



# The Evaluation of Cot Stability in Patient Transport

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EMS cots are subjected to weight that may not always be coaxial with the cot's center of gravity, especially during the course of patient transfer from emergency scene to cot, or cot to bedside. Having offset weight distribution on a cot lessens its mechanical integrity, and in these instances, stability is lost. Loss of cot stability is dangerous to the patient and medic. **The objective of this study was to determine the resistance to tip of an EMS cot based on offset patient placement at multiple cot heights using (pounds-force: lbf or Newtons: N).**

## Methods

An EMS cot was placed at three cot heights often utilized during an emergency service call: **low cot height, patient seated height, and transport height**. For each height, a quasi-static load was applied in displacement control on one side of the cot via a custom free-pulley system. The origin of the load vector was evenly distributed about the seat panel with the direction simulating a patient seated on the edge of the cot with feet hanging to the side. A load cell was placed in line with the direction of applied load, and the resultant force in which both opposite side wheels ceased contact with the ground was considered the tipping point of the cot (Figure 1). Two emergency cots were tested at the same height as measured from the floor to seat panel: Ferno iNjX Intergrated Patient Loading System (Wilmington, OH) and Stryker Power-PRO XT (Portage, MI) cots. Runs were performed in triplicate, and data was averaged, with statistical analyses reported at  $\alpha = 0.05$ .

## Results

Resistance to tip was exceeded in all scenarios at loads below the full simulated patient weight on the cots, which was 700 lbf (3114 N), respectively (Figure 2). There was no functional difference between the force required to tip the iNjX ( $402 \pm 3$  lbf [ $1788 \pm 13$  N]) and Power-PRO XT ( $392 \pm 3$  lbf [ $1744 \pm 13$  N]) cots at low position. **At patient seated height position, the iNjX cot was 55% more resistant to tip** as compared to the

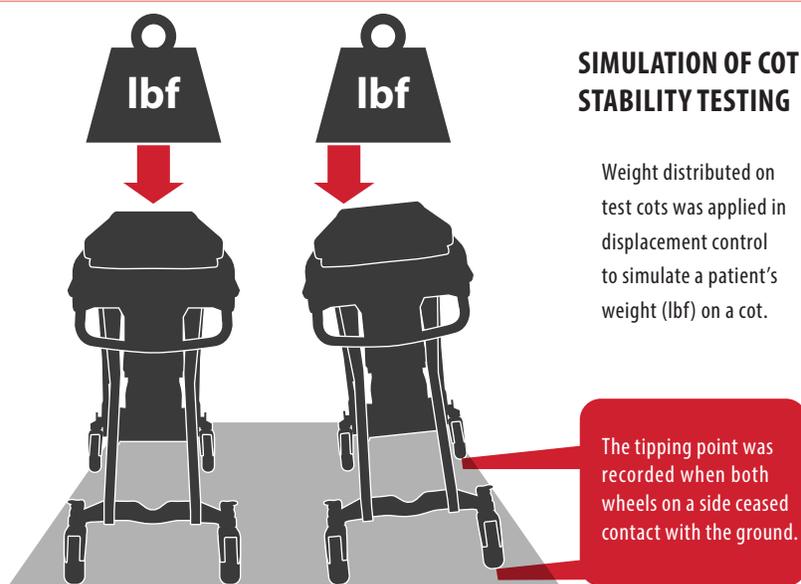
## KEY DEFINITIONS

**"N"="Newton"**— the standard unit of force in the International System of Units.

**LBF**— The pound-force (symbol: lbf, or lbf) is a unit of force.

**For purposes of this white paper, LBF represents "simulated patient weight" and "N" or "Newtons", is used as a unit of measurement during stability testing.**

Power-PRO XT ( $500 \pm 15$  lbf [ $2224 \pm 67$  N] versus  $322 \pm 3$  lbf [ $1432 \pm 13$  N],  $p << 0.05$ ). **At transport height position, the iNjX cot was 32% more resistant to tip** as compared to the Power-PRO XT ( $333 \pm 28$  lbf [ $1481 \pm 125$  N] versus  $252 \pm 10$  lbf [ $1121 \pm 44$  N],  $p = 0.009$ ). There was a nonlinear correlation between cot bed height and resistance to tip for the iNjX; a parabolic relationship existed in



## SIMULATION OF COT STABILITY TESTING

Weight distributed on test cots was applied in displacement control to simulate a patient's weight (lbf) on a cot.

The tipping point was recorded when both wheels on a side ceased contact with the ground.

Fig. 1: Test set-up of tipping point due to side load as a result of patient weight.

## TECHNICAL STUDY

Across three tested heights, the iNjX provided **30% greater stability** on average as compared to the Power-PRO XT.

which the patient seated height displayed the greatest stability. This was attributed to the fact that at the fully collapsed low cot height, the cot is fully supported by its structure and results in greater rigidity than at other heights. Greater rigidity resulted in decreased stability, but stability was still similar to that of the Power-PRO XT. At positions other than lowest cot height, the structural flexibility of the cot absorbed the applied patient weight prior to tipping and provided a more stable cot. The Power-PRO XT was found to be more rigid than the iNjX since there was an extremely high negative correlation between cot height and resistance to tip; as height increased, resistance to tip decreased ( $r = -1$ ). The lack of flexibility contributed to a less stable cot for the Power-PRO XT.

### Conclusion

EMS cot stability is important to the safe transfer of patients. Loss of stability can lead to medic or patient injury. The resistance to tip due to applied offset loading, as is often the case from a seated patient, was assessed in this study. Significant differences existed between the iNjX Intergrated Patient Loading System and Power-PRO XT with regard to the force required to tip. Across all three tested cot heights, the iNjX provided **30% greater stability** on average as compared to the Power-PRO XT.

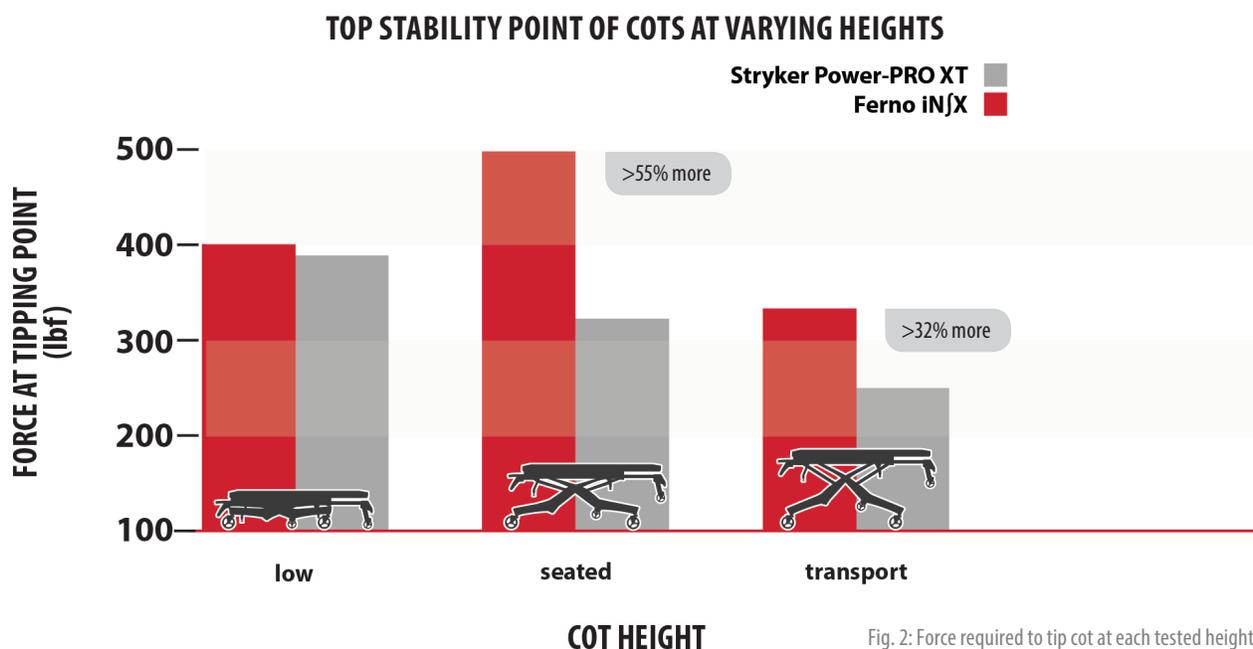


Fig. 2: Force required to tip cot at each tested height.