Child-Resistant IV Guard to Prevent Catheter-Related Infection

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Introduction

More than 300 million peripheral intravenous catheters are administered each year in US hospitals. Although intravenous catheters are necessary for vascular access, they often put patients at risk for local and systemic infections. These infections increase hospital stay and treatment costs. IV catheters are reported to be the single most common source of bacteremia and fungemia. Infections are often caused by contamination of the skin, catheter hub, and dressing. Current catheter securements primarily use adhesives, which attract debris and bacteria. In addition, pediatrics patients can easily remove these securements, increasing the chances of contamination and further complications. Our child-resistant IV guard allows nurses to quickly and easily protect catheter insertion sites.

Need Statement

A way to prevent unwarranted catheter removal and bacterial contamination at the catheter insertion site in pediatric patients (ages 3 – 12).

Need Specifications

<table>
<thead>
<tr>
<th>Must Haves</th>
<th>Nice To Haves</th>
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<tr>
<td>90% effectiveness in preventing bacterial colonization</td>
<td>90% effectiveness in preventing bacterial colonization</td>
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<td>90% effectiveness in preventing CRBSIs</td>
<td>90% effectiveness in preventing CRBSIs</td>
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<tr>
<td>$10</td>
<td>&lt;$5</td>
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<tr>
<td>Needs to be changed every 7 days</td>
<td>Needs to be changed every 10 days</td>
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<td>Catheter site fully visible and ventilated</td>
<td>Comfortable and allows mobility</td>
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<td>Secure, remains in place on the body</td>
<td>Fun and appealing to children</td>
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<td>Easily locked and unlocked by nurses</td>
<td>Lightweight (&lt;7oz)</td>
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References


Prototype

We 3-D printed a model of the shell and C-locks and created a large scale model of the inner locking mechanism. This mechanism will be included inside the C-locks.

Concept Analysis

We developed a clear, dome-shaped guard that can be placed on top of the catheter insertion site. The guard provides ventilation, visibility, and protection. Our device consists of two parts: a disposable shell and C-shaped locks that secure the shell in place. The shell will have ventilation holes to allow air to flow to the insertion site. Each C-lock is attached to an end of an adjustable fabric band. This band can be wrapped around various catheter insertion sites on the patient’s body, such as the forearm, chest, neck, and hand. The locks can only be opened with two hands, making it difficult for patients to remove the device by themselves. There is a switch on each end of the C-lock that must be pulled with a finger to unlock the device.

Competitor Analysis

- Tegaderm™ I.V. Paediatric Dressing
  - Seals catheter with transparent film
  - Sticky film difficult for nurses to remove
  - Easy for children to tug at and rip off

- I.V. House UltraDome
  - Plastic half dome shape with ventilation holes
  - Foam base for comfort
  - Large vent, susceptible to bacteria
  - Easy for children to remove

How the device is used:
1. Insert the IV
2. Place shell over catheter site.
3. Wrap fabric band attached to C-locks around arm.
4. Stabilize IV tubing by placing it into indent of C-lock.
5. Pull back switches located on C-locks to pull down rectangular block.
6. Connect C-locks around shell rim.
7. Release switches to connect C-locks together.

Conclusion/Future Steps

Test subjects’ reviews show that the device is comfortable and secure. Prototyping is still in progress, so we have yet to test its ability to prevent infection. We placed the shell on test subjects’ forearms, and the shell remained in place when they walked.

Our next steps include:
- Designing more efficient locking mechanisms using materials that have lower coefficients of friction
- Modifying the device to better fit various catheter sizes and insertion locations
- Using fluorescent markers to indicate pathogenic bacteria on the device

Making interactive shell attachments to appeal to pediatrics patients

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