LINET

SAFE PATIENT TRANSPORT WITH THE SPRINT 200/400

Strategies to Minimize Musculoskeletal Injury Risk



BACKGROUND

Emergency department caregivers face the highest patient admission rates among all hospital departments. As the gateway to essential care, emergency departments must manage a high patient turnover, placing significant demands on healthcare professionals. They must react quickly, provide immediate care, and transport patients across the hospital for examinations and admissions to different wards.

Hospital patient transport is a frequent and time-intensive task. In a single year, over 10,000 patients can be moved a total of 34,715 times, meaning that, on average, each patient can be transferred at least three times during their hospital stay, which was evaluated in Blay study. This research also found that patient transfers took an average of 42 minutes per transfer, highlighting the substantial time commitment involved in this process (Blay N, 2017).

Efficient patient transportation is essential, and hospital stretchers are designed to support smooth movement over long distances while navigating hospital obstacles. However, despite these design considerations, transporting patients can still impose significant physical strain on caregivers, who must balance speed and safety during transfers.

CONCLUSION

Patient transport and transfer are physically demanding tasks that can contribute to musculoskeletal disorders (MSDs) among caregivers. Investing in advanced hospital stretchers with ergonomic and effortless driving features can help mitigate physical strain and reduce work absences caused by injuries. One of the most effective solutions is implementing stretchers with an electric drive, which significantly decreases the physical effort required for patient transport.

LINET has designed Sprint 200/400 hospital stretcher to facilitate safe and effective patient transport across hospital environments. To further enhance usability, the stretcher can be equipped with i-Drive Power®, an advanced electric drive system activated with a simple button press. This system enables caregivers to transport patients effortlessly over long hospital corridors, with a driving range of up to 11 km on a single charge and load of up to 320 kg on flat ground by one caregiver.

Even when the electric drive is not activated, the Sprint 200/400 remains lightweight and easy to maneuver thanks to manual 5th wheel FlexiDrive®, ensuring smooth operation under all conditions - representing a 77% reduction in physical effort compare to maximum limit for 1 caregiver.

Ergonomic design in patient transport extends beyond reducing pushing forces–it also includes proper driving posture. LINET addresses this with the IV&Drive®, a unique combination of IV poles and integrated pushing handles. This innovation allows caregivers up to 180 cm tall to push the stretcher ergonomically without requiring additional adjustments. LINET's IV&Drive® is engineered to withstand up to 1000 N of pushing force–equivalent to the combined effort of five caregivers using the maximum recommended force as per AORN guidelines. This ensures durability, safety, and ease of use while preventing damage to IV poles during transport.

The Sprint 200/400 stretcher with i-Drive Power® and IV&Drive® technology offers a safe, efficient, and ergonomic solution for patient transportation. By significantly reducing physical strain on caregivers, it not only enhances patient safety but also supports long-term caregiver well-being, minimizing the risk of musculoskeletal injuries, which impact work absences.

The link between patient handling and staffing crises in healthcare

Musculoskeletal disorders (MSDs) have a notably high prevalence among caregivers, placing them among the occupational groups most affected by these injuries. MSDs in this population are primarily associated with back, shoulder, and neck pain, and are largely attributed to patient handling tasks such as repositioning, lifting, transferring, and transporting patients (Davis KG, 2015)

The consequences of these injuries extend beyond individual caregivers, significantly impacting healthcare facilities as a whole. When caregivers are injured, the effects ripple through hospital operations—contributing to absenteeism, increased turnover, and staffing shortages. Musculoskeletal injuries frequently force nurses and aides to take time off work or even leave the profession altogether. In fact, no nurse is immune to injury risk, and the cumulative burden of MSDs is a critical factor in the ongoing nursing shortage. Notably, up to 20% of nurses who leave direct patient care roles cite physical injury risks, particularly back injuries, as a primary reason for exiting the field (OSHA, 2017).

A study of hospital workplace injuries reported 824 cases of caregiver musculoskeletal injuries over a four-year period, resulting in a staggering 22,159 lost workdays (Amaro J, 2018). Each of these lost days represents a shift that must be covered—often by unfamiliar or temporary staff—ultimately disrupting workflow, reducing continuity of care, and placing additional strain on the remaining workforce.

One in five nurses leave direct care roles due to injury risks, such as back strain

(OSHA, 2017)

Ergonomic principles of driving a hospital stretcher

PUSHING VS. PULLING: OPTIMAL FORCE AND BODY MECHANICS

One of the key ergonomic considerations in patient transport is whether to push or pull a stretcher. Research consistently supports pushing over pulling due to its biomechanical advantages. According to the AORN Journal, the maximum recommended initial force for pushing an occupied stretcher with a 136 kg patient is 199 N for 1 caregiver (Waters T, 2011).

Pushing is preferred because it allows for better body alignment, engages stronger muscle groups, and reduces strain on the lower back and shoulders compared to pulling. In contrast, pulling increases the risk of awkward postures, such as excessive backward leaning and wrist strain, which can contribute to long-term musculoskeletal injuries.

Pushing is safer than pulling, easing strain on the back and shoulders.
(Waters T, 2011)

STRETCHER DESIGN AND MANEUVERABILITY

Beyond pushing techniques, the design and maneuverability of the stretcher itself play a crucial role in reducing physical strain and improving transport efficiency.

The total weight of the stretcher, patient, and medical equipment also impacts the initial push force required. Lighter yet durable frame materials can reduce caregiver effort while maintaining safety and durability. The integration of ergonomic stretcher designs with advanced maneuverability features such as ergonomic pushing handles, design of castor or steering wheel significantly enhances ease of transport, minimizing the risk of caregiver injuries.

FORCES REQUIRED FOR TURNING AND NAVIGATING OBSTACLES

Beyond straight-line pushing, caregivers frequently navigate complex hospital environments, including tight corridors, ramps, doorways, and elevators, which introduce additional ergonomic challenges.

Studies indicate that the force required to turn a stretcher 90 degrees is often higher than the initial pushing force, as it requires overcoming inertia and lateral resistance. Stretchers with central 5th wheel or powered drive systems help reduce this effort, allowing for smoother manoeuvrability.

Stretchers with central 5th wheel or powered drive systems help reduce effort, allowing for smoother maneuverability.

Additionally, ramps and sloped surfaces require increased effort to push a stretcher uphill and controlled resistance when moving downhill. Stretchers with braking assistance and powered drive systems help caregivers maintain control and reduce physical strain in these conditions.

POWERED STRETCHERS REDUCE PUSHING FORCES

For emergency medical services and any teams that transport patients can benefit from powered stretchers. Armstrong's study found that switching from manual stretchers to powered stretcher could reduce musculoskeletal injuries to paramedics by 78% (Armstrong DP, 2017). In the study, one EMS department that adopted powered stretchers saw injury rates drop from 20 per 100 workers to 4.3 per 100 in one year, while a comparable service using traditional stretchers saw injuries increase in that time (Armstrong DP, 2017). Each powered stretcher can cost higher than manual hospital stretcher, but researchers concluded they offer a strong return on investment by virtually eliminating many back injuries and lost days. By keeping paramedics healthier and on the job, such equipment also helps avoid shift vacancies, overtime pay or need hire substitution during caregiver absence.

Powered stretchers can reduce MSD by 78 %

(Armstrong DP, 2017)

ERGONOMIC HANDLE POSITIONING FOR REDUCED STRAIN

The height and positioning of stretcher handles play a crucial role in ensuring caregiver comfort and efficiency. Studies emphasize that improper handle height can lead to poor posture and excessive force on the back and shoulders. The AORN Journal recommends that the optimal handle height for most users is 92 cm from the floor, aligning with mid-vertical height to allow for a more natural pushing posture (Waters T, 2011).

Further research by Zhou J highlights the importance of handle height adjustability. The study, focused on hospital bed push handles, concluded that the preferred height is slightly below elbow level, as this position reduces shoulder elevation and wrist strain while allowing for optimal force application (Zhou J, 2017).

Positioning stretcher or bed handles just below elbow height minimizes shoulder elevation and wrist strain.

(Zhou J, 2017)

This principle can also be applied to stretchers, ensuring that caregivers of varying heights can maintain a natural and ergonomic posture while pushing. The study also found that a single fixed handle height is not suitable for all users, reinforcing the need for adjustable stretcher handles to accommodate different caregiver heights and preferences.

LINET solution SPRINT 200/400 addressing driving challenges in patient transport

At LINET, we developed the Sprint 200/400 hospital stretcher to address the challenges of patient transport while ensuring effortless maneuverability for caregivers.

To minimize physical strain and improve ease of movement, the Sprint 200/400 stretcher can be equipped with i-Drive Power®, an advanced electric driving system. This feature enables effortless transport on flat surfaces and provides support when navigating slopes, reducing the physical effort required from caregivers. Even when used in its non-powered version called FlexiDrive®, the Sprint 200/400 remains highly maneuverable due to its lightweight construction and large castors, ensuring that caregivers can push the stretcher with minimal force while maintaining smooth and controlled movement.

From an ergonomic perspective, the stretcher can be equipped with the IV&Drive® system, a unique combination of IV poles and integrated pushing handles. This innovative solution ensures that caregivers of all heights can push the stretcher ergonomically, eliminating the need for frequent height adjustments. Unlike conventional IV poles, which are not designed to withstand pushing forces, the IV&Drive® system is reinforced for durability while offering an optimal pushing height, reducing strain on the back and shoulders.

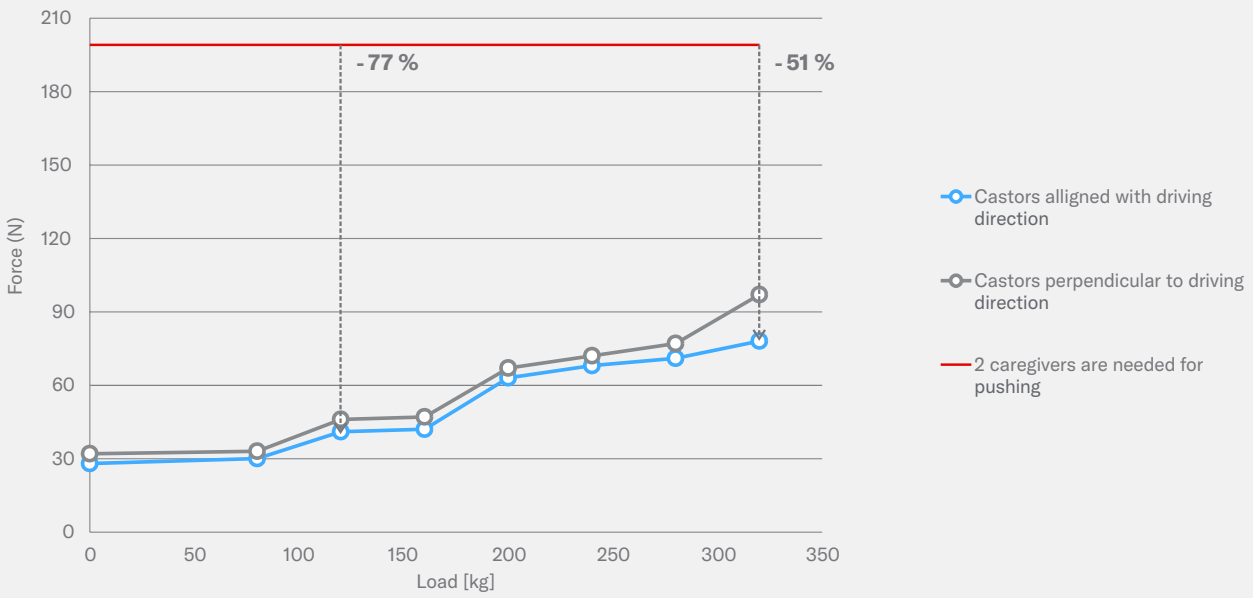
To validate the ergonomic benefits and driving efficiency of these features, the Sprint 200/400 underwent extensive testing in the LINET lab. The findings from these evaluations have been summarized in recommendations for effective and ergonomic patient transport, ensuring that hospitals can optimize caregiver well-being while enhancing efficiency in daily operations.

DRIVING CAPABILITIES OF SPRINT 200/400 WITH FLEXIDRIVE®

In the LINET lab, we conducted testing to determine the required pushing forces for the FlexiDrive®, which is represented by the central 5th steering wheel. This wheel assists with straight-line driving, smooth cornering, and an overall comfortable transport experience for patients when lying on the Sprint 200/400.

During the tests, we evaluated various castor positions to understand their impact on the initial pushing force of the stretcher under different loads. The stretcher was tested with loads ranging from 80 kg to 320 kg, representing the Safe Working Load (SWL) of the Sprint 200/400. Then we compared the measured initial pushing force with the maximum recommended initial pushing force for a single caregiver, which is 199 N, according to the AORN ergonomic tool (Waters T, 2011).

GRAPH 1 | Force required to drive the Sprint 200/400 under different load weights and caster orientations



As shown in Graph 1, the initial pushing force is, on average, 10% higher when the castors are positioned perpendicular to the direction of movement compared to when they are aligned. This difference increases with the load of the stretcher.

FlexiDrive® reduces initial pushing force by 77% compared to recommended maximum force for single caregiver by AORN *(Waters T, 2011)*

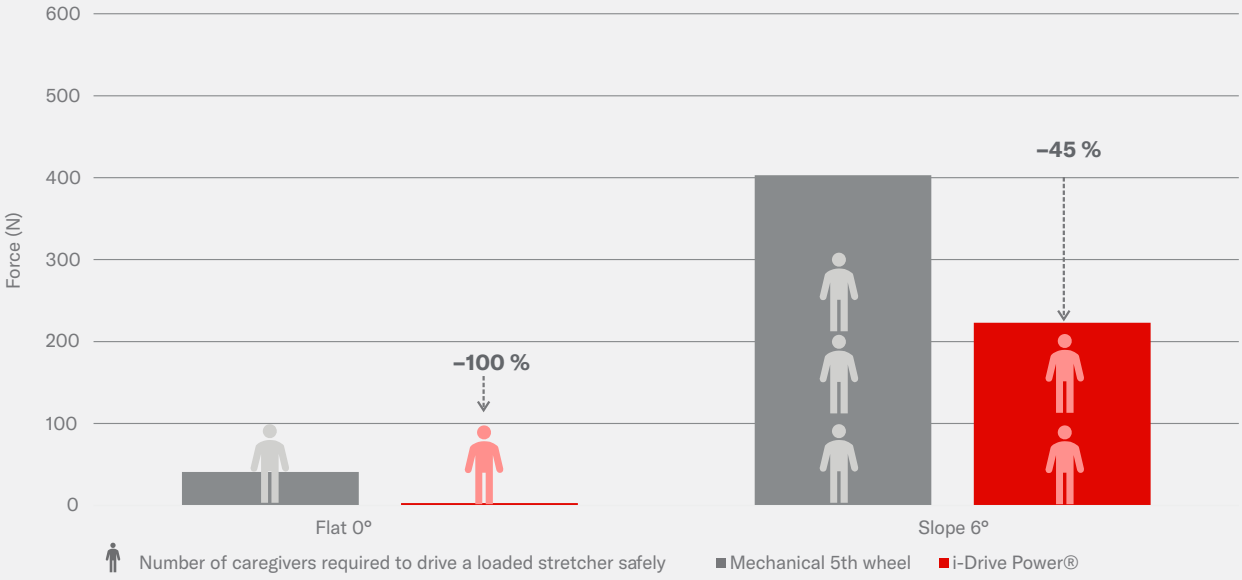
Summary

Sprint 200/400 significantly reduces the initial pushing force—by 77% for a 136 kg load and by 51% for a 320 kg load—compared to the AORN standard for one caregiver. This enables a single caregiver to drive the stretcher while also second can focus on the patient condition during transport.

DRIVING THE SPRINT 200/400 ON FLAT AND SLOPED SURFACES WITH I-DRIVE POWER®

Another series of tests in the LINET lab focused on the performance of the stretcher on both flat and inclined surfaces. We measured the initial pushing force required when using the mechanical 5th wheel versus the powered 5th wheel, i-Drive Power®, with a 120 kg load. Again, the results were compared to the 199 N limit of initial pushing force recommended for one caregiver by AORN (Waters T, 2011), which is visually demonstrated as caregiver character on Graph 2.

GRAPH 2 | Force and number of caregivers needed to drive the Sprint 200/400 with and without i-Drive Power®, under a 120 kg load on flat ground and a 6° slope



The i-Drive Power® system allows the bed to be moved just with the press of a button on flat surfaces, and reduces both the number of caregivers and pushing force by 45 % on slopes

(Waters T, 2011)

Summary

As shown in Graph 2, on flat surfaces, both stretchers can be operated by a single caregiver. However, the i-Drive Power® significantly reduces the effort needed—requiring only the press of a button to engage the drive system. On slopes, the i-Drive Power® acts as a pushing support, reducing the number of caregivers needed from 3 to 2 and decreasing the pushing force by 45%, compare to mechanical 5th wheel.

IV&DRIVE®: A UNIQUE DESIGN FOR ERGONOMIC DRIVING

To evaluate the ergonomic efficiency of IV&Drive®, we designed a test to measure the time needed to adjust the driving handles to an ergonomic height for users of various statures. For comparison, we used standard push handles to evaluate the time-efficiency of IV&Drive® design.



STANDARD STRETCHER

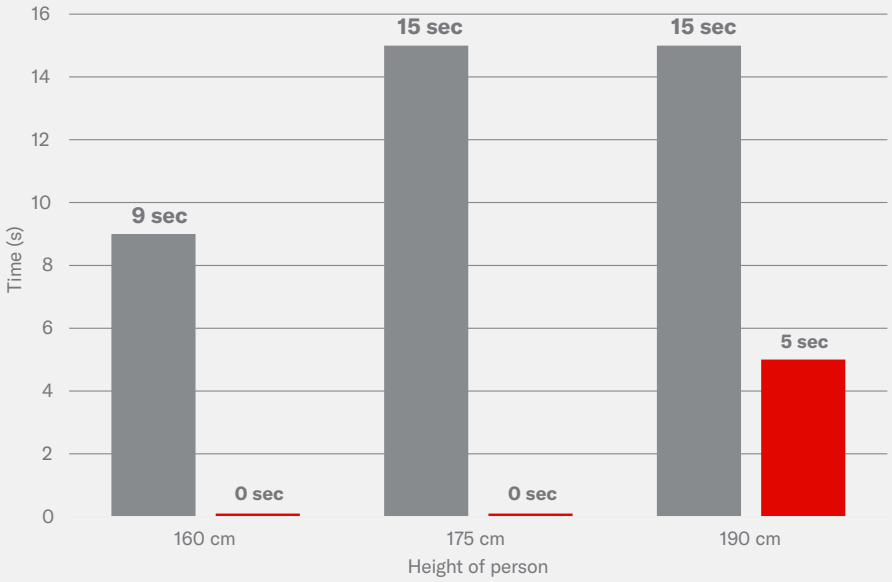
Risk of an unergonomic position while using standard push handles



STRECHER WITH IV&DRIVE®

Upright ergonomic position at any height, thanks to the unique combination of IV poles and push handles

GRAPH 3 | Comparison of time needed for adjusting stretcher to ergonomic height (elbow height)



■ Standard handles



■ IV&Drive®



IV&Drive® enables ergonomic driving of Sprint stretchers without the need for height adjustments - it works for caregivers of any height *(Waters T, 2011)*

Summary

The Sprint 200/400 equipped with IV&Drive® is immediately ready (stretcher doesn't need to be adjusted) for transport by caregivers up to 175 cm tall, even when the stretcher is in its lowest position (Graph 3). In contrast, stretchers with standard handles require up to 15 seconds to be adjusted to an ergonomic height. In order to achieve ergonomic height using standard handles, the stretcher must be elevated, compare to IV&Drive® solution.

Additionally, caregivers taller than 175 cm cannot maintain an ergonomic posture with standard push handles—unlike with IV&Drive®, which allows for grip anywhere.

ROBUSTNESS OF IV&DRIVE®

How do we know IV&Drive® can withstand real-world pushing forces? It is engineered from high-quality materials, designed not only to function as an IV pole but also as an driving element and push handle.

In the LINET lab, we conducted long-term durability tests. The IV&Drive® underwent 10,000 push cycles with a force of 800 N and an additional single test with a 1,000 N force. 10,000 push cycles simulate approximately two years of daily use. As previously mentioned, the ergonomic initial push limit for one caregiver is 199 N (AORN, Waters T, 2011), so for imagination of testing forces are illustrated in Graph 4.

GRAPH 4 | Comparison of the applied force on the IV&Drive® system during cycle and maximum testing, relative to the recommended safe maximum pushing force for one caregiver

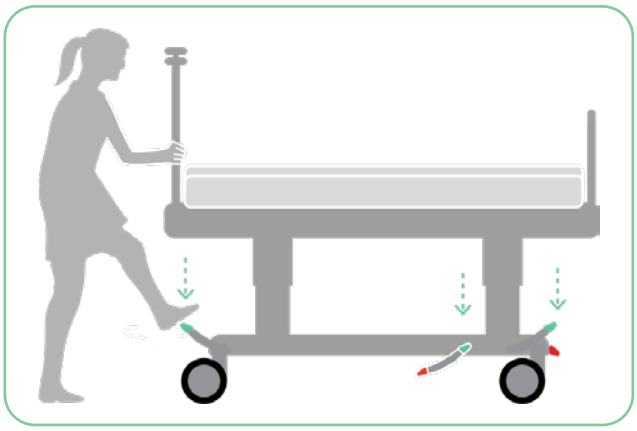


Summary

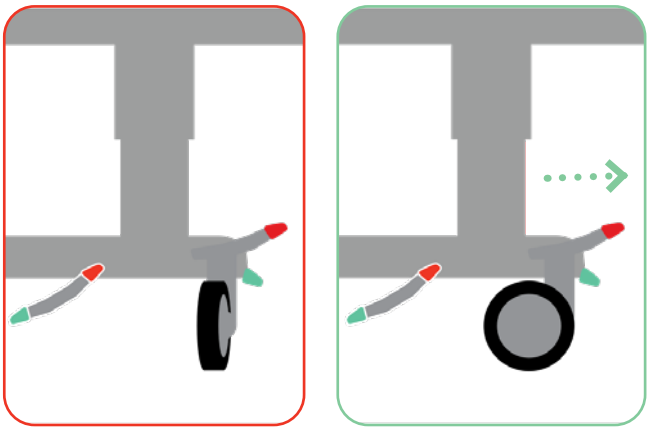
Following both the long-term and single-force tests, no damage was observed on the IV&Drive® system. This confirms that IV&Drive® can withstand forces up to 5 times the ergonomic limit recommended for a single caregiver.

ERGONOMIC RECOMMENDATIONS TO DRIVE A STRETCHER SPRINT 200/400

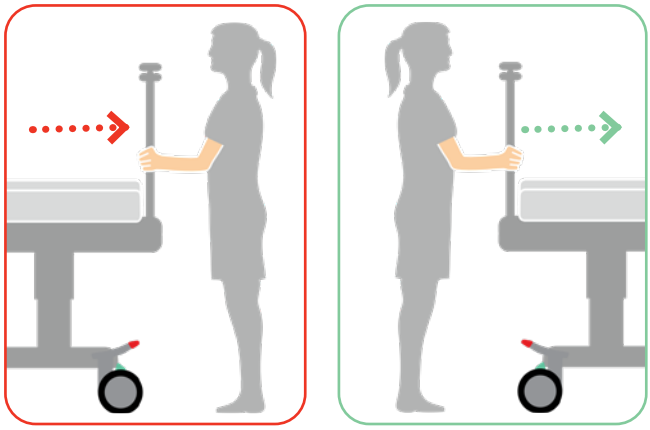
1 Don't forget to unbrake the bed by pushing the green pedal down



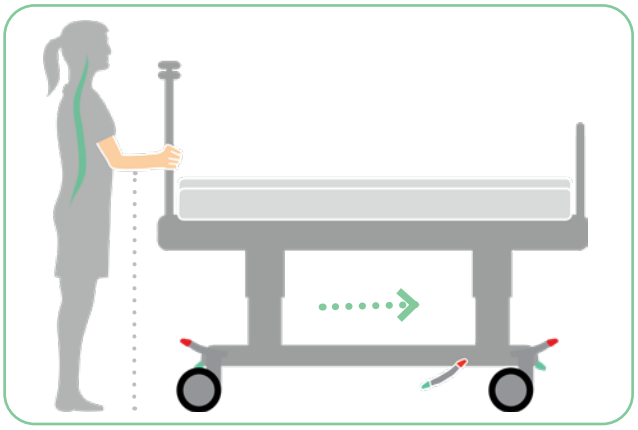
2 Make sure that castors are in the steering direction



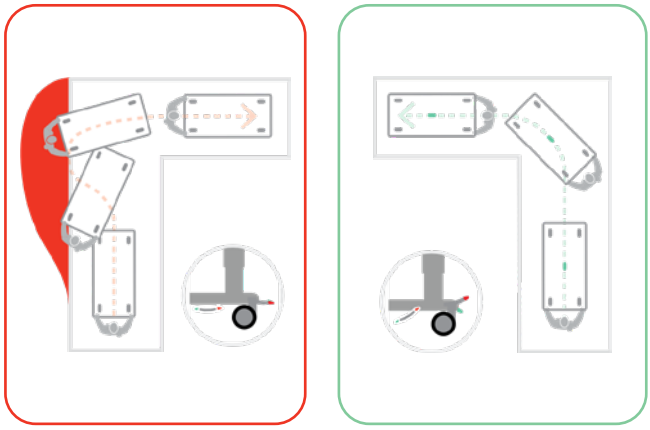
3 Prefer pushing over pulling



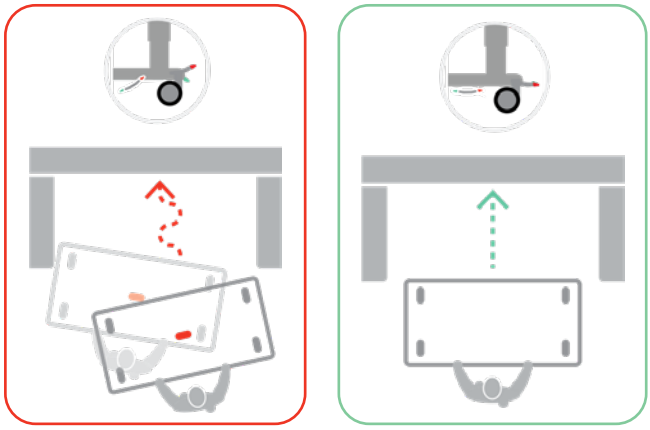
4 Drive a stretcher at the height of elbow



5 Use the 5th wheel to drive in corridors and around corners



6 Don't use the 5th wheel when parking the stretcher



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