NEST-ED

Technical Modules

February 2021

Newborn Essential Solutions and Technologies-Education (NEST-ED) Technical 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 technical guidelines or device-specific manuals.
Newborn Essential Solutions and Technologies-Education
Technical 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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page 3  Technical Education Modules  Respiratory Support – Suction Pump
This series has been designed with the intent of supporting the clinical use and technical repair of technologies in newborn care units.

Newborn Essential Solutions and Technologies-Education (NEST-ED) Technical 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 technical guidelines or to replace the use of device-specific user and service manuals or textbooks. They are to be used to facilitate the implementation of comprehensive newborn care, including bubble CPAP, in a resource limited setting.

The NEST-ED Technical 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

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<th>Description</th>
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<td>bCPAP</td>
<td>Bubble continuous positive airway pressure</td>
</tr>
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<td>BMET</td>
<td>Biomedical Equipment Technician</td>
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<tr>
<td>dL</td>
<td>Decilitre</td>
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<tr>
<td>ESD</td>
<td>Electrostatic Discharge</td>
</tr>
<tr>
<td>FiO₂</td>
<td>Increased Fractional Concentration of Oxygen</td>
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<tr>
<td>Fr</td>
<td>French size</td>
</tr>
<tr>
<td>HAI</td>
<td>Hospital acquired infections</td>
</tr>
<tr>
<td>HCWs</td>
<td>Healthcare workers</td>
</tr>
<tr>
<td>KMC</td>
<td>Kangaroo mother care</td>
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<tr>
<td>LBW</td>
<td>Low birth weight</td>
</tr>
<tr>
<td>LCD</td>
<td>Liquid Crystal Display</td>
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<tr>
<td>LED</td>
<td>Light-Emitting Diode</td>
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<tr>
<td>mm Hg</td>
<td>Millimeters of mercury</td>
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<td>NEST-ED</td>
<td>Newborn Essential Solutions &amp; Technologies-Education</td>
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<td>NEST360°</td>
<td>Newborn Essential Solutions &amp; Technologies</td>
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<tr>
<td>nm</td>
<td>Nanometer</td>
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<tr>
<td>O₂</td>
<td>Oxygen</td>
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<tr>
<td>OGT</td>
<td>Orogastric tube</td>
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<tr>
<td>PCB</td>
<td>Printed Circuit Board</td>
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<td>ppm</td>
<td>Parts per million</td>
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<tr>
<td>ROP</td>
<td>Retinopathy of Prematurity</td>
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<tr>
<td>PSA</td>
<td>Pressure Swing Adsorption</td>
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<tr>
<td>PSU</td>
<td>Power Supply Unit</td>
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<tr>
<td>ROP</td>
<td>Retinopathy of Prematurity</td>
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<tr>
<td>SpO₂</td>
<td>Peripheral blood oxygen saturation</td>
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<tr>
<td>UPS</td>
<td>Uninterruptible power supply</td>
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<td>WASH</td>
<td>Water, sanitation and hygiene</td>
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NOMENCLATURE

- Allen keys
- bCPAP prongs
- Barbed oxygen fitting, nipple and nut adapter
- Christmas tree adapter
- Control PCB
- Cot
- Flat head screwdriver
- Flow splitter
- Glucometer
- Glucose meter
- Hospital Acquired Infection
- Iatrogenic infection, nosocomial infection
- Multi
- Multimeter
- Nasal prongs
- Oxygen catheter, oxygen cannula, oxygen prongs
- Positive Pressure
- Positive end expiratory pressure, positive airway pressure
- Radiant warmer
- Resuscitaire, resuscitation table
- Star screwdriver
- Torx screwdriver
- Suction pump
- Suction machine
Introduction

The NEST-ED Technical Modules have been prepared to help technical staff and students understand the basics of when and how to use equipment essential to newborn care. More importantly, the Technical Modules support staff in troubleshooting common issues, as well as prepare staff to repair equipment when it breaks down or malfunctions. Modules 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. Modules should be used alongside device user and service manuals to provide additional context as needed.

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.

The NEST-ED Technical Modules are intended as a flexible resource that hospitals and partners can adapt to their specific needs. The Technical Modules consist of generic content that can be applied to any model within a device category, coupled with model specific device images that can be exchanged for alternative images depending on the devices available at your facility. Individuals who are interested in gaining access to the editable NEST-ED Technical Modules should contact the NEST Training Materials Coordinator (Anniina Lockwood, all90@rice.edu) or the NEST Biomedical Tech Training Director (Sara Liaghati-Mobarhan, slmobarhan@rice.edu).

CLINICAL PROBLEM

This section provides useful information on the clinical application of a device that would bear relevance to the biomedical team, not only to aid in their troubleshooting, but also for user training.

ASSESSMENT

This section explains how the device works, and what kinds of patients it is useful for. This section also includes comprehensive diagrams of internal and external views of the devices, including consumables that may be used with the device. This section also contains detailed descriptions of key device components (including alarms) and includes a diagram of typical device flow (including components and how they interact with each other, electrical current and fluid movement through the device if relevant).
MANAGEMENT

This section focuses on clinical management and provides step by step directions on how to set the device up for a patient, followed by instructions on starting the patient on the device and monitoring a patient whilst on the device. This section also describes how to remove the equipment from the patient when it is no longer needed. Although a biomedical engineer or a technician will not be responsible for providing care, understanding these steps will be useful in training and when assessing the device.

INFECTION PREVENTION

This section lays out the basic infection prevention measures that should always be taken when handling equipment, followed by directions for disinfecting the equipment both during and after use. This section also describes the crucial Infection Prevention and Control steps that are particularly relevant to biomedical engineers and technicians.

COMPLICATIONS

This section explains some of the common but serious clinical complications that relate to and can arise from the use of the equipment (e.g., complications that will be seen or directly apply to the patient). Biomedical engineers’ and technicians’ understanding of potential complications for the patient is crucial to ensure patient safety. This section also describes common device complications (e.g., complications that will be seen or directly apply to the device).

CARE & MAINTENANCE

This section describes where to place equipment for use, how to safely handle devices and their consumables, whether calibration is recommended, and how to decommission the equipment. Biomedical engineers and technicians are responsible for second-line care and maintenance to ensure the equipment lasts to their potential lifetime; as such, this section also lists the necessary daily, weekly, monthly and annual preventive maintenance steps required to keep the device in good working condition. First-line care and maintenance is the responsibility of the user and is described in the NEST-ED Clinical Modules.

TROUBLESHOOTING & REPAIR

This section describes steps that should be taken when a device malfunctions and first-line troubleshooting efforts have failed to address the issue. This section describes tools and spare parts that might be required to prepare for repairs and to troubleshoot failures, and provides a list of components commonly provided with the device to ensure that all components return to the ward post-repair. Finally, this section also explains steps for testing, repairing, and replacing specific parts of the device.
REFERENCES & ALERTS

References & 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 Technical 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

Suctioning is an essential procedure within multiple hospital settings. In newborn care units, suction pumps are used to remove obstructions from blood or secretions in the mouth, nose or upper airway.

Suction pumps may be used in newborn patients to help remove obstructions from blood or secretions in the mouth, nose, or upper airway.

2 Assessment

A suction pump uses an internal pump to create negative pressure.

A suction pump may be tailored to adult (2.1) or paediatric patients. (2.2) Although adult suction pumps may be able to reach the therapeutically recommended suctioning levels for paediatric or neonatal patients, the vacuum range is much higher and it is difficult or impossible to control for the low ranges required for neonatal patients. **Use of an adult pump to treat neonatal patients is not encouraged.**

Low pressure suctioning may also be provided through the use of penguin suction devices, reusable devices made of a flexible silicone, which can be used to provide low pressure suctioning. (2.3) **Penguin suction devices can be sterilised with autoclaving or high-level disinfection with**
boiling water or chemical processing. Although suction bulbs (2.4) may also be used for low-level suctioning, they are not autoclavable, are difficult to clean, and are not recommended due to greater infection risk between patients.

When using a suction pump, 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.¹

**HOW IT WORKS**

A suction pump uses an internal pump to create a partial vacuum in a collection reservoir through which suction fluid is collected. The partial vacuum creates negative pressure inside the **collection reservoir** and draws fluid from the patient via device tubing and suction catheter and into the collection reservoir. The collection reservoir sits between the suction pump and suction catheter. Inside the collection reservoir is an overflow **float valve** to prevent suction fluids from entering the machine. An **antibacterial filter** is placed between the collection reservoir and machine to prevent bacteria from entering into the suction pump.

The suction system should be sealed (not exposed to atmosphere) from end to end. When there is a leakage or crack in any part of the system, the atmospheric pressure will find a shorter route to balance the pressure, preventing the device from suctioning appropriately. Suction pumps can either be driven by an electric motor or manually by a foot operated pedal.

Standard external and internal device components are annotated below in **Figures 2.5 and 2.6**. Components should be similar regardless of model. However, specific locations, visual setup and component type may vary by brand and device model. Refer to service and user manuals if model in use is different from the displayed version.
2.5 Major external components of a suction pump.

2.6 Major internal components of a suction pump.
Typical Device Flow:

- Vacuum Pump
- Piston
- Capacitor
- Power Distribution Board
- Power Supply
- Muffler
- Reservoir Jar
- Antibacterial Filter
- Vacuum Gauge
- Vacuum adjustment knob
- Float Valve
- To Patient

Air Flow

Electrical Signal
MAIN COMPONENTS

The following device components should be similar regardless of model. However, specific locations, visual setup and component type may vary by brand and device model. Refer to model service and user manuals if different from the displayed model for more device-specific information.

Bacterial Filter

All suction pumps have an antibacterial filter fitted between a collecting reservoir and the machine. Their function is to stop any bacteria or pathogens from the suction fluids from penetrating into the pump and eventually into the environment. Bacterial filters have a direction, which is usually indicated on the filter. **Always make sure it is fitted in the correct orientation and location for effective filtration.** Some suction pumps have a secondary bacterial filter fitted internally in the machine.

Collection Reservoir

Container that collects suctioned fluids. The collection reservoir lid must be well sealed to the collection reservoir to ensure the system retains vacuum and have an overflow float valve installed to monitor fluid level.

Float valve

An overflow float valve is fitted in the collection reservoir to protect the machine and pump from damage. Its function is to stop suctioning when the collection reservoir is filled with fluids. As the fluids are filling, it pushes the floater up until it closes the suction inlet port thereby blocking vacuum at the catheter end. **The overflow float valve must be placed in the correct orientation to work properly.** If the suction pump is used without a float valve or with a non-functioning float valve, when the collection reservoir is full, body secretions/fluids may overflow into the pump inside the machine and damage the pump (by short circuiting the motor or clogging the internal pump assembly).

Vacuum pump

The pump is responsible for generating vacuum in the system. Pumps are typically diaphragm and piston or vane pumps. Diaphragm and piston vacuum pumps draw air through a series of valves as the volume of the cylinder changes continuously, creating a partial vacuum. The diaphragm or piston is driven by a motor. Vane vacuum pumps consist of a rotor, which is mounted eccentrically and vanes that move radially outwards under spring force as they rotate inside circular housing. Continuous vane rotation creates the vacuum.

Vacuum gauge

Indicates the magnitude/strength of suction set by the user using the adjustment knob.
Vacuum adjustment knob

Used to regulate the amount of vacuum in the system. For neonates, the vacuum range is usually set between -60 to -100 mmHg. The knob works by admitting atmospheric air into the system.

Muffler

At the exhaust side of the pump, a muffler is fitted to reduce noise as the pump expels air into the atmosphere.

Prime mover

The source of power that drives the vacuum pump to generate suction, the prime mover can be a foot pedal or an electric motor. Electric motors may be powered via AC or DC power. DC motors are used in battery powered or rechargeable suction machines. DC motors may pose a challenge to maintain because brushes or commutators can wear out and they additionally require adaptors for charging (AC mains power to DC). AC motors are inductive and do not require brushes or a commutator. They require a starting capacitor.

Capacitor

Used in AC motor powered suction pumps, capacitors start and keep the motor running. The most common capacitor used in small suction units is a capacitor start motor or a permanent split capacitor. These types of capacitors are embedded in the winding circuits.

3 Management

Management covers how to use the suction pump, including set up for a patient, patient commencement, care whilst on the device, and removal of the patient from the device. These instructions are helpful for a biomedical engineer or technician both in user training and in assessing the appropriate functionality of 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
   - Appropriately sized suction catheter or Yankauer suction tip
   - Water
2 Visually inspect the suction pump’s collection reservoir. If there are secretions present (3.2), dispose of the secretions appropriately, clean the reservoir and device tubing and reassemble. For more details on cleaning, refer to Suction Pump: Infection Prevention: Disinfection After Use.

3 If a filter is not already 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 power cable into device. (3.5) Plug the power cable into socket outlet and turn on suction pump.

6 Connect the suction catheter or Yankauer suction tip 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 mmHg). Test the suction functionality by suctioning a small amount of water. (3.7)
STARTING A PATIENT

1 Collect:
   - Appropriately sized suction catheter or Yankauer suction tip
   - Suction pump with collection reservoir and tubing in place
   - Sterile water or saline

2 Follow hand washing protocol.

3 Plug suction machine into power outlet and turn on.

4 Connect suction catheter marked with appropriate suction depth or Yankauer suction tip to long suction tubing. (3.11)

5 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.

6 **When using a suction catheter:** 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. Interrupt vacuum by pinching the catheter or blocking vacuum hole on 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)

7 **For thicker secretions or meconium, it may be necessary to use a Yankauer suction tip.** If using a Yankauer suction tip, suctioning should only be conducted as far as can be visually assessed. Some Yankauer suction tips may require a hole at the hub of the sucker to be occluded for suctioning pressure.

8 Allow the patient to visibly recover from the procedure. While waiting, suction sterile water or saline with the catheter to rinse. (3.13) Repeat this process on the other side of the mouth or nostril.

9 Repeat steps 5 through 7 until all secretions are removed. **Suctioning should be a gentle procedure. Do not suction too vigorously or too long.** Suction only until the reservoir is ¾ full.

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

3.7 Adjust suction vacuum to desired safe level and test by suctioning water from container.
full; if it reaches this point, remove collection jar and dispose of contents before continuing.

3.11 Connect suction catheter or Yankauer suction tip 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 and the frequency with which suctioning is being conducted.
- 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.

**CLINICAL 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. Refer to local guidelines for extensive recommendations.

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 and Yankauer suction tips should never be reused unless they can withstand high-level disinfection or boiling.** Suction catheters and Yankauer suction tips that will be used for one patient may be rinsed with water, labelled and left at the patient’s bedside. (Alert 4.1)

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.

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**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.¹,²

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**DISINFECTION AFTER USE**

1. Gently disconnect the suction catheter or Yankauer suction tip from the suction tubing and discard appropriately. If catheter or Yankauer suction tip can withstand high-level cleaning, immediately begin hospital protocol for disinfection. **Delay in initiating cleaning of reused medical devices can lead to the need for more intensive cleaning procedures to remove pathogens.**

2. Turn off and unplug the suction pump, if not using with another patient. Check filter. If filter is obviously dirty or wet, 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 suction pump housing should be cleaned according to ward guidelines for surface disinfection.

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 tubing disinfection.

4.1 Check if the filter is dirty.  
4.2 Remove the collection reservoir.

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**BMET INFECTION PREVENTION**

1 Any piece of equipment used in providing patient care must be handled carefully, as it may be contaminated and have the potential to spread infection.

2 Clean and disinfect suction pump housing and components whilst wearing PPE as appropriate (e.g., rubber gloves, apron, face protection, etc.) **before any repairs or maintenance are made.** Avoid any contact between used piece of equipment and skin, mucosa or clothing.

3 Post-maintenance, decontaminate all tools and surfaces used with 70% alcohol or according to manufacturer guidelines. Do not use equipment until it has fully dried following decontamination.
Alert 4.2 Disinfecting Equipment

Disinfection of equipment should always comply with manufacturer guidelines. WHO recommends 0.5% dilution of chlorine (0.5% or > 100ppm available sodium hypochlorite) as the standard disinfectant for materials and surfaces contaminated by blood or body fluids. For metal and rubber surfaces, which may be corroded by chlorine, 70% alcohol is also commonly utilised for low level disinfection.

Other appropriate low-level disinfectants include quaternary ammonium, improved hydrogen peroxide and Iodophor germicidal detergent. Phenolic germicidal detergent is also identified but should not be used in neonatal wards since affordable, effective alternatives are available; and, there are concerns it may cause hyperbilirubinemia and/or neurotoxicity in neonates.


5 Complications

Equipment in newborn care units are highly specialised. Without proper knowledge and skills, this equipment can be potentially dangerous for the infants, families and care providers.

Clinical Complications

- **Low oxygen levels (hypoxia):** if a patient is on oxygen, nursing or clinical staff must remove oxygen treatment to suction effectively. This interruption in treatment may worsen patient’s hypoxia. The patient should be placed back on oxygen as soon as the cavities of the nose and mouth are clear.

- **Trauma:** incorrect or excessive suctioning of the nose and mouth may cause trauma to the mucosal surfaces.

- **Vomiting:** incorrect measurement of the suction catheter or suctioning too far may stimulate the gag reflex and induce vomiting, which poses the risk of potential aspiration.

- **Vagal stimulation:** inappropriately deep suctioning can cause vagal stimulation resulting in apnoea or bradycardia.

DEVICE COMPLICATIONS

- **Device positioning:** suction pumps are not heavy devices but are frequently positioned on walls or shelves. This is appropriate if appropriately secured during use. If improperly secured, suction pumps may fall, causing permanent or fatal damage, particularly to small neonatal patients.
6 Care & Maintenance

Biomedical engineers and technicians are responsible for second-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.

WARD LOCATION

Suction pumps should be secured in an accessible location where medical staff can regulate vacuum easily, but where the pump is not at risk of falling, and the pump cable is not posing a tripping hazard. Suction consumables should be kept nearby for easy access.

DEVICE CALIBRATION

Although the suction pump’s pressure gauge can be calibrated, the cost to request calibration from the manufacturer or local calibration companies is typically too disproportionately expensive for the cost of the machine to justify calibration.
DECOMMISSIONING

Assuming appropriate use and consistent maintenance, a suction pump may last for five to seven years or longer. Paediatric suction pumps are generally low-cost; in such models, component breakages (i.e., pump assemblies) may cost more to repair than to replace. These should be decommissioned and replaced if possible. When decommissioning, pump housing may be repurposed for other devices; pump components (i.e., pistons) are typically worn past reuse and should be discarded.
### PREVENTIVE MAINTENANCE

**After Each Use**

- Turn off and unplug the suction pump. Empty suction collection reservoir and disinfect using 70% alcohol solution.
- Check the bacterial filter. If discoloured or wet, replace.
- Disinfect the suction pump pressure gauge controls and suction pump housing using gauze and 70% alcohol.

See **Suction Pump: Disinfection After Use** and **Alert 4.2** for more information.

**Weekly**

- Check the bacterial filter for discolouration or other damage.
- Turn on the suction pump and allow the pump to run for 15 minutes.
- Test the operation of the float valve by shaking the empty collection reservoir with lid in place and noting the rise and fall of the internal floating piece.
- Visually assess the condition of the device housing and collection reservoir for physical damage (e.g., cracks or chips).
- Document preventive maintenance actions taken.

**Monthly**

- Perform **Weekly** preventive maintenance steps.
- **Test the vacuum capacity** of the suction pump:
  - Set up the device for use. Plug the power cable in and turn the power switch to ON. Leave the machine on for 1 minute.
  - Using the suction regulator, adjust suction vacuum to the desired level within safe neonatal levels (60 to 100 mmHg). Test the suction functionality with some water.
  - Observe pump’s functionality for noises or smells outside standard operation.
- Document preventive maintenance actions taken.

**Quarterly**

- Perform **Monthly** preventive maintenance steps.
- Measure grounding integrity and casing leakage current.
- **Clean motor and motor brushes**:
  - Remove two motor brushes from motor, noting orientation.
  - Using compressed air, blow dust out of motor. If motor brushes show signs of build-up, gently clean with fine sandpaper. Replace motor brushes in original orientation.
- Document preventive maintenance actions taken.

**Annually**

- Perform **Quarterly** preventive maintenance steps.
- Confirm supply of spare bacterial filters, pump assemblies, vacuum gauges, collection reservoirs and lids are adequate to support estimated replacement for next year.
- Document preventive maintenance actions taken.
7 Troubleshooting & Repair

Biomedical engineers and technicians are responsible for providing rapid maintenance, troubleshooting & repair support for users.

PREPARE FOR REPAIR

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TROUBLESHOOTING FAILURES

The suction pump is not turning on.

Probable Cause: Faulty power supply

Components to Check:
- Power cable continuity
- Power switch physical integrity & continuity
- Power entry module fuse(s) physical integrity & continuity
- Power supply unit continuity & voltage

The suction pump motor runs but the pump is not suctioning.

Probable Cause: Activated float valve or damaged collection reservoir

Components to Check:
- Float valve activation
- Suction regulator knob, collection reservoir and lid
- External and internal tubing physical integrity
The suction pump motor runs but the pump is not suctioning well.

**Probable Cause:** Damaged internal pump assembly or collection reservoir

**Components to Check:**
- Pump assembly and collection reservoir physical integrity
- External and internal tubing physical integrity

The suction pump makes noise outside of normal operational sound.

**Probable Cause:** Damaged internal pump assembly

**Components to Check:**
- Pump assembly and motor bearing physical integrity
- Muffler, vibration suppressors and cover/screws physical integrity

The suction pump emits a foul odour when in use.

**Probable Cause:** Fluid contamination

**Components to Check:**
- Pump assembly fluid damage
- Float valve & bacterial filter physical integrity

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**REPAIR & REPLACE**

Where technically possible and not likely to obstruct clinical care, repairs may be made within the newborn care ward. Use discretion to determine if this is appropriate or if the device should be removed to the biomedical workshop for more testing or repair.

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**Alert 7.1**

All testing, repair and replacement steps should be conducted with the power to the device switched off and the power cable removed from mains power, unless otherwise stated.

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**Testing & replacing the power supply fuses**

Fuses may be located both on the suction pump housing and on the power supply cable. Fuse integrity may be visually assessed or evaluated by testing the continuity across the fuse. Always refer to the manufacturer specifications for replacement fuses to ensure that the device remains electrically sound in standard operation.
Testing & replacing the power switch

Power switches should be tested in both the off and on positions to confirm functionality. In the **On** position, the switch terminals should be continuous. In the **Off** position, the switch terminals should show a high resistance, or **OL** in most multimeters.

If the switch shows continuity or discontinuity inappropriately, assess the switch for visible physical or electrical damage. If the switch is visibly damaged or dislodged, assess whether the part can be repaired with glue or solder. If it cannot be easily repaired, replace the switch. Always refer to the manufacturer specifications for replacement switches to ensure that the device remains electrically sound in standard operation.

Testing & replacing the power supply unit

Visually assess the power supply unit for fluid damage before testing the voltage delivery through the unit. If fluid is present near or on the power supply unit, **check that the device is disconnected from all sources of power** and wipe the fluid from the unit thoroughly using a non-abrasive cloth.

Testing the power supply unit cannot be completed without checking the alternating voltage at the power supply unit. **This should be completed with caution**, as the power to the device must be switched on to accurately measure the voltage delivered. If the power supply unit or module is damaged, contact the manufacturer to request a replacement part and repair instructions.
Testing & replacing the float valve

The overflow float valve is fitted in the collection reservoir to protect the machine and pump from fluid damage. If the overflow float valve has been physically damaged, installed in the wrong orientation or is not installed on the collection reservoir lid, any fluid overflow will enter into the internal pump assembly through the bacterial filter, potentially damaging the internal pump assembly.

If the collection reservoir has consistently activated the float valve, dried fluids within the valve may cause it to stick, blocking the suction pump from suctioning. Test the float valve by shaking it gently back and forth between fingers: the floater should move as it is shaken. If the float valve appears deteriorated or damaged, replace.

7.3 Check the voltage at the power supply module using a multimeter.

7.4 Correct float valve orientation.

7.5 Incorrect float valve orientation.

7.6 Float valve installation: push in until firmly secured.
Testing & replacing the collection reservoir & lid

Suction pump circuits must be sealed (not exposed to atmosphere) from end to end. If there is a leakage or crack in any part of the system, the atmospheric pressure will find a shorter route to balance the pressure, preventing the device from suctioning appropriately. A cracked collection reservoir or lid also presents additional risk of infection for those using or maintaining the suction pump. Visually assess the collection reservoir for any cracks, damage or blockages. Repair or replace if possible.

![Images of suction pump](image)

7.7 Assess the collection reservoir for cracks.
7.8 Remove the lid to inspect and replace.

Testing & replacing internal or external tubing

Leak testing may contribute to inaccurate or low vacuum. Tubing can be assessed for leaks by running soapy water or foam along the suspected tubing, pipes and fittings during operation and checking for bubbles or movement of the liquid.

Repairing & replacing the internal pump assembly

The internal pump assembly may be damaged through fluid entering the internal system or over time through standard wear and tear. If fluid has entered the internal pump assembly, the pump should be disassembled, cleaned with alcohol and dried thoroughly. The internal pump assembly and electrical components should be tested and visually assessed for damage. In most cases, if one element of the internal pump assembly has been damaged due to wear and tear, the entire assembly should be replaced.
Assessing & replacing the bacterial filter

The 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. The bacterial filter paper is placed within a housing of hard plastic to keep it in place. If the bacterial filter is wet or discoloured, it should be immediately replaced with a new filter.

The bacterial filter is directional. Filters should have visible markings to clarify the direction in which the flow should enter. Refer to **Suction Pump: Assessment: Typical Device Flow** and the device's manual to confirm that the bacterial filter is placed in the correct location and orientation. Some models may have a port for the bacterial filter on the collection reservoir lid, whilst others may have the bacterial filter in a tubing circuit between the collection reservoir and the pump. Care should be taken when putting the bacterial filter into place to prevent the bacterial filter housing from snapping.

7.9 Unscrew housing to access the pump.

7.10 Visually inspect the pump and internal condition.

7.11 Remove chassis ground to prevent damage during repair.

7.12 Remove pump assembly at all connection points.

7.13 Inspect pump assembly for damage to components.

7.14 Replace assembly if needed.
Alert 7.2 Repurposing Parts

In some cases, parts on the unit may be replaced with a repurposed or recycled part from another piece of equipment being used for parts. **Repurposed parts should be considered with caution and guidance from the manufacturer to ensure specifications of the repurposed part is compatible with the equipment.** This includes spare parts and accessories that may not be compatible with multiple systems.
References


3. World Health Organization, Regional Office for the Western Pacific, World Health Organization, & Regional Office for South-East Asia. Practical guidelines for infection control in health care facilities. (World Health Organization, Regional Office for Western Pacific ; World Health Organization, Regional Office for South-East Asia, 2004).