

LINET

INNOVATING INFECTION CONTROL WITH COMPLETE WASHABLE SOLUTION



BACKGROUND

Infection control is a crucial aspect of patient care in hospital settings. However, despite persistent and continuous investment, it remains a challenge that requires ongoing focus and creative interventions to prevent hospital-acquired infections. When patients enter the hospital, their immune systems are already weaker, and any additional infections can potentially compromise their lives. This is further underscored by data from hospitals, indicating that 3.1–4.6 million people acquire healthcare-associated infections (HAIs) in acute care hospitals in Europe every year (NHS, 2020). HAIs are recognized as the most deadly and costly adverse events, consuming up to 6% of public hospital budgets (OECD/European, 2020).

During a patient's stay, the most contaminated areas within patient rooms are often the most frequently touched surfaces, such as the hospital bed, mattresses, linens, patient gowns, and overbed tables (EOScu, 2020). Coupled with the presence of Methicillin-resistant *Staphylococcus aureus* (MRSA) or *Clostridium difficile* (C-diff)—types of bacteria that can cause symptoms ranging from diarrhoea to life-threatening inflammation of the colon, typically in individuals who have recently taken antibiotics—these bacteria are the most common and easily spread in clinical environments (Monegro AF, 2023). Additionally, the risk of infection potentially increases through the common scenario of having damaged beds and mattresses, a common situation in healthcare facilities (Hooker, 2021).

Given these challenges, healthcare facilities are constantly striving to improve infection control measures in response to evolving infections. One innovation in this regard is the development of automated washing tunnels to facilitate standardized cleaning of hospital beds, mattresses, and other furniture, thereby limiting cross-infection between patients and removing resistant bacteria and viruses from the patient's environment. In support of this approach, LINET has developed the washable version *Essenza 300 W*. The following white paper describes how LINET has addressed these challenges.

CONCLUSION

Washing tunnels are increasingly recognized as an effective tool for cleaning hospital equipment, enabling standardized cleaning processes. This technology is beneficial in large healthcare facilities that experience high patient turnover. Most standard hospital equipment is not designed for use in washing tunnels, as the equipment must withstand the high pressure of water jets, elevated temperatures, and harsh chemicals. This understanding has driven LINET to develop a new model, the *Essenza 300 W*, enhancing the versatility of the *Essenza 300* series.

The *Essenza 300 W* incorporates various non-corrosive materials, including aluminium telescopic siderails and durable plastic siderails and other components. A cataphoresis coating also protects its metal parts to ensure increased longevity. To validate the effectiveness of its cleaning capabilities and durability, LINET conducted extensive testing with Miele, a leading manufacturer of washing tunnels. The *Essenza 300 W* demonstrated excellent endurance, effective cleaning of all surfaces, and reliable protection of electrical components against leaks. These tests facilitated the integration of additional features designed to create a safer and more ergonomic environment for caregivers. These features include a lateral tilt of the bed frame, integrated control panels, a brake alarm, and an undercarriage safety light, all of which enhance the bed's utility in nursing practice.

In summary, the hospital will achieve standardized and effective cleaning across a wide range of washing tunnels thanks to the design of the *Essenza 300 W* hospital bed and the *ViskoMatt 30 W* mattress. The effectiveness of this solution was proven through testing in accordance with AK-BWA 9.2022 guidelines and other norms. Additionally, 500 washing cycles of a stress test were performed, demonstrating the durability of the materials and design of the LINET washable solution for a 10-year lifespan.

Hospital bed cleaning strategies in the fight against HAI

Infection control guidelines in hospitals incorporate diverse strategies to combat healthcare-associated infections (HAIs). Emphasizing the findings from various studies and considering the amount of time patients spend in their rooms, there is a marked focus on cleaning and disinfecting surfaces around patients, particularly hospital beds and mattresses. These areas are significant sources of infection, due to high patient turnover, frequent visits, and substantial room occupancy. To mitigate the risk of HAIs, equipment decontamination must occur periodically and following each patient's use.



Image 1: Demonstration of contaminated surfaces in patient room comparing most contaminated and most touched surfaces (EOScu, 2020)

To achieve fast and effective decontamination of hospital beds, several prerequisites must be fulfilled. Firstly, clear guidelines for the infection control of hospital beds, including precise steps and the use of appropriate chemicals, must be established. Secondly, hospital beds should have a seamless design without cavities and be constructed from materials conducive to cleaning and disinfection with various chemicals. Thirdly, bed surfaces should be resistant and maintained without damage or corrosion to facilitate cleaning. However, the most crucial condition is having trained staff to perform precise cleaning and disinfection of the bed surfaces.

Automatically cleaned beds achieve more consistent and reliable decontamination compared to manual method.
(Hopman J, 2015)

Meeting the first three conditions is feasible, even with limited resources, but staffing for cleaning presents challenges from various angles. Efficient and effective cleaning requires individuals who are responsible, dedicated, and capable of working within tight timeframes. However, this vital work is often stigmatized as undervalued, poorly paid, and physically demanding, leading to staffing shortages and high turnover. Consequently, beds and mattresses may not receive adequate decontamination due to time and staff constraints, low staff motivation, or insufficient training in effective cleaning techniques.

To address this challenge, an automated washing tunnel has been developed to reduce the impact of limited human resources on the implementation of hygiene and infection control protocols. Hence, studies investigating the efficiency of different cleaning methods are imperative. Hopman's study comparing manual and automated (mechanical) cleaning found that automatically cleaned beds achieve more consistent and reliable decontamination compared to manual methods, with lower adenosine triphosphate (ATP) levels indicating superior removal of organic matter and contaminants (Hopman J, 2015).

Diving into washing tunnel technologies

Washing tunnels use various technologies, primarily differentiated by their cleaning methods and the level of automation they provide. The technologies can be categorized as follows:

- Washing tunnels that utilize high-pressure water jets in combination with disinfectants
- Washing tunnels that use UV-C technology
- Steam washing tunnels
- Dry fog disinfectant washing tunnels



Image 2: Essenza 300 W in Miele washing tunnel

Each of these technologies offers distinct advantages. Automated washing tunnels are ideal for high-throughput environments, while UV-C disinfection provides a chemical-free option. Steam disinfection is highly effective against a wide range of pathogens, and dry fog can thoroughly cover complex surfaces.

In the case of hospital beds, the most common process involves automated washing tunnels. This preference stems not only from its fully automated nature but also from its design to clean multiple beds and even mattresses simultaneously. These tunnels typically employ a combination of high-pressure water jets, steam, and disinfectants to ensure thorough hygiene and disinfection. Beds are conveyed through a tunnel-like structure where different cleaning processes occur in sequence. This method is highly efficient for managing a large volume of beds in facilities with high turnover rates.

State of the Art of washable beds and Importance of norm compliance

The high pressure and temperature, combined with aggressive disinfectants used on the automated washing tunnels challenge the materials' quality and the design of the beds that can be successfully used by this kind of technology. The hospital beds need to be built with waterproofed electric components and materials that can withstand repeated exposure to high water pressure and high temperatures, while also allowing for fast drying. All these requirements significantly limit the functionalities of washable beds compared to non-washable versions.

The compliance with established norms and guidelines for washable hospital beds is fundamental to ensuring effective infection control, maintaining high standards of patient care, and achieving operational efficiencies within healthcare facilities. Ensuring that these standards are met consistently is key to minimizing risks and enhancing the overall healthcare environment.

NORM AND GUIDELINES GOVERNING WASHABLE BEDS

EN 60601-2-52 is a crucial standard ensuring that medical beds are safe, reliable, and effective for patient care. It covers a wide range of requirements from electrical and mechanical safety to usability and infection control, aiming to provide a comprehensive framework for the design, testing, and use of medical beds in healthcare settings. Some parts of this standard also cover requirements for washable beds such as:

201.11.6.6.101	Focuses on the need to be properly marked as a washable bed.
201.11.6.6.103.1	Construction from materials that resist corrosion and damage from detergents and disinfectants used during mechanical washing.
201.11.6.6.103.2	Design of features which facilitate easy cleaning and prevent water ingress into critical components.
201.11.6.6.103.3	Testing to validate their resistance to mechanical washing processes, including exposure to water jets, temperature variations, and cleaning agents.
201.11.6.6.103.4	Detailed washing and maintenance instructions must be provided by the manufacturer.

AK-BWA 9.2022 focuses on guidelines for the mechanical decontamination of hospital beds and other related medical equipment. It provides detailed standards and procedures to ensure the effective and safe cleaning, disinfection, and maintenance of hospital beds. Summary of guidelines related to hospital beds, which emphasize the importance of robust decontamination processes to maintain hospital beds in a hygienic state, ensuring patient safety and compliance with healthcare standards. The guideline covers the following topics:

Compliance with Hygiene Standards	Hospital beds must be designed to meet stringent hygiene standards, ensuring they can be effectively cleaned and disinfected using mechanical systems.
	Regular decontamination is crucial to prevent the spread of infections in healthcare settings.
Design and Material Selection	Materials used in hospital beds must be resistant to corrosion and damage from cleaning agents.
	The design should eliminate crevices and hard-to-reach areas where contaminants can accumulate.
Operational Efficiency	The use of automated decontamination systems can significantly improve the efficiency and reliability of cleaning processes.
	Ensuring beds are properly positioned and exposed to cleaning agents reduces the risk of incomplete decontamination.
Maintenance and Validation	Regular maintenance and validation of both beds and decontamination equipment are essential to maintain high hygiene standards.
	Keeping detailed records of maintenance and validation activities ensures traceability and compliance with regulatory requirements.

Norm IEC 60529 (IPX6) is an international standard for the classification of degrees of protection provided by enclosures for electrical equipment. The standard is commonly known as the IP (Ingress Protection) Code. IPX6 rating means the device is protected against strong jets of water from any direction. Devices with this rating are suitable for outdoor use in heavy rain or in environments where they might be exposed to high-pressure water jets.

Essenza 300 W solution

In 2023, LINET launched a hospital bed called the Essenza 300. This bed is versatile and incorporates numerous features to create a safer and more comfortable environment for patients, as well as transforming the bed into an ergonomic tool for caregivers. Examples include the lateral tilt of the bed platform and low height. However, one version of the Essenza 300 was still missing to truly make it a versatile hospital bed: a version suitable for cleaning in automated washing tunnels.

While washable beds are not new in the world of hospital bed designs, what is new are the features allowed to be used in washable designs. Most washable beds have only the most basic functionalities, which do not align well with safe nursing practices. A hospital bed is not only for patient resting but also serves as a tool to reduce the physical demands on caregivers.

In summary, the washability of hospital beds often comes at the cost of reduced features. This is something we aim to change with our new Essenza 300 washable design.

A CLOSER LOOK AT ESSENZA 300 WASHABLE OPTIONS AND FEATURES

The Essenza 300 Washable comes in two options: one with telescopic aluminium siderails and the other with plastic siderails. The Essenza 300 W with plastic siderails is a brand-new addition to LINET's portfolio of washable beds. The plastic design is gaining popularity due to its non-corrosive material and clean, non-cavity design.

From a materials perspective, the bed is made not only of aluminium and plastic parts but also includes metal components that are sensitive to corrosion if the lacquer layer is damaged through daily use in the hospital. For this reason, the Essenza 300 W has a cataphoresis coating on all metal parts, which provides an additional layer of protection. Cataphoresis ensures that all metal parts are evenly covered and increases resistance to corrosion because it adheres strongly to the metal surface and reduces chipping, scratching, or peeling.



Image 3: Essenza 300 W with plastic siderail design



Image 4: Essenza 300 W with telescopic siderail design

Each version of the washable bed can be customized based on the specific requirements of the hospital and caregivers. The Essenza 300 W can be equipped with features that are well-known within the Essenza 300 family of beds. The benefits of these features are detailed separately in the Essenza 300 White Papers.

Lateral Tilt



Low bed height



Ergoframe®



Softbrakes®



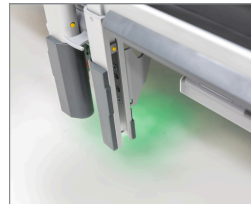
Mobi-Grips



Brake alarm



Night & Safety light



Aluminium linen shelf



The following features of the Essenza 300 W are unique to the washable version, designed specifically to withstand the conditions of cleaning in washing tunnels.

Mattress platform design



The mattress platform design assures no need to any repositioning while undergoing washing and drying procedures.

Integrated control panels



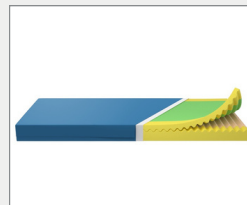
Integrated controls for both caregiver and patient can be always found in head siderails and provide easy and ergonomic access to positioning the bed.

Go Button



The Green Go Button is always included in for all the washable versions of Essenza 300 in order to increase the protection of the electronic components due to extreme conditions in a washing tunnel.

ViskoMatt 30 W



ViskoMatt 30 W is a newly designed washable hospital mattress for pressure injury prevention. This mattress features a unique leak-proof zipper.

EVIDENCE OF NORMS AND GUIDELINES COMPLIANCE BY TESTING ESSENZA 300 WASHABLE IN MIELE

The Essenza 300 W is not LINET's first washable bed. LINET's portfolio already includes washable beds that have been tested across various washing tunnel brands, including Miele, Dirschl, Belimed, Kleindienst, RehaWash, SteelCo, Sem Staal, and Sauter.

To prove the washability of the Essenza 300 W, LINET comprehensively tested the bed in an automated washing tunnel in Miele. In accordance with EN 60601-2-52 section 201.11.6.6.103.3, we conducted tests to validate the bed's resistance to the mechanical washing process by high pressure water jets, in high temperature with cleaning chemicals. This testing led to the development of detailed washing instructions of Essenza 300 W for the washing tunnel. According to AK-BWA 9.2022, it was required to test the bed in the washing tunnel at least 50 times without any damage to materials or functionality and to conduct biological validation of cleanliness at specific spots on the bed (Image 6), ensuring the design allows effective washing.



Image 5: Validation of biological testing by stripes, where is visible effect of cleaning process (after washing stripes are tested in laboratory)



Image 6: RFID tag for counting number of washing cycles based on temperature

In addition to the 50-cycle testing according to AK-BWA 9.2022, we also planned stress testing of the Essenza 300 W in a washable tunnel to determine if and when material damage would occur after an additional 450 washing cycles, corresponding to a 10-year lifespan of the bed. Each cycle was tracked by a LINET RFID tag, which is sensitive to the temperature inside the washing tunnel, reaching at least 60°C (Image 6).

According to guideline AK-BWA 9.2022 we also evaluated the drying process after each washing cycle, which should be a maximum of 10 minutes. Observation of Essenza 300 W and mattress ViskoMatt 30 W came with results, that both of them dried within 5 minutes. To document the drying process, we captured images and measured the time, as demonstrated in Image 7.

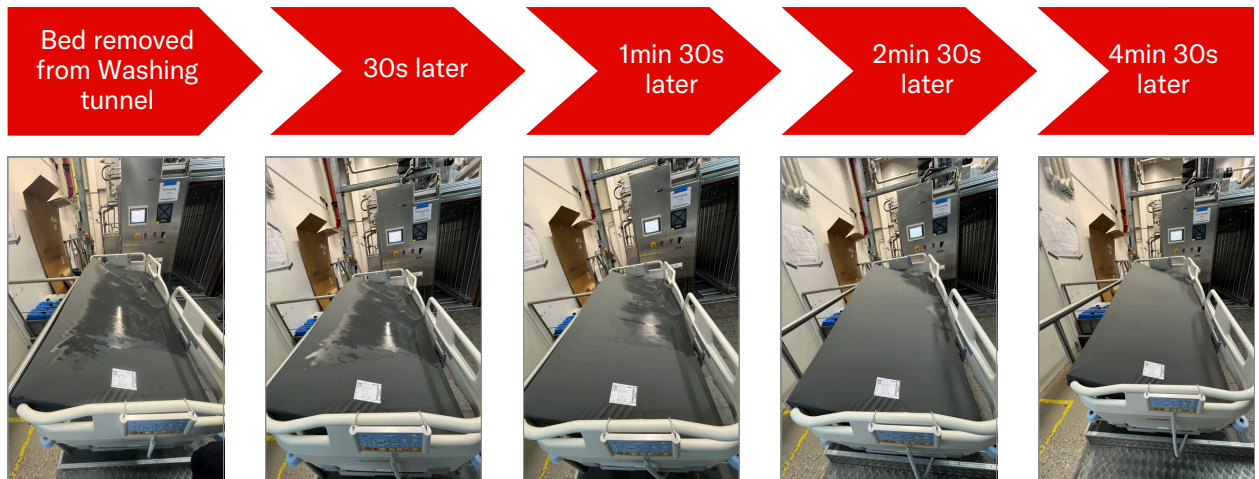


Image 7: Demonstration of drying process in time

In summary, the hospital bed Essenza 300 W with the mattress ViskoMatt 30 W endured 50 washing cycles according to AK-BWA 9.2022 without any material damage. Therefore, Essenza 300 W can withstand an additional 450 cycles, demonstrating the durability of the materials. After a total of 500 cycles, there was no material damage or water leakage, confirming the bed's waterproofness under IEC 60529 (IPX6) standards. The bed also retained its functionality.

Biological testing was conducted according to the AK-BWA 9.2022 guideline using testing strips. The results confirmed effective cleaning.

The duration of drying also proves the proper design of LINET solution for washable tunnels. Drying of Essenza 300 W and ViskoMatt 30 W was demonstrated by achieving complete drying within 5 minutes after the washing cycle.

For more detailed information, a certificate of testing according to AK-BWA 9.2022 and EN 60601-2-52 can be requested.

Essenza 300 W with ViskoMatt 30 W can withstand 500 washing cycles while maintaining full functionality.

(Testing according AK-BWA 9.2022)

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