

Background

- Nova Scotia Rehabilitation and Arthritis Centre (NSRAC) houses all NS Health inpatient wheelchairs for Central Zone.
- Wheelchairs are ordered by Occupational Therapists (OTs) using WheelEase database.
- Orders are assembled in the Workshop in the basement of NSRAC according to OT's prescription.
- Orders are delivered to hospitals using NSH mail truck.
- Staff includes two builders, one cleaner, and one half time OTA.

Problem Definition

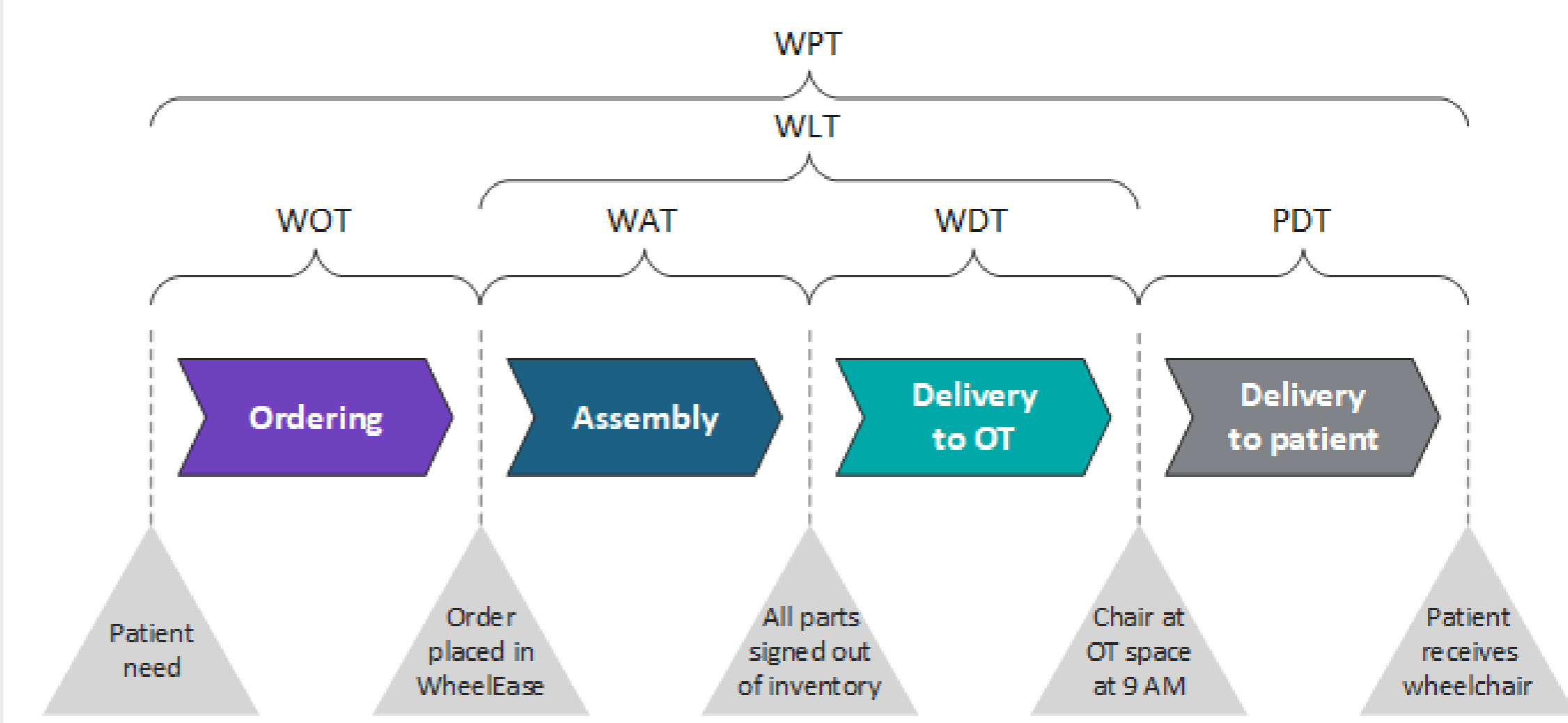
The sooner a wheelchair reaches a patient, the sooner the patient will be discharged

- The sooner the patient can begin mobilizing.
- On average, the quicker they will mobilize, due to the fewer effects of bedrest they will suffer [1].
- Early mobilization can lead to shorter length of stay in hospital and fewer complications [1] [2] [3] [4].

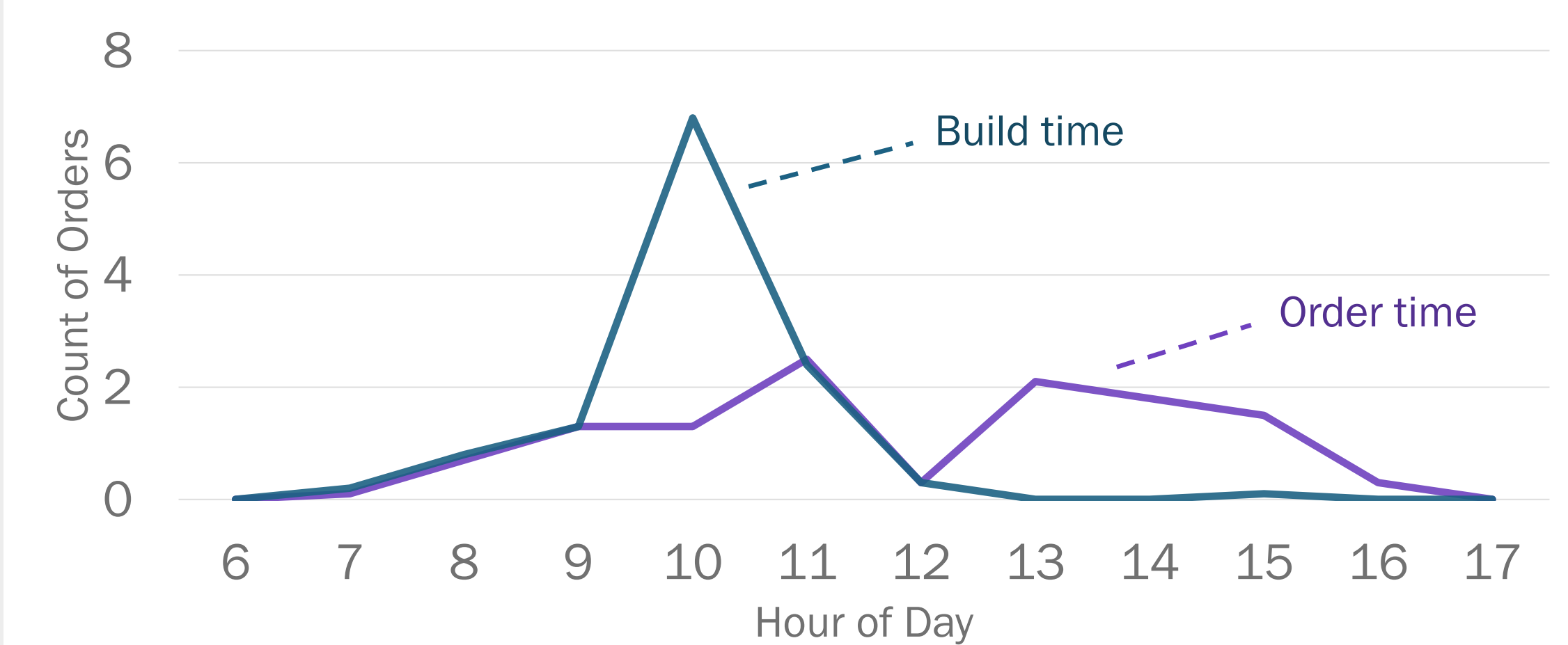
Eliminating delays to Wheelchair Provision would have systemic benefits

- Better patient outcomes and quality of care.
- Help free up their bed for the next patient.
- Save cost of bed days (avg cost for 24-hour patient stay is \$1101) [2] [5].

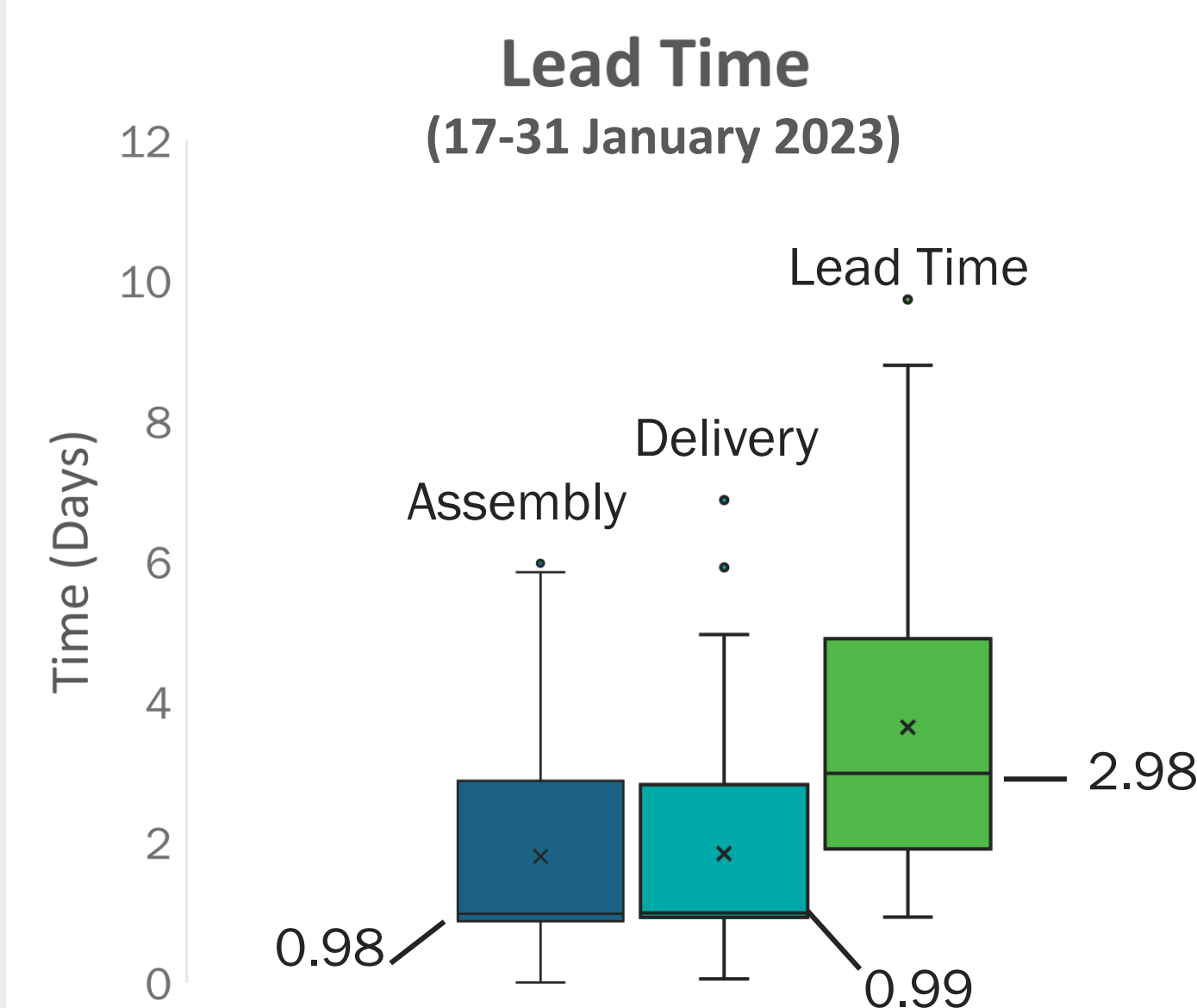
Defining Wheelchair Lead Time



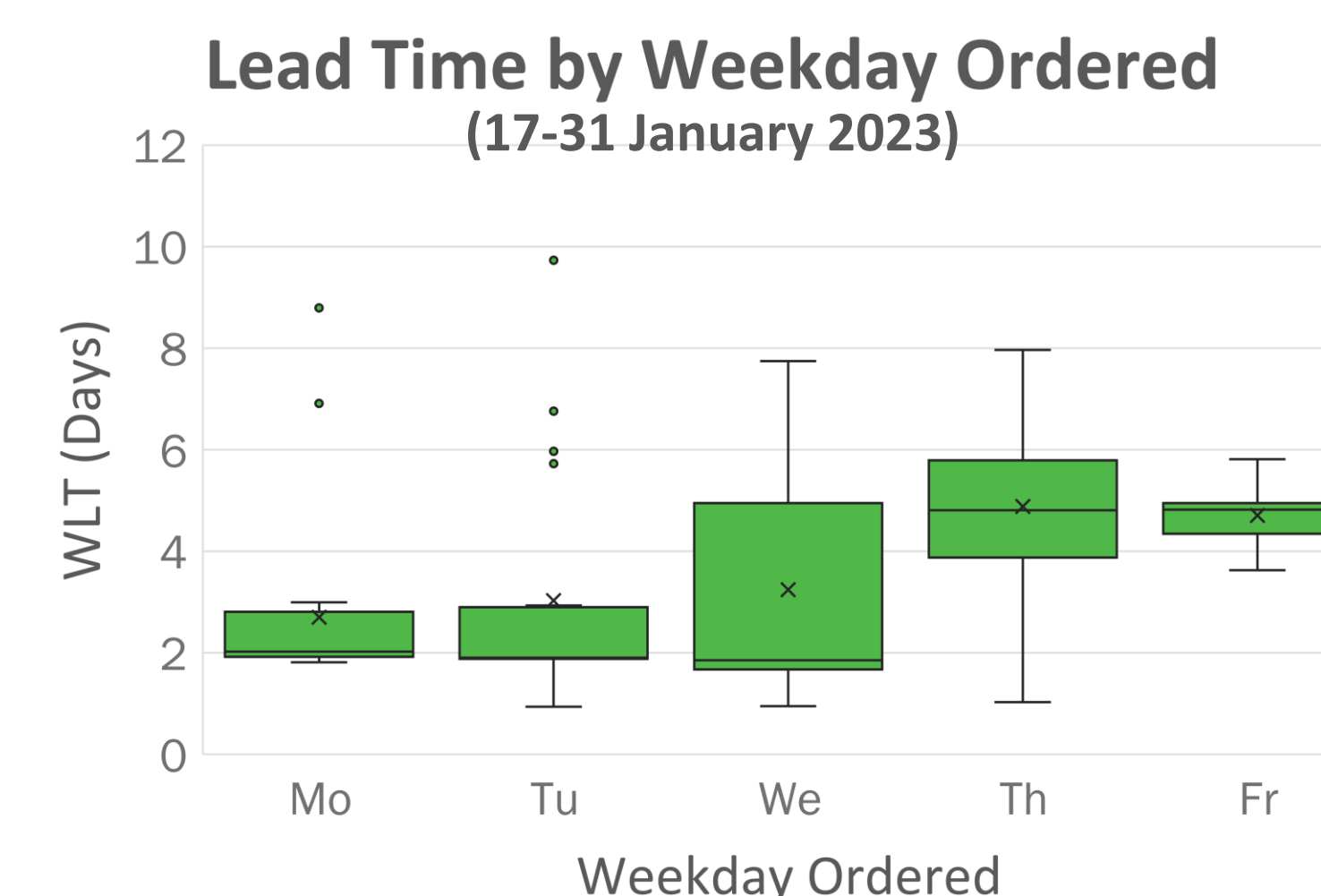
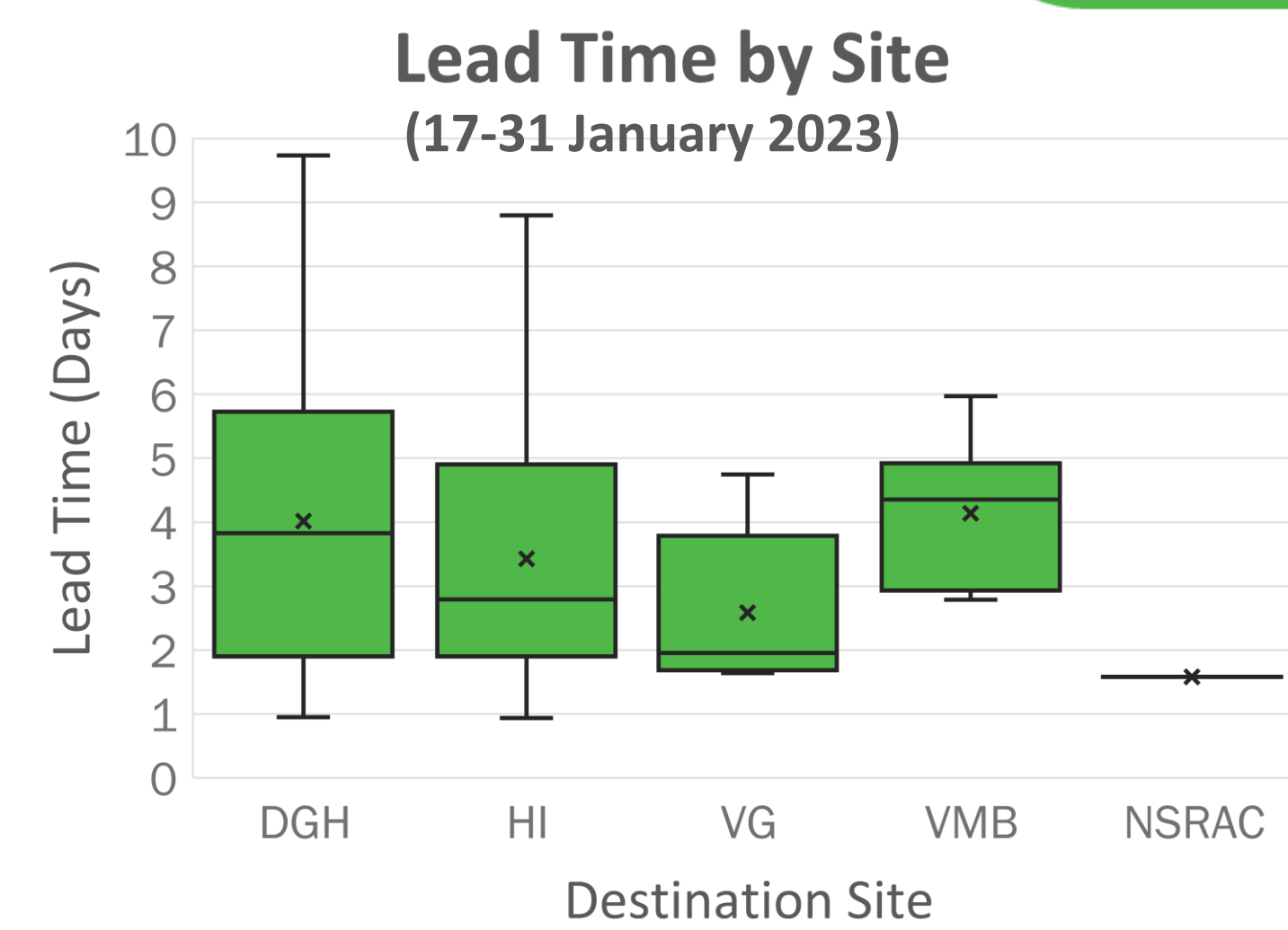
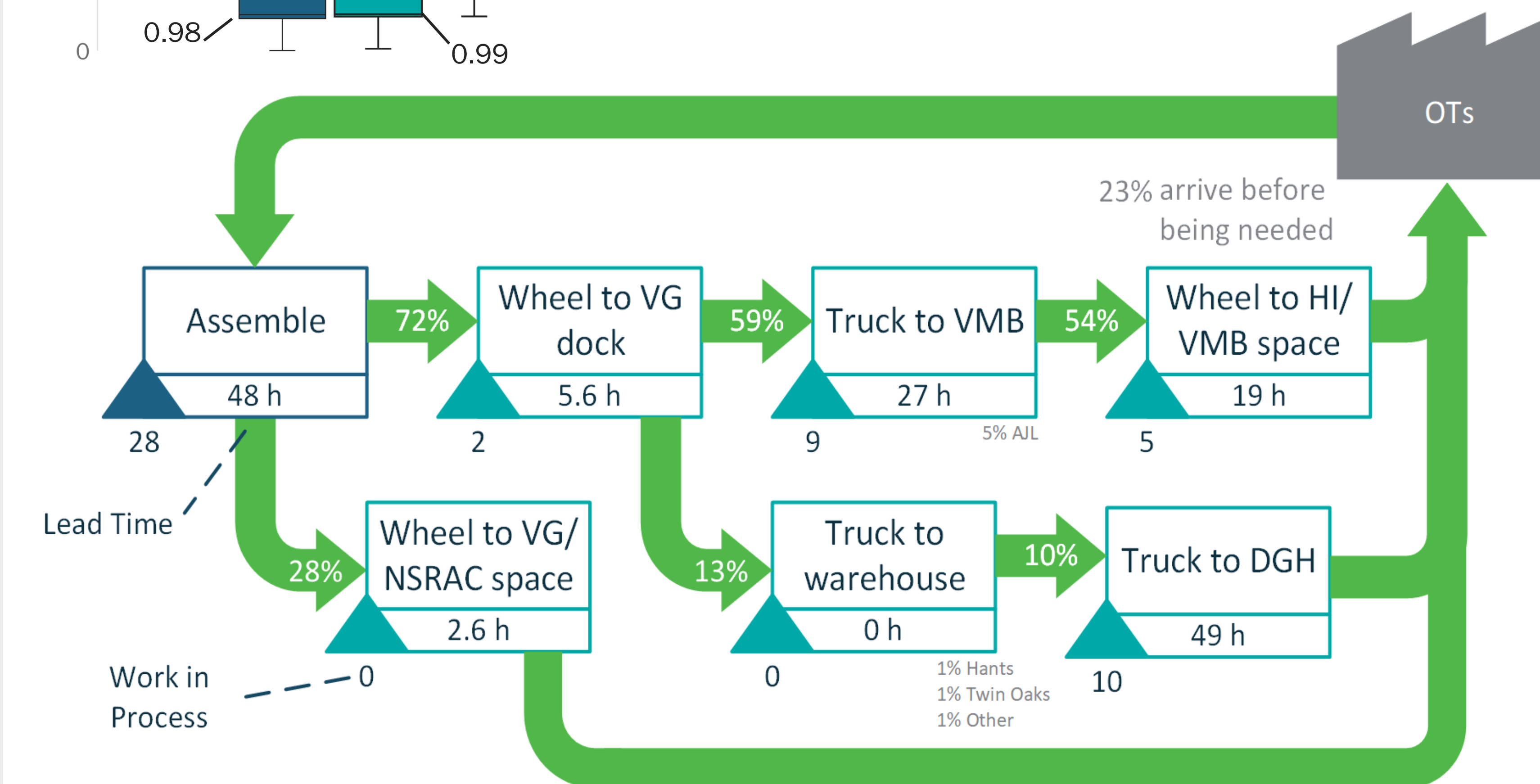
Order volume by time of day



Measuring Wheelchair Lead Time

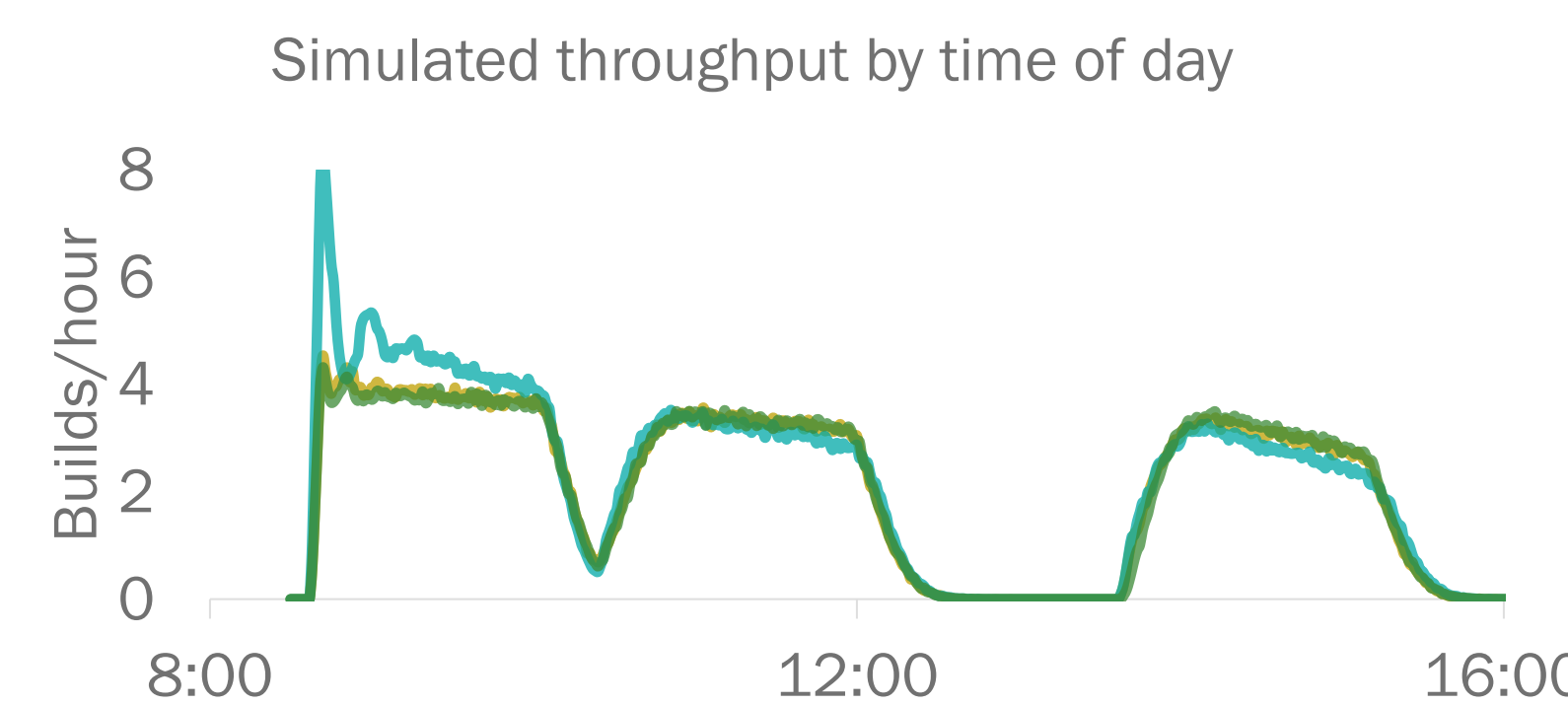


- Lead Time was previously completely unknown to NSH
- Data for analysis gathered via:
 - OT chair arrival tracking sheet
 - Observations at NSH hospital loading docks
 - WheelEase database data
 - GPS trackers
- Calculated Lead Time and examined impacts of seasonality, time of day, day of week, destination site.
- Data set of orders from 17-31 January consisted of 119 wheelchair orders over a 2-week normal period (no holidays, vacation, etc.).



Simulation

Compared the effectiveness of the Workshop under 3 different sequencing rules using an Excel/VBA discrete event simulation model.



Build Sequence	Built	Shipped	Leftover
FCFS (First Come, First Served)	16.2	12.3	18.9
SPT (Shortest Processing Time first)	17	13.4	16.9
EDD (Earliest Due Date first)	16.1	15.0	13.9

Results scaled to match current measured performance (EDD)

Courier Costs

Delays due to trucking are significant, especially over the weekend. Cost of couriers compared to the time value of Wheelchair Lead Time:

Destination Hospital	Courier Cost	Cost of 48-hour stay
Twin Oaks	\$ 90	\$ 944
Musquodoboit Valley	\$ 144	\$1908
Eastern Shore	\$ 200	\$2022
Dartmouth General	\$ 41	\$1318
Hants	\$ 116	\$ 857

Recommendations

- Bring up chairs from the loading dock as soon as the chair arrives.
- Use an additional truck at VGH in the early morning.

- Use a dedicated courier system to deliver chairs to hospitals instead of the NSH mail truck.
- Perform a final quality check of wheelchairs before shipping.
- Gather parts for multiple wheelchair orders at once
- Build in EDD sequence
- Add "Drying status to WheelEase to account for parts unavailable due to drying
- An additional drying rack to increase wheelchair cleaning rate.
- Scan wheelchair parts as they are gathered at the start of the assembly process.
- Reduce the number of trips from Workshop to shipping dock by maximizing transporting chairs in both directions.
- Tag printer to print order tags
- Increase the Workshop OTA's hours to full-time to cover absences and QA.
- WheelEase refreshers for OTs.

References

[1] A. Hunter, L. Johnson and A. Coustasse, "Reduction of Intensive Care Unit Length of Stay," The Health Care Manager, vol. 33, no. 2, pp. 128-135, 2014.
 [2] P. Santos, N. Ricci, É. Suster, D. Paisani and L. Chiavegato, "Effects of early mobilisation in patients after cardiac surgery: a systematic review," Physiotherapy, vol. 103, no. 1, pp. 1-12, 2017.
 [3] R. Ding and H. Zhang, "Efficacy of very early mobilization in patients with acute stroke: a systematic review and meta-analysis," Annals of Palliative Medicine, vol. 10, no. 11, 2021.
 [4] P. Langhorne, J. M. Collier, P. J. Bate, J. Bernhardt and M. N. Thuy, "Very early versus delayed mobilisation after stroke," Cochrane Database Syst Rev, vol. 10, no. 10, 2018.
 [5] T. Hogg, "Patient Costing - Cost per Hospital Day [109009]," Nova Scotia Health, Halifax, 2022.