Sound Control in the NICU — Materials

By Kathleen Philbin, PhD
Director, Infant Development
The Children’s Regional Hospital (Camden, New Jersey, US)

and

Robert White, MD
Director, Regional Newborn Program
Memorial Hospital of South Bend (Indiana, US)
Consensus Committee to Develop Recommended Standards for Newborn ICU Design

Introduction

Good design and policies are critical for the control of unwanted sound in the NICU, but the use of the right high-quality materials is also important. If a NICU is built using a wonderful design but constructed of materials that are difficult to maintain and easily soiled, it will become both noisier and unattractive as time goes by. Kathleen Philbin has spent many years researching the best materials to use for sound control in the NICU, and has first-hand experience with many of them in the course of the NICU construction projects she has been affiliated with. She has offered us a compendium of information on appropriate surface materials for the NICU, with useful comments when indicated.

Please note: These surface finishes are not interchangeable but serve specific purposes. The choice of surface finish needs to be carefully tailored to each nursery and institution. The installation of flooring, in particular, must meet quite specific standards or the flooring can fail.
What is the best flooring material to use in a NICU?

There are three basic options for flooring in the NICU – sheet vinyl, carpet, and rubber flooring. Specific aspects of sheet vinyl follow:

Sheet Vinyl --

a. Features:

1. Cushioned to absorb impact sound
2. Highly puncture resistant
3. Sheet vinyl is more easily cleaned than carpet and while it does not look as "homey", it is a good choice if the cleaning schedule or methods are unreliable or if the space for each bed is small.

b. Downsides:

1. Cheap vinyl can delaminate (separate into layers).
2. Need good installation, reliable workmen to seal seams correctly.

c. Example:

1. Manufacturer: Tarkett (manufacturer)
   Product Name: "Eminent Acoustiflor" commercial specialty sheet vinyl flooring
   Contact: Tarkett Inc., PO Box 264, Parsippany, NJ 07054, phone 201-428-9000, www.tarkettna.com
What is the best flooring material to use in a NICU?

There are three basic options for flooring in the NICU – sheet vinyl, carpet, and rubber flooring. Specific aspects of carpet follow:

Carpet --

a. Features (important terms for state code enforcement agencies):
   1. Impermeable backing (spills cannot soak through)
   2. 100% solution dyed (bleach will not change the color)
   3. Fiber has antimicrobial properties.
   4. Seams are chemically welded to provide “monolithic flooring”.
   5. Ordinary commercial carpet applied over concrete or linoleum is not sound absorbent and does not meet infection control standards.

b. Downsides:
   1. Carpet provides sound absorption for impact-generated noise. However, cleaning is the central issue in deciding whether to use it. Carpet should be vacuumed at least every other day, "bonneted" every other week, and "extracted" about every six months. Staff members have to be conscientious about catching total parenteral nutrition, intravenous, and other liquids in a diaper or other device to avoid letting it run out on the floor. Staff members also need to be reliable in soaking up spills promptly and notifying housekeeping to do spot cleaning. Individual cleaning needs vary with use patterns in a given nursery. Cleaning staff must use the appropriate cleaning materials. The space around each bed needs to be big enough to allow the incubator or warmer to be moved completely to one side to allow cleaning of the entire area surrounding the bed. The noise generated by vacuuming and shampooing has been shown to be a negligible burden for the individual infant, as long as the machines are not started up near the bed and that the operator does not bump into the bed during cleaning. A good resource for information on vacuums is http://www.nd.edu/~kkolberg/Vacuum.htm. Carpet cannot be used in areas where spills or standing water are common (such as around sinks), or where sterility is essential, and good installers are required to get the chemical weld right.

c. Example:
   1. Manufacturer: Collins and Aikman
      Product Name: "Terrian"
      Contact: C&A Floorcoverings, P.O. Box 1447, Dalton GA 30722-1447, phone 800-248-2878, www.powerbond.com
What is the best flooring material to use in a NICU?

There are three basic options for flooring in the NICU – sheet vinyl, carpet, and rubber flooring. Specific aspects of rubber flooring follow:

Rubber Flooring --

a. Features:

1. Impermeable
2. Non-stainable
3. Fused rubber back (delamination not an issue)
4. Very easy on feet. Used in operating rooms where staff stand for long periods.
5. Extremely durable (eg, 30+ years) -- you will be tired of it long, long before it wears out or even looks old
6. Good colors that can be cut into designs with contrasting colors, which looks great, but can be expensive
7. Cleans with almost any soap and water
8. No surface finish is needed (eg, wax, sealant, "mop & glow"). If a low gloss shine is desired, the clean floor can be buffed with a dry, clean, cotton buff cloth. Tremendous savings in maintenance over sheet vinyl in terms of this maintenance cost.

b. Downside:

1. The installers have to know what they're doing and the administration/construction company has to cooperate with them. For example, if the flooring is laid over new cement, it needs to cure (dry out) for a specific length of time (several weeks or longer depending on the cement, the weather, etc.). If the job is rushed, the cement will still be releasing moisture under the flooring and the flooring will lift up in places, or all over. There are similar problems if the flooring is being laid over old glue from previous flooring.

c. Example:

1. Manufacturer: Nora
   Product Name: Noraplan Elastic "Mega Elastic" (operating-room quality) or "Stone Elastic" (non-slip texture) -- comparable cost to Tarkett cushioned vinyl.
Are acoustical ceiling tiles useful in the NICU for sound control?

The largest area in a nursery available for sound absorption is the ceiling. Ceilings are particularly important to consider if the heating/air conditioning system is noisy and cannot be modified for more quiet operation.

a. Features (important infection control terms for code enforcement agencies):

1. Dimensionally stable woven glass fibers
2. Moisture resistant
3. Paintable surface
4. Surface burning characteristics meet fire codes
5. Noise reduction coefficient (NRC) 0.90 to 1.00 for 1-inch thick panels

b. Examples:

1. Manufacturer: Armstrong Contract Interiors
   Product Name: "Painted Nubby" Fiberglass

2. Manufacturer: Armstrong Contract Interiors
   Product Name: "Optima Open Plan" (for a more flat or smooth surface; looks like a dry wall/plaster finish)
Is there anything that can be done to make wall surfaces more sound absorbent?

Although most sound is produced at heights of 3 to 6 feet from the ground, sound absorbent materials cannot usually be placed at that level because they are not durable enough to tolerate the wear. Wall panels can be placed on the upper walls to absorb some sound after it bounces off the walls at mid-height.

a. Features:

1. Substrate of perforated, noncombustible, mineral fiberboard
2. Washable, vinyl fabric covering
3. Installed with concealed vinyl splines attached to drywall, cement block, metal partitions
4. Noise reduction coefficient (NRC) of .50

b. Example:

1. Product Name: Armstrong Classic Vinyl Sound Soak Wall Panels
Greetings from the Tech Front,

We have evaluated several online (web-based) survey programs over the past few weeks. The main benefits of using a web-based survey are the speed/ease of distribution and the auto compilation of results that contribute to near instant access to your survey data.

We had expected to present several different programs in this letter, but will instead present just one: Quask (www.Quask.com). This program stood out from the competition in terms of scalability, ease of use, “look and feel,” and features. While we can use another solution, this software is preferred for many technical and non-technical reasons. Quask was also competitively priced.

Quask will give us the ability to
- Create custom survey questions (as opposed to choosing questions from a “pool” of template questions).
- Create a visually stimulating and fun survey environment, quickly
- Use any browser to answer the survey (i.e. the survey can be viewed like a webpage)
- Use a computer “engine” to manage distribution
- Output to a Database and/or Excel for analysis

We recommend the purchase of the professional version of their Quask FormCaster software. The software is sold in the form of a subscription to use their web servers for a 12-month period (with the use of up to 500MB of space). The use of their web servers translates into less headaches dealing with server problems and allows us to focus only on the software side. The only downside is that the data will be stored on servers not owned by Pediatrix. In addressing possible concerns about data safety, Quask assured us the servers were secure enough for many of their most security conscious customers such as the U.S. Army. Quask also has a version of the software that can be configured to run on company web-servers but it is significantly more expensive and time consuming to setup and is not recommended at this point.

Cost for this service are as follows:

<table>
<thead>
<tr>
<th>Service</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-month subscription</td>
<td>$1299</td>
</tr>
<tr>
<td>Estimated cost of extra storage space</td>
<td>$1000</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$ 2299</strong></td>
</tr>
</tbody>
</table>

I encourage you to shoot me an email if you are interested in further clarification or have any general questions.

Sincerely,

Garrett Ratner
314-614-0181
Ratnerg@olin.wustl.edu
Is there any problem with latex sensitivity for rubber flooring? It seems it must be sealed somehow since it is used in operating rooms, some of which are designated latex free.

I will take a shot at your question.

Latex allergy is most prevalent among healthcare workers, where the most common symptom is contact dermatitis, but it can occur in patients (especially those with spina bifida), industrial workers exposed to latex, and even in the general population, and symptoms can be systemic as well as local. Although latex is a common ingredient of many items (perhaps most notably, house paint), exposure seems to require either extended direct contact (as with latex gloves) or airborne allergen particles. Asthma and systemic symptoms are more likely when the allergens are airborne, which can be minimized by using unpowdered gloves with low allergen content, and by good airflow with frequent air exchanges.

Since I couldn't find any reports where even those who had well-defined latex sensitivity were bothered by the presence of latex paint, (perhaps because it is not likely to become airborne or to be in extended direct contact), I suspect its use in flooring would also be safe, but this argument is admittedly based not on direct proof of its safety, but on the absence of any reports I could find on PubMed that indicated any danger.


An update by way of Kathleen Philbin: The Nora company, one of the manufacturers of rubber flooring, would be happy to answer this question or others about their product from current or potential users; call Michael Goullette at 800-336-5096 x217, and he will be happy to field questions and send a copy of the company's statement about latex/rubber allergies. There is also information about this at their website: www.nora.com.

Have there been any issues with the ceiling tiles made from fiberglass? Facilities where I am working is hesitant to use these tiles because of the fiberglass component.

thanks
Sculp
Nurse Manager, NICU
Johns Hopkins Hospital

Thanks for the question, Susan. I will forward this question to Kathleen Philbin and others on our Recommended Standards panel and post a response on this board later this week.

"Regarding fiberglass in the ceiling tiles:

The nursery must be vacated while the ceiling is installed as tiny fiberglass filaments are loose in the air when the tiles are cut to fit around the various ceiling openings for lights, HVAC registers, fire sprinklers, etc. Careful clean-up is, of course required. Installers should know the specific techniques required for safe installation. This is quite routine for professional installers.

The benefit of the fiberglass over other possible materials is that it will not support microbial growth or mould growth. It does not become friable as regular "acoustic" ceiling tiles do, so it holds up without deteriorating for

http://www.pediatrixu.com/webboard/wbpx.dll/~nicu/read?3178,328
very long periods of time. The typical "acoustic" ceiling tile eventually starts to crumble and drop little bits of stuff, particularly where the tile is removed off and on for access to the space over the ceiling itself. Regular tile also supports mould growth if it becomes damp. Fiberglass is also far more fire resistant than typical commercial and residential "acoustic" ceiling tile.

These fiberglass acoustic ceilings have been used for a long time in many, many applications: offices, restaurants, government buildings, as well as hospitals. The manufacturer will provide a statement regarding safety and durability if one is requested.

I think we will have more feedback from other Consensus Committee members coming shortly, but in the interim, I wanted to add that infants who are perhaps the most vulnerable (extremely premature or with severe respiratory problems) are also the most protected, since the air supply to incubators and ventilators is filtered. If fiberglass truly was a problem, I would be more concerned about the health care workers in that environment for years than about the babies there for days or weeks; those who stay for months are usually in an incubator and/or on a ventilator for the majority of that time.

A useful site for info about the health benefits(!) of carpeting is at www.carpet-health.org. It is provided by the industry, but includes a number of references from neutral or peer-reviewed sources. Perhaps the key one is at http://www.carpet-health.org/pdf/CarpetHealthcare.pdf, on page 2 of the article, where the CDC statement regarding the safety of carpet is cited.

At the annual Perinatal Workshop meetings this year, a reference was made to a "new" vinyl flooring that was much more durable than the original products. Can someone point me in the right direction.

My second question is about sinks. My request for porcelain sinks was denied by Infection Control due to the CDC recommendation that a non-porous material be used for sinks. Any one have experience with this issue?
Thank you for your help.

Dear Mark,

I have asked Kathleen Philbin to respond to your first question; she is the expert on flooring materials. I'm not sure what to make of your second question. I believe your Infection Control people are misinterpreting whatever they are reading from the CDC, because porcelain sinks have been used in NICUs, ORs, and in many areas throughout the hospital (including ours) for many years, and the AIA Guidelines for Design and Construction of Hospitals and Health Care Facilities certainly permits them. "Porous materials" include wood but not porcelain, since the inner surface of porcelain has a smooth, non-porous, non-permeable finish. Could you ask them to give you the specific CDC guideline they are referring to, and I can make a contact at the CDC to get a clarification directly from them on this.

Thanks!

Bob

The response from Kathleen Philbin:

Regarding a "New" vinyl flooring - I don't know of any particularly new or improved vinyl floor. For a good quality vinyl floor look for a thick layer of vinyl and color that goes all the way through the vinyl layer. Some vinyl flooring has a soft backing that is sometimes advertised as reducing sound, but this effect is minimal and brings with it the possibility of puncture or of developing grooves where heavy objects (e.g., the portable x-ray machine) travel in the same path over and over.

The most durable, flat floor that can actually reduce sound generated by impact (e.g., foot fall, dragging a chair, dropping something) is made of rubber. The oldest and best quality manufacturer is Freudenberg, a German company, and the product name is "Nora". The flooring is readily available in the US - see the Sound materials list on this website. This material is virtually unstainable, does not require wax or any other finish, and cleans with any soap and water. It comes in various thicknesses, with and without a cushioned backing, for use in a wide variety of applications. The allergenic aspects of the latex are rendered harmless in the process of vulcanization used by this manufacturer. Freudenberg will provide a statement about the absence of allergens in this product. Some rubber flooring off-gasses for a very long time. The odor is truly bad. The Freudenberg product has no odor at all, even when laid initially. Additionally, the material comes in a variety of good-looking colors that can
be made into attractive designs using a laser knife to cut the pieces. Laying these designs requires an expert craftsman who does this work routinely.

Most good quality vinyl and rubber floors fail because they have been laid improperly. Holes, rips, bubbles, and pulling up around the edges are all signs of being improperly installed. In a renovation the problem is usually that the original cement/glue was not completely removed before the new cement/glue was applied. The two interact and the new flooring lifts. Holes and some punctures are due to unevenness beneath the flooring that was not repaired before the floor was laid. In other words, preparation of the subsurface is critical and expert workmanship is required.

In new construction the cause of flooring failure is often rushing to get the building opened and pushing the contractor to lay the flooring before the cement subflooring has completely cured. The cement continues to give off water such that a highly humid atmosphere under the newly laid flooring compromises the adhesive.

Regarding porcelain sinks:
Most likely the infection control person who rejects porcelain sinks for nurseries is operating from an old knowledge base. Nurseries are not operating rooms. There are porcelain sinks in use in NICUs throughout the United States without apparent problem. Sinks, by their nature, are very dirty as are floors. They must be cleaned regularly and nevertheless must always be considered contaminated. Porcelain sinks clean as well as stainless steel and look considerably better in normal use. They also generate considerably less noise. Wide porcelain sinks are available through the usual hospital plumbing suppliers.

The size of a sink is also a consideration in infection control. Very deep sinks create big splashes as the water usually strikes from a distance. The splashed water must be considered contaminated whether the sink is stainless steel or porcelain. Very wide (front to back) sinks cause the handwasher to lean into the sink, again contaminating clothing on the sink. Countertops around sinks should also be avoided as staff and parents tend to set items on the counter (e.g., baby bath basins, feeding bottles). These counters must also always be considered contaminated. Our nursery recently traced the source of an infection to the always-wet counter around the stainless steel sink.