healthcare design **insights**

In the hospital world we're all familiar with the dramatic growth of technology, in both tools and evaluation metrics. From stethoscopes and scalpels we've grown to robotic surgeries. From pulse and temperature we've advanced to radiography and fluoroscopy. At the same time (and literally underfoot) has been similar growth of new materials for interior surfaces, particularly floors.

From the long-familiar "wet look" of sealed and polished vinyl tile, hospitals today have rubber, engineered and veneered wood, poured epoxy, recycled carpet squares, and more. With new flooring has also come a greater understanding of the benefits and tradeoffs of different choices, such as maintenance, resilience, therapeutic effect, comfort for staff, and toxicity.

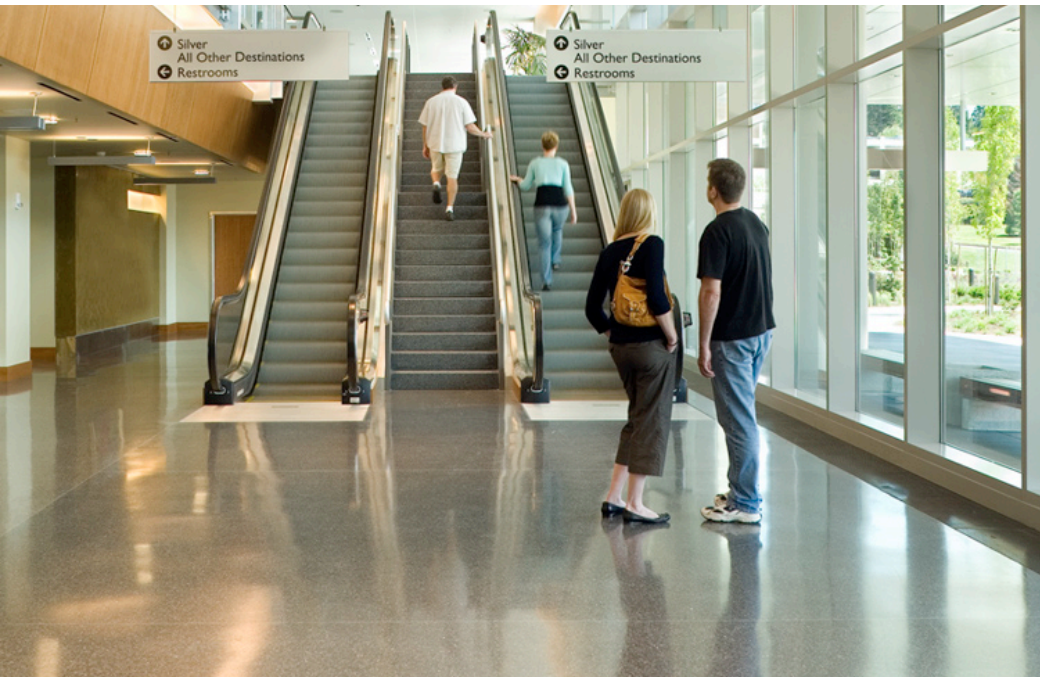
For issue #3 of *Healthcare Design Insights,* we're delving deep into flooring, and offering a discussion framework and tools for hospital designers, administrators, managers, builders, and others to help in flooring choices. Our goal is to provide a guide for your use in renovating and building new facilities, including:

- **An evaluation of 17 flooring types against 17 key criteria (cost, sustainability, maintenance, comfort etc.).**
- **Recommendations for using this data in your design and construction process.**
- **Examples to illustrate effective use of flooring materials.**

In this Issue:

Below: Rubber flooring is an increasingly popular choice for hospitals, with strong performance across maintenance, therapeutic, comfort, and sustainable criteria. With a ride range of color choices and seamless edges, designers can create patterning, such as at Evergreen Hospital Medical Center.

Below: Resiliency, low maintenance, and formality make terrazzo a popular choice for public and entrance areas.



Hospital Floors: Performance & Applications

The past decade has brought an explosion of flooring choices for healthcare. This range of materials, production methods, application technologies, and more is exciting for architects and clients seeking greater aesthetic, maintenance, and therapeutic choices.

As the choices have grown, so have the criteria for evaluation. We're ever more focused on sustainability in manufacture, application, maintenance, and recycling. We're smarter and more aware of the multiple impacts flooring has on a hospital's operational efficiency. Flooring is an important factor in patient and staff comfort and health, from sound attenuation to infection control. And much more.

Benefitting from all these choices requires understanding which materials best fit your specific needs. **On these pages we offer tools to help you through the options.** While our goal is to provide specific analytics, we recognize that cost and performance criteria will vary significantly, and your building and operational practices are unique. What follows is a discussion guide.

Performance Evaluation Matrix

The following Performance Evaluation Matrix evaluates the performance of 17 distinct flooring types split into four categories:

1. **Carpet**
2. **Hard Surface**
3. **Poured**
4. **Resilient**

We then evaluate each flooring type against 17 criteria, in the following five groups, to address these questions:

Cost

What are the price ranges for first cost and maintenance? What can we expect for material life span? What is the potential life cycle cost (at least in rough terms)?

Constructability

How easy or difficult is installation? Are special certifications and/or construction processes required? Is the material sensitive to construction conditions such as temperature and moisture? How soon after installation will the floor be usable?

Use/Maintenance

How do the materials affect the operations of hospital staff? How often does the product need to be cleaned, and how invasive are the cleaning requirements (for example, damp mop vs. floor buffer). Are special processes, tools and/or training required for maintenance? Does the product require ongoing treatment, such as waxing?

Health & Environmental

How do the materials affect the health and comfort of users, both actual and perceived? What is the effect on indoor air quality? What materials help create an inviting and nurturing environment in patient rooms, or reduce noise and glare? Does the material reduce fall impacts? What does evidence-based performance tell us? Does the material support infection control? How does it affect medical personnel, for example avoiding slipping and reducing fatigue?

Sustainability

How are the materials created and delivered? Does the basic material require additional coatings, both initially and periodically (such as stain or sealant). How long will the materials last, and when they are removed is recycling possible? What are the toxicity implications during installation and permanently?

This information comes from a number of sources. Our first source is the experience of our engineering, materials, and contractor partners, along with research into a variety of industry publications and data. Secondly, direct data comes from post occupancy evaluations (POEs) performed by Mahlum in coordination with client facility, operations, and medical staff. Additional studies in flooring performance are underway with two of our major healthcare clients. The POEs provide key data for evidence based design solutions.

Above: Acoustic dampening and perceived warmth are factors for family gathering areas; provided here with carpet tiles.

Performance Evaluation Matrix

This Performance Evaluation Matrix is offered to help with your design choices. Each cell is graded (see legend) and some cells include additional notes regarding specific performance characteristics or why the grade might vary depending on the specific situation.

The performance grades and cost ranges are presented not as definite judgments or measures; they're tools to **inform discussion** and decision for your teams.

LEGEND

- ★ Outstanding
- ★ Very Good
- ★ Typical/Average
- ★ Below Average
- ★ Poor

Flooring Type	First & Life Cycle Cost			Constructability	Use/Maintenance				Health & Environmental					Sustainability		
	Installation, per SF	Maintenance, SF per Year	Expected Life Span	Certification Notes; Unique Installation/ Requirements	Durability	Maintenance Ease	Mobility of Hospital Equip.	Stain Resistance/ Hiding	Comfort	Infection Control	Reflectivity/ Glare	Slip Resistance	Sound Attenuation	Maintenance Toxicity	Manufacturing Processes	Recycled Content/ Recyclability / C2C / LBC Red List
1: CARPET																
Roll	**$3.20-$4.20**	**50¢-75¢**	**3-5 years** Depends on location & quality; practical life span often less than manufacturer warranty		★	★ Not recommended in areas subject to bodily fluids	★	★ Color choice & pattern are key; Dyed solution increases resistance	★ Good for perceived warmth & therapeutic affect	★ Fibers can attract allergens & hold until vacuumed; Holds dirt; Anti-microbial is optional	★	★	★	★ Permeability of backing is key	★ Backing & adhesive is key to sustainability of materials themselves	★
Tiles	**$3.75-$4.00** Inherently less wasteful & more material efficient than rolled carpet	**50¢-75¢**	**5-7 years** Offers greater flexibility to update the appearance at a low cost		★	★ Ease & lower cost to replace sections	★	★ Stained tiles can be replaced	★	★	★	★	★	★	★ Higher recycled content; Recyclability after use	★
2: HARD SURFACE																
Concrete	**$5.50-$6.00** In addition to structure	**50¢-75¢** Radiant heat option has cost benefits & increase both real and 'perceived' warmth	**40 years**	Multiple factors effect quality/aesthetic outcome; Protecting during construction is critical; Installer experience is important	★ In high traffic areas, concrete stain may wear; Cracks likely over time	★	★	★ Can absorb spilled fluids	★ Super hard surfaces can be uncomfortable for long-term staff use	★ Likely cracking may complicate infection control; sealant is factor	★ Can vary per sealant & color	★	★	★	★ Multiple factors such as what's in the concrete mix, etc.	★ High fly-ash content
Terrazzo	**$22.00-$35.00**	**50¢-75¢**	**40 years**		★	★	★	★	★	★	★	★	★	★	★ Varies with materials; Epoxy binders poor sustainable choice	★ Depends on mix of hard materials in product
Tile Porcelain, Ceramic, Concrete, Quarry	**$12.50-$16.00** Anti-fracture membrane req'd (add $2.00); epoxy grout (add $1.50-$2.00)	**50¢-75¢**	**25 years** Tile quality & patterning can vary life span	Some products require special installation certification; Tightest grout joint allowed by manufacturer is recommended; use epoxy, not cement	★	★ Tiles may be more prone to chipping, etc.	★	★ Grout can stain	★	★ Grout can hold contaminants	★ Typically using matte finish	★ Size of tiles & % of grouted joints to surface area can affect slip resistance	★	★	★ Varies significantly with product mix	★ Varies significantly per product
Tile & Slab Stone	**$25.00-$45.00**	**50¢-75¢**	**25 years**		★	★	★	★	★	★	★ Typically using matte finish	★	★	★	★	★ Varies significantly per product
3: POURED																
Epoxy	**$7.50-$10.00**	**N/A**	**50 years**	Installer certificate required for warranties; Smooth pour & subfloor preparation affect quality; Toxicity complicates installation & other occupants in area	★	★ Reseal required every 3 years	★	★	★	★ No seams; Can be integral with base	★ Can be matte finish or polish	★ Textured surface	★	★	★	★

Performance Evaluation Matrix (continued)

Flooring Type	First & Life Cycle Cost			Constructability	Use/Maintenance				Health & Environmental					Sustainability		
	Installation, per SF	Maintenance, SF per Year	Expected Life Span	Certification Notes; Unique Installation/ Requirements	Durability	Maintenance Ease	Mobility of Hospital Equip.	Stain Resistance/ Hiding	Comfort	Infection Control	Refectivity/ Glare	Slip Resistance	Sound Attenuation	Maintenance Toxicity	Manufacturing Processes	Recycled Content/ Recyclability / C2C / LBC Red List
4: RESILIENT																
Linoleum Sheet	**$5.00-$7.00** Includes welded seams but not integral cove; lineal footage at base is key cost determinant	**50¢-$1.00**	**10 years** Life span depends on location & color	Certification required for some manufacturer warranties Floor prep is critical	Good dimensional flexibility from inherent self-healing properties Sensitive to extended exposure to pooling liquids	Does not require regular sealing & waxing, although some experience is mixed Could have integral cove		Counter-intuitive; natural linoleum product fades less with sunlight exposure		Linseed oil is natural anti-bacterial Performs better than linoleum tile in wet locations						
Linoleum Tile	**$7.00-$8.50**	**50¢-$1.00**	**10 years**													
Rubber	**$5.00-$7.00**	**50¢-75¢**	**15 years** Scratches & cuts easily, negatively affecting appearance	Installer certificate required for warranties Smoother subfloor required for precise adhesion Longer cure time due to moisture sensitivity						Naturally anti-microbial & anti-bacterial Non-porous No seams		Performs well even when wet "Give" of product mediatesimpacts of falls		pH neutral cleaning product		
Vinyl Sheet	**$4.00-$5.00**	**$1.50-$2.00**	**10 years**			Some newer materials need only a damp mop & buffing			Cushioned is an option	Welded seams increase infection control for vinyl, linoleum & other sheet products	Typical installations are "shiny"	Varies depending on sealant/ waxing product		Less strip & reseal requirements increase sustainability	High level of toxics in life cycle of manufacture, install & maintenance	
Vinyl Tile	**$2.50-$3.50**	**$1.50-$2.00**	**10 years**			Labor intensive to strip & wax Wax can spill onto adjacent materials such as base								Traditional chemicals can be more toxic, aggravating patient/staff sensitivities		
Vinyl "Wood Look"	**$5.00-$7.00**	**$1.00-$2.00**	**15 years**			Does not require reseal or wax Grooves can collect dirt/ contaminants										Some availability of recycled content
Wood Natural	**$13.50-$15.00** Includes $2.00 for wood subfloor	**$1.00-$2.00**	**20 years** Solid wood can be refinished and look new	Installer certificate required for warranties Wood subfloor increases acoustic quality, ability to refinish					Increases perceived warmth/ "homey" feel						Depends on source, FSA certification, etc.	
Wood Plastic Laminate "Wood Look"	**$4.00-$6.00**	**$1.00-$2.00**	**15 years**													
Wood Pre-engineered w/Wood Veneer	**$7.50-$10.00**	**$1.00-$2.00**	**10 years**													
General Notes For All Flooring Types	Broad cost ranges for "generic/modest/typical" application Maintenance cost considers supplies, staffing, and energy implications and is generalized from several sources and highly variable to unique facility conditions Costs are for comparative purposes only			Resilient floors (other than vinyl) may require additional sealant for moisture control; add $1.00/SF					Anti-microbial materials are an option; efficacy is not yet proven Reflectivity may be desired or not, depending on room/functional area No industry standard on single "coefficient of friction" testing method; can be reduced with slip-resistant finishes					Many materials have choice of greater/lesser toxicity maintenance solutions Potential staff/patient toxicity created by both product & installation, e.g. glue or nail		

Choices, Choices, Choices

The Performance Evaluation Matrix on the previous pages presents a detailed analysis of flooring, cost, and performance. In using the matrix, it's important to **personalize the criteria** for your facility. You might add a new criteria or weight the criteria (e.g. do you place more value on durability or patient comfort?). In fact, "re-grading" our opinions may be a good process to vet the particular flooring choices and measures for your facility. An organized evaluation process is critical to hone choices.

We also suggest you **create mock-ups** for "real-life" testing in your conditions. Mock-ups can range from simple "laying-down" the flooring materials in existing spaces, to mini-installations mirroring specific sub-floor, finish, wall/cove, and other details. Part of the value of mock-ups is that they support evidence-based or real-life experience. Additional value comes from the opportunity for users as well as project team members to see, feel and touch the material. Maintenance staff can test and practice: on one Mahlum project, the client covered the flooring with soda, jello, gravel, Benzedrine and other "spills" and let them sit overnight.

The organization of the evaluation matrix reinforces the opportunity to **include different stakeholders,** from your maintenance staff to sustainability experts to clinical department representatives. Important as well is to focus on constructability and installation sequence/ materials/process with the construction team.

Education, particularly if newer flooring materials are chosen, is important for maintenance, facilities, and clinical staff.

New materials and technology have greatly expanded the tools and materials required for maintenance, and many products require specific cleaning techniques. Manufacturer specifications are key and should be highlighted during construction and the transition to operations/maintenance.

Increasingly, manufacturers are requiring specific education for maintenance staff to ensure product warranties. Traditional cleaning techniques can invalidate warranties and reduce effectiveness of materials; for instance, linoleum should not be waxed!

Hospital staff will benefit from clear expectations of how new products will "feel" and affect operations. Rubber floors will never be "shiny," but rubber is inherently anti-bacterial. Rubber soled shoes, which many hospital workers use to counteract hard surface flooring, can make rubber floors feel "too soft."

At Mahlum, we're using this matrix in our own design work. A "living" tool, it is evolving and growing more detailed with use. As such, we'd love your feedback and suggestions. E-mail us at info@mahlum.com.


A


B


C

Photo A: A post-occupancy evaluation revealed that the height difference between the rolled carpet and carpet tiles became a trip hazard.

Photo B: "Wood look" sheet vinyl is perceived as 'warm' and 'homey' in a patient room.

Photo C: Flooring samples are tested at Mahlum's office.

B

Flooring Case Studies

Alberty Surgery Center

This surgery center illustrates practicality in choice of flooring. Sheet product Loneco has held up well to clinical and surgical activities. A two toned color pattern helps not only create visual interest and reduce institutional feel, but also increase the important "look" of clean (**A**). Carpeting in public and reception areas reduces noise and creates soothing and warm notes, together with views to healing gardens immediately outside (**B**). Patterned carpet in high traffic areas maintains a clean look with high camouflage characteristics, while single color near the windows activates and focuses the natural light patterns.

A

C

Evergreen Hospital Medical Center

Rubber flooring is increasingly popular for healthcare, balancing comfort, cost, operational and maintenance ease, and sustainability. Particularly attractive to staff at Evergreen Hospital Medical Center in Kirkland, Washington, were the significant reduction in maintenance requirements and lower life cycle cost. While there is a wide range of color choices, there was concern for the "look," which the design team addressed by creating a pattern using both solid color and speckled portions for visual interest (**C**). Because the edges between color-ways are virtually seamless, rubber is an excellent choice for individualized patterns without creating traps for bacteria and dirt. Of particular note in the Evergreen POE is the dimensional stability and resilience of rubber, for example to "pop back up" after the significant weight of bariatric gurneys. At the same time as rubber is truly resilient and soft underfoot, it has low slip resistance and performs well for moving equipment and supplies.

Healthcare Design Insights, produced by Mahlum, furthers evidence-based design, offering practical tools and ideas to healthcare administrators, facility managers, and developers. We welcome your feedback and ideas for future issues!

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Projects featured in this issue:		**Architect:**
Pages 1, 2, 5, 6:	Evergreen Hospital Medical Center, Kirkland, WA	Mahlum
Page 2:	Providence Newberg Medical Center, Newberg, OR	Mahlum
Page 6:	Alberty Surgery Center, Portland, OR	Mahlum