



NEST-ED

Clinical Modules

June 2020

Newborn Essential Solutions and Technologies-Education (NEST-ED) Clinical Modules provide educational support for each of the technologies included in the NEST360° bundle for newborn care. These materials are intended to strengthen locally developed neonatal and technical trainings in pre-and in-service settings and are not intended to be comprehensive clinical guidelines or targeted towards intensive care of the newborn.

**FACILITATING THE CLINICAL USE OF
TECHNOLOGIES FOR NEWBORN CARE IN LOW-
RESOURCE SETTINGS**

Newborn Essential Solutions and Technologies-Education
Clinical Modules: Suction Pump

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The authors have made every effort to check the accuracy of all information and instructions for use of any devices or equipment. As knowledge base continues to expand, readers are advised to check current product information provided by the manufacturer of each device, instrument, or piece of equipment to verify recommendations for use and/or operating instructions.

In addition, all forms, instructions, checklists, guidelines, and examples are intended as resources to be used and adapted to meet national and local health care settings' needs and requirements.

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PREFACE

This series has been designed with the intent of supporting the clinical use of technologies in newborn care units.

Newborn Essential Solutions and Technologies–Education (**NEST-ED**) Clinical Modules provide educational support for each of the technologies included in the NEST360° bundle for newborn care. These materials are intended to strengthen locally developed neonatal and technical trainings in pre- and in-service settings. Of note, these materials are not intended to be comprehensive clinical guidelines or targeted towards intensive care of the newborn. They are to be used to facilitate the implementation of comprehensive newborn care, including bubble CPAP, in a resource limited setting.

The NEST-ED Clinical Modules were developed through a combination of international standard review, international expert feedback, and multinational NEST360° expert consensus opinion. NEST-ED Modules form the backbone of all lectures, power points, job aids, and other supportive education materials supplied by NEST360°.

**THIS IS ONE MODULE IN A SERIES OF NEST-ED
CLINICAL & TECHNICAL MODULES AVAILABLE.**

To view the full series, visit the [NEST360° Resources](#) website.

ABBREVIATIONS

| | |
|------------------------|--|
| ABC | Airway, Breathing, Circulation |
| bCPAP | Bubble continuous positive airway pressure |
| dL | Decilitre |
| FiO₂ | Increased Fractional Concentration of Oxygen |
| Fr | French size |
| HAI | Hospital acquired infections |
| HCWs | Healthcare workers |
| HFNC | High flow nasal cannula |
| IV | Intravenous |
| KMC | Kangaroo mother care |
| LBW | Low birth weight |
| LCD | Liquid crystal display |
| LED | Light emitting diode |
| mm Hg | Millimeters of mercury |
| NEST360° | Newborn Essential Solutions and Technologies |
| NEST-ED | Newborn Essential Solutions and Technologies-Education |
| NGT | Nasogastric tube |
| nm | Nanometer |
| O₂ | Oxygen |
| OGT | Orogastric tube |
| ppm | Parts per million |
| ROP | Retinopathy of Prematurity |
| SpO₂ | Peripheral blood oxygen saturation |
| UPS | Uninterruptible power supply |
| WASH | Water, sanitation and hygiene |
| WHO | World Health Organization |
| wks | Weeks |

NOMENCLATURE

| | |
|------------------------------------|--|
| bCPAP prongs | bCPAP patient interface |
| Cot | Bassinet, infant crib |
| Christmas tree nozzle | Barbed oxygen fitting, nipple and nut adapter |
| Flow splitter | Oxygen splitter, flow meter stand |
| Glucometer | Glucose meter |
| Hospital Acquired Infection | Iatrogenic infection, nosocomial infection |
| Nasal prongs | Oxygen catheter, oxygen cannula, oxygen prongs |
| Positive Pressure | Positive end expiratory pressure, positive airway pressure |
| Radiant warmer | Resuscitaire, resuscitation table |
| Suction pump | Suction machine |

Introduction

This NEST-ED Clinical Module has been prepared to help healthcare staff & students understand when & how to use suction pumps in newborn care. This is one module in a series of NEST-ED Clinical and Technical modules available that may be used by teaching institutions to supplement current newborn care curricula or by hospitals, clinical departments, and individuals to update their knowledge and to better facilitate the effective and safe use of newborn care equipment.

Whilst reading this series, navigate to the **Table of Contents** by clicking the NEST360° logo that appears at the bottom right corner of each page: **NEST360°**

Every module has a similar structure with sections and subsections. The sections have similar headings and subheadings to make it easy for the user to navigate them. However, words may have different meanings for the various cadres of staff reading them and so to reduce misinterpretation, the heading titles are explained below.

An exception to this structure is the **Infection Prevention & Control: General Infection Prevention** module. This module describes general infection prevention measures in relation to the use of equipment in the ward. There are also sections on reprocessing of single use items and a useful table of suitable disinfectants.

CLINICAL PROBLEM

This describes the situations in which a piece of equipment may be clinically useful. It does not include all the clinical background in making that decision, as this should be covered in country-specific neonatal care protocols & clinical training materials.

ASSESSMENT

This section explains how a piece of equipment works, as well as how it may be useful in certain patient care settings (e.g., why an overhead radiant heater is useful for short term warming in the labour ward while resuscitating a newborn).

MANAGEMENT

Step by step preparation for setting up, checking, and using the equipment is described. This is followed by explanations of how to remove the equipment from a baby when it is no longer needed, how to clean it, and how to store it safely until further need.

INFECTION PREVENTION

In this section infection prevention measures are described for the equipment when in use, followed by instructions on how to disinfect the equipment both during and after use.

COMPLICATIONS

The complications described in this section are those relating to the use of the equipment and do not include all clinical complications that may arise from underlying medical problems. These are beyond the scope of the modules and should be covered in clinical training materials.

CARE & MAINTENANCE

Advice is given on where to place equipment for use, how to safely handle such devices and their consumables, and how to keep them functioning well by using preventive maintenance measures.

TROUBLESHOOTING & REPAIR

This section provides helpful advice on what to check if equipment is malfunctioning on the ward. It is intended to help healthcare staff deal with minor technical difficulties for which there are simple remedies. Detailed machine maintenance is beyond the scope of these modules and is covered in the technical modules that accompany these clinical ones.

ASSESSMENT QUESTIONS

A few questions are attached based on module content. These may be used, for example, during mentoring visits or to emphasise some of the points raised in teaching with the module.

REFERENCES & ALERTS

References and alert boxes are included within each module to provide clarity on areas where recommendations are governed by published standards, evidence, and/or expert opinion. This is included for the dual purpose of facilitating (1) feedback and continuous improvement of NEST-ED Education Modules and (2) implementer review of content for incorporation in local trainings.



ALERT 0.0 Subject

QUERY ALERT BOXES appear where there may be controversy or disagreement. In these cases, alert boxes provide background to the recommendations that are made in the body of the document. Relevant documents are cited and brief explanation of reasoning for current module content provided.



ALERT 0.0

RECOMMENDATION ALERT BOXES appear where there are recommendations based largely on expert opinion or consensus, or to emphasize an important element of care. Relevant documents are cited and brief explanation of reasoning for current module content provided.

Respiratory Support

Suction Pump

1 Clinical Problem

Obstruction of the nostrils, mouth or upper airway with secretions or blood will cause respiratory compromise and potential hypoxia.

Suction pumps can be used in patients to clear secretions, vomitus, and blood from the mouth, nostrils, or upper airway.

LABOUR & OBSTETRIC NOTE

If meconium stained liquor is present at delivery and the baby is not vigorous or has not taken a breath, inspect the nose and mouth for obstruction. If meconium is present, gentle suctioning is recommended.¹ Routine suctioning is not recommended.

2 Assessment

A suction pump (2.1) uses a negative vacuum created by an internal pump to remove blood or secretions from oral and nasopharyngeal cavities.

A bacterial filter is used in circuit with the suction pump to filter out any aerosolised particles or bacteria from the blood and secretions suctioned from a patient.



2.1 A typical suction pump.

A suction pump may be tailored to adults (2.2) or paediatric patients. (2.3) Although an adult suction pump can be used on paediatric or neonatal patients, the vacuum range is much higher which makes it more difficult to control for the low ranges required for neonatal patients. **Use of an adult pump to treat neonatal patients is not encouraged.**



2.2 Adult suction pump.



2.3 Paediatric suction pump.

Penguin suckers are reusable devices made of a flexible silicone, which can be used to provide low pressure suctioning. (2.4) **Penguin suckers are autoclavable.** Although suction bulbs (2.5) may also be used, they are not autoclavable, are difficult to clean, and are not recommended due to greater infection risk between patients.



2.4a Penguin sucker.



2.4b Open penguin sucker.



2.5 Suction bulb.

Neonatal patients should be suctioned gently, no deeper than the eye can see and only within a range of 60 to 100 mmHg of negative pressure and for a period less than 10 seconds. **(Alert 2.1)**



ALERT 2.1 Suction Efficacy

In the referenced document, WHO recommends a range of 50-100 mmHg for suctioning for no more than 10 seconds. Based on expert feedback, it was felt that 60-100 mmHg is likely a more effective range and still within the WHO recommendation.²

3 Management

Management covers how to use the suction pump, including set up for a patient, patient preparation & commencement, care whilst on the device & removal of the patient from the device.

SETTING UP FOR A PATIENT

1 Collect: **(3.1)**

- Suction pump with collection reservoir
- Suction pump filter (if not already attached to pump)
- Short suction tubing
- Long suction tubing
- Suction catheter or Yankauer sucker
- Water in a suitable container (e.g., kidney dish, bowl)



3.1 Materials needed to use a suction pump.



3.2 Reservoir full of fluid.

- 2 Visually inspect the suction pump's collection reservoir. If it is full or there are secretions present (3.2), dispose of the secretions appropriately, clean the reservoir and place it back in place with the lid firmly closed.
- 3 If a filter is not attached to the collection reservoir, place the filter in the lid of the collection reservoir at the port labelled "Vacuum". Using the short suction tubing, connect the inlet of the suction filter on the suction pump collection reservoir to the suction pump outlet port. (3.3)
- 4 Connect long suction tubing to the collection reservoir outlet port labelled "Patient." (3.4)
- 5 Plug the power cable in the device. (3.5) Plug the power cable into the wall and turn on suction pump.



3.3 Connect short tubing to filter & inlet port.



3.4 Connect long suction tubing to collection reservoir outlet labelled "patient."

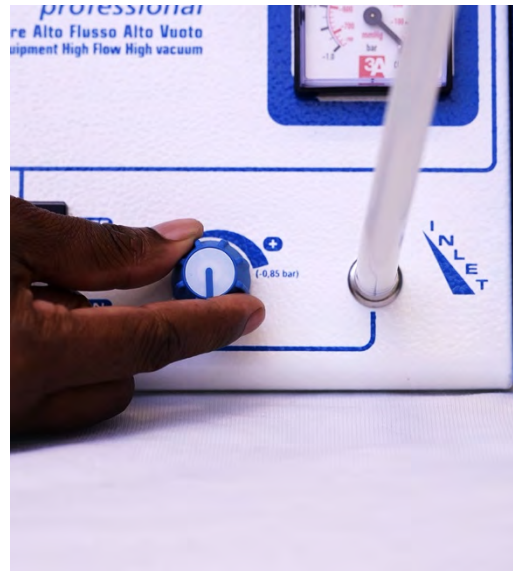


3.5 Connect power cable to device.

- 6 Connect the suction catheter or Yankauer sucker to the long suction tubing. (3.6)
- 7 Using the suction regulator, adjust the suction vacuum to the desired level within safe neonatal levels (60 to 100 mm Hg). Test the suction functionality with some water. (3.7)



3.6 Connect suction catheter or Yankauer sucker to long sucker tubing.



3.7 Adjust suction vacuum to desired safe level and test by suctioning water from container.

PREPARING A PATIENT

- 1 Collect: **(3.1)**
 - Suction pump with collection reservoir
 - Suction pump filter (if not already attached to pump)
 - Short suction tubing
 - Long suction tubing
 - Suction catheter or Yankauer sucker
 - Water in a suitable container (e.g., kidney dish, bowl)
- 2 Always explain the purpose, risks, and benefits of a procedure to guardians BEFORE performing the procedure. Follow handwashing protocol and put on gloves.
- 3 Suctioning is only required when there is airway obstruction. Visually inspect the patient's oral and nasopharyngeal cavities for secretions or blood.
- 4 Assess whether to use a suction catheter or Yankauer sucker.
 - For thicker secretions it may be necessary to use a Yankauer sucker but do not use in the nares of a newborn.
 - For thinner secretions, use an appropriately sized suction catheter (typically Fr sizes 6, 8 or 10). A correctly sized suction catheter should be the approximate size of the nostril. Nasogastric tubes are not recommended as a substitute for a suction catheter.
- 5 If secretions, blood, or meconium are visible, collect:
 - Clean suction catheter or Yankauer sucker
 - Tape
- 6 If using a suction catheter: determine suction depth by measuring from the nose to the ear and halfway back. Mark this distance with a small piece of tape. **(3.8)**
- 7 If using a Yankauer sucker, no measurement is required. **Suctioning should only be conducted as far as can be visually assessed.**
- 8 Place the infant in a neutral position to ensure effective suctioning. **(3.9)**



3.8 For the suction catheter, measure from nose to ear and halfway back and mark with tape. This is the suction depth.



3.9 Place the infant in a neutral position.

STARTING A PATIENT

- 1 Collect: **(3.1)**
 - Suction catheter marked with appropriate suction depth or Yankauer sucker
 - Suction pump with collection reservoir and tubing in place
 - Water in a container
- 2 Always explain the purpose, risks, and benefits of a procedure to guardians BEFORE performing the procedure.
- 3 Follow handwashing protocol.
- 4 Plug suction machine into power outlet and turn on.
- 5 Connect suction catheter marked with appropriate suction depth or Yankauer sucker to long suction tubing. **(3.11)**
- 6 Using the suction regulator, adjust the suction vacuum to the desired level, maintaining safe vacuum levels for neonates. Test the suction functionality by suctioning the water.
- 7 **When using a suction catheter:** pinch the catheter and insert **gently** into the patient's mouth or nostril to the point marked by the tape. When introducing catheter into the nose do so following the floor of the nose. Release the pinch on the catheter slowly as you withdraw the catheter from the mouth or nostril, gently rotating until it is completely removed. **(3.12)**
- 8 **If using a Yankauer sucker:** for thicker secretions or meconium, it may be necessary to use a Yankauer sucker.
 - Suctioning should only be conducted as far as can be visually assessed when using a Yankauer sucker. If secretions are thick, application of 1-2 drops of normal saline to both nostrils may assist suctioning and reduce nasal trauma.
 - Some Yankauer suckers may require a hole at the hub of the sucker to be occluded for suctioning pressure.

- 9 Allow the patient to visibly recover from the procedure. While waiting, rinse the catheter with water. **(3.13)** Repeat this process on the other side of the mouth or nostril.
- 10 Repeat steps 5 through 7 until all secretions are removed. **Remember: suctioning should be a gentle procedure. Do not suction too vigorously and do not suction too long.** Suction only until the reservoir is $\frac{3}{4}$ full; if it reaches this point, remove collection jar, dispose of contents and reattach to complete suctioning.



3.11 Connect suction catheter or Yankauer sucker to long sucker tubing.



3.12 Pinch catheter and insert gently in nostril to point marked by tape.



3.13 Rinse catheter with water.

CARING FOR A PATIENT

Observe suctioned contents carefully whilst suctioning procedure is taking place:

- If fresh blood starts to be suctioned, trauma may have been caused to the oral or nasopharyngeal cavities. Decrease the force with which the suction catheter is being inserted into the patient's nose or mouth.
- If stomach contents are being suctioned, the patient's suction catheter is being inserted into the oesophagus. Recheck the suction depth measurement.

REMOVING A PATIENT

Gently withdraw the suction catheter from the patient's passageway.

4 Infection Prevention

Routine and adequate cleaning of medical devices is critical to prevent hospital-acquired infections in newborn care units. If devices & equipment are not disinfected promptly & adequately between patients, they pose a significant infection risk.

GENERAL INFECTION PREVENTION

- 1 Clean hands with soap and water or alcohol before and after initiating treatment using a suction pump or handling any tubing that will be used on a patient.
- 2 Ensure that all patient-related tubing and consumables (including suction catheters and collection reservoirs) are new or have been cleaned thoroughly before use (if following re-use guidelines). Any patient-related tubing must be cleaned (following the ward protocol) before it is used to suction another patient. Tubing should be hung to dry after disinfection and should not touch the floor or other unsanitary surfaces whilst drying.
- 3 When re-using suction tubing there is a risk of infection if inadequately cleaned. If the machine is not cleaned after each use, it can become a source of infection for patients in the ward. **Suction catheters should never be reused.**
- 4 All patient-related consumables should be stored in a clean, dry location. Tubing should be stored in loose rolls, preventing sharp bends and kinks, which will decrease its lifetime.

ALERT 4.1



Electrical suction pumps and associated equipment, if not re-processed or cleaned appropriately between patients, pose a significant infection risk. Please refer to [WHO Technical Specifications for Resuscitation Equipment](#) chapter 2.6 or [Infection Prevention and Control: Reference Manual for Health Care Facilities with Limited Resources, Jhpiego](#) Module 6 for more detailed guidance on reprocessing of equipment associated with suction pumps.^{2,3}

DISINFECTION AFTER USE

- 1 Gently disconnect the suction catheter from the suction tubing and dispose of catheter appropriately. If reusing, immediately begin hospital protocol for disinfection of tubing. **Delay in initiating cleaning of reused medical devices can lead to the need for more intensive cleaning procedures to remove pathogens.** If not reusing, discard safely.
- 2 Turn off and unplug the suction pump, if not using with another patient. Check filter. If filter is obviously dirty, replace. **(4.1)** Refer to user manual for specific instructions on when to change the filter.
- 3 Disinfect the suction pump pressure gauge controls using gauze and 70% alcohol.
- 4 The housing of the suction pump should be cleaned according to ward guidelines for disinfecting surfaces.
- 5 All tubing and collection reservoir should be cleaned after each patient.
 - Remove the collection reservoir from suction pump. **(4.2)** Dispose of contents and disinfect reservoir appropriately, **wearing gloves, a mask and apron to ensure staff safety.** Return collection reservoir to suction pump and store in secure location until next use.
 - Remove short and long suction tubing pieces. Follow hospital protocol for disinfection of tubing.



4.1 Check if the filter is dirty.



4.2 Remove the collection reservoir.

5 Complications

Introduction of equipment in newborn care units poses clinical and device complications for patients. Awareness of potential complications is critical to maximise patient safety.

CLINICAL COMPLICATIONS

- **Hypoxia:** if a patient is on oxygen, it may be necessary to remove oxygen treatment during suctioning, especially when suctioning the oropharynx. This interruption in treatment may worsen patient's hypoxia. Place the patient back on oxygen as soon as oral and nasopharyngeal cavities are clear.
- **Trauma:** incorrect or excessive suctioning of the nose and mouth may cause trauma to mucosal surfaces. If bleeding occurs, stop suctioning, assess severity, and restart when safe.
- **Vomiting:** incorrect measurement of the suction catheter or suctioning too far may stimulate the gag reflex and induce vomiting. This also risks potential aspiration.
- **Vagal stimulation:** inappropriately deep suctioning can cause vagal stimulation resulting in apnoea or bradycardia.

DEVICE COMPLICATIONS

- **Positioning:** suction pumps are not heavy devices but are frequently positioned on walls / shelves. This is appropriate if well secured during use. If improperly secured, suction pumps may fall, causing potential permanent or fatal injury, particularly to neonatal patients.

6 Care & Maintenance

Users are responsible for basic first-line care and maintenance to ensure equipment lasts to their potential lifetime.

POWER SOURCE

Suction pumps may be powered by mains or battery power **(6.1)** or manually via a foot or hand pump. **(6.2)** If a suction pump is battery powered, it should be taken off its charger **only as necessary** to ensure that it is charged for use in the event of a power blackout.



6.1 Battery-powered suction machine.



6.2 Foot-powered suction machine.

WARD LOCATION

Suction pumps should be secured in an accessible location where nursing staff can regulate and view vacuum easily, but where the pump is not at risk of falling. Suction consumables should be kept nearby for easy access in case of emergency.

USER PREVENTIVE MAINTENANCE

The suction pump should be turned on and allowed to run for 15 minutes every week.

7 Troubleshooting & Repair

Although users are not responsible for repairing their devices, there are steps that may be taken to troubleshoot first-line errors that may occur before contacting maintenance or engineering support.

1 The device does not turn on

- Check that the machine's power cable is firmly secured **(7.1)** and that the power at the socket is on. If it is loose, secure the power cable.
- If the machine still does not turn on, contact your maintenance team.

2 The device stops suctioning

- Suction pumps often have a fail-safe valve installed in the lid of the collection reservoir to ensure that fluid is not sucked into the machine's internal pump. Check that the collection reservoir is not full **(7.2)**; if it is, empty and continue procedure.
- Check that the tubing is not loose and leaking. If the machine still does not suction, contact your maintenance team.



7.1 Check that power cable is securely attached.



7.2 Check that the collection reservoir is not full.

Assessment Questions

1 Label the image below.



2 What is the appropriate range of negative pressures that can be used with neonatal patients?

60–100mmHg

3 What is the purpose of the filter in the suction pump circuit?

The bacterial filter filters out bacteria that exhausts off blood & secretions whilst suctioning a patient.

4 What are 2 complications that may occur due to suctioning? Please describe how you would manage each.

- (1) Hypoxia; place the patient back on oxygen as soon as oral and nasopharyngeal cavities are clear
- (2) Trauma: stop suctioning, assess severity & restart when safe, using a gentler suctioning style

References

- 1 *Helping babies breathe provider guide.* (American Academy of Pediatrics, 2016).
- 2 *WHO technical specifications for neonatal resuscitation devices.* (World Health Organization, 2016).
- 3 Curless MS, Ruparelia CS, Thompson E, and Trexler PA, eds. 2018. *Infection Prevention and Control: Reference Manual for Health Care Facilities with Limited Resources.* Jhpiego: Baltimore, MD.

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