LINET

BEST PRACTICES

for Patient Transport on the Sprint 200 for Reducing Work Related Musculoskeletal Disorders

BACKGROUND

Nurses and non-medical staff are at high risk of musculoskeletal injuries related to patient handling; these injuries are often debilitating, career-ending, and life changing. The increased spinal force load caused when pushing and pulling occupied beds or stretchers has been identified as a high-risk activity and can lead to work related musculoskeletal disorders (WRMSD) (Waters TR, 2007). WRMSDs do not affect only the lower back, the shoulders and neck are often affected too (Davis KG, 2015).

Evidence based best practices support efforts to provide ergonomic solutions for patient transportation within the hospital. This white paper will review this evidence and identify how the Sprint 200 by LINET supports these practices.

CONCLUSION

In the conclusion of this white paper, the LINET Sprint 200 stretcher features help to reduce WRMSD. If hospitals choose to invest in the Sprint 200 with its motorized castor i-Drive power, hospital staff will reduce WRMSD because it is not necessary to push the Sprint 200, the stretcher will drive without any caregiver effort simply by pressing a button. The unique IV&Drive feature enables the Sprint 200 to be driven in an ergonomic posture without spending time on adjusting the height of the stretcher. When the i-Drive power is not used, the initial force needed to manually push the Sprint 200 is low, even when the stretcher is loaded to its maximum weight.

Reducing incidences of WRMSD has a direct effect on the hospital. When hospital staff are not affected by WRMSD, they do not lose days to sick leave, and the hospital reduces budget spending on WRMSD.

Pushing & Pulling Tasks

77 % less

initial pushing force with Sprint 200
(LINET lab testing)

Patient transport is an everyday activity for caregivers of all grades. According to the AORN Journal, the maximum recommended initial force for pushing an occupied stretcher with a 300 lbs (136 kg) patient is 43.8 lbF (19.9 kgF). Pushing is always recommended over pulling because of better ergonomics (Waters T, 2011).

The new generation of LINET stretchers, such as the Sprint 200, set new standards and ambitious goals to significantly reduce the forces of pushing & pulling to the minimum possible.

Results of LINET Testing

We tested in the LINET lab that initial push and pull forces are similar. If the Sprint 200 is pushed with the castors in the opposite direction, the user needs to exert 10% more force than when the castors are in the same direction as the direction of travel.

Maximum recommended pushing force of occupied stretcher of 300 lbs (136 kg)		Sprint 200 **load**		**Initial pushing force** with castors in opposite direction		**Reduction in pushing force with Sprint 200**
		300 lbs	136 kg	10.3 lbF	4.7 kgF	**77 %**
43.8 lbF	19.9 kgF	529 lbs	240 kg	15.8 lbF	7.2 kgF	**64 %**
		705 lbs	320 kg	21.3 lbF	9.7 kgF	**51 %**

Summary

The LINET Sprint 200 significantly reduces the initial pushing forces to 77% below the standards recommended by the AORN (Waters T).
The recommendation according to the AORN (Waters T, 2011) is that beds/stretchers should be pushed to feel how much force is needed for transport. If the force is too high, help should be asked from a colleague, or a different bed/stretcher chosen with lower pushing forces or with powered drive. This is the only way to avoid extensive forces on the back which can lead to WRMSD.

The Organizational Benefits of Investing in Powered Stretchers

Implementing stretchers with a motorized castor as a standard transport tool brings patient transportation to the highest standards. Many hospitals still see powered stretchers as expensive equipment, but tests and studies have proven a fast return on investment. The motorized castor on the Sprint 200 is called i-Drive power.

Reducing WRMSD in Hospital Staff

The force needed to push the Sprint 200 with i-Drive power is zero in flat conditions.
(LINET lab testing)

Powered stretchers reduce the risks to hospital staff during patie nt transport and minimize pushing forces. The kind of impact powered stretchers have on spinal force load for hospital staff has been investigated. In one of the latest studies relevant to the measurement of spinal force load, manual and powered stretchers were compared (Kotowski SE, 2022). This study evaluated that powered drive reduces three-dimensional spinal force load by 8-21% and users can perform complex stretcher tasks, such as moving around corners and driving up/down on a ramp (slope), easier.

Sprint 200 i-Drive power testing in LINET lab

Load 705 lbs (320 kg)	**Initial pushing force**
On flat	0 %
On 6° slope	50 %

Driving up to 11 km without recharging

Kotowski's study used powered drive; however, the user still needed to push the stretcher initially. The design of the LINET Sprint 200 incorporates i-Drive power, which eliminates the need for the user to push to get the stretcher moving. The Sprint 200 starts moving by simply pushing a button. To maximize safety, a sensor control recognizes when the caregiver's hand is placed on it and allows the stretcher to move. When the caregiver removes their hand, the stretcher stops automatically. The force needed to push the Sprint 200 with i-Drive power is zero in flat conditions and significantly lower on a slope of 6°. This results in a reduction in spinal force load, which is a positive benefit of investing in powered stretchers to reduce WRMSD.

Reducing Costs Related to WRMSD in a Hospital Budget

Armstrong compared paramedic departments with manual and powered drive stretchers for his study. In one hospital (HPS) they used manual stretchers, and the other hospital (NEMS) introduced a powered stretcher and load system. WRMSD incidences related to stretchers were evaluated over a year following the introduction of the powered stretcher and load system. Before implementing the powered stretchers, both hospitals had similar stretcher related WRMSD incidence rates. One year after the introduction, it was noted that WRMSD had decreased by 78%. Powered stretchers

Save up to 80% costs

in stretcher related MSD

(Armstrong DP, 2017)

were related to a 70% reduction in WRMSD and 8% related to the load system; in the department that continued to use manual stretchers, WRMSD incidence rates were similar to the previous year. From this perspective, this study provides strong evidence that powered stretchers can reduce stretcher related WRMSD and the associated economic benefits are favorable (Armstrong DP, 2017). As can be seen in the table below, reducing WRMSD has a positive impact upon hospital budgets. The total cost of investing in powered stretchers demonstrated an 80% saving on WRMSD, and 73.5% fewer lost workdays between 2014 and 2015 in the NEMS hospital.

					Before	After
	Hospital	**2011**	**2012**	**2013**	**2014**	**2015**
Stretcher Related MSD Incidence Rates (100 FTE)	HPS	16.7	17.1	26.7	26.2	24.6
	NEMS	22.7	16.7	28.0	9.9	4.3
Days Lost to Stretcher Related MSD (days/100 FTE)	HPS	40.1	19.7	61.3	28.1	19.3
	NEMS	3.5	34.7	17.6	20.2	5.3
Direct Costs of Stretcher Related MSD ($/100 FTE)	HPS	$ 23,393	$ 74,226	$ 44,306	$44,352	$ 20,466
	NEMS	$ 15,047	$ 14,407	$ 11,622	$12,044	$ 2,565

Table is adapted from Armstrong study, 2017

TABLE LEGEND	HPS – Hamilton Paramedic Service (manual stretchers) NEMS – Niagara Emergency Medical Service (powered stretcher and load system from 2015) FTE – full-time equivalent

Summary

Investing in powered stretchers is beneficial for the physical and mental well-being of hospital staff and can lead to cost savings for the organization. Kotowski recognized that powered stretchers reduce physical overload for caregivers, and Armstrong identifies that, alongside the physical benefits, mental well-being is also improved. Both studies identify that powered stretchers lead to a reduction in WRMSD and, in turn, save hospitals money.

The Ergonomics of Pushing/Pulling a Stretcher

Finally, in this section we will look into the ergonomics of pushing and pulling stretchers. In both studies, correct posture and features of pushing handles are basic principles of good ergonomics. The studies noticed that the height of the handles is important for reducing the load on the back and shoulders (Waters T, 2011). According to the AORN Journal, pushing is more ergonomic than pulling, and the handles should be positioned in the middle of the vertical height (36,2 in = 92 cm above floor) (Waters T, 2011). One more study (Zhou J, 2017) discusses push handle location relevant to hospital beds. The conclusion of the studies state that "the preferred height of a hospital bed push handle is slightly below elbow height." This principle is possible to apply to stretchers. Results showed that the height of the handles should be adjustable; a single handle height will not be acceptable to all users (Zhou J, 2017).

From these studies we have learned that one handle height is not suitable for all staff, because staff vary in height. Based on the evidence, LINET has designed push handles that are continuous and vertical. This makes them suitable for a broader range of height variations among staff.

Continuous Vertical Handles on the Sprint 200 are Time-Saving

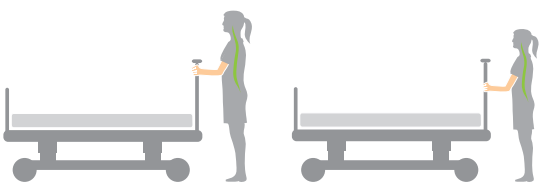
IV&Drive reduce time for the setting stretcher to ergonomic position.

(LINET lab testing)

In the emergency department, time is critical and spending time setting up a bed/stretcher to the ergonomic height is not always possible because it could be detrimental to patient care. Setting up a bed/stretcher to optimal ergonomic height is essential, according to Zhou's study. At LINET we questioned: how much time is needed to get the stretcher from minimal height to elbow height? This was tested in the LINET laboratory. We examined the time needed to get the handles to ergonomic elbow height for a variety of people with varying heights. A comparison test was performed with the Sprint 200 with its unique concept of IV&Drive (continuous vertical handles) versus a stretcher with horizontal handles.

Height of person	Elbow pushing height	Time Sprint 200 (min – elbow)	Time stretcher (min – elbow)
160 cm	100 cm	0 s	9 s
175 cm	115 cm	0 s	15 s
190 cm	130 cm	5 s	15 s*

* max handle height = 115 cm



Results of LINET Testing

The Sprint 200 with IV&Drive is immediately ready for transport in the lowest position, even for caregivers with a body height of up to 175 cm. Stretchers with fixed horizontal push handles always need to be adjusted for ergonomic posture. We discovered that tall caregivers (above 175 cm) are not able to push a stretcher with horizontal handles in an ergonomic position.

Continuous Vertical Handles on the Sprint 200 are Multipurpose – IV&Drive

IV poles of Sprint 200 can sustain

5 × more pushing force

than is recommended by AORN ergonomics

(Waters T, 2011)

With the LINET Sprint 200 stretcher we have combined IV poles with push handles that can withstand a pushing & pulling force of 220lbF (100 kgF), which makes them more robust than any IV pole stretcher available on the market. This unique feature is called the IV&Drive.

Testing IV&Drive in the LINET lab

Pushing IV&Drive poles simulating use in hospital environment:

Number of cycles:
10 000 equals 2 years stretcher use

Tested pushing force:
176 lbF (80 kgF)

Individual pushing & pulling force on IV&Drive poles:

Tested pushing and pulling force:
220 lbF (100 kgF)

Results of LINET Testing

The maximum recommended pushing force is 43.8 lbF (19.9 kgF), according to the AORN (Waters TR, 2007); **IV poles can withstand 4 times more force during cycle testing and 5 times more for individual testing than is recommended without bending or sustaining damage.**

Summary

The ergonomics of pushing/pulling is a complex topic with a lot of variables (type of push handle, different pushing postures, varying height of hospital staff, etc.). Most stretchers available on the market are focused only on one aspect of ergonomics and do not comply with the varied heights of care professionals. The design of the Sprint 200 is focused

on maintaining the ergonomic posture of all caregivers in challenging conditions, where speed in the emergency department is a priority.

References

Armstrong DP, Ferron R, Taylor C, McLeod B, Fletcher S, MacPhee RS, Fischer SL. 2017. IMPLEMENTING POWERED STRETCHER AND LOAD SYSTEMS WAS A COST EFFECTIVE INTERVENTION TO REDUCE THE INCIDENCE RATES OF STRETCHER RELATED INJURIES IN A PARAMEDIC SERVICE. Appl Ergon. [Online] 2017. https://pubmed.ncbi.nlm.nih.gov/28411738/.

Davis KG, Kotowski SE. 2015. Prevalence of Musculoskeletal Disorders for Nurses in Hospitals, Long-Term Care Facilities, and Home Health Care: A Comprehensive Review. Hum Factors. 57(5):754-92. [Online] 2015. https://pubmed.ncbi.nlm.nih.gov/25899249/.

Kotowski SE, Davis KG, Marras WS. 2022. PATIENT HANDLING THROUGH MOVING OF THE BEDS AND STRETCHERS. International Journal of Industrial Ergonomics, Volume 87. [Online] 2022. https://www.sciencedirect.com/science/article/abs/pii/S0169814121001700 .

Waters T, Lloyd JD, Hernandez E, Nelson A. 2011. AORN ERGONOMIC TOOL 7: PUSHING, PULLING, AND MOVING EQUIPMENT ON WHEELS. AORN J. [Online] 2011. https://pubmed.ncbi.nlm.nih.gov/21884845/.

Waters TR, Nelson A, Proctor C. 2007. PATIENT HANDLING TASKS WITH HIGH RISK FOR MUSCULOSKELETAL DISORDERS IN CRITICAL CARE. Crit Care Nurs Clin North Am. [Online] 2007. https://pubmed.ncbi.nlm.nih.gov/17512469/.

Zhou J, Wiggermann N. 2017. ERGONOMIC EVALUATION OF BRAKE PEDAL AND PUSH HANDLE LOCATIONS ON HOSPITAL BEDS. Appl Ergon. [Online] 2017. https://pubmed.ncbi.nlm.nih.gov/28166890/ .

wissner-bosserhoff LINET

Members of LINET Group

LINET spol. s r.o.
Želevčice 5 | 274 01 Slaný | Czech Republic
tel.: +420 312 576 400 | fax: +420 312 522 668 | e-mail: info@linet.com | www.linet.com

www.linet.com

LINET® | Art. nº 9601-1086 | Edition 06/2022 | Slight colour differences are possible. Change of technical parameters reserved.