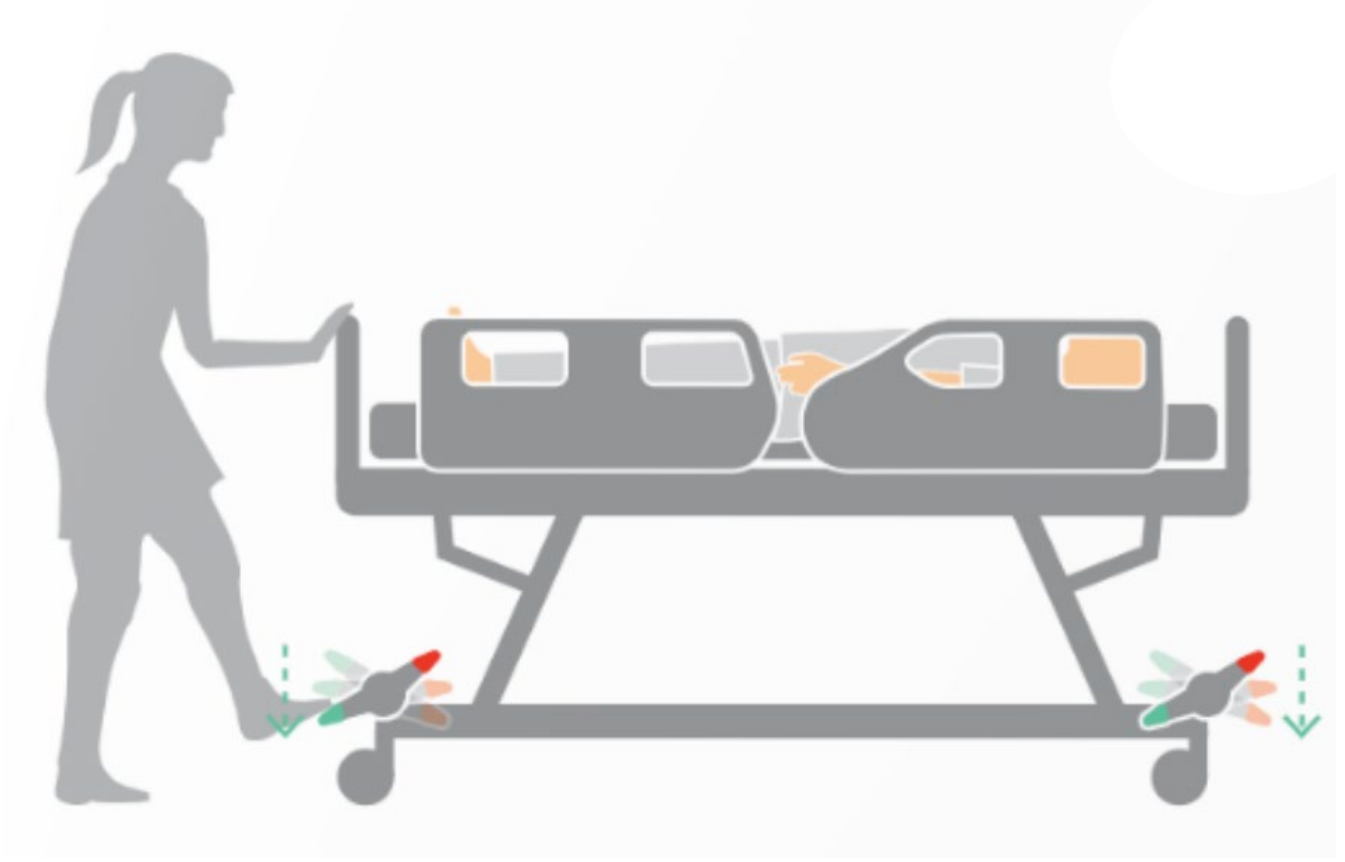
LINET

ERGONOMIC AND EFFORTLESS ACTIVATION OF SOFTBRAKES® OF NEW HOSPITAL BED ESSENZA 300



BACKGROUND

Brake pedals are a mandatory feature of all hospital beds and stretchers since the invention of movable beds with castors. Securing the bed in place has become a part of fall prevention guidelines, where moving the bed can create a risk of a patient falling. Caregivers may need to apply the brakes several times during the day, and this potentially accumulates into musculoskeletal strains, along with other physically demanding tasks they perform. Caregivers should be able to direct their physical and mental energy towards the patient rather than the use of equipment. Therefore, LINET has set a goal to eliminate unnecessary physical efforts required to brake a bed.

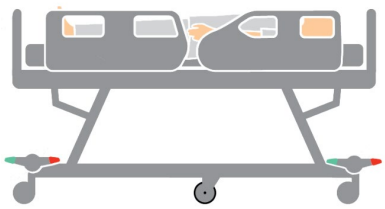
CONCLUSION

In conclusion, the design of brakes should incorporate various features to facilitate effortless and ergonomic braking of hospital beds. From an ergonomic perspective, the accessibility and clearance around the pedal impact the caregiver's posture. From a physical demand standpoint, the type of pedal and the amount of force required for activation play a significant role too. Put simply, if the brake pedals are excessively rigid or positioned too far away, they can lead to awkward postures and greater physical strain on the musculoskeletal system of caregivers. The new brake types developed for Essenza 300 that promote ergonomic postures and, in the case of SoftBrakes®, also require minimal force for activation. On top of that, LINET brakes are always combined with a 5th-wheel activation pedal, enabling the easy manipulation and transportation of the bed and, therefore, bringing additional operational benefits.

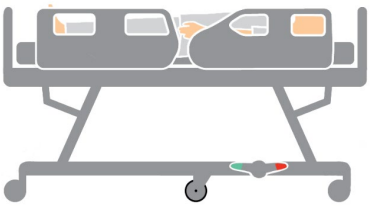
CURRENT DESIGNS OF BRAKING SYSTEMS

If we closely examine the brakes of hospital beds, we can observe various designs and approaches for immobilizing a bed. Image 1 provides a summary of these diverse designs. The design can be categorized based on the brake type, the method of activation, its placement, and also certain brake designs can be even linked to the activation of other features such as retraction of the 5th wheel.

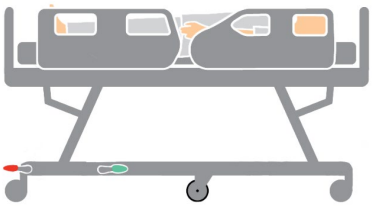
Image 1 – Various designs for braking hospital beds, red color-braking, green color-retraction of 5th wheel



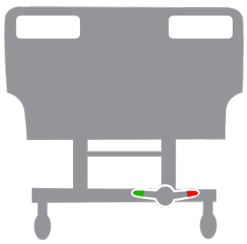
Location of pedals over all wheels



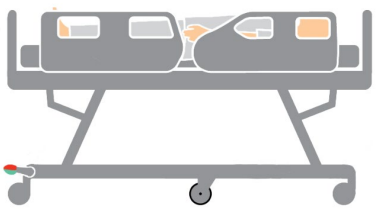
Location of pedals on the side



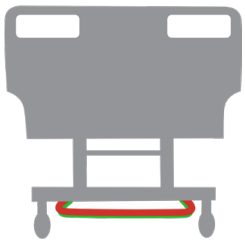
Separate location of pedals for braking and for 5th wheel



Location of pedals at the end of the bed



Location of single pedal over wheels



Location of braking bar at the end of the bed

ERGONOMIC PRINCIPLES TO DEVELOP A BRAKING SYSTEM

How do you create an ergonomic brake design? When designing, we must consider the caregiver's workflow, how and when they need to engage and disengage the brake. Pushing and releasing the bed brake occurs in two different scenarios: when the bed needs to be moved with or without a patient within the hospital and when the bed's position in the room requires adjustment.

LOCATION OF BRAKES

From the perspective of brake placement, it's evident that for bed transportation, the brakes should be situated where the bed is maneuvered, which can be either at the head end or the foot end. However, for bed manipulation, it is preferable to have them positioned on the sides because caregivers need to move the bed from side to side most of the time. This aspect was also assessed in a study by Kim (2009), where the placement of brakes for various tasks was evaluated. The study concluded that, during experiments, the side location was more ergonomic compared to the head-end or foot-end placement. It was found that brake pedals at the head end and foot end were more physically demanding and required awkward postures (Kim S, 2009). However, this study did not assess the design of the brake or the type of brake engagement, which is closely related to the force required for brake activation and whether a person can maintain an ergonomic posture.

On the other hand, a study by Zhou (2017), focused on the design and placement of braking pedals, along with their impact on the caregiver's musculoskeletal system. It was clearly explained that if the pedal is located too far under the bed platform, the muscle force needed for brake activation increases. At this point, the force required for pedal activation can vary in terms of physical demand based on its location. From posture perspective, the deeper the pedal is positioned and the less clearance it has, the more awkward the posture needs to be assumed. In this study, the maximum acceptable force for engaging the pedals was estimated and ranging from 196.5N to 222.5N, depending on the pedal's location (Zhou J, 2017).

The side location of brakes was more ergonomic compared to the head-end or foot-end placement

(Kim S, 2009)

TYPE OF BRAKE ACTIVATION

When considering the type of activation, various options are available. Pedals can be designed to either be pushed down for activation and lifted for deactivation or have both activation and deactivation performed by pushing down on the pedals. Lately is more commonly seen in combination with 5th wheel pedal activation. These pedal activation mechanisms can facilitate bed manipulation and transportation, offering more positions of the pedals.

There have not been many studies on brake activation methods, but from an ergonomic perspective, pushing down on a pedal is generally more comfortable than lifting it up by instep.

ERGONOMIC RECOMMENDATIONS TO EASILY BRAKE A HOSPITAL BED

The following table (Table 1) consider all the information discussed on the previous chapters and summarizes it in order to provide clear ergonomic recommendations on how to brake a hospital bed easily and effortlessly.

Table 1 –The features of ergonomical pedal design

Location	Available from head-end, foot-end and side of the bed
Accessibility	Pedals should be easily reached and not be placed too deep under bed platform
Dimensions of pedals	Pedal needs to be wide enough to allow the redistribution of pressure on the foot
Clearance around pedal	Pedals need to have enough space around to allow foot and leg access
Type of activation	Pushing down by sole is easier than pushing up by instep
Force needed for activation	<196,5 - 225 N (Zhou J.2017)

LINET BED SOLUTION FOR ERGONOMIC BRAKING

At LINET, we have been offering single pedals as well as pedals combined with 5th wheel activation for many years. The pedal placement can be on all four wheels or only on the wheels at the head-end or foot-end of the bed, depending on customer preferences. Even if a customer chooses to have brakes on the wheels at the head-end or foot-end, they can still be activated from the side due to their accessible location. All brakes are centralized, so it does not matter which pedal is used.

Combined pedals at LINET use also a colour code, making it quick and easy to understand which side of the pedal applies the brake (red) and which side deactivates it (green).

LINET has developed new brakes for its latest addition to their bed portfolio, Essenza 300, known as SoftBrakes®, featuring low-force activation to enable easy braking with minimal physical effort.

ERGONOMIC ADVANTAGES GAINED FROM USING BRAKING SYSTEM OF ESSENZA 300

Location of combined pedals allowing to drive or manipulate the bed in patient rooms. With Essenza 300, you can choose between 2 or 4 pedals. From a usability standpoint, having 4 brake pedals provides better accessibility, as every step during a caregiver's shift matters, including when they need to locate and activate the brake pedals.

Image 2 – Acuity adaptable hospital bed by LINET

ACCESSIBILITY AND CLEARANCE AROUND PEDALS

The pedals have enough space for a foot to comfortably step on them with the sole. The dimensions and clearance around the pedal allow for pedal activation from various angles, as demonstrated in the photos (Image 3).

Another aspect of good accessibility is whether caregivers can maintain an ergonomic posture while activating the brake pedals. We conducted a posture evaluation using Essenza 300 considering not only which side the brakes are activated from, but also different heights of the bed platform. The following pictures intend to demonstrate the results of this evaluation.

Image 3 - Demonstration photos with clear area when bed needs to be brake from foot end (a) and side (b) of the Essenza 300 bed.

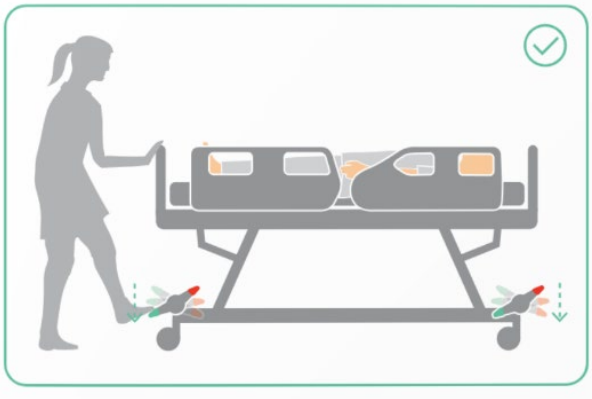
Another aspect of good accessibility is whether caregivers can maintain an ergonomic posture while activating the brake pedals. We conducted a posture evaluation using Essenza 300 considering not only which side the brakes are activated from, but also different heights of the bed platform. The following images demonstrate easy access to the pedals from side and foot end (Image 4) in different heights of bed.

Image 4 - Demonstration of easy access to the pedals from side and foot end for different heights of the Essenza 300 bed.

The Essenza pedals are easily accessible from the side and end of the bed, ensuring an ergonomic posture and preventing any collisions with the leg, even at different bed heights.

VERSATILITY OF PEDALS FROM BRAKING TO DRIVING A BED

Essenza 300 pedals are primarily designed for braking the bed by pushing the pedal down. If the bed is equipped with a 5th wheel, the pedals are combined, as illustrated in the picture below.



Bed is braked

Bed is unbraked and 5th wheel is active

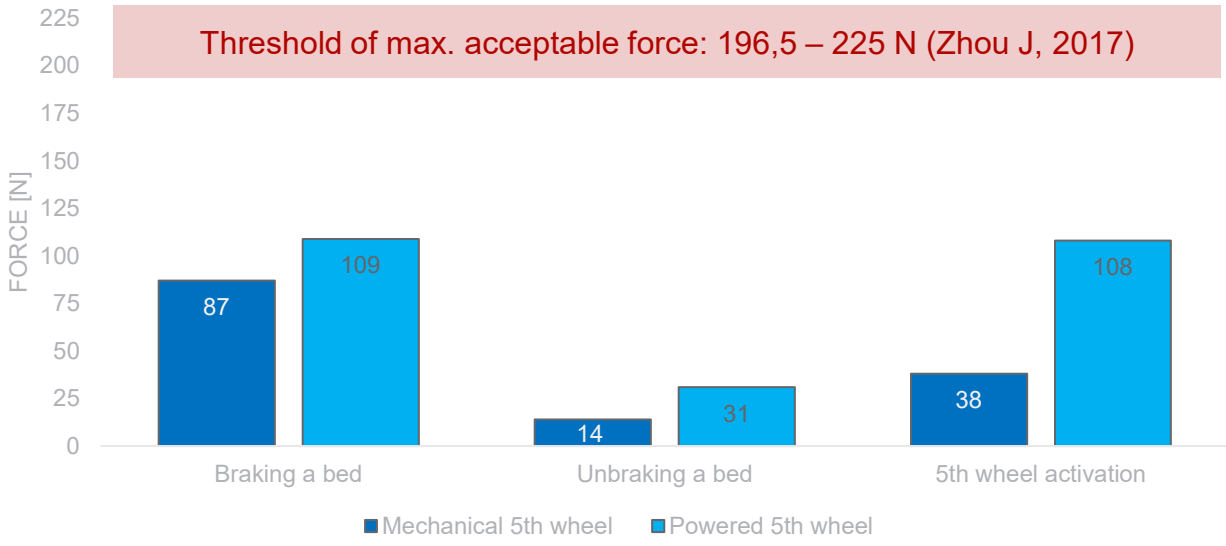
Bed is only unbraked

SOFTBRAKES® DESIGNED TO REDUCE THE NECESSARY FORCE FOR BRAKE ACTIVATION

As explained in the previous chapters, the ergonomic use of braking pedals relates also to the amount of force required for its activation. For this reason, we have developed SoftBrakes®, which enables braking Essenza 300 with less force than any other brakes.

At the LINET Lab, we conducted tests to determine the force required for braking with standard braking pedals and results can be seen in Chart 1.

Chart 1 - Force needed for activating brakes and pedals with technology SoftBrakes®



When calculating the force reduction achieved with SoftBrakes®, a comparison between the minimum and maximum force values reveals that, in comparison to the lower threshold for acceptable force, we consistently achieve a minimum of 45% force reduction. Furthermore, the maximum reduction can reach up to 93%.

SoftBrakes® ensure effortless pedal activation, whether with a mechanical or powered 5th wheel, offering a 45-93% force reduction compare to the maximum acceptable level.

REFERENCES

Kim S, B. L. (2009). Effects of two hospital bed design features on physical demands and usability during brake engagement and patient transportation: a repeated measures experimental study. Retrieved from Int J Nurs Stud. 46(3):317-25: https://pubmed.ncbi.nlm.nih.gov/19027904/

Zhou J, W. N. (2017). Ergonomic evaluation of brake pedal and push handle locations on hospital beds. Retrieved from Appl Ergon.: https://pubmed.ncbi.nlm.nih.gov/28166890/

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