

Maternal and Child Healthcare Service by Portable Health Clinic System Using a Triage Protocol

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Abstract. The number of deaths of a mother and child caused by maternal and child healthcare (MCH) issues has been greatly decreased recently, but still, the number is extremely high especially in developing countries. Although the governments have been given a priority in this issue, the lack of financial and human resources brings a limit. Thus, the use of low-cost but appropriate technology is required. Portable Health Clinic (PHC), a telemedicine system developed for providing primary healthcare, is such a technology. This study aimed to address this MCH issue with the aid of a low-cost PHC service involving a continuum-of-care protocol to the rural communities of Bangladesh. Moreover, this study introduces a triage protocol to distinguish high-risk patients from the early stage of the continuum of care who need special care and refer to specialized physicians to prevent unwanted deaths.

Keywords. Telemedicine, MCH triage, decision support, preventive healthcare

1. Introduction

Globally, the number of annual deaths of women caused by maternal issues is approximately 295,000 [1]. Conversely, the annual deaths of children aged < 5 years are approximately 5,300,000. Among these, approximately 47% of deaths occur within the first 1 month of life or during the neonatal period. Unfortunately, the majority of these deaths occurs in underdeveloped or developing countries. Moreover, most of these deaths could be prevented if access to healthcare services was ensured [2]. Therefore, this issue has been strongly addressed in Sustainable Development Goals, and the United Nations has called to reduce the global maternal mortality ratio (to < 70 per 100,000 live births) and neonatal mortality (12 per 1000 live births) by 2030 [3].

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The concept of the continuum of care has been proposed as a way to globally improve maternal and child health (MCH) [4]. The continuum of care is an integrated series of care steps in multiple stages throughout life: adolescence/prepregnancy, pregnancy, delivery, postpartum, childhood, and motherhood. Because of its ability to reach patients at different stages, the use of the continuum of care is an effective strategy to improve MCH. The MCH module of the Portable Health Clinic (PHC) system has been developed for this purpose. As there is a huge shortage of obstetrics and gynecology in low economies, it needs to make the best use of these valued resources. This study introduces a triage protocol for the MCH module for classifying patients in terms of disease severity. Patients who will be identified as high-risk patients will be connected to specialist physicians for teleconsultancy. Patients who are not at high risk will be followed by local health workers or attend teleconsultancy from general physicians.

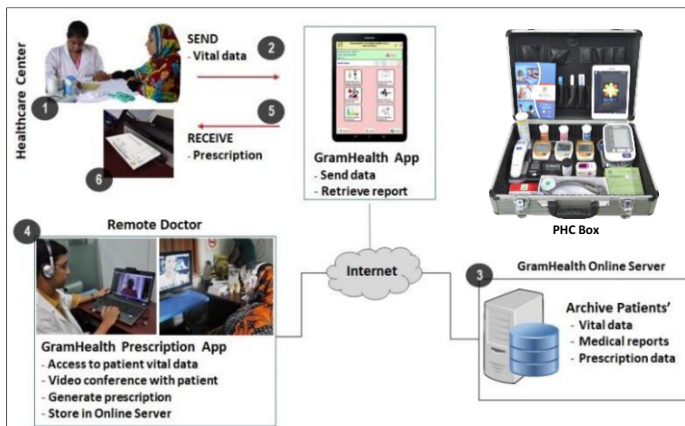


Figure 1. Portable health clinic workflow.

2. Methods

2.1. Portable Health Clinic

The PHC has been developed as a telehealthcare system for unreached rural communities of Bangladesh [5]. Initially, it was designed for primary healthcare with a special focus on preventive care for noncommunicable diseases (NCDs).

In this service delivery system, a trained village health worker visits patients at their home with a PHC box equipped with a number of medical sensors. Then, the health worker (1) collects various vital information from patients using digital sensors and questionnaire; (2) enters the data to the PHC application, which classifies the patients in four categories on risk level, namely, green (healthy), yellow (caution), orange (affected), and red (emergent) using a triage system; and (3) stores the data on the online server; (4) in case of green and yellow patients, the health worker supports the patients; otherwise, the remote physician monitors the vital data, holds a video conference with the patients, and writes an e-prescription, and (5) the prescription is printed to be delivered to the patient by the health worker with a verbal explanation (Figure 1). Thus, the patient can obtain total service, including checkup, diagnosis, and consultancy, in a few minutes being at home.

2.2. MCH Module

There is a huge need for MCH service in rural communities. As there is no specialized MCH service in the local medical facilities, in most cases, village women depend on local midwives who mostly do not have any professional training. If they like to consult any specialist (Obs and Gyne), they need to visit a district or subdistrict, which is far and expensive for this low-income group. Therefore, PHC staff receive a huge request for this specialized service by this system, and thus, this MCH module has been developed.

The PHC basic module has been equipped with basic medical sensors for collecting 14 common vital information in the context of Bangladesh. These are as follows: body mass index, body temperature, hip–waist ratio, blood pressure, pulse rate, arrhythmia, blood oxygenation, blood glucose (random), urinary sugar, urinary protein, blood group, cholesterol, hemoglobin, and uric acid. The MCH module just includes handheld ultrasound, fetal Doppler, infant height measure meter and infant scale.

Table 1. Triage logic for antenatal care patients in MCH module of the PHC system.

Stage	Checkup Items	Unit	Green (Healthy)	Yellow (Caution)	Orange (Affected)	Red (Emergent)
Antenatal Care of Mother (from 16 weeks of pregnancy)	Expected Date of Delivery	Calculation: 280 days to the first day of last menstrual period				
	Blood Pressure (H/D)	mmHg	<120 <80	≥120 & ≤129	≥130 & ≤139 ≥80 & ≤89	≥140 ≥90
	Pulse	bpm	≥60 & <100	≥50 & <60 ≥100 & <120	<50 ≥120	
	Temperature	°C	<37.0	≥37.0 & <37.5	≥37.5 & <38.0	≥38.0
	Hemoglobin	g/dl	≥11	<11 & ≥10	<10 & ≥8	<8.0
	Urine Protein		Negative	±	+	++ +++
	Urine Sugar		Negative	±	+	++ +++
	Blood Glucose (PBS/FBS)	mmol/dl	<5.56 <5.1	≥5.56 & <7.0	≥7.0 & <11.11 ≥5.1 & <7.0	≥11.11 ≥7.0
	BMI (Pre-Pregnancy BMI)	Kg/m2	≥18.5 & <25	≥25 & <30 <18.5	≥30	
	Fetus Beat / Minute	bpm	≥110 & ≥160		<110 >160	
	Height of Uterus	cm				
	Swelling of Fingers, Face and Legs (Edema)		No		Yes	
	Position of Baby		Normal		Breech	
	Ask Mother Her Condition	Movement of Baby		Yes		No (for more than 1 hour)
Regular Contractions			No		Yes	
Rupture			No		Yes	
Vaginal Bleeding			No		Yes	
Smell Vaginal Discharge						
Severe Headache with Blurred Vision			No		Yes	
Severe Abdominal Pain			No		Yes	
Vomiting			No		Yes	
Fever and too Weak to Get Out of Bed			No		Yes	
Convulsions			No		Yes	

2.2.1. Service Protocol of MCH Module

The MCH module basically follows the eight WHO- proposed stages of antenatal and postnatal checkup protocol for continuum of care using a telemedicine system. These checkups occur (1) within 4 months, (2) 6 months, (3) 8 months, and (4) 9 months of pregnancy; (5) right after delivery; (6) 2 days after delivery; (7) 7 days after delivery; and (8) 6 weeks after delivery. The newborn baby’s health checkup is also conducted together with the mother in the four final stages. The patients receive home delivery service by female health workers at their own premises. The consulting physician connects to the patients from the city and if needed, they refer to the nearest hospital.

2.2.2. Antenatal and Postnatal Triage Logic

Like any other developing country, Bangladesh has a huge shortage of medical physicians and nurses. Therefore, it is greatly important to make the best use of these valued human resources. Like basic PHC, the MCH system has also adopted a triage

system to classify the health status of the patients into four categories based on their severity. The orange and red patients are considered high-risk patients who need physician’s consultation. However, patients who fall under green and yellow categories are considered comparatively safe and are served by the village healthcare worker.

Table 2. Triage logic for postnatal care patients in MCH module of the PHC system.

Stage	Checkup Items	Unit	Green (Healthy)	Yellow (Caution)	Orange (Affected)	Red (Emergent)	
Postnatal Care of Mother	Blood Pressure (H/D)	mmHg	<120 <80	≥120 & ≤129	≥130 & ≤139 ≥80 & ≤89	≥140 ≥90	
	Pulse	bpm	≥60 & <100	≥50 & <60 ≥100 & <120	<50 ≥120		
	Temperature	°C	<37.0	≥37.0 & <37.5	≥37.5 & <38.0	≥38.0	
	Hemoglobin	g/dl	≥11	<11 & ≥10	<10 & ≥8	<8.0	
	Urine Protein		Negative	±	+	++ +++	
	Urine Sugar		Negative	±	+	++ +++	
	Blood Glucose (PBS/FBS)	mmol/dl	<5.56 <5.56	≥5.56 & <7.0 ≥5.56 & <6.11	≥7.0 & <11.11 ≥6.11 & <7.0	≥11.11 ≥7.0	
	Weight	kg					
	Smelly Vaginal Discharge		No		Yes		
	Amount of Bleeding		- ±	+	++		
	Hardness of Uterus		Hard		Soft		
	Nutrition	Breastfeeding / Mixed / Formula					
	Swollen, Red or Tender Breasts or Nipples		No		Yes		
	Perineum Tear Problem		No		Yes		
	Infection in the Area of Wound		No		Yes		
	Problem in Urinating or Leaking		No		Yes		
	Calf Pain, Redness or Swelling		No		Yes		
	Severe Headache with Blurred Vision		No		Yes		
	Shortness of Breath or Chest Pain		No		Yes		
	Fever and too Weak to Get Out of Bed		No		Yes		
	Convulsion		No		Yes		

The triage logic for the antenatal care of the mother and postnatal care of both the mother and baby are different. These protocols are shown in Tables 1, 2, and 3, respectively. These logics are incorporated in the MCH module of the PHC system so that the village health workers can easily identify the risk level of the individual patients with assistance of the system and refer the critical cases to the distanced experts.

Table 3. Triage logic for postnatal care of infant in MCH module of the PHC system.

Stage	Checkup Items	Unit	Green (Healthy)	Yellow (Caution)	Orange (Affected)	Red (Emergent)	
Postnatal Care of Infant (up to 2 Months)	Weight	WHO	±	+ / -	++ or --		
	Height	Curve	±	+ / -	++ or --		
	Temperature	°C	≥36.5 & <37.4		≥37.4 <36.5	≥38.0 <36.0	
	Cyanosis: Dark Purple Color in One of the Parts Indicated		No		Palm / Toes	Mouth, Nose, Face, Tongue	
	Ask Mother About Child's Condition	Difficulty in Breathing or Indrawing		≥ 40 & <60		<40 ≥60	
		Taking Less than 8 Feeds in 24 Hours		No		Yes	
		Yellow Color in One of the Indicated Parts		No		Eyeball Conjunctiva/ Forehead	Trunk / Limbs / Palms / Sole
		Pus Coming from the Eyes or Skin Pustules		No		Yes	
		Irritated Cord with Pus or Blood		No		Yes	
		Diarrhea		No		Yes	
		Bleeding		No		Yes	
		Convulsions		No		Yes	

3. Results

In this study, we have offered basic healthcare service to 630 productive age women aged 15–49 years in a rural community of > 14,000 people in Bangladesh. Of them, we have offered specific MCH care services to 175 pregnant women (cohort) until the end of

March 2021. This triage process identified 84 (48%) patients in the orange category and 14 (8%) patients in the red category who needed special consultation from professional physicians at least once during the antenatal period. The major causes identified for the problems were high blood pressure, low hemoglobin saturation, and high blood sugar level.

A total of 134 women have given birth without any stillbirth, and the rests are under antenatal care. Of these 134 births, two babies died within an hour of birth in the hospital due to the absence of emergency support facilities during the COVID-19 pandemic. As the COVID-19 pandemic is an extraordinary situation, this incidence can be considered out of the scope of this study. Moreover, we have found no reported death of any mother during delivery in this study.

4. Discussion

Bangladesh has significantly improved the infant mortality rate in the country, but still, it is 25.6 per 1000 in 2019 [6]. Currently the rate of decrease is extremely low and this is important to take new measures to bring a rapid improvement. The present result shows a significantly lower infant mortality rate achieved by this MCH service. Moreover, the result shows zero maternal death. One of the main reasons for this improvement is that the patients do not miss any continuum care as they receive the service at their home. Besides, this technical assistance to the village health workers by this automated triage system is very important to respond to the sensitive differences in various stages of the continuum of care what is very difficult to manage manually.

5. Conclusion

Although Bangladesh has a poor physician–patient ratio, the physician–nurse ratio is worse. Therefore, there is an urgent need to train and empower the existing rural health workers to tackle the current situation. The PHC system can play a significant role in this purpose and empower the rural health workers with this technology, especially for primary healthcare with a focus on the MCH service.

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