0. Categorical variables were presented as frequencies and percentages. Line graphs and histograms were derived from the frequency of the encounters. Data were skewed. Comparisons of responses and feedbacks across the months were done with Kruskal–Wallis H-test. *Post hoc* analysis was further done for the responses. Mann–Whitney U-test was used in analyzing symptoms in both encounters, while Fisher's exact test was used in comparing the choice of the type of future encounters. Statistical significance was set at $P < 0.05$ at 95% confidence interval.

Results

As of August 5, 2020, the hospital has had no documented or recorded case of confirmed COVID-19 in any child with SCA,

and as the lockdowns were lifted, the number of children with SCA seen per week in the clinic dwindled to 5.

Of the 271 text messages that were sent out, there were 158 individual responses with 115 calls and 43 text messages from the parents/guardians by the end of July 2020. The difference in the responses was statistically significant across April and July [Tables 1a and b].

The following symptoms were recorded: respiratory (cough, catarrh, and difficulty in breathing) (85 [40%]), bone pain and abdominal pain (57 [27%]), fever (34 [16%]), worsening paleness (21 [10%]), worsening yellowness of the eyes (12 [6%]), and abdominal swelling (2 [1%]). The most frequently observed symptom in each month was respiratory [Figure 1].

The prescribed interventions for these symptoms were verbal drug prescriptions (49 [31%]) and routine counseling (93 [59%]), while 16 (10%) respondents were asked to visit the emergency room where their children were admitted. These interventions peaked in June [Figure 2]. No death was recorded during the period and outcome by day 7, following the intervention, showed few symptoms. The difference between each symptom during both encounters was statistically significant ($P < 0.001$), except abdominal swelling [Table 2].

In addition to the outcome, 96 (60.8%) respondents elected to continue mobile health telemedicine for future interactions. Parents (10%) of the admitted children preferred physical meeting, while 34 (21.5%) respondents were either undecided or wanted both forms of interactions. The differences between those that wanted a physical meeting and mobile health across the months were statistically significant [Table 3]. However, the course of communications over the months showed an upward trend [Figure 3]. Calls increased as follows: 19 (16.5%) in April, 29 (25.2%) in May, 28 (24.4%) in June, and 39 (33.9%) in July, while texts increased as follows: 10 (23.3%) in April, 9 (20.9%) in May, 11 (25.6%) in June, and 13 (30.2%) in July.

Table 1a: Response across the months (N=271)

Month in 2020	Response, *n* (%)		Mean rank	*H*-test	*p*-value
	Yes	No			
April					
Calls	19 (7.01)		563.50	χ^2=7.97	0.047*
Texts	10 (3.69)				
Total	29 (10.70)	242 (89.3)			
May					
Calls	29 (10.70)		545.50		
Texts	9 (3.32)				
Total	38 (14.02)	233 (86.0)			
June					
Calls	28 (10.33)		543.50		
Texts	11 (4.06)				
Total	39 (14.39)	232 (85.6)			
July					
Calls	39 (14.39)		517.50		
Texts	13 (4.80)				
Total	52 (19.19)	219 (80.8)			
Total					
Calls	115 (42.43)				
Texts	43 (15.87)				
Total	158 (58.30)	113 (41.70)			

*Statistically significant; *H*-test: Kruskal-Wallis H-test; χ^2 = Chi square.

Table 1b: Pairwise comparison of months

Sample 1-Sample 2	Test statistic	*p*-value
July-June	26.000	0.114
July-May	28.000	0.088
July-April	46.000	0.005*
June-May	2.000	0.903
June-April	20.000	0.224
May-April	18.000	0.273

*Statistically significant

Discussion

This study has shown that there was a gradual increase in the usage of phones to communicate with physicians. Respiratory symptoms, bone pain and abdominal pain were the most common complaints. The most frequently prescribed interventions were drugs and counselling which led to a marked reduction of symptoms 7 days later. Majority of the respondents opted to continue using mobile health telemedicine.

All the parents/guardians did not participate in the survey. The response rate was 58.3%. The possible reasons for non-response from 41.7% of the parents may be that their children were healthy during the study period; the parents did not have airtime to call the physicians or that the initial message was not received.

However, the response steadily increased over the months, with a significant difference between responses in April and

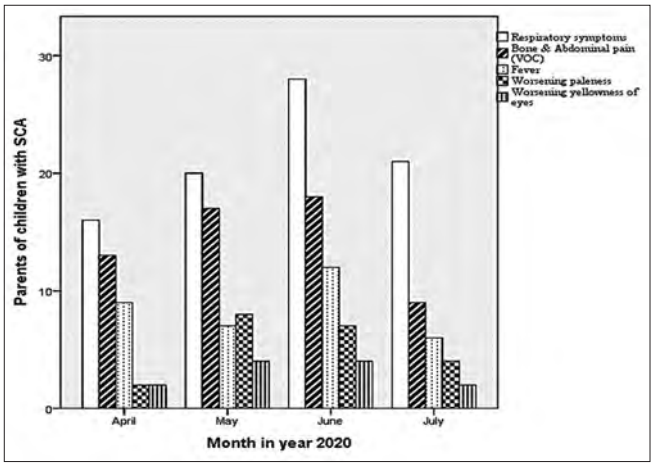

Figure 1: Monthly occurrence of symptoms among children with sickle cell anemia during the COVID-19 pandemic in Nigeria. VOC: vaso-occlusive painful crises

Table 2: Symptoms during initial encounter and second (outcome) encounter (*n*=158)

Variable	First encounter (symptom)		Second encounter (symptom)		*U*	*p*-value
	Frequency, *n* (%)	Mean rank	Frequency, *n* (%)	Mean rank		
Cough	43 (27.2)	29.00	14 (8.9)	58.00	301.00	<0.001*
Catarrh	34 (21.5)	21.50	8 (5.1)	47.50	136.00	<0.001*
Fever	34 (21.5)	17.50	0 (0.0)	51.50	0.00	<0.001*
Difficulty in breathing	8 (5.1)	4.50	0 (0.0)	12.50	0.00	<0.001*
Bone pain	43 (27.2)	23.50	3 (1.9)	63.50	64.50	<0.001*
Whitening palms and soles	21 (13.2)	13.50	5 (3.2)	29.50	52.50	<0.001*
Worsening yellow of eyes	12 (7.6)	6.50	0 (0.0)	18.50	0.00	<0.001*
Abdominal pain	14 (8.9)	8.50	2 (1.3)	20.50	14.00	<0.001*
Abdominal swelling	2 (1.3)	1.50	0 (0.0)	3.50	0.00	<0.083

*Statistically significant. *U*=Mann-Whitney U-test

Table 3: Feedback on further mode of interaction from parents across the months

Month in year 2020	Feedback on further mode of interaction		Test statistic (FET)	*p*-value
	Physical meeting, *n* (%)	Mobile health (handset phone use), *n* (%)		
April (*n*=29)	6 (20.7)	16 (55.2)	6.147	0.020*
May (*n*=38)	7 (18.4)	23 (60.5)	5.596	0.029*
June (*n*=39)	7 (17.9)	24 (61.5)	5.332	0.031*
July (*n*=52)	8 (15.4)	33 (63.5)	5.444	0.021*

*Statistically significant. FET: Fisher's exact test

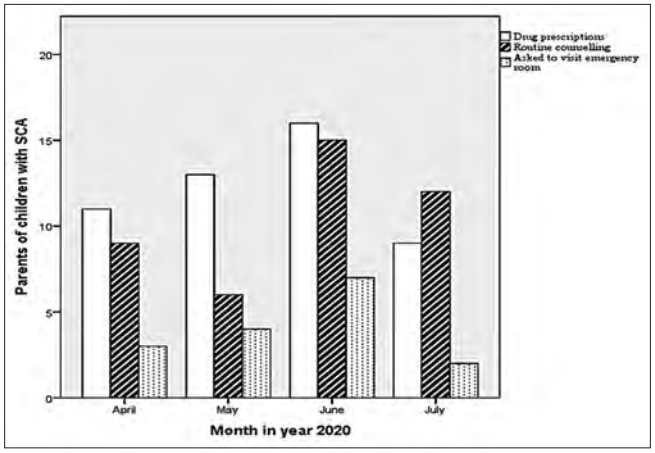

Figure 2: Verbally administered interventions on children with sickle cell anemia during the COVID-19 pandemic in Nigeria

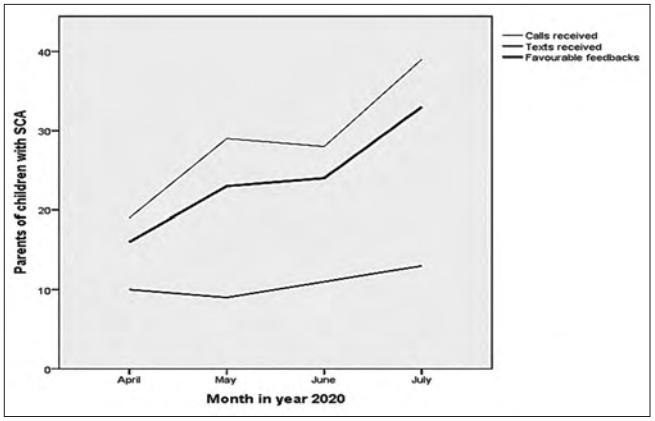

Figure 3: Trend of communication with parents of children with sickle cell anemia over the first 4 months of COVID-19 pandemic in Nigeria

July. This may imply that the parents are in harmony with this current step of discussing their children via phone with their physicians in other to limit COVID-19 spread. Davis *et al*[23] have demonstrated that 82% of their patients were likely to prefer telemedicine over physical consultation during flu seasons.

Flu is common during peak rainy season (April through August) in Nigeria, and this may be the reason majority of the recorded symptoms were respiratory which resolved either at home or in the emergency room. However, in this COVID-19 pandemic, one should be careful of these symptoms despite no recording of confirmed COVID-19 which may, in addition, be due to low testing capacity in our locality.

A week after each initial encounter, majority of the symptoms significantly resolved across the months. This may not be unconnected with the advice to buy over-the-counter medications and counselling which were the main intervention prescribed. Continuation of routine medications (hydroxyurea, folic acid, penicillin V and proguanil) and liberal fluid intake were reiterated for those with what seemed like mild-to-moderate vaso-occlusive painful crises.

In addition, most respondents (60.8%) wanted to continue the use of mobile health telemedicine in future interactions. The difference among respondents who wanted a physical meeting and mobile health significantly increased from April through July. This preference for mobile health telemedicine may be due to the national lockdown and fear of contracting the deadly

virus, and it may have led to the reduced number of patients seen in clinic after the lockdown. Therefore, mobile health telemedicine is favourable.

The lack of a confirmed case of COVID-19 among children with SCA in the center may be due to the enforcement of preventive measures and continuous education through the media by the government. Another possible reason for low COVID-19 prevalence among children with SCA may be the protective effect of normally high levels of interleukins 1, 6, and 17; tumor necrotic factor-alpha; monocyte chemoattractant protein-1; and macrophage inflammatory protein 1-α.[24] These cytokines and chemokines are usually increased in COVID-19 infection and are responsible for the inflammation (cytokine storm) seen in the severe form of the disease.[25] Since children with SCA are used to these cytokines, they may not be symptomatic or present with the severe form of COVID-19. Nevertheless, parents of these children should continually be advised via text messaging on the use of face masks because the case fatality rate in Nigeria rose to 2.0% as of August 5, 2020.[6,26]

Conclusion

The use of handset phones for telemedicine mobile health is a valuable tool that helps in reducing morbidity among children with SCA, especially during this COVID-19 era in a low-middle-income country, even as the lockdowns are being gradually relaxed. Most of the caregivers who are indigent may not afford smartphones for video conferencing, and internet services may either be absent or at best, poor in the rural areas. Mobile health telemedicine aids in bridging the gap between doctors and their patients in other to maintain care and keep COVID-19-related childhood SCA mortality minimum. The use of mobile health in a resource-poor clinical setting is another way of protecting doctors as there are few of them in Nigeria (about 4 medical doctors per 10,000 population as of 2018).[27,28] Elsewhere, patients have embraced telemedicine as a safe way of connecting with their physicians.[23,29] Audio-visual conferencing is obviously better than audio alone. Efforts should be made by relevant authorities to institute video conferencing by creating free communication links between rural and specialist hospitals.

Limitations of the study

1. After the first and day 7 encounters, subsequent care provider-driven encounters were not done as a follow-up to the initial interactions due to lack of funding. This would have given a clearer picture of the trend of the child's illness and outcomes, especially among those that did not call back
2. Audio-visual communication would have been a better form of telemedicine in these interactions because the physician may be able to discern visually what the parent is finding it difficult to explain. However, the resources are unavailable.

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Conflicts of interest

There are no conflicts of interest.

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