Continuous Positive Airway Pressure (CPAP)

Guide to Selection

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Approximately 15 million babies are born prematurely each year, and preterm birth complications are the leading cause of neonatal mortality worldwide.[i] Over 60 percent of all preterm births occur in Africa and South Asia, but preterm birth rates are increasing in nearly every country across the globe.[ii] A serious complication of preterm birth is respiratory distress due to insufficient lung development. Of the numerous interventions for respiratory distress syndrome (RDS) that have been introduced over the past 60 years, the greatest declines in RDS-specific neonatal mortality in high-income countries have been due to the use of oxygen and CPAP.[iii]

Although advances in mechanical ventilation have greatly reduced mortality rates for preterm infants, evidence indicates that mechanical ventilation contributes to chronic lung disease.[iv] Research has shown that CPAP reduces the need for assisted ventilation in infants less than 28 weeks gestation and the need to transfer infants less than 32 weeks gestation to neonatal intensive care units.[ii]

CPAP technology delivers pressurized gas (blended air/oxygen) to the airway, through a mask or nasal cannula interface. For added benefit, the pressurized gas is humidified and warmed. Devices can be categorized into continuous flow and variable flow. The continuous flow devices provide a fixed flow of gases, and therefore pressure, regardless of the phase of expiration, while the variable flow devices exert a lower pressure during the expiratory cycle so that the infant does not need to exhale against a continuous flow of gases.[v] Bubble CPAP, a type of continuous flow device, uses a column of water to create continuous, end-expiratory pressures that are accompanied by fluctuations arising from the bubbling of air exiting the expiratory limb tubing.[iv] Research suggests that the vibrations that result from the bubbling help contribute to gas exchange and reduce the infant's work of breathing.[vi] When comparing the impact of CPAP devices, bubble CPAP has been demonstrated to be superior in terms of reduced complications, cost, and duration of hospital stay.[vi]

Because of the high level of technology involved in CPAP devices, they are generally used at tertiary care facilities by skilled operators, but recent studies in low-resource settings show that nurses can safely operate a bubble

CPAP device after training.[vii,viii] While a current commercially available bubble CPAP can cost just 15 percent of the cost of the cheapest mechanical ventilator,[ix] they can still be prohibitively expensive. Further, CPAP devices often require the ongoing purchase of accessories, such as nasal prongs, caps, and masks. Many clinics have opted to assemble improvised devices. Unfortunately, the oxygen blender is not easily improvised. This increases the risk to the neonate due to the delivery of 100% oxygen. A number of university research programs and independent, small businesses are working to develop improved and lower-cost CPAP devices for low-resource settings.

This booklet contains a sample of the CPAP devices that are on the market today.

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[i] World Health Organization (WHO). *Fact sheet: Preterm birth.* November 2012. Available at: http://www.who.int/mediacentre/factsheets/fs363/en/. Accessed October 7, 2013.

[ii] March of Dimes, PMNCH, Save the Children, World Health Organization (WHO). *Born too soon: The global action report on preterm birth*. Eds CP, Howson, MV Kinney, JE Lawn. Geneva: WHO: 2012.

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[iv] PATH, USAID. Technologies for Health Consultative Meeting: MNCH. Intrapartum-related events rapid landscape analysis—CPAP. February 2012. Available at: http://sites.path.org/technologysolutions/files/2012/04/HealthTech_Intrapartum-Related-Events_Rapid-Landscape_UPDATED-March-15-2012-c.pdf. Accessed October 8, 2013.

[v] Deorari AK, Paul VK. *Neonatal Equipment: Everything that you would like to know!* 4th Edition. New Dehli: Sagar Publications; 2010.

[vi] Bahman-Bijari B, Malekiyan A, Niknafs P, Banesi MR. Bubble CPAP vs. Ventiliatory CPAP in preterm infants with respiratory distress. *Iran J Pediatr*. 2011;21(2):151–159.

[vii] Koyamaibole L, Kado J, Qovu JD, et al. An evaluation of bubble-CPAP in a neonatal unit in a developing country: effective respiratory support that can be applied by nurses. *Journal of Tropical Paediatrics*. 2006;53(4):249–253.

[viii] Van den Heuvel M., Blencowe H, Mittermayer K, et al. Introduction of bubble CPAP in a teaching hospital in Malawi. *Annals of Tropical Paediatrics*. 2011;319(1):59–65.

[ix] Wyatt J. Appropriate medical technology for perinatal care in low-resource settings. *Annals of Tropical Paediatrics*. 2008;28:243–251.

Prices noted here are approximate. Manufacturers often provide discounts for volume purchases or pricing deals for developing countries. Permission was granted from the manufacturers for all included photographs.

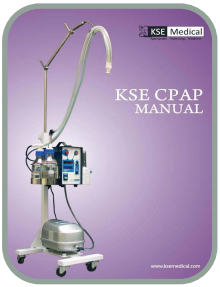
PUMANI bCPAP

Basic information	Manufacturer	Hadleigh Health Technologies
	Link	http://hadleighhealthtechnologies.com/
	Manufacturer description	Provides a continuous flow of pressurized air into the patient's nostrils via nasal prongs which allows the patient's airway to remain open and prevents the patient's lungs from collapsing during exhalation. Capable of delivering flow from 0 to 10 L/min and pressure from 5-8 cm H_2O. Also has the ability to blend room air with oxygen.
	Type	Bubble CPAP Device
	Characteristics applicable to low-resource settings	Requires electricity. Designed specifically for low-resource settings.
	Features	Includes teaching module, user manual, spare parts kit, patient accessories kit, and repair guide.
	Pre-/post-sales support	No
	Approximate price	US$800 (estimated). Expected to be available in early 2015
Characteristics for CPAP in low-resource settings	Low cost for setting	✓
	Safe	✓
	Durable	✓
	Easy to use	✓
	Easy to repair	✓

MTTS CPAP

Basic information	Manufacturer	MTTS
	Link	http://www.mtts-asia.com/
	Manufacturer description	Not available
	Type	Bubble CPAP Device
	Characteristics applicable to low-resource settings	Requires electricity. Developed and manufactured in Vietnam.
	Features	System is 100% reusable and price includes sanitizer system. Partners working with East Meets West Breath of Life program receive equipment training.
	Pre-/post-sales support	Yes
	Approximate price	US$1,600
Characteristics for CPAP in low-resource settings	Low cost for setting	✓
	Safe	✓
	Durable	✓
	Easy to use	✓
	Easy to repair	✓

KSE BUBBLE CPAP



Basic information	Manufacturer	KSE Medical
	Link	http://ksemedical.com/
	Manufacturer description	Not available
	Type	Bubble CPAP Device
	Characteristics applicable to low-resource settings	Requires electricity. Developed and manufactured in Vietnam.
	Features	KSE trains local end-users and technicians to manage technical and repair issues. KSE also invented its own stand-alone sterilizing unit for the CPAP, to allow reusable instead of disposable components.
	Pre-/post-sales support	Yes
	Approximate price	US$1,950
Characteristics for CPAP in low-resource settings	Low cost for setting	✓
	Safe	✓
	Durable	✓
	Easy to use	✓
	Easy to repair	✓

ACQUATHERM

Basic information	Manufacturer	Shreeyash
	Link	http://www.shreeyashindia.com
	Manufacturer description	Acquatherm is an innovative system manufactured by Shreeyash for the first time, which can deliver high flows of air or oxygen ranging from 1 to 15 LPM.
	Type	Bubble CPAP Device
	Characteristics applicable to low-resource settings	Requires electricity. Designed and manufactured in India.
	Features	Includes separate air oxygen blender with markings to accurately control the delivered FiO_2 and built-in medical air compressor with pressure regulator.
	Pre-/post-sales support	Yes
	Approximate price	US$2,000
Characteristics for CPAP in low-resource settings	Low cost for setting	✓
	Safe	✓
	Durable	✓
	Easy to use	✓
	Easy to repair	✓

INFANT FLOW SIPAP

Basic information

Manufacturer	CareFusion
Link	http://www.carefusion.com
Manufacturer description	The Infant Flow SiPAP System, combined with the patented variable flow generator, provides noninvasive positive pressure ventilation, by offering nasal CPAP, Biphasic and Biphasic tr* modalities.
Type	Variable Flow CPAP Device
Characteristics applicable to low-resource settings	Requires electricity. Include 2 hours of battery back-up. Design not focused on low-resource settings.
Features	BiPhasic and NCPAP modes, 2 hours of battery back-up.
Pre-/post-sales support	Yes
Approximate price	US$4,900

Characteristics for CPAP in low-resource settings

Low cost for setting	**NO**
Safe	✓
Durable	✓
Easy to use	✓
Easy to repair	**NO**

F&P BUBBLE CPAP SYSTEM

Basic information	Manufacturer	Fisher & Paykel
	Link	http://www.fphcare.com
	Manufacturer description	Incorporating unique features and world-leading humidification technology, the Fisher & Paykel Bubble CPAP System has been developed to provide a respiratory support system that is safe, effective, and easy to use.
	Type	Bubble CPAP Device
	Characteristics applicable to low-resource settings	Requires electricity. Design not focused on low-resource settings.
	Features	Can connect to various interfaces. Includes Fisher & Paykel FlexiTrunk lightweight nasal tubing allowing for normal infant movement.
	Pre-/post-sales support	Yes
	Approximate price	US$6,000
Characteristics for CPAP in low-resource settings	Low cost for setting	**NO**
	Safe	✓
	Durable	✓
	Easy to use	**NO**
	Easy to repair	**NO**

BABYLOG VN500

Basic information	Manufacturer	Draeger
	Link	http://www.draeger.com
	Manufacturer description	The Babylog VN500 combines our years of experience and dedication with the latest innovative technology in the field of neonatal ventilation. The result is a complete, integrated ventilation solution for the tiniest of patients.
	Type	Ventilator with CPAP mode
	Characteristics applicable to low-resource settings	Requires electricity. Full ventilation machine with several ventilation options, including CPAP. Design not focused on low-resource settings.
	Features	CPAP mode is SPN-CPAP/PS (pressure support) and an optional SPN-CPAP/VS (volume support). Device includes extensive neonatal ventilation therapy modes and automatic leakage compensation to reduce deformation and pressure from nasal cannula or masks.
	Pre-/post-sales support	Yes
	Approximate price	US$10,000
Characteristics for CPAP in low-resource settings	Low cost for setting	**NO**
	Safe	✓
	Durable	✓
	Easy to use	**NO**
	Easy to repair	**NO**

NeoPAP

Basic information	Manufacturer	Philips Healthcare
	Link	http://www.healthcare.philips.com
	Manufacturer description	NeoPAP is a sophisticated CPAP delivery and treatment system developed to treat newborns and infants with respiratory distress syndrome (RDS) or who are recovering from RDS.
	Type	Variable flow CPAP device
	Characteristics applicable to low-resource settings	Requires electricity.
	Features	NeoPAP was unveiled by Philips Healthcare India in June 2013. Includes three modes: CPAP mode, flow mode, and resuscitation mode. Leak compensation technology reduces deformation and pressure from nasal cannula or masks.
	Pre-/post-sales support	Yes
	Approximate price	information unavailable
Characteristics for CPAP in low-resource settings	Low cost for setting	**NO**
	Safe	✓
	Durable	✓
	Easy to use	✓
	Easy to repair	**NO**

The following device is in development.

PATH Bubble CPAP Kit		Features
Designer	PATH	PATH has developed a low-cost bubble CPAP kit in collaboration with Dr. Ashish Jain of Hindu Rao Hospital in New Delhi, India. Made from components commonly found in hospital settings and combined with a low-cost oxygen blender designed by PATH, the bubble CPAP device does not require a source of electricity.
Type	Bubble CPAP device	
Characteristics for Low resource settings	Does not require electricity.	
Price	Less than $US20 (estimated)	

This guide to selection is part of a six-piece series of Survive and Thrive guides, including birthing and cesarean section simulators, continuous positive airway pressure (CPAP), fetal monitors, portable ultrasound, rechargeable lighting, and thermoregulation devices. You can search for any of these guides in the PATH Publications Catalogue at http://www.path.org/publications/index.php.

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