FREQUENTLY ASKED QUESTIONS

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TRINITY GUARDION

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DISINFECTION/MATTRESS DAMAGE FAQ

Hospital-acquired infections (HAI) continue to be a problem within healthcare facilities. This has resulted in hospitals looking for causes of high HAI numbers and solutions to solve these problems. In recent years, more light has been shed on the role that hospital mattresses play in disease transmission. Studies have found that mattresses can remain contaminated even after terminal cleaning[1-5] and have been linked to infection outbreaks.[6-9] In fact, one study showed that patients were 5.83x more likely to develop an HAI if the previous bed occupant had an infection.[10] Other studies corroborate an increased risk when the previous bed or room occupant had an infection.[11-13] This growing body of evidence prompted ECRI Institute to name healthcare mattresses the #2 patient safety technology concern in 2019 up from #3 in 2018,[14,15] while the FDA updated a safety communication on hospital mattress failures in 2017.[16]

Not only have the current disinfection protocols proven to be inadequate, but chemical disinfectants have also been shown to cause premature damage to mattresses.[17,18] This damage exacerbates the problems found with mattress disinfection, making it impossible to decontaminate because body fluids and pathogens seep in and out of the mattress core. UV light has also been shown to cause damage to polymers used in healthcare settings,[19] such as the polyurethane material used for mattress covers. This damage may shorten the useful life of the mattress cover.

Alternative processes have been introduced to combat these issues, but most have proven to be ineffective or too burdensome for hospitals to implement. However, Trinity Guardion's Soteria Bed Barrier® has given hospitals a solution that not only works but is cost-effective. The barrier uses an evidence-based, validated laundry process that reduces pathogens including *C. diff* spores by 99.9999% or more and has been shown to decrease hospital-onset *C. diff* infections (HOCDIs) by up to 50% in two peer-reviewed studies.[20-22] Below, you will find answers to common questions about mattress reprocessing and mattress damage.

BACK TO OTHER QUESTIONS

Q How clean should a mattress be following terminal cleaning?

At a minimum, the FDA recommends mattresses, generally considered a non-critical medical device, undergo low-level disinfection, which is defined as: "A lethal process utilizing an agent that kills vegetative forms of bacteria, some fungi, and lipid viruses."[23] This should be able to achieve a 99.9999% reduction in *Pseudomonas aeruginosa, Staphylococcus aureus, Escherichia coli,* and representatives of the Klebsiella and Enterobacter genus.[24] However, many patients often lie on mattresses with non-intact skin (e.g. port-a-cath, open wounds, dermatitis). Medical devices that make contact with non-intact skin are considered semi-critical medical devices.[23] Because linens do not prevent mattresses from contamination[25] and the FDA states that devices should be tested to the worst-case scenario, mattresses should be disinfected at least to the level recommended for semi-critical medical devices: high-level disinfection.

FOLLOW-UP: Perform a study on your mattresses to see if they remain contaminated after terminal cleaning. ATP Meters and conventional swabs can underestimate your contamination.[26-28] Consider using alternative testing to identify contamination on mattresses.

BACK TO OTHER QUESTIONS

What is the significance of 99.9999% (6-log) reduction of pathogenic organisms? Do 99.999% (5-log) or lesser log reductions really make a difference?

The FDA has recommended that medical devices are disinfected after each use, prior to the next patient.[23,24] They define high-level disinfection as a process that kills all forms of microbial life (viruses, mycobacteria, fungi, vegetative bacteria) except for large numbers of bacterial spores. This is demonstrated by a 6-log (99.9999%) reduction in specific test organisms after reprocessing the medical device. Trinity Guardion's laundry process takes this a step further by producing a 99.9999% reduction not only in all the test organisms, but also *C. diff* spores.[22] This provides patients with a truly clean mattress surface. A process that achieves a lower log reduction could put your patients at risk. For example, there are approximately 3.8 million spores in 1 gram of *C. diff* stool.[29] Patients with diarrhea have at least 200g of stool in a 24hr period and up to 15 stooling events in a day.[30,31] This could result in hundreds of millions of spores on surfaces within the patient environment. A process that achieves a 5-log reduction in *C. diff* spores would leave 10x as many spores on a surface as compared to a 6-log reduction. This is troublesome as animal studies have suggested that the infectious dose of *C. diff* is extremely low,[32,33] meaning any spores remaining in the patient ecosystem could put them at risk of infection. Lawley et al. also found that disinfectants that achieve a 6-log reduction of *C. diff* spores completely eliminated environmental transmission in mice, whereas those with lesser log reductions were not as successful at reducing transmission.

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I thought hand hygiene was the most important factor in cross-transmission. Is mattress disinfection really that crucial?

Absolutely. While hand hygiene remains the most important factor in germ transmission, it is impossible to maintain clean hands if the environment is not adequately disinfected. Weber et al. reported that 20-40% of HAI's have been attributed to cross infection via the hands of care staff,[34] highlighting the importance of hand hygiene. However, hands become contaminated not only from direct contact with the patient, but also by touching contaminated environmental surfaces. In fact, Guerrero et al. showed that gloved hands pick up *C. diff* from commonly touched environmental surfaces just as easily as they do from commonly examined skin sites.[35] As research shows, mattresses very often remain contaminated even after terminal cleaning.[1-5] Since mattresses are the 2nd most touched surface by caregivers in the ICU and 4th most touched on med-surg units,[36] it's easy to see how hands can become contaminated when caring for the patient. Therefore, transmission to the patient via the hands of hospital staff can occur even when following the WHO's recommendations on hand hygiene if the mattress is not adequately disinfected.[37] In addition to this dilemma, transmission could also occur directly from the mattress to the patient if the mattress remains contaminated from previous patients. Because patients have intimate contact with the mattress throughout their entire stay, it is critical that we provide them with a clean and safe mattress surface to prevent germ transmission.

FOLLOW-UP: Read the published research demonstrating that mattresses remain contaminated after terminal cleaning[1-5] and can contribute to outbreaks in hospitals.[6-9]

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What level of protection do sheets and other linens on the mattress provide to germ-transmission?

The CDC recognizes that bed sheets do not protect mattresses from becoming contaminated with body fluids and substances.[25] This means that any body fluids or pathogens from the patient can directly contact the mattress and vice versa. This puts patients at serious risk and emphasizes the importance of providing patients with a completely clean mattress and the need to perform high-level disinfection.[23]

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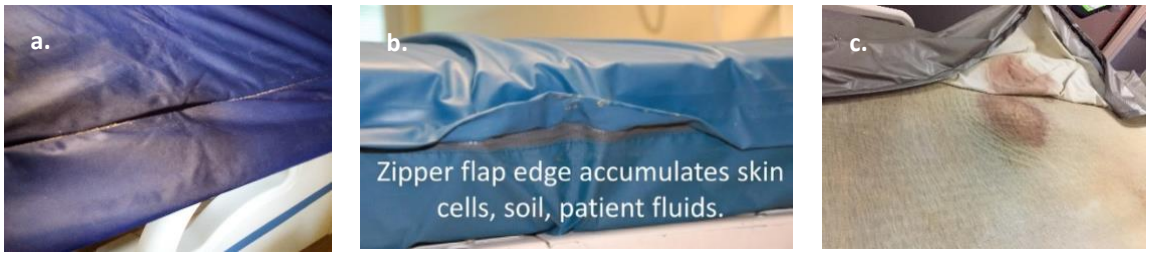
Can I use a 1-step process to clean/disinfect my mattresses?



(a) and (b) Bioburden can build up along sewn seams and under zipper flaps of mattress covers if not precleaned before disinfecting. (c) Disinfectants not rinsed off the mattress cover can cause damage and allow body fluids to leak through to the mattress core.

No. Research shows that 1-step processes achieve less than a 90% reduction in harmful bacteria on mattresses.[38] Using the broadest interpretation, the FDA recommends that mattress reprocessing achieves at least a 99.9999% reduction in vegetative bacteria.[23,24] A 1-step process can also leave residual chemicals on the mattress surface, a concern for patient safety.[39] Additionally, a 1-step process can cause premature damage to your mattresses, which may void your warranty and expose patients to additional risk.[17,18] Not only this, but a 1-step process of simply wiping the mattress with a disinfectant falls well short of the processes recommended by manufacturers, which usually involve 5-6 steps. This includes pre-cleaning visible soil, cleaning non-visible soil, rinsing off the cleaning agent, disinfecting with an approved disinfectant, rinsing off the disinfectant, allowing the mattress to dry, and visually inspecting the mattress for damage.[40-42]

FOLLOW-UP: Perform a mattress audit at your facility to determine if any of your mattresses have been compromised. The FDA recommends removing any damaged, worn, or visibly stained mattresses according to facility procedures and MIFUs and replacing mattress covers that have visible signs of stains, damage, or wear.[16] The bed deck should be checked for rust as well.

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Q Can UV light effectively disinfect mattresses?

No. Research shows that UV light is not capable of achieving the necessary 6-log reduction in pathogens recommended for mattresses even on hard surfaces.[43-46] The FDA has acknowledged that UV light is not effective on soft, porous surfaces such as hospital mattresses.[47] Furthermore, UV light has been ineffective at decreasing *C. diff* rates in healthcare facilities.[43,48,49] UV has also been shown to damage polymers used in healthcare facilities,[19] such as the materials used to make mattress covers. Damage to the mattress cover could lead to fluid ingress to the mattress core, making disinfection impossible.

FOLLOW-UP: Ask your mattress manufacturer if they recommend using UV light for disinfection on the mattress or if it will cause damage to the polyurethane mattress surface.

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Q Our bed/mattress vendor recommends and CMS mandates that we follow the manufacturer's instructions for use (MIFUs) for cleaning and disinfecting the mattress. Does the MIFU process achieve an adequate level of disinfection for mattresses?

While following the MIFUs will certainly improve cleaning and disinfection, it may not provide a completely disinfected surface. MIFUs for cleaning and disinfecting mattresses require multi-step processes,[40-42] as opposed to the 1-step process used by many facilities and are likely more effective than using UV light since mattresses are soft surfaces.[47] But while the FDA Reprocessing Guidance mandates that manufacturers validate their instructions for use for cleaning and disinfection,[23] Trinity Guardion is unaware of any published research that shows manual cleaning processes, including following MIFUs, can achieve even low-level disinfection on hospital mattresses. Additionally, the FDA does not require manufacturers to validate their cleaning and disinfection MIFU for *C. diff* while the Support Surface Standards Initiative (S3I), the standards body for healthcare mattresses in the U.S., admits in their cleaning/disinfection guidance, "Prevention of serious disease transmission may require more aggressive interventions."[39] *C. diff* is likely the most challenging organism in a facility, as it remains the most common HAI in the United States.[50] Peer-reviewed research has demonstrated that both symptomatic and asymptomatic patients contribute *C. diff* spores to the environment.[51-54] Therefore, disinfection protocols should be able to effectively address *C. diff* with every cycle.

FOLLOW-UP: Ask your mattress vendor to provide you with the expected life of the mattress skin and mattress as defined by the IEC. You should also request that they provide any peer-reviewed research showing their cleaning/disinfecting process can kill 99.9999% of vegetative bacteria (low-level disinfection) throughout the entire expected life of the product.

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What does it mean when mattress manufacturers say they test for efficacy and compatibility?

Per the 2015 FDA guidelines, mattress manufacturers must validate their cleaning and disinfection procedures.[23] This means that the manufacturer's instructions for cleaning and disinfection should be able to consistently produce a certain level of disinfection throughout the stated expected life of the product. However, that does not necessarily mean that following MIFUs for mattress reprocessing provides a 99.9999% reduction in pathogens, and unfortunately, bed manuals written prior to 2015 may not be updated to reflect processes that follow the guidelines. Manufacturers also test to ensure that the disinfectants they recommend will not significantly damage the mattress skin before reaching the expected life. Not all mattress fabrics are the same and can have vastly different expected lives. The stated expected life assumes the user is cleaning and disinfecting the mattress per the MIFUs. Therefore, chemicals recommended by the manufacturer could cause premature damage to your mattress if you fail to rinse after using the disinfectant or use a different process, greater concentrations, or longer contact times than recommended.[17,18]

FOLLOW-UP: Review the MIFU for all the different mattresses in your facility. Not all mattresses are the same. They can have different life expectancies depending on the composition of the polyurethane coating. Ask your mattress manufacturer for testing of the compatibility/efficacy of your facility disinfectant on each of your mattress models.

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What does it mean to use a chemical disinfectant "off-label"?

Healthcare disinfectants are intended for use on hard, non-porous surfaces. In fact, there are no chemicals registered with the EPA that can make disinfection claims on soft surfaces.[55] Mattresses are soft, porous surfaces, and therefore, can be damaged by the harsh disinfectants used in healthcare facilities. It is recommended that chemicals be rinsed off the mattress after allowing the disinfectant to set for the indicated contact time.[39-42] This is to reduce the amount of damage caused by the chemicals on the mattress cover. Additionally, the chemical concentrations recommended by mattress manufacturers may be too low to achieve adequate disinfection of the surface, leaving patients at risk.

FOLLOW-UP: Contact your chemical disinfectant provider and ask what level of disinfection the mattress manufacturer's recommendations will produce on a soft surface such as a mattress. Also ask if the chemicals will cause any damage to the mattress surface.

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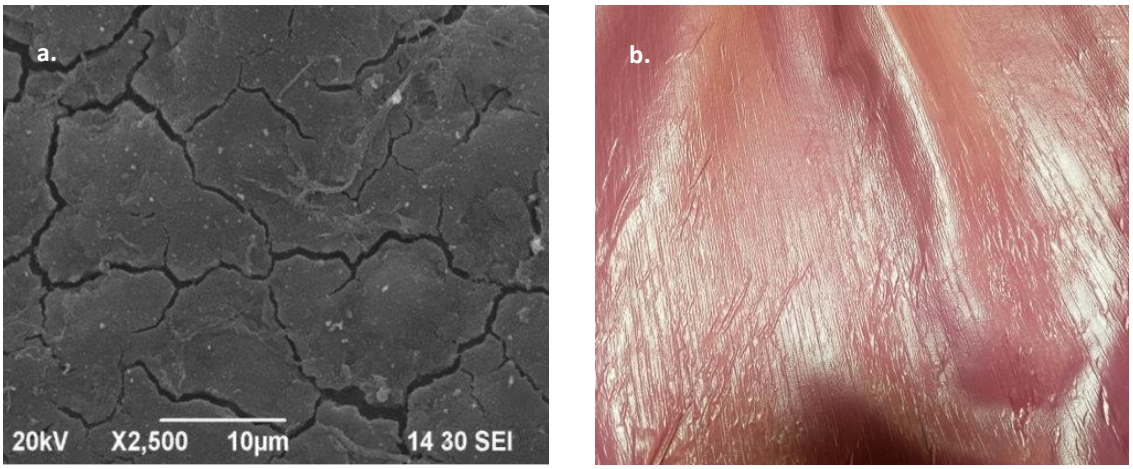
What are the consequences of disinfectant damage to mattress skins?



(a) SEM image of damaged polyurethane mattress cover caused by disinfectants. (b) Striations in mattress cover fabric caused by disinfectant damage.

Disinfectants degrade mattress surface fabrics making them more difficult to disinfect over time.[17,18] For example, a 2-year-old mattress may require more rewetting than a 1-year-old mattress, increasing the time EVS staff take to turn a room. Eventually, the fabric may break down to the point that fluids and pathogens can freely enter and exit the mattress core, making the mattress impossible to disinfect.

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Can I use the AHA asset depreciation table as a guide to mattress life?

No. While the AHA depreciation guidance for mattress life is five years,[57] often the manufacturer's stated expected life of a healthcare mattress, the expected life for most mattress covers is one to three years. The AHA depreciation table does not distinguish between the cover and the mattress. Additionally, mattresses can be damaged from disinfectants and routine use, and many may not reach the expected 5-year life.[56,58,59]

FOLLOW-UP: Review your user manual or contact the mattress manufacturer to determine expected life of the mattress and mattress cover.

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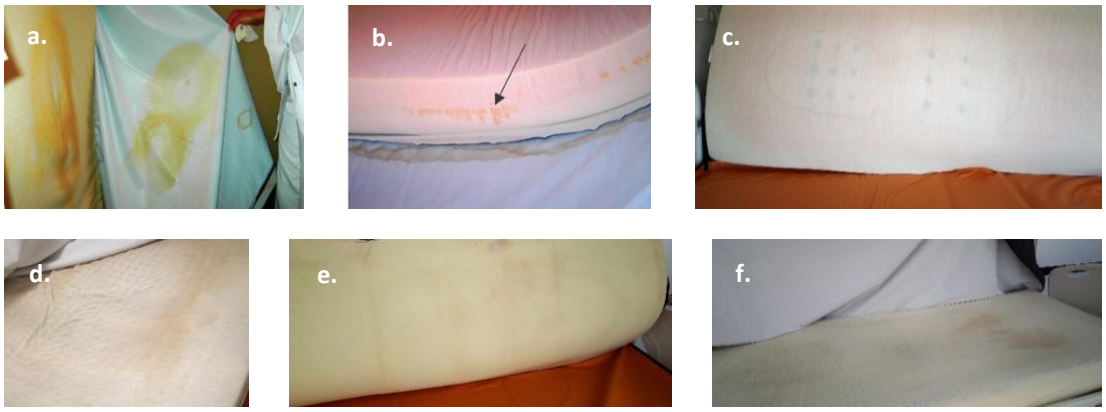
How often should mattresses be inspected for damage?



(a) and (b) 6-month-old therapeutic mattress with staining on mattress foam under patient and along seams of mattress cover.[9] (c) 8-month-old mattress with staining on bottom of mattress core. (d) 19-month-old mattress with stain on top of mattress core. (e) and (f) 20-month-old mattress with stains on top and bottom of mattress core.

According to the instructions for use of the major hospital bed manufacturers, hospital mattresses should be visually inspected after every patient to determine if they have been compromised and whether they are safe for continued use.[39,41] Unfortunately, damage often goes unnoticed since it can be invisible to the naked eye.[5,9,56] Many mattresses have sewn zipper seams around the perimeter and small holes can develop in the mattress cover as a result of chemical damage or everyday wear-and-tear allowing fluid ingress.[16] This means that the mattress **core** needs to be inspected after each use to ensure fluids have not leaked inside.

FOLLOW-UP: Ask your mattress manufacturer how often mattresses should be inspected, who should inspect them, how to inspect them, and the estimated time needed to inspect them.

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Will replacing damaged mattresses or mattress covers solve the problem of mattress contamination?

No, this will not solve the problem. Replacement of damaged mattresses and mattress covers can certainly reduce infections, but this is only a temporary solution.[6-9] Over time, mattresses and their covers will become damaged again due to the use of harsh disinfectants and everyday wear and tear. Following MIFUs can limit this damage, but these 5 to 6 step processes are often impractical and take too much time. Furthermore, we have been unable to find any evidence that demonstrates manual cleaning processes can achieve the recommended level of disinfection on mattresses, regardless of mattress age or condition.

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What are the advantages of using a laundry process rather than a manual cleaning process?

(a) Soil on barrier before laundering. (b) Dried soil on barrier before laundering. (c) Barrier surface completely clean of soil after laundering.

The laundry process is easily repeatable and allows you to eliminate pathogens using a variety of means including rinsing, agitation, heat, and chemicals. Moreover, the barrier is brought back to a neutral pH to avoid skin irritation. The process allows you to inspect the barrier on a light table, ensuring that the patient will be lying on an uncompromised surface. Conversely, manual cleaning processes do not achieve a 6-log reduction in pathogens on soft surfaces.[60,61] They have also been shown to spread germs from contaminated areas to previously uncontaminated areas,[1,38,62] a problem avoided by laundering.

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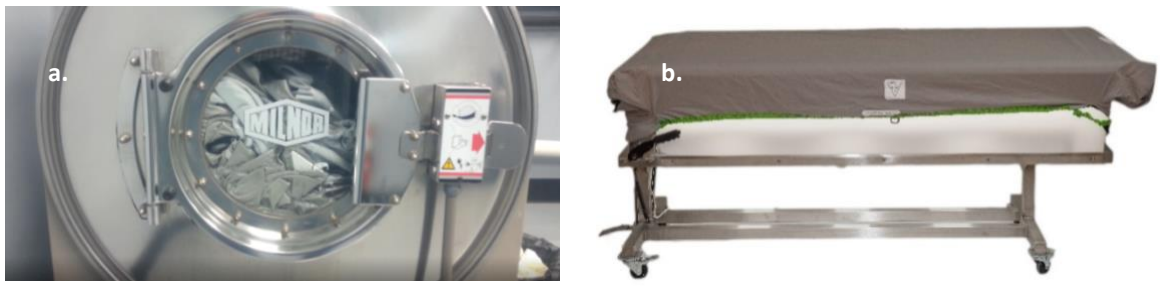
Where/how are the barriers laundered?



(a) Barriers being washed following a prescriptive laundering process. (b) Barriers are inspected on a light table after laundering.

Barriers are typically laundered at the hospital's usual laundry facility. They are washed with a detergent, chlorine bleach, 160°F water, and then brought to a neutral pH using a souring agent. The barriers are dried at 160°F temperatures, then inspected for damage over a light table. The process achieves a 6-log or greater reduction in pathogens including *C. diff* spores, even in the presence of soil.[22]

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My bed/mattress vendor sells launderable mattress covers. How does the Soteria barrier differ from these covers?

Some mattress covers can be laundered to remove gross soil and blood. However, these are not meant to be removed and laundered between every patient, and they generally cannot be laundered using adequate concentrations of disinfectants or at a temperature high enough to kill *C. diff*. Furthermore, these covers do not provide protection to the bed deck, whereas the bed barrier does.

FOLLOW-UP: Ask the manufacturer for their laundry guidance to address *C. diff.*

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Why don't we just use a disposable cover rather than a reusable barrier?

For cost-effectiveness, disposable covers would likely be made of low-quality materials that would be permeable to fluids and could increase the risk of developing pressure ulcers. Moreover, a cover of this type would not likely be compatible with all the functions of the bed. Finally, disposable covers would increase waste going to the landfill.

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BED BARRIER USE FAQ

The Soteria Bed Barrier® gives hospital staff an all-in-one solution that protects patients from infections, allows mattresses to perform therapeutically, and is simple to implement. The barrier's patented design allows beds and mattresses to work unhindered. Read below for questions and answers on use of the bed barrier.

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Q Does the Barrier adversely affect pressure injury outcomes?

No. All data collected to date does not indicate any adverse effects. This includes two peer-reviewed studies in which the barrier was used in two LTACHs and one acute care hospital for a total of 98,732 patient-days.[20,21] The barriers were used on Hillrom VCP 500, TotalCare Sport, Accumax, and Envision mattresses. These studies showed there was no increase in skin injuries as a result of using the barrier.

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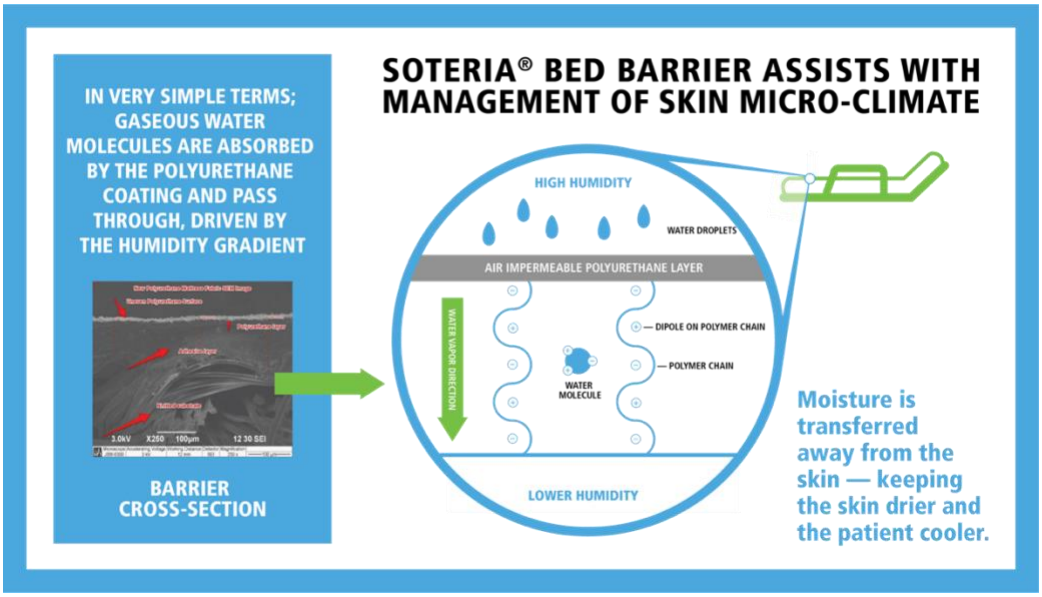
Q Does impermeable to pathogens and fluids mean that the mattress will not be able to breathe?



Not at all. The barrier will not allow pathogens or fluids to pass from the patient to the mattress or the mattress to the patient. However, it does allow water vapor molecules to pass through in order to maintain an ideal microclimate.[63]

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Will the barrier block air from the mattress from reaching the patient?

No, and in fact, current low-air loss (LAL) mattresses do not blow air directly on patients but rather under the mattress skin. The barrier will not inhibit this function.

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Are all mattress skins the same?

No, but that does not necessarily mean that one skin will produce better clinical results than another. For example, mattress skin MVT rates typically range from low MVT of 200g/(m^2·24hr) to high MVT of 1200g/(m^2·24hr). However, no peer-reviewed studies document clinical outcomes that are better or worse with a higher MVT cover. Additionally, higher MVT fabrics break down faster due to decreased compatibility with disinfectants.[17,18]

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Does Trinity Guardion conduct tests to assess the therapeutic performance of the barrier on a mattress?

Yes, tests were conducted during barrier development. Testing with and without the barrier has shown the barrier has minimal impact on pressure redistribution and microclimate with results usually being no different than use of a sheet and better than the effects of incontinence pads.[63]

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How important is mattress performance testing?

S3I testing and similar mattress performance tests are excellent engineering tools to provide comparative data for design input. For example, an immersion test may tell an engineer that Mattress Foam A permits more immersion than Mattress Foam B. Choosing Mattress Foam A may lead to better pressure injury outcomes. However, it is unknown whether this single variable will influence clinical results or to what extent, and other factors must be considered such as cost, durability, and micro-climate. As S3I states, "…no individual test result is predictive of pressure injury prevention effectiveness," and, "Standard tests are not intended to demonstrate clinical outcomes or determining overall ranking or scoring of support surfaces…"[64] Simply put, differences in mattress performance test results do NOT necessarily reflect differences in pressure injury outcomes.

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Does use of the barrier make it harder to pull a patient up in bed?

No. Trinity Guardion has conducted tests showing that the use of the barrier does not increase the force needed to move a patient in bed when a bottom sheet is in use. These tests were conducted on four different beds/mattresses, including both foam and low air loss surfaces. Furthermore, a blind study of 50 nurses showed that there was no perceived difference in the amount force needed to move a patient in bed.

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How is the barrier constructed?

The Soteria Bed Barrier® protects both the mattress & bed deck with its patented pocketed design.

The barrier includes a pocketed corner design that allows you to protect both the mattress and bed deck while still allowing for the use of fitted sheets over the barrier. The fabric acts as a two-way barrier to fluids and pathogens, keeping both the patient and mattress safe. The four-way stretch and moisture-vapor transfer properties allow the mattress to properly perform while keeping patients comfortable. The barrier has fluid-proof, RF welded seams that keep body fluids and pathogens from reaching the mattress. It also includes a barcode and RFID tag for full traceability. The barriers are designed to allow complete functionality of all bed features.

BACK TO OTHER QUESTIONS

What kind of beds can the Soteria barrier be used on?

The barrier is available for most bed types including med-surg, ICU, labor and delivery, and more.

The barrier can be used on nearly all hospital beds and mattresses. Each model is uniquely designed and warranted by Trinity Guardion to fit a specific bed model for optimal fit and full functionality.

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Q Will the bed barrier inhibit the use of any bed features?

Barrier demonstrated in use with various features including (a) turn assist, (b) & (c) CPR straps & levers, & (d) an add-on bed extender.

No. The barrier is designed to allow full functionality of the bed & mattress. Common features the barrier accommodates include but are not limited to: complete articulation of the bed including full chair position, continuous lateral rotation therapy, air mattresses, CPR controls, extreme turn assist functions, bed extenders (manual and powered), x-ray ports, and line management features.

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Q How does the Soteria process work?

The Soteria Bed Barrier® uses a simple & easily repeatable process similar to the cycle bed linens go through:

1. The barrier is placed on a clean mattress.
2. After patient discharge, the barrier is removed from the mattress, placed in a soiled barrier bag, and sent to the laundry.
3. The top and sides of mattress are cleaned, and a clean barrier is placed on the mattress.
4. The soiled barrier is laundered per Trinity Guardion's protocol (providing a 99.9999% reduction in pathogens[22]), inspected, and sent back to the hospital.

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BED BARRIER VALUE FAQ

Current mattress reprocessing strategies are expensive, ineffective, & not always in line with federal regulations & recommendations. Damaged mattresses & infection outbreaks are a source of morbidity & mortality, burdening hospitals with high costs, & common disinfection practices are likely to blame. The Soteria Bed Barrier® offers a superior alternative to mattress reprocessing that not only increases patient safety, but also complies with federal regulations & recommendations while saving hospitals money. The questions and answers below will help you understand the costs associated with current practices and how the Soteria Bed Barrier® can add value to your hospital.

BACK TO OTHER QUESTIONS

Q Is the barrier compliant with federal regulations & recommendations?

Yes, the Soteria Bed Barrier® is compliant with federal regulations. The barrier is a registered Class I medical device. It includes an RFID chip and barcode for traceability. Hospitals can also use piggyback labels on EVS log sheets to track compliance. The laundry process achieves a 6-log reduction or greater in pathogens including *C. diff* spores,[22] exceeding recommendations, & the barrier is inspected over a light table after each laundering. On the contrary, not following the manufacturer's cleaning & disinfection protocols (such as using a 1-step process) can result in a citation from CMS and creates significant risk according to the Joint Commission.[65,66]

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Q If CMS requires hospitals to follow mattress manufacturers MIFUs, then will we be cited for using the barrier?

No. Trinity Guardion can help your hospital create a thorough Alternative Equipment Maintenance (AEM) plan that follows AAMI standards and includes a complete risk analysis. This is validated through peer-reviewed research that shows the effectiveness of the barrier process.

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Q How expensive are the bed barriers?

Barriers cost much less than many replacement covers sold by mattress manufacturers. Barriers can also be leased on a per laundering basis.

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Q Which units benefit the most from the barrier?

Every unit can benefit from the barrier as current mattress disinfection processes are inadequate and often cause damage to your mattresses and beds. However, units with higher infection rates, faster turn times, and immunocompromised patients would likely benefit the most from the barrier.

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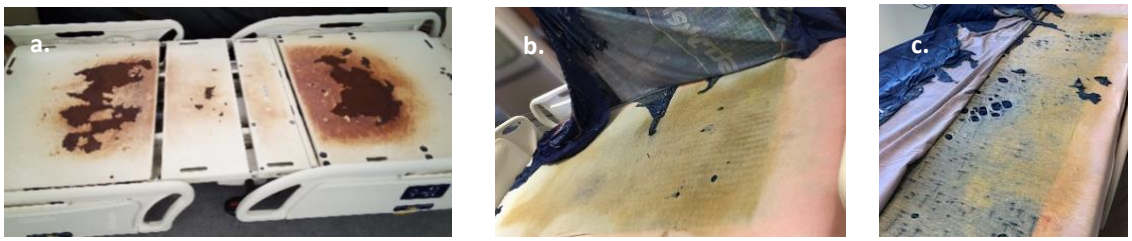
Q What are the hidden costs of mattress ownership?



(a) Severe bed deck rust can be the result of not allowing the bed deck and mattress to dry during terminal cleaning before laying the mattress back on the surface. (b) and (c) Mattress covers can be damaged if disinfectants are not rinsed off the surface, allowing fluid ingress to the mattress core.

Mattress ownership comes with many costs that may not have been previously considered. For example, following MIFUs for cleaning & disinfection of just the mattress can take up to 25 minutes, exhausting EVS resources.[67] Also, mattress damage is common, especially when using a 1-step disinfection process.[56,58,59] This can increase the frequency at which you replace mattresses & mattress covers. Other costs include those to complete inspections, mattress disposal costs, or expensive maintenance agreements.

FOLLOW-UP: Read your mattress MIFUs and watch instructional videos provided by mattress manufacturers to learn how to clean and disinfect mattresses according to the manufacturer. Watch Trinity Guardion's cleaning and disinfection time study video to determine if MIFUs are feasible at your facility or if a better, evidence-based practice is needed.

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How can we prove to others in our organization that the barriers are a necessary intervention?

Bodily fluid staining & mold on mattress cores. These mattresses were in use immediately before time of inspection, potentially exposing dozens or even hundreds of patients to harmful pathogens.

Present the relevant research to them showing current processes are not adequate and that the barrier can save lives and money. Take pictures of any damaged/stained mattresses or rusted bed decks in your facility. Examine internal data to determine if infection rates rose as mattresses aged.

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What value does the Soteria Bed Barrier® provide to my hospital?

FINANCIAL

1. Eliminates need to replace mattress covers at end of expected life.
2. Prevents chemical damage to mattress covers, eliminating the need to prematurely replace mattresses & mattress covers.
3. Prevents rusting of the bed deck, eliminating the need to repair or replace expensive hospital beds due to excessive deck rusting.
4. Decreases time & cost to reprocess patient rooms after discharge when compared to mattress MIFUs.
5. Eliminates need to regularly inspect mattresses or need for expensive mattress service contracts that can cost in excess of $1,000 a year per bed.
6. Reduces HAIs.
7. Could potentially increase Medicare reimbursement.

PATIENT SAFETY

1. Can reduce HOCDI's by approximately 50%.[20,21]
2. Provides a clean surface for patients, using a validated laundry cycle that reduces pathogens including *C. diff*. spores by 99.9999%.[22]
3. Barriers are inspected on a light table before each use to ensure they have not been damaged.
4. Research shows that the barrier does not increase healthcare-acquired pressure injuries.[20,21]

FOLLOW-UP: Contact Trinity Guardion to learn the full value of the Soteria Bed Barrier® using our customizable ROI calculator.

BACK TO OTHER QUESTIONS

REFERENCES

1. de Andrade D, Angerami ELS, Padovani CR. A bacteriological study of hospital beds before and after disinfection with phenolic disinfectant. *Rev Panam Salud Publica.* 2000;7(3):179-184. doi:10.1590/s1020-49892000000300007

2. Fernando FSL, Ferreira AM, Colombo TE, Rubio FG, Almeida, MTG. Fungal contamination of hospital mattresses before and following cleaning and disinfection. *Acta Paul Enferm*. 2013;26(5):485-491.

3. Hu H, Johani K, Gosbell IB, et al. Intensive care unit environmental surfaces are contaminated by multidrug-resistant bacteria in biofilms: combined results of conventional culture, pyrosequencing, scanning electron microscopy, and confocal laser microscopy. *J Hosp Infect.* 2015;91(1):35–44. doi:10.1016/j.jhin.2015.05.016

4. Viana RH, dos Santos SG, Oliveira AC. Recovery of resistant bacteria from mattresses of patients under contact precautions. *Am J Infect Control.* 2016;44(4):465-469. doi:10.1016/j.ajic.2015.10.027

5. Vickery K, Deva A, Jacombs A, Allan J, Valente P, Gosbell IB. Presence of biofilm containing viable multiresistant organisms despite terminal cleaning on clinical surfaces in an intensive care unit. *J Hosp Infect.* 2012;80(1), 52-55. doi:10.1016/j.jhin.2011.07.007

6. Bousquet A, van der Mee-Marquet N, Dubost C, et al. Outbreak of CTX-M-15–producing *Enterobacter cloacae* associated with therapeutic beds and syphons in an intensive care unit. *Am J Infect Control*. 2017;45(10):1160-1164. doi:10.1016/j.ajic.2017.04.010

7. Cadot L, Bruguière H, Jumas-Bilak E, et al. Extended spectrum beta-lactamase-producing *Klebsiella pneumoniae* outbreak reveals incubators as pathogen reservoir in neonatal care center. *Eur J Pediatr*. 2019;178(4):505–513. doi:10.1007/s00431-019-03323-w

8. Pantel A, Richaud-Morel B, Cazaban M, Bouziges N, Sotto A, Lavigne JP. Environmental persistence of OXA-48–producing Klebsiella pneumoniae in a French intensive care unit. *Am J Infect* Control. 2016;44(3):366-368. doi:10.1016/j.ajic.2015.09.021

9. van der Mee-Marquet N, Girard S, Lagarrigue F, et al. Multiresistant Enterobacter cloacae outbreak in an intensive care unit associated with therapeutic beds. *Crit Care.* 2006;10(1):405. doi:10.1186/cc4835

10. Cohen B, Liu J, Cohen AR, Larson E. Association between healthcare-associated infection and exposure to hospital roommates and previous bed occupants with the same organism. *Infect Control Hosp Epidemiol*. 2018;*39*(5):541-546. doi:10.1017/ice.2018.22

11. Datta R, Platt R, Yokoe DS, Huang SS. Environmental cleaning intervention and risk of acquiring multidrug-resistant organisms from prior room occupants. *Arch Intern Med*. 2011;171(6):491-494. doi:10.1001/archinternmed.2011.64

12. Russotto V, Cortegiani A, Raineri SM, Iozzo P, Gregoretti C, Giarratano A. What is the risk of acquiring bacteria from prior intensive care unit bed occupants?. *Crit Care*. 2017;21(1):55. doi:10.1186/s13054-017-1652-y

13. Shaughnessy MK, Micielli RL, DePestel DD, et al. Evaluation of hospital room assignment and acquisition of *Clostridium difficile* infection. *Infect Control Hosp Epidemiol*. 2011;32(3):201-206. doi:10.1086/658669

14. 2019 Top 10 Health Technology Hazards: Executive Brief. *ECRI Institute*. https://www.ecri.org/Resources/Whitepapers_and_reports/Haz_19.pdf. Published October 2019. Accessed September 4, 2020.

15. Top 10 Health Technology Hazards for 2018: Executive Brief. *ECRI Institute.* https://www.ecri.org/Resources/Whitepapers_and_reports/Haz_18.pdf. Published 2017. Accessed April 19, 2021.

16. Covers for Hospital Bed Mattresses: Learn How to Keep Them Safe. *fda.gov*. https://www.fda.gov/medical-devices/hospital-beds/covers-hospital-bed-mattresses-learn-how-keep-them-safe. Published November 20, 2017. Accessed September 4, 2020.

17. Milnes J. The impact of cleaning chemicals on polyurethane mattress cover materials and their propensity for physical damage. *Dartex Coatings Limited*. http://www.dartexcoatings.com/Dartex/media/SiteImages/Applications/events/TVS-Poster-Presentation-%28-news-article-5%29.pdf. Published 2012. Accessed September 4, 2020.

18. Ripley D, Milnes J, Gregg T. A comparative study of microclimate in mattress; clinical and financial factors for consideration. *Dartex Coatings Limited.* http://www.dartexusa.com/Dartex/media/SiteImages/Applications/events/EPUAP.pdf. Published September 16, 2012. Accessed April 14, 2021.

19. Raeiszadeh M, Adeli B. A critical review on ultraviolet disinfection systems against COVID-19 outbreak: applicability, validation, and safety considerations. *ACS Photonics.* 2020;acshphotonics.0c01245. doi:10.1021/acsphotonics.0c01245

20. Hooker EA, Bochan M, Reiff TT, Blackwell C, Webb KW, Hart KW. Decreasing Clostridium difficile health care–associated infections through use of a launderable mattress cover. *Am J Infect Control*. 2015;43(12):1326–1330. doi:10.1016/j.ajic.2015.07.002

21. Hooker EA, Mallow PJ, McKinney C, Gnoni ML, Fernandez Gonzales F. Use of a launderable bed barrier and antibiotic stewardship to decrease hospital onset Clostridioides difficile infections in an acute care hospital: A retrospective pre/post case study. *JHEOR*. 2019;6(3):196-202. doi:10.36469/001c.11149

22. Hooker EA, Ulrich D, Brooks D. Successful removal of *Clostridioides difficile* spores and pathogenic bacteria from a launderable barrier using a commercial laundry process. *Infect Dis (Auckl)*. 2020;13:1-6. doi:10.1177/1178633720923657

23. Reprocessing Medical Devices in Health Care Settings: Validation Methods and Labeling. *fda.gov.* https://www.fda.gov/media/80265/download. Published March 17, 2015. Updated June 9, 2017. Accessed September 11, 2020.

24. Enforcement Policy for Sterilizers, Disinfectant Devices, and Air Purifiers During the Coronavirus Disease 2019 (COVID-19) Public Health Emergency. *fda.gov.* https://www.fda.gov/media/136533/download. Published March 2020. Accessed September 11, 2020.

25. Guidelines for Environmental Infection Control in Health-Care Facilities: G. Laundry and Bedding. *cdc.gov*. https://www.cdc.gov/infectioncontrol/pdf/guidelines/environmental-guidelines-P.pdf. Published 2003. Updated July, 2019. Accessed February 5, 2020. Pg. 118-119.

26. APIC Practice Guidelines Committee (PGC) Position Statement on Adenosine Triphosphate (ATP) Testing of Reusable Textiles in Healthcare Facilities. *APIC.* http://www.apic.org/Resource_/TinyMceFileManager/Position_Statements/APIC_position_ATP_and_reusable_textiles_082012.pdf. Published August 15, 2012. Accessed September 4, 2020.

27. Corbella X, Pujol M, Argerich MJ, et al. Environmental sampling of *Acinetobacter baumannii*: moistened swabs versus moistened sterile gauze pads. *Infect Control Hosp Epidemiol*. 1999;20(7):458-460. doi:10.1086/503137

28. Hooker EA, Allen SD, Gray LD. Comparison of rayon-tip swabs and film plates for use in collecting and quantifying bacteria on hospital bed mattresses. *Am J Infect Control*. 2011;39(5):E191-E192. doi:10.1016/j.ajic.2011.04.014

29. Naaber P, Stsepetova J, Smidt I, et al. Quantification of *Clostridium difficile* in antibiotic-associated-diarrhea patients. *J Clin Microbiol.* 2011;49(10):3656-3658. doi:10.1128/JCM.05115-11

30. Bennett J, Gilberti B. Diarrhea. *Core EM*. https://coreem.net/core/diarrhea/. Published March 2, 2020. Accessed April 30, 2021.

31. C. difficile infection. *Mayo Clinic*. https://www.mayoclinic.org/diseases-conditions/c-difficile/symptoms-causes/syc-20351691. Published January 4, 2020. Accessed April 30, 2021.

32. Larson HE, Borriello SP. Quantitative study of antibiotic-induced susceptibility to *Clostridium difficile* enterocecitis in hamsters. *Antimicrob Agents Chemother*. 1990;34(7):1348-1353. doi:10.1128/aac.34.7.1348

33. Lawley TD, Clare S, Deakin LJ, et al. Use of purified *Clostridium difficile* spores to facilitate evaluation of health care disinfection regimens. *Appl Environ Microbiol*. 2010;76(20):6895-6900. doi:10.1128/AEM.00718-10

34. Weber DJ, Rutala WA, Miller MB, Huslage K, Sickbert-Bennett E. Role of hospital surfaces in the transmission of emerging health care-associated pathogens: norovirus, *Clostridium difficile*, and *Acinetobacter* species. *Am J Infect Control.* 2010;38(5):S25-S33. doi:10.1016/j.ajic.2010.04.196

35. Guerrero DM, Nerandzic MM, Jury LA, Jinno S, Chang S, Donskey CJ. Acquisition of spores on gloved hands after contact with the skin of patients with *Clostridium difficile* infection and with environmental surfaces in their rooms. *Am J Infect Control.* 2012;40(6):556-558. doi:10.1016/j.ajic.2011.08.002

36. Huslage K, Rutala WA, Sickbert-Bennett E, Weber DJ. A quantitative approach to defining "high-touch" surfaces in hospitals. *Infect Control Hosp Epidemiol.* 2010;31(8):850-853. doi:10.1086/655016

37. Hand Hygiene: Why, How and When? *World Health Organization.* https://www.who.int/gpsc/5may/Hand_Hygiene_Why_How_and_When_Brochure.pdf. Revised August 2009. Accessed February 16, 2021.

38. Hooker EA, Allen S, Gray L, et al. A randomized trial to evaluate a launderable bed protection system for hospital beds. *Antimicrob Resist Infect Control*. 2012;1(27). doi:10.1186/2047-2994-1-27

39. Best Practices for Cleansing, Disinfecting, and Care of Polyurethane Support Surface Covers. *National Pressure Injury Advisory Panel.* https://cdn.ymaws.com/npiap.com/resource/resmgr/s3i/S3i_NPIAP_Cleansing_Disinfec.pdf. Published 2020. Accessed April 13, 2021.

40. Cleaning and Disinfecting Instruction Video (REV 1). *Hillrom.* https://www.hill-rom.com/international/Education/education-by/e-learning/cleaning-instructions/. Accessed September 9, 2020.

41. Stryker® Maintenance Manual: Isolibrium™ Support Surface (REV B). *Stryker.* https://techweb.stryker.com/Support_Surfaces/2971/0815/maintenance/2971-009-002B.pdf. Published 2017. Accessed September 4, 2020.

42. User Manual and Technical Description: Eleganza 5 Positionable Bed for Intensive Care and Opticare Integrated Mattress Replacement System (Version 6). *Linet.* Published October 2018.

43. Anderson DJ, Chen LF, Weber DJ, et al. Enhanced terminal room disinfection and acquisition and infection caused by multidrug-resistant organisms and *Clostridium difficile* (the Benefits of Enhanced Terminal Room Disinfection study): a cluster-randomised, multicentre, crossover study. *Lancet*. 2017;389(10071):805-814. doi:10.1016/S0140-6736(16)31588-4

44. Anderson DJ, Gergen MF, Smathers E, et al. Decontamination of targeted pathogens from patient rooms using an automated ultraviolet-C-emitting device. *Infect Control Hosp Epidemiol.* 2013;34(5):466-471. doi:10.1086/670215

45. Havill NL, Moore BA, Boyce JM. Comparison of the microbiological efficacy of hydrogen peroxide vapor and ultraviolet light processes for room decontamination. *Infect Control Hosp Epidemiol.* 2012;33(5):507-512. doi:10.1086/665326

46. Kitagawa H, Nomura T, Nazmul T, et al. Effectiveness of 222-nm ultraviolet light on disinfecting SARS-CoV-2 surface contamination. *Am J Infect Control*. 2020. doi:10.1016/j.ajic.2020.08.022

47. UV Lights and Lamps: Ultraviolet-C Radiation, Disinfection, and Coronavirus. *fda.gov.* https://www.fda.gov/medical-devices/coronavirus-covid-19-and-medical-devices/uv-lights-and-lamps-ultraviolet-c-radiation-disinfection-and-coronavirus. Updated August 19, 2020. Accessed September 4, 2020.

48. Attia F, Whitener C, Mincemoyer S, Houck J, Julian K. The effect of pulsed xenon ultraviolet light disinfection on healthcare-associated *Clostridioides difficile* rates in a tertiary care hospital. *Am J Infect Control*. 2020;48(9):1116-1118. doi:10.1016/j.ajic.2019.12.019

49. McMullen K, Guth RM, Wood H, et al. Impact of no-touch ultraviolet light room disinfection systems on *Clostridioides difficile* infections. *Am J Infect Control*. 2021;49(5):646-648. doi:10.1016/j.ajic.2020.08.030

50. Antibiotic Resistance Threats in the United States, 2019: *Clostridioides Difficile*. *cdc.gov.* https://www.cdc.gov/drugresistance/pdf/threats-report/clostridioides-difficile-508.pdf. Published 2019. Accessed April 29, 2021.

51. Blixt T, Gradel KO, Homann C, et al. Asymptomatic carriers contribute to nosocomial *Clostridium difficile* infection: a cohort study of 4508 patients. *Gastroenterology.* 2017;152(5):1031-1041. doi:10.1053/j.gastro.2016.12.035

52. Donskey CJ, Sunkesula VCK, Stone ND, et al. Transmission of *Clostridium difficile* from asymptomatically colonized or infected long-term care facility residents. *Infect Control Hosp Epidemiol.* 2018;39(8):909-916. doi:10.1017/ice.2018.106

53. Riggs MM, Sethi AK, Zabarsky TF, Eckstein EC, Jump RLP, Donskey CJ. Asymptomatic carriers are a potential source for transmission of epidemic and nonepidemic *Clostridium difficile* strains among long-term care facility residents. *Clin Infect Dis.* 2007;45(8):992-998. doi:10.1086/521854

54. Worley J, Delaney ML, Cummins CK, DuBois A, Klompas M, Bry L. Genomic determination of relative risks for *Clostridioides difficile* infection from asymptomatic carriage in ICU patients. *Clin Infect Dis.* 2020;ciaa894. doi:10.1093/cid/ciaa894

55. McGoldrick M. Soft surface sanitizing. *Home Healthcare Now*. 2015;33(1):52-53. https://www.homecareandhospice.com/pdfs/McGoldrick_Soft_Surface_Sanitizing.pdf. Accessed September 4, 2020.

56. Bradbury SL, Mack D, Crofts T, Ellison RT. Potential bloodborne pathogen exposure from occult mattress damage. *Am J Infect Control*. 2014;42(4):421-422. doi:10.1016/j.ajic.2013.10.011

57. Estimated Useful Lives of Depreciable Hospital Assets. *American Hospital Association*. 2018. Nursing departments:p14;table 7

58. Hooker EA. Damaged hospital mattresses and bed frames are common in acute care hospitals. Poster Presentation at SHEA Spring Conference, April 14-16, 2021.

59. Marks B, de Haas E, Abboud T, Lam I, Datta IN. Uncovering the rates of damaged patient bed and stretcher mattresses in Canadian acute care hospitals. *Can J Infect Control*. 2018;33(3):171-175.

60. Cadnum JL, Mana TSC, Jencson A, Thota P, Kundrapu S, Donskey CJ. Effectiveness of a hydrogen peroxide spray for decontamination of soft surfaces in hospitals. *Am J Infect Control*. 2015;43(12):1357-1359. doi:10.1016/j.ajic.2015.07.016

61. Yeargin T, Fraser A, Huang G, Jiang X. Recovery and disinfection of two human norovirus surrogates, feline calicivirus and murine norovirus, from hard nonporous and soft porous surfaces. *J Food Prot*. 2015;78(10):1842-1850. doi:10.4315/0362-028X.JFP-14-515

62. Nkemngong CA, Chaggar GK, Li X, Teska PJ, Oliver HF. Disinfectant wipes transfer *Clostridioides difficile* spores from contaminated surfaces to uncontaminated surfaces during the disinfection process. *Antimicrob Resist Infect Control.* 2020;9:176. doi:10.1186/s13756-020-00844-0

63. Wound Care. *Trinity Guardion.* https://trinityguardion.com/resources/wound-care/. Accessed April 15, 2021.

64. Guidance on Interpretation of Performance Standards for Support Surfaces. *National Pressure Injury Advisory Panel.* https://cdn.ymaws.com/npiap.com/resource/resmgr/s3i/12-10-2020__S3I_Guidance_on_.pdf. Published December 10, 2020. Accessed April 13, 2021.

65. Hospital Infection Control Worksheet. *Centers for Medicare & Medicaid Services*. https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/SurveyCertificationGenInfo/Downloads/Survey-and-Cert-Letter-15-12-Attachment-1.pdf. Published 2015. Accessed September 16, 2020. Section 2.d. environmental services:pg16,18.

66. Standards FAQs. *The Joint Commission*. https://www.jointcommission.org/standards/standard-faqs/critical-access-hospital/infection-prevention-and-control-ic/000002250/. Updated March 17, 2021. Accessed May 3, 2021.

67. Trinity Guardion Time Saving/Infection Protection. *Trinity Guardion.* https://trinityguardion.com/resources/our-videos/. Accessed April 15, 2021.