Vayu Bubble Continuous Positive Airway Pressure (bCPAP)Introduction under the SWAP Project in Bangladesh (2022 – 2025)

স্বাস্থ্য ও পরিবার কল্যাণ মন্ত্রণালয়

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Save the Children

BACKGROUND

Bangladesh, with an annual preterm birth rate of 16.2%, is estimated to have the highest preterm BR in the world (WHO 2023). Respiratory conditions, a common complication of preterm birth, account for many of the newborn deaths associated with preterm birth (Blencowe 2013). The bubble continuous positive airway pressure (bCPAP) device is a medical device to assist breathing and can be life-saving for small and sick newbornsexperiencing respiratory distress (Dundek 2021). bCPAP is included in Bangladesh's National Newborn Health Programme (NNHP) as a key component for quality care of newborns with complications. Additionally, Vayu bCPAP has been evaluated to have positive outcomes for neonates in Bangladesh (Banik 2024).

The Vayu-bCPAP device allows for precise delivery of oxygen concentration, flow, and pressure that can improve clinical management of newborn care (Dundek 2021). The Vayu bCPAP, just like many other bubble CPAP systems, ensures non-invasive ventilation to supply continuous positive airway pressure to spontaneously breathing neonates. However, the Vayu bCPAP device also supplies blended oxygen at varying concentrations without the usage of electricity, helping to prevent retinopathy of the prematurity (ROP). It allows for multiple oxygen sources including tubing from an oxygen tank, piped compressed air or oxygen concentrator machines (Vayu Innovations 2020). The Save the Children Saving Women and Premature Babies (SWAP) project in Bangladesh introduced Vayu-bCPAP device to treat newborns with respiratory distress in the five SWAP-supported health facilities.

SWAP PROJECT

The Saving Women and Premature Babies (SWAP) Project, supported by an anonymous donor and implemented by Save the Children, addresses persistent challenges of maternal and neonatal mortality in Bangladesh. The SWAP project assists the Bangladesh Ministry of Health and Family Welfare (MOHFW), including the National Newborn Health Program (NNHP) and Integrated Management of Childhood Illness (IMCI), to improve the quality of care for mothers (particularly those likely to deliver premature/low birthweight babies) and small and sick newborns by supporting provision and institutionalization of evidence-based, life-saving interventions in selected facilities. Implemented in five health care facilities in Dhaka, Sylhet, and Chittagong divisions of Bangladesh, the goals of the program are to improve quality of care and reduce preventable maternal and neonatal deaths from causes such as postpartum hemorrhage, eclampsia, preterm birth complications, and low birth weight, to bring Bangladesh closer to global Sustainable Development Goals. The project works in partnership with in Bangabandhu Sheikh Mujib Medical University (BSMMU), Centre for Injury Prevention and Research Bangladesh (CIPRB), Vayu Global Health Foundation (Vayu), and Laerdal Global Health.

Map of Bangladesh shwoing project-sypported health facilities

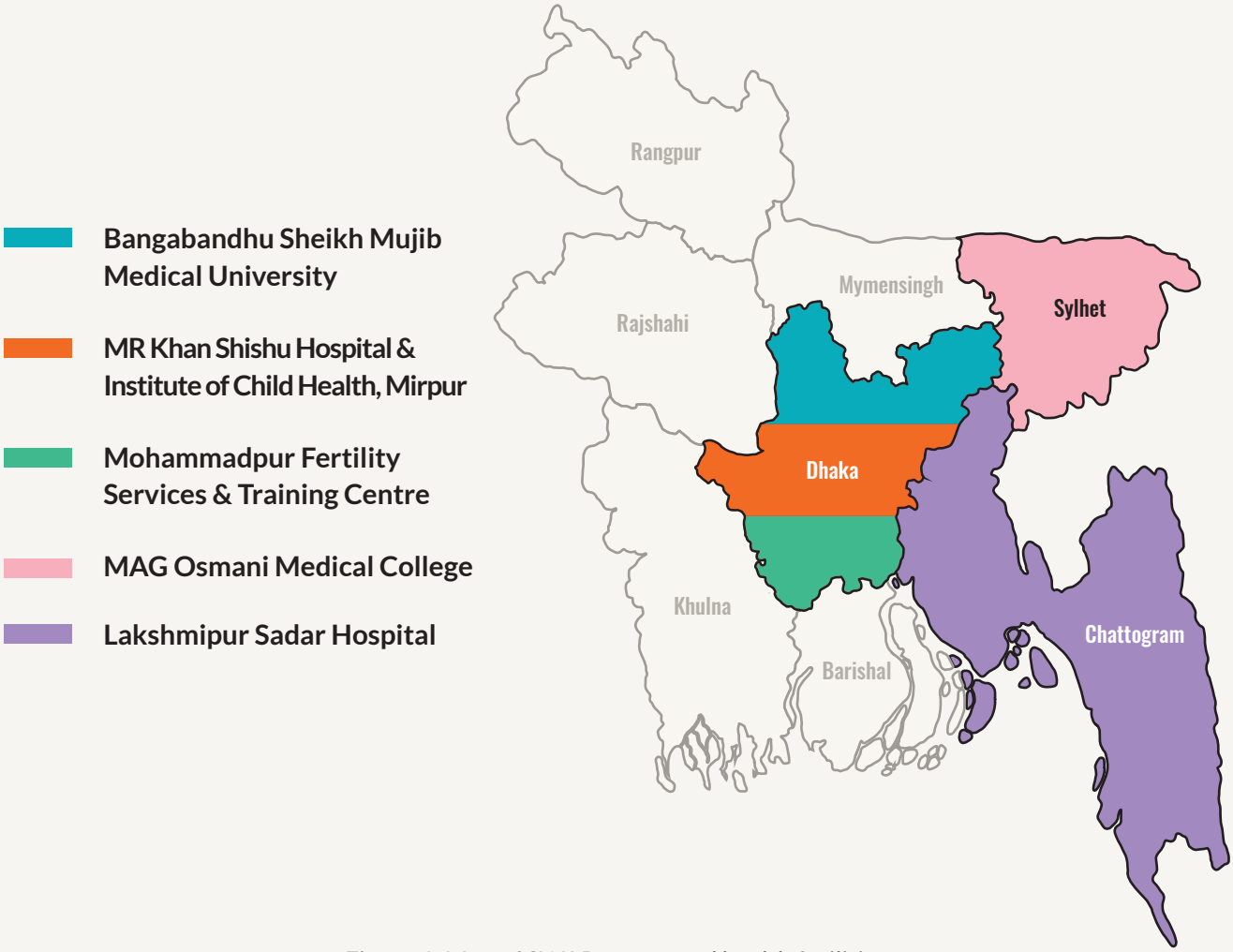


Figure 1. Map of SWAP-supported health facilities

VAYU BCPAP INTRODUCTION INTO SWAP-SUPPORTED FACILITIES

The five SWAP-supported health facilities where Vayu bCPAP was piloted are a mix of public and private, urban and district-level health facilities which include three health facilities in Dhaka: Bangabandhu Sheikh Mujib Medical University (BSMMU); Dr. M R Khan Shishu Hospital, and Mirpur (DMRKSHICH), Lakshmipur District Hospital [LSH] Mohammadpur Fertility Services & Training Center [MFSTC] in Chittagong, and Sylhet MAG Osmani Medical College Hospital [SMOMCH] in Sylhet (see Figure 1). These facilities differ substantially in services provided. For example, MR Khan Shishu Hospital does not have a maternity ward.All admitted patients are newborns who transfer in and tend to be in more critical condition. The other four facilities (Bangladesh Medical University , Sylhet Osmani Medical College Hospital, Mohammadpur Fertility Service and Training Centre and Laskhmipur District Hospital) have large maternity wards. Newborns at the special newborn care units (SCANU) from this facility tend to be transferred from that ward in addition to accepting referrals from outside of the facilities (babies born outside the health facility). In terms of bCPAP services, all facilities had other cPAP devices, with the exception of Laskhmipur District Hospital which did not have other cPAP devices. Given the patient population, service utilization patterns and existing cPAP facilities, the use of Vayu bCPAP varied across the five facilities.

The following steps were used by the SWAP program to roll out the Vayu bCPAP device in the supported facilities:

- A pool of Master Trainers were created using a Training of Trainers approach, conducted by the Vayu Foundation virtually (20 TOTs total: 6 at BSMMU, 3 at MFSTC, 5 at SOMCH, 4 at MR Khan and 2 at Laskhmipur) (Table 1)
- Vayu facilitators were trained by the master trainers, (60 facilitators total)
- Health service providers in the newborn care unit trained by facilitators (116 health service providers total)

In 2022, 24 Vayu bCPAP devices were distributed to the SWAP-supported facilities (Table 1). Trainer of trainers (ToTs) were all medical doctors who worked in the SCANU of the health facility. The initial ToT training was conducted virtually by the Vayu Foundation team and was a one-day training that covered xx, yy and zz. The TOTs then cascaded training on Vayu bCPAP to doctors and nurses in the other hospitals. Ongoing mentorship to trained service providers was primarily provided by the trainers, with virtual support by the Vayu Foundation. From month/year to month/year, the Vayu Foundation continued to work closely with the project to troubleshoot device and clinical issues that arose during use of the device in care.

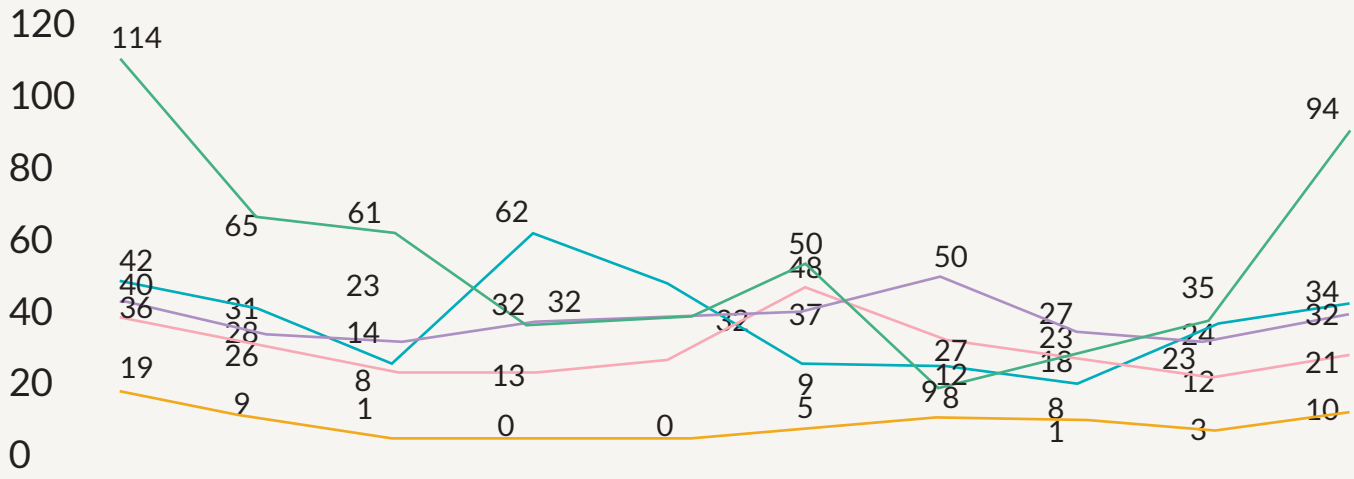
Table 1. Vayu utilization factors in SWAP-supported health facilities

Facility (level of care)	Annual volume of SCANU clients (2024)	TOTs trained	Health care providers trained	Vayu devices provided)	Other bCPAP devices already in use?
Bangabandhu Medical University (BMU)(tertiary care facility)	450	6	36	6	Yes
M R Khan Shishu Hospital (tertiary Care facility)	1207	4	41	6	Yes
Osmani Medical College Hospital (tertiary care facility)	930	5	36	6	Yes
LakshmipurDistrict Hospital (secondary care facility)	468	2	23	2	Yes
Mohammadpur Fertility Services & Training Centre (MFSTC) (secondary care facility)	809	3	42	4	Yes

Utilization of Vaya bCAP, monitoring data

Overall, over the life of the project, 1,399 newborns were put on Vayu bCPAP. Figure 2 shows facility use over time. As can be seen in Figure 2, with the exception of Lakshmipur District Hospital, there was high uptake after introduction, somewhat maintained in most sites in the second year of use. Some of the anecdotal reasons of the modest decline included human resource capacity, availability of consumables, and follow-up support.

Figure 2: Newborn treated with Vayu bCPAP in SWAP facilities from program monitoring data (September 2022 – March 2025)



	Sep+Q4 2022	Q1 2023	Q2 2023	Q3 2023	Q4 2023	Q1 2024	Q2 2024	Q3 2024	Q4 2024	Q1 2025
BSMMU	42	31	8	62	41	9	8	1	24	32
Lakshmipur DH	19	9	1	00	00	5	9	8	3	10
MAG Osmani MCH	114	65	61	32	32	50	12	23	35	94
MFSTC	36	26	14	13	18	48	27	18	12	21
MR Khan Hospital	40	28	23	31	33	37	50	27	23	34

Evaluation of Vayu bCPAP

An evaluation of introduction of Vayu bCPAP was conducted in the first quarter of 2025 in the five supported health facilities, with the goal of documenting use of Vayu. The study was a cross-sectional look at use of Vayu and non-Vayu bCPAP and outcomes of infants using Vayu (non-comparative design). The evaluation included review of Vayu-specific usage records which covered the 6 month period from October 2024 – March 2025.

Record review results

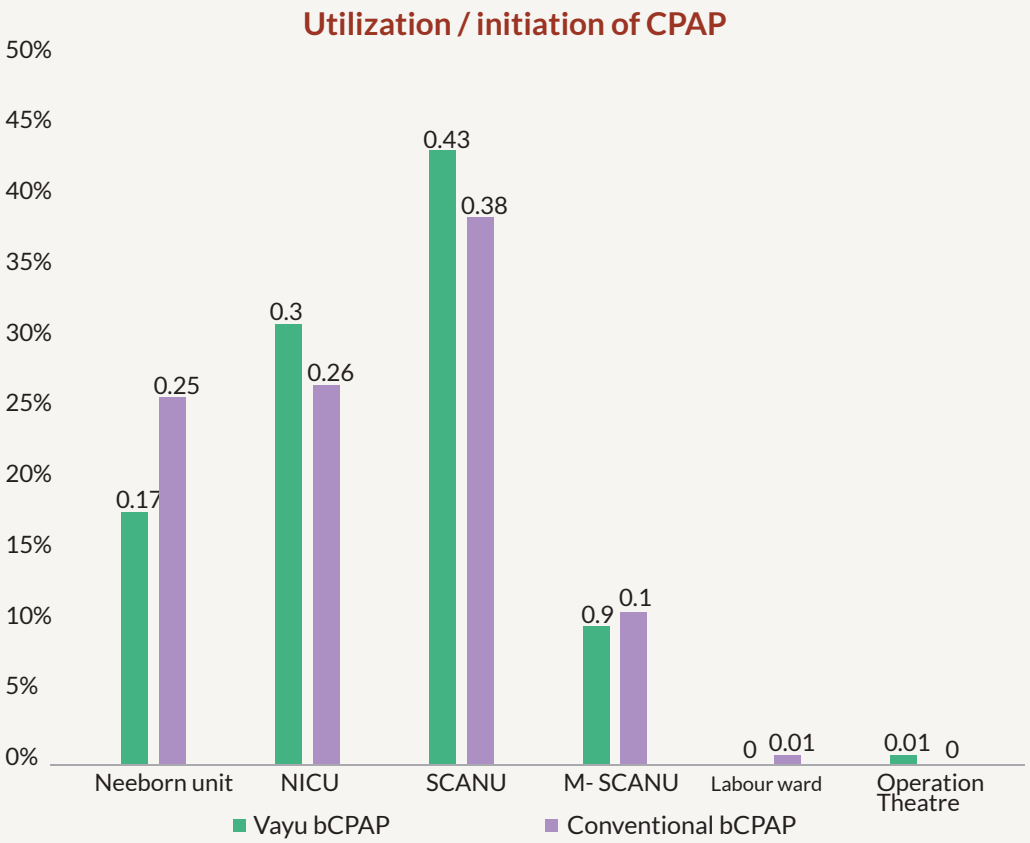
Characteristics of babies put on Vayu bCPAP

The majority of the babies put on Vayu bCPAP (58%) of them were at term - 42% were preterm. The distribution of newborns born in facilities and those referred in to the facility was roughly half for each category (Table 2). For those referred in, the largest proportion (34.7%) were born at home, followed by roughly a quarter (25.3%) who were born at a private hospital.

Table 2. Place of birth of newborns using Vayu bCPAP
(October 2024– March 2025)

Place of birth	**Vayu bCPAP**	
	n= 153	%
Inborn	78	51.0
Outborn	75	49.0
Birth place of outborn baby	n= 75	%
On the way	2	2.7
Private Hospital	19	25.3
MCH	5	6.7
MCWC	1	1.3
DH	12	16.0
UHC	9	12.0
UH&FWC	0	0.0
Home	26	34.7
NGO Clinic	1	1.3
Others	0	0.0

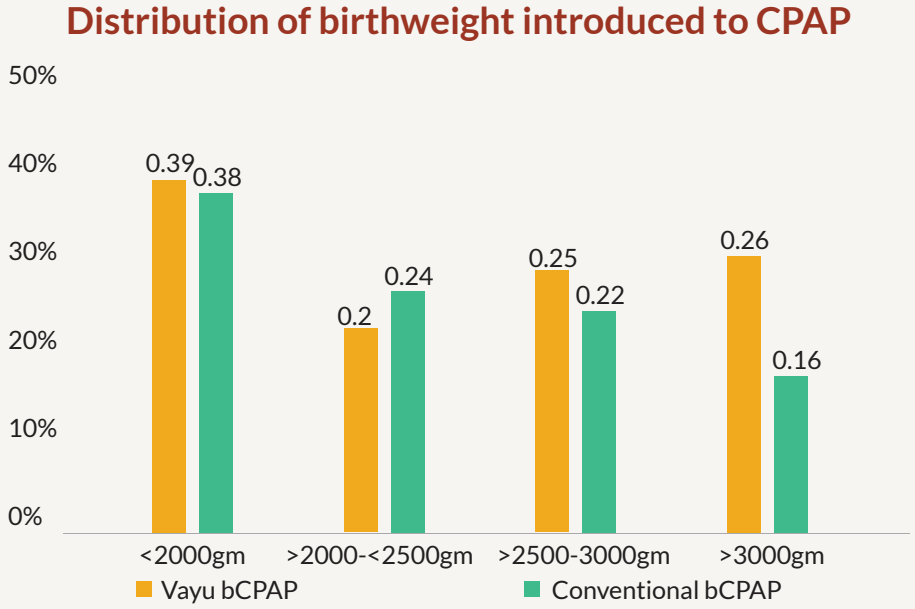
Figure 3. Usage patterns of Vayu and other bCPAP from evaluation (n=289, March – May 2025)



As shown in Figure 3, Vayu bCPAP is used in a variety of settings across the five facilities, from NICU to in exceptional cases, the labour ward or operational theatre. The most common place to use cPAP is the SCANU, clearly a critical location for neonatal respiratory support. In SCANUs as well as NICUs, the use of Vayu exceeded the use of other bCPAP devices. This may vary from health facility to health facility given the differences noted in Table 1.

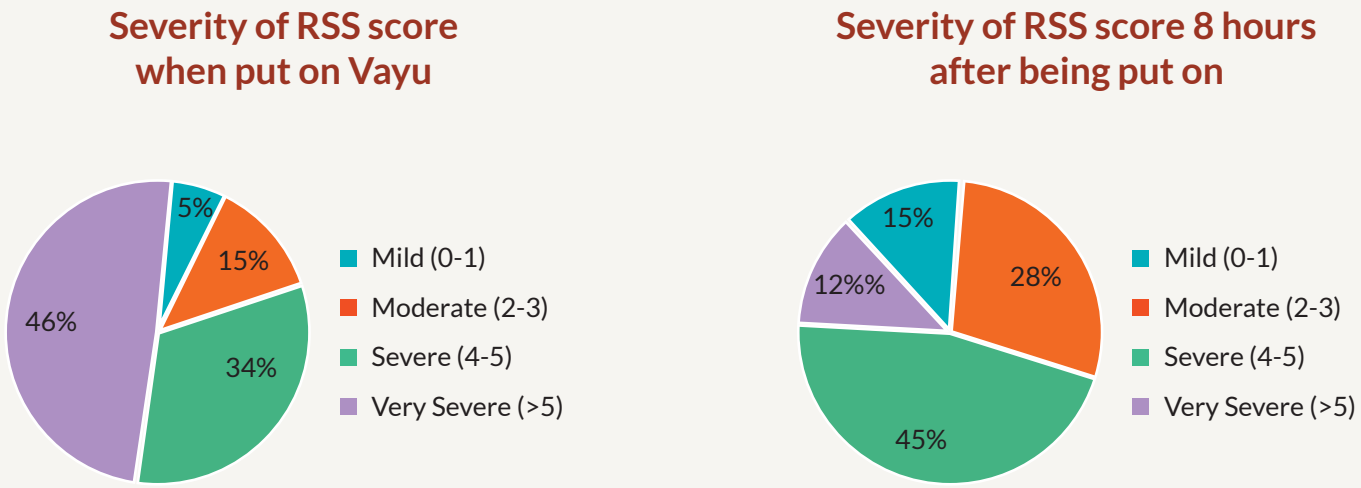
Overall, a similar proportion of low birthweight (LBW) newborns were put on either Vayu or other bCPAP machines in the health facilities (39 and 38%, respectively) (Figure x).

Figure 4. Birth weights of newborns put on Vayu and other bCPAP from evaluation (n=289, March – May 2025)



Severity before and after being put on Vayu

Figure 4. Severity of RSS upon being put on Vayu and 8 hours after being put on Vayu (March – May 2025)

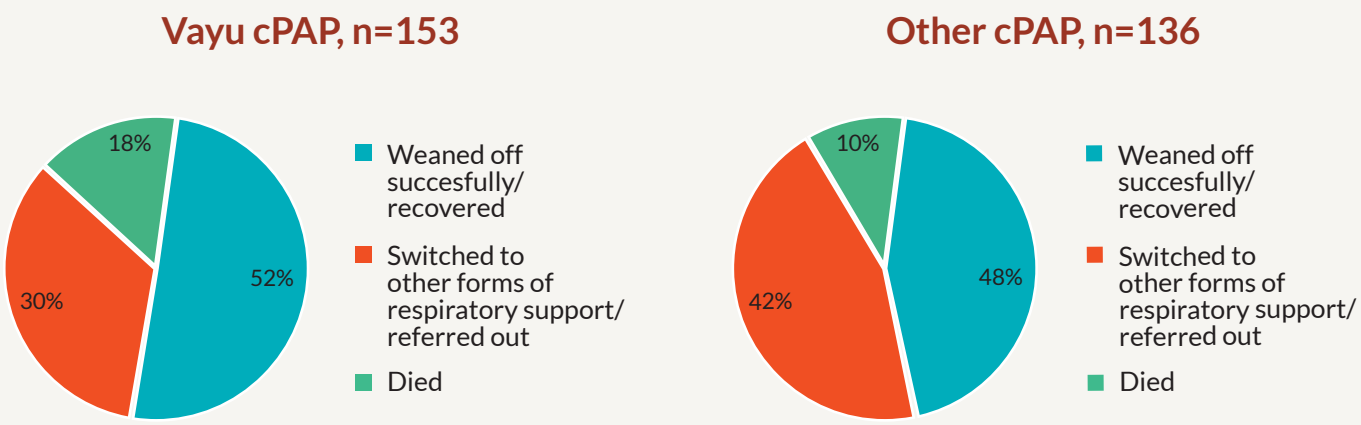


RSS= respiratory support score

Findings showed that among 153 newborns who were put on Vayu, 46% had very severe respiratory distress. Eight hours after being put on Vayu, this dropped to 12% had very severe respiratory distress.

Outcomes of newborns on Vayu

Figure 5. Outcomes of newborns put on Vayu and other cPAP machines (n=289, October 2024 - March 2025)



As can be seen in Figure 5, there was a difference in the outcomes of newborns put on Vayu bCPAP and other cPAP. In both cases, roughly half of newborns put on the device recovered and were weaned off successfully (52% Vayu, 48% other CPAP machines). More newborns were referred out or switched to other respiratory support with other CPAP machines (42% versus 30%) – and this may have included transferring to a facility using Vayu. Mortality was 18% with Vayu and 10% with other CPAP machines. However, these findings reflect the fact that provider and facility practice may have included putting newborns with more severe respiratory distress on Vayu.

Implementation challenges with Vayu

There were a number of challenges experienced when introducing Vayu to the SWAP-supported health facilities. Despite having received initial training on the device and refresher training, some nurses and doctors lacked confidence to initiate patients on the device. This may relate to long-standing lack of confidence due to previously held perceptions of bCPAP being complex and difficult to operate. Limited opportunities for hands-on experience may underscore a need for more mentorship, particularly in the facilities with limited CPAP experience. The second major challenge is that, notwithstanding the relative simplicity of the Vayu bCPAP device, it still required maintenance, which generally fell to the healthcare providers (HCPs) using the device. The Vayu Foundation provided remote support to address this issue; however readily-available local support is needed. Recurrent consumables, such as filters, were not available in the country and had to be sourced externally; this affected the readiness of the equipment for use. Completeness and consistency of entry of patient care data was an issue due to the use of VAYU specific data collection tools that may have been new and parallel to the one routinely used in these facilities.

Conclusion and Recommendations

The study findings indicate that Vayu bCPAP was generally accepted and taken up by facilities; thus contributing to improving /expanding access to care for newborns requiring respiratory support. Vayu bCPAP device holds promise as a cost-effective, electricity-free solution for managing neonatal respiratory distress. Its sustained use /uptake is influenced by human resource capacity, sustained availability of consumables, training quality, and follow-up support. Addressing these constraints is essential for scaling up the device nationwide and achieving better neonatal

- Local capacity strengthening needs to ensure providers have gained confidence in use of the VAYU device. This could include identifying champions in each facility who are capable and available to mentor their peers. In addition, integrating hands-on training and simulation exercises for healthcare workers can optimize patient outcomes.
- User-friendly guides should be developed to facilitate setting up, trouble shooting and maintenance of the Vayu bCPAP machine.
- Need for point person trained within each facility to support maintenance of the devices.
- Consumables should be sourced locally, hence a need for local suppliers to procure and supply as soon as introduction has launched.
- Explore equipping local suppliers with skills to provide maintenance / servicing of devices
- Integrate VAYU data collection systems into routine health management information system tools (routine patient monitoring HMIS tool

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