

# Experiences with use of a pulse oximeter multimodal device in outpatient management of children with Acute Respiratory Infection during Covid pandemic

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## ABSTRACT

**Background:** While Covid-19 infection rate in children is low, respiratory symptoms are a common mode of presentation which calls for better management of such symptoms. However, ARI case management in primary health settings has challenges as health workers lack skills to count respiratory rate and check chest indrawing. To address this multimodal pulse oximeters have been introduced in health and wellness centres of seven states to ease the work of front line health workers. A study was undertaken to understand the usability of the multimodal pulse oximeter during Covid times. **Methods:** A qualitative study was conducted with the aid of indepth interviews among a convenience sample of eleven health care workers from ten health and wellness centres. Interviews were conducted and recorded over phone, after obtaining consent. Transcribed interviews were coded and analysed on a qualitative analysis software. Content analysis was conducted. **Results:** Total children screened during covid lockdown period (April 1-May 31) is 571, those diagnosed with pneumonia and severe pneumonia is 68 and 2. Health care workers were satisfied with pulse oximeter as it helped in timely diagnosis and treatment, and offered protection from possible infection as it mitigated the need for physical contact. **Conclusion:** The multimodal pulse oximeter is well accepted among providers as it is easy to use aiding in timely management of ARI in children. It has an added protection as it's use reduces the need for physical contact. It can be adopted in other HWC and primary health facilities.

**Keywords:** Childhood pneumonia, Covid 19, Health and Wellness Centre, infection prevention, pulse oximeter

## Introduction

The Covid pandemic is a global health crisis causing loss of life and disrupting the economies of several countries worldwide. In India 182,143 cases have been reported by 31 May with 5164 total deaths. In children, the disease is mild and has a low mortality compared to adults.<sup>[1,2]</sup> Nevertheless, a limited number of studies

show that a number of children need to be hospitalized, especially those below 1 year of age.<sup>[3-5]</sup> The full spectrum of the disease in children across the world is still unknown leading WHO to call for collection of standardized data describing clinical presentations, severity, outcomes, and epidemiology.<sup>[6]</sup>

India faces a challenge in curbing childhood pneumonias as it contributes to 15 percent of under five deaths (approximately 1.4 lakhs children) annually in India.<sup>[7]</sup> WHO IMCI guidelines recommend counting respiratory rate (RR) for 1 minute, checking

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chest indrawing and SpO<sub>2</sub> in sick children with cough or difficult breathing.<sup>[8]</sup> However, studies have found that inadequate assessments and prescribing practices were common despite IMCI guidelines on pneumonia management.<sup>[9]</sup> To have an improved diagnostic tool for pneumonia that would obviate the need for RR measurement the pulse oximeter (PoX) has been introduced in community health care settings in several low and middle income countries. Combination of pulse oximeter and IMCI was found to have led to increased pneumonia identification in children compared to IMCI algorithm only<sup>[10]</sup> while pulse oximeter was also found to discriminate better between severe and non-severe pneumonia.<sup>[11]</sup>

Respiratory symptoms are common in suspected covid 19 cases, and remains the commonest mode of presentation in children.<sup>[12]</sup> This calls for rigorous monitoring and case management of children with cough or difficult breathing.

The USAID Vriddhi project is supporting the state governments of Haryana, Punjab, Uttarakhand, Himachal Pradesh, Jharkhand, Odisha, and Chattisgarh in implementing a multimodal pulse oximeter intervention in Health and Wellness Centres (HWC) of twelve selected Aspirational Districts (AD). These districts lag behind others in health and development indices. The pulse oximeter introduced is the Masimo Rad-G multimodal handheld pulse oximeter (Pox). It features a SET® pulse oximetry technology to measure SpO<sub>2</sub>, respiration rate from the Pleth (RRp™), pulse rate (PR), and perfusion index (pi). In a previous Indian study the device was found to have high sensitivity of 95% and specificity of 94%.<sup>[13]</sup>

Before implementation a three day IMNCI training was conducted for service providers from HWC. As Covid-19 infections rose in India, additional infection prevention measures were taught using mobile technology to health care workers for cleansing the device and precautions for preventing them from getting infected.

The device has been used successfully in managing around 3000 children. When reports of the corona outbreak started pouring in the experience of care delivery among front line health workers was unknown. Enhancement of infection prevention protocols also brought into question the usefulness of the multimodal device. A small, qualitative study was undertaken to understand the current scenario of pneumonia management in the HWC.

## Methods

### Objectives

The study sought to

- Understand the experience of service providers in ARI case management of children during covid times.
- Assess the usability of the multimodal pulse oximeter and related operational challenges when there is high suspicion of covid infection.

### Study design and sampling

A qualitative study was conducted among service providers of selected HWC. As health care workers were engaged in covid related activities, the sample of facilities and study participants was kept purposively small. While the total intervention was implemented in 19 HWC, the sample of facilities for the study was 10. A convenience sample of 12 providers comprising AYUSH medical officer, Community Health Officer (CHO), Staff Nurse and ANM was selected for in depth interviews.

### Study tools

An interview guide was developed and translated into Hindi. It contained open ended questions on current ARI diagnostic practices, usability and acceptability of PoX, patient flow, etc., Informed consent forms were developed and translated into Hindi. It contained information on the study, risks, benefits and confidentiality.

### Data collection

In depth interviews were conducted remotely over telephone by a member from the Vriddhi project national team. Appointments were made by the state project offices and informed consent forms were sent to the participants ahead of the interview date. Verbal and signed consent was obtained. Interviews were recorded with the permission of the study participants, and later transcribed.

### Data management and analysis

Interview transcripts were entered on ATLAS ti, a software for qualitative analysis, and coded. Categories of findings were extracted in an inductive process. Additionally, program data was computed to find the total cases screened, and detected for pneumonia and severe pneumonia. Data of cases during the Covid lockdown period (April-May 31) as well as during previous two months is provided.

### Ethical clearance

The multimodal device was implemented by the state governments with technical support of Vriddhi project. Before implementation, providers were trained on IMNCI guidelines and given the device as job aids. Permission was granted by the state governments for the current study. Informed consent forms were developed and provided to the study participants before interviews were conducted.

## Findings

### Number of children screened and assessed

The total number of children screened at the study sample facilities (n = 10) during the lockdown period was 392, with 54 children detected with pneumonia and 1 with severe pneumonia who was subsequently referred to a higher facility. Compared to the previous two months, the number screened and diagnosed was less [Table 1].

**Table 1: Children with ARI screened and diagnosed at selected sample facilities (n=10) during lockdown and previous 2 months**

State	District	Facility	Screened		Pneumonia		Severe pneumonia	
			Apr 1 to May 31	Feb 1 to Mar 30	Apr 1 to May 31	Feb 1 to Mar 30	Apr 1 to May 31	Feb 1 to Mar 30
CHHATTISGARH	KORBA	RAJKAMMA	67	95	21	35	1	3
HARYANA	MEWAT	DHULAWAT	14	103	0	21	0	0
HIMACHAL PRADESH	CHAMBA	CHEEMA	28	16	1	0	0	0
JHARKHAND	BOKARO	KURA	42	114	8	31	0	1
JHARKHAND	HAZARIBAGH	PARTAN	59	79	15	24	0	0
JHARKHAND	WEST SINGHBHUM	RENGALBERA	50	24	5	3	0	0
ODISHA	KANDHAMAL	PABURIA	115	54	0	2	0	0
PUNJAB	FIROZPUR	SHAKOOR	16	35	4	8	0	0
UTTARAKHAND	HARIDWAR	BIHARINAGAR	0	6	0	0	0	0
UTTARAKHAND	UDHAM SINGH NAGAR	LALPUR	1	3	0	0	0	0
Total			392	529	54	124	1	4

**Table 2: Children with ARI screened and diagnosed at all facilities (n=19) during lockdown and previous two months**

Facility	Screened		Pneumonia		Severe pneumonia		Referred	
	Apr 1 to May 31	Feb 1 to Mar 30	Apr 1 to May 31	Feb 1 to Mar 30	Apr 1 to May 31	Feb 1 to Mar 30	Apr 1 to May 31	Feb 1 to Mar 30
All facilities	571	908	68	211	2	12	2	11

The total number screened at all the intervention facilities (n = 19) for the same period was less than the previous two months [Table 2].

The finding is substantiated by qualitative data. Service providers (5 out of 11) reported a decrease in the number of OPD patients. Only four facilities reported that it was the same as before or has increased. The provider in a facility in Haryana reported a marked decrease due to fear created in the community that patients reporting cough and fever would be forcibly taken away to a hospital to be isolated. A few of the providers (3 out of 11) reported being busy in the field due to several covid related activities and being unable to attend to any OPD cases since the infection began. ASHAs were requested to actively screen and refer children with ARI symptoms to the facility in Punjab.

*There is fear of coming here now. So I've asked the ASHA to visit households and to send us any children with cough and cold.* (Staff nurse 09, Punjab).

### Change in diagnostic protocol

All participants reported following strict protocol in managing children with ARI symptoms. They donned masks and gloves, made the mother and child enter in individual pairs, wiped the probe of the device with cotton swab and sanitizer before use, ensured that the mother and the child, if its older, had their face covered, made them sit at a distance and after applying the probe and noting the reading, wiped the probe again with sanitizer. Most of them have minimized physical contact with the child, checking the child only through the device.

*I ask the mother to cover her nose and mouth. I ask her to use sanitizer that I keep here in the room. Oh before that, we wash our hands with soap and water from a bucket we keep outside. Then I wear my gloves. I ask the mother and child to sit down. Then the place where I put the probe I sanitize that area and also the probe. When it's a small child and makes movements, I sit a bit closer and when a bigger child comes who does not move about much I sit at a distance* (ANM 02, Jharkhand)

Prior to covid pandemic, several of them had also checked a child closely through a stethoscope and by touching the child to check fever. Currently, only the two medical officers reported they additionally checked with the stethoscope in case of severe illness for a confirmatory diagnosis.

### General utility of the multimodal device

All participants reported a high level of satisfaction with the device as it enabled them to make quick and accurate diagnosis helping them in providing timely treatment to a child. They compared the present experience with their previous experience when they had to count respiratory rate manually that was reportedly difficult. Being unable to confirm a diagnosis of pneumonia, they referred parents to higher facilities. Additionally, they reported prescribing antibiotics indiscriminately in the absence of a confirmed diagnosis. The device mitigated these challenges.

*See, earlier, we had to X ray the child. There were blood reports. After doing all this, we could diagnose whether a child has pneumonia. But sometimes there are no visible symptoms so in this case, the device quickly picks up whether the child actually does have pneumonia or not. It's become very easy for us. And also, the child gets timely treatment.* (MO 02, Uttarakhand).

## Utility of device during Covid-19 pandemic

Participants were unanimous in their perception of the device as a protective measure against possible infection. They reported that the device enabled timely diagnosis without requiring physical contact with the patient.

*The pulse oximeter is very useful. It doesn't take time like we used to take when counting respiratory rate, it is easy to use and during this time, it helps us to maintain distance, protect ourselves and the child, and yet treat a child correctly.* (ANM 07, Jharkhand).

One described the hypothetical challenge of diagnosing a child during covid times in the absence of the diagnostic device,

*It would be difficult as we would not be able to touch or physically examine. We wouldn't be able to diagnose or confirm any diagnosis. Now, without touching also we are able to diagnose and treat.* (ANM 04, Jharkhand).

Medical officers who were used to conducting clinical examination also avowed that the multimodal device offered protection

*We do it the same way. For covid, you use the pulse oximeter, here also we do the same. But because we don't need to touch the child now – the machine gives us the reading- it is helping in prevention.* (MO 01, Chattisgarh).

One service provider in Odisha had a different opinion about the usefulness of the device. She reported on the ability to measure SPO<sub>2</sub> which she felt was an essential measurement for Covid infection

*The device is very helpful to diagnose pneumonia during this time as it helps in determining blood SPO<sub>2</sub>. COVID-19 infection affects oxygen saturation in blood and child may present respiratory difficulty due to low SPO<sub>2</sub>. Hence, knowing the blood oxygen by finding the SPO<sub>2</sub> through the device helps in diagnosing severe pneumonia.* (ANM 12, Odisha)

## Challenge in usage

Movements of a young child, particularly between the age of twelve and twenty four months, were reported to create fluctuation and error in the readings leading them to wait for the child to calm down and take numerous measurements. This was the only challenge reported by the participants.

*With small babies I don't have any problem, but with the older infants I have because they move a lot, cry a lot, it takes time then to take a reading as I have to take the reading a number of times.* (MPHW 1, Himachal Pradesh).

## Discussion

The multimodal pulse oximeter is well accepted by healthcare workers as it has obviated the need for manual counting of respiratory rate and checking chest indrawing which is globally shown to be time consuming and difficult.<sup>[14]</sup> even among IMCI trained workers.<sup>[9]</sup> A study in Pakistan found that SPO<sub>2</sub>

measurements were obtained with a PO in less than 1 minute along with a high level of acceptance among parents leading the authors to conclude that it was feasible in primary care settings.<sup>[15]</sup>

Study participants reported additional benefits of using the pulse oximeter. Providers were able to confirm pneumonia which enabled them to provide timely treatment and referral. This also reduced indiscriminate use of antibiotics. The only challenge they mentioned was when an infant moved while the measurement was being taken. This gave rise to error in readings, and providers had to wait for sometime for the child to calm down before reusing the device. Consistent with a finding from Malawi and Bangladesh<sup>[16]</sup> the use of pulse oximeter in small and agitated children was challenging. However, this occurred only in a few cases specifically among children aged between 1 and 2 years.

Another facet of the pulse oximeter was revealed in the context of infection prevention during the Covid pandemic. **The device reportedly protected providers and patients from infection as it mitigated the need for close physical contact.** Only the probe had to be attached to the finger of a child.

Although the pulse oximeter was implemented in HWC, the findings are applicable for primary care physicians in PHC and CHC in several ways: 1) provision of pulse oximeter will improve classification of pneumonia and severe pneumonia as it detects hypoxemia, 2) it will reduce screening time as well as provide protection from infection, and 3) it will reduce flow of referrals from lower centres as all HWC under the PHC become equipped to diagnose and treat pneumonia with correct referrals of those with severe pneumonia.

The providers also reported following strict infection prevention protocol for case management. **Based on the availability of local resources, the health providers ensured hand hygiene for visiting patients.** Outside some of the health centres, a bucket of water and soap was kept for hand washing by patients and attendants while ANM demonstrated the steps of handwashing. Moreover, the providers took added precaution in admitting patients to the OPD and conducting examination. Most of them sat at a distance from the mother-child dyad and ensured that the mother's and child's hands were sanitized. They sanitized their own hands too before and after examination, and a few of them also wore gloves (wherever available). This is heartening as until very recently, hand hygiene among health care workers globally has been low.<sup>[17,18]</sup> In centres that are the primary point of care in a community, front line workers are especially vulnerable to exposure to pathogens during infectious disease outbreaks. Coupled with a stressful work environment it predisposes them to acquire or transmit infections such as COVID-19.<sup>[19]</sup> Based on their narratives, we can safely assume that the study participants, all of them at peripheral health centres, are practicing good hand hygiene.<sup>[20]</sup>

The program data highlights a marked decrease in patient flow. This could be a result of the lockdown. It could also be an effect of seasonal change as respiratory problems decrease during the

summer. The qualitative data points to mixed findings regarding patient flow. In a few facilities, there was no significant change in patient flow whereas most reported a drop in OPD patients. Conversely, one facility recorded an increase due to parental anxiety about coronavirus in their children suffering from cold and cough. We see the opposite also- that people were fearful of accessing a health facility due to Covid infection. In Mewat, they had an irrational fear about being removed to a hospital. Thus there could be varied impact of the Covid -19 pandemic on utilization of health care services. Delayed presentation of childhood illnesses could well be a real possibility having an impact on child health in India.<sup>[20]</sup>

In summary, the multimodal pulse oximeter adds value to new diagnostic procedures of ARI cases by improved classification, treatment and referral. In the specific context of Covid-19 it offers protection to the health care worker and the patient. There were mixed findings about patient flow. Where there is acute decrease, ASHA can reinforce messages and enhance identification and referrals of sick children from the community. The PO can be adopted in other HWC and primary health facilities. At the same time, infection prevention supplies such as alcohol-based hand rubs, gloves and masks need to be continually provided to these facilities.

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### Conflicts of interest

There are no conflicts of interest.

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