

Point-of-care ultrasound identified venous congestion in patients with septic shock: Pilot prospective multicenter observational study

AUTHORS

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INTRODUCTION

- Early, aggressive IV fluids are the cornerstone treatment for septic shock however, iatrogenic volume overload can precipitate organ injury.
- Venous congestion is a pathophysiologic state that can be identified before kidney injury occurs.
- Point-of-care ultrasound can quantify venous congestion by interrogating the inferior vena cava, and blood flow patterns of the hepatic, portal, and intrarenal veins.
- Venous Excess Ultrasound Score (VEXUS) is a validated scoring tool to guide IV fluid administration to prevent organ injury.

OBJECTIVES

Primary Objective:

To determine feasibility of a definitive observational study that will quantify the association between venous congestion (via POCUS) and clinical outcomes in patients with septic shock.

Secondary Objectives:

- Determine the prevalence and natural history of venous congestion in septic shock
- Differentiate between congested and non-congested patients
- Explore association between venous congestion and outcomes

METHOD

- Study Design & Setting:** Pilot Protective observational study at University and Victoria Hospitals
- Eligibility Criteria:**
 - Inclusion:** Adults with septic shock **within 12 hours** of ICU admission.
 - Exclusion:** DNR; ESRD; Previous liver transplant
- Study Procedures:**
 - U/S operators performed venous congestion ultrasound **within 24 hours and on day 3**
 - U/S evaluation of 4 vessels: **IVC, HV, PV, and IRVs**
 - Treating physicians were blinded to VEXUS results. The outcome assessors were blinded to the VEXUS results.
- Outcomes:**
 - Primary feasibility outcomes: Recruitment rate, VEXUS scan completion rate, & consent rate.
 - Secondary clinical outcomes: collected up until day 28 (or ICU discharge or death)

RESULTS

Feasibility Outcomes:

- Recruitment rate of 6.25 patients per month (**75 total**)
- Consent rate **100%** (95% CI 94 to 100).
- Successful completion of VEXUS scans **94.5%** (95% CI 89.5 to 97.6)

Clinical Outcomes:

- Severe venous congestion was present in **19%** (14/75) on day 1 and **16%** (10/61) on day 3.
- No difference in cumulative fluid balance between groups (1296 [IQR 205 – 3523] vs 2514mL [IQR 1152 – 6229], p=0.09)
- Congested more often received inotropes on day 1 (35.7% vs. 11.5%, p=0.03).

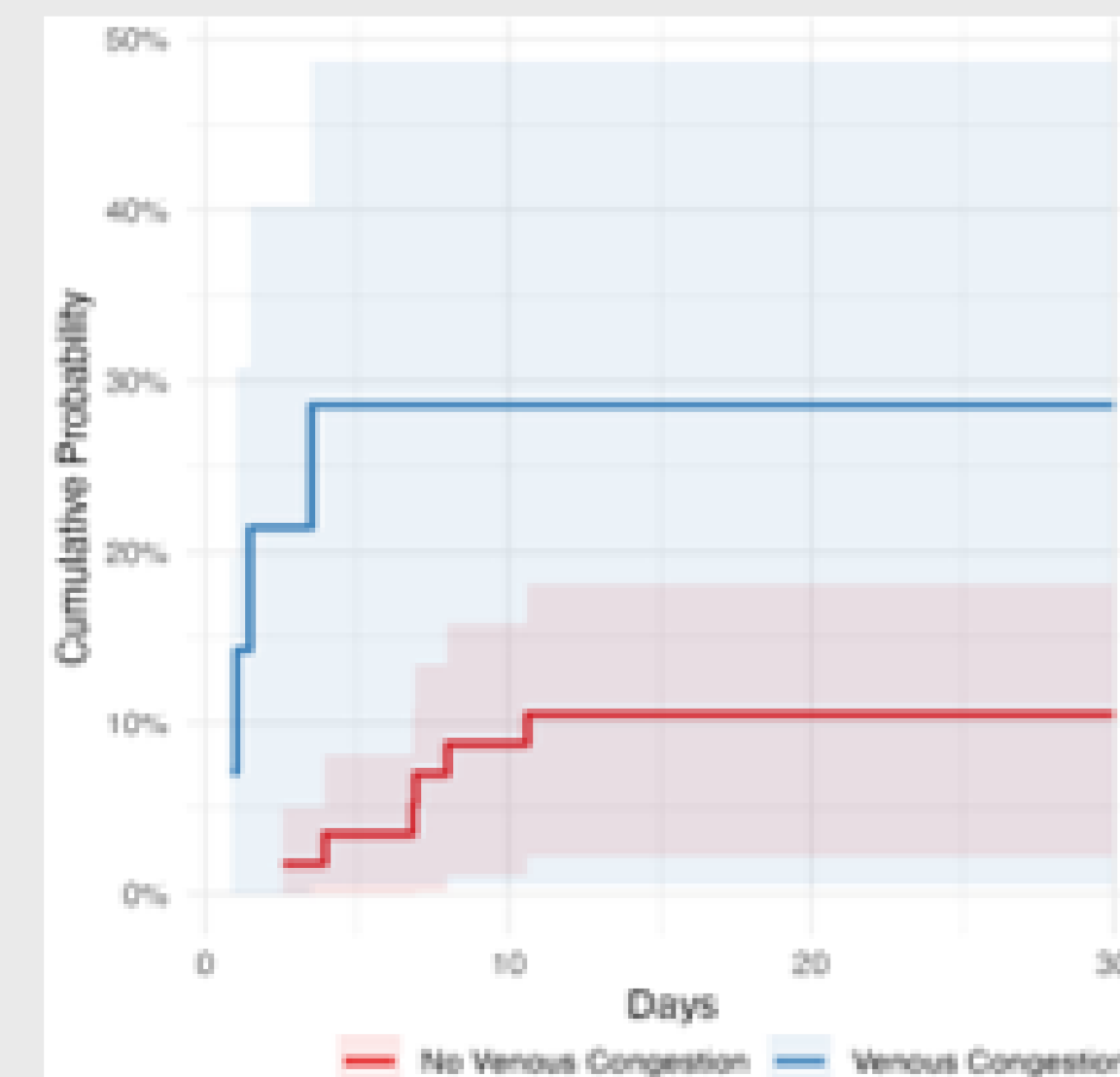


Figure 2 | Cumulative incidence function for renal replacement therapy at 30 days based on venous congestion

Clinical Outcomes Cont:

- Patients with venous congestion on day 1 were more likely to exhibit:
 - Left ventricular systolic dysfunction** (42.9% vs. 13.1%, p=0.01)
 - Right ventricular dysfunction** (57.1% vs 13.1%, p<0.001)
- Venous congestion on day 1 *may* be associated with a **higher risk of requiring RRT or death** (unadjusted HR 3.35, 95% CI 0.94 to 11.88, p=0.06).

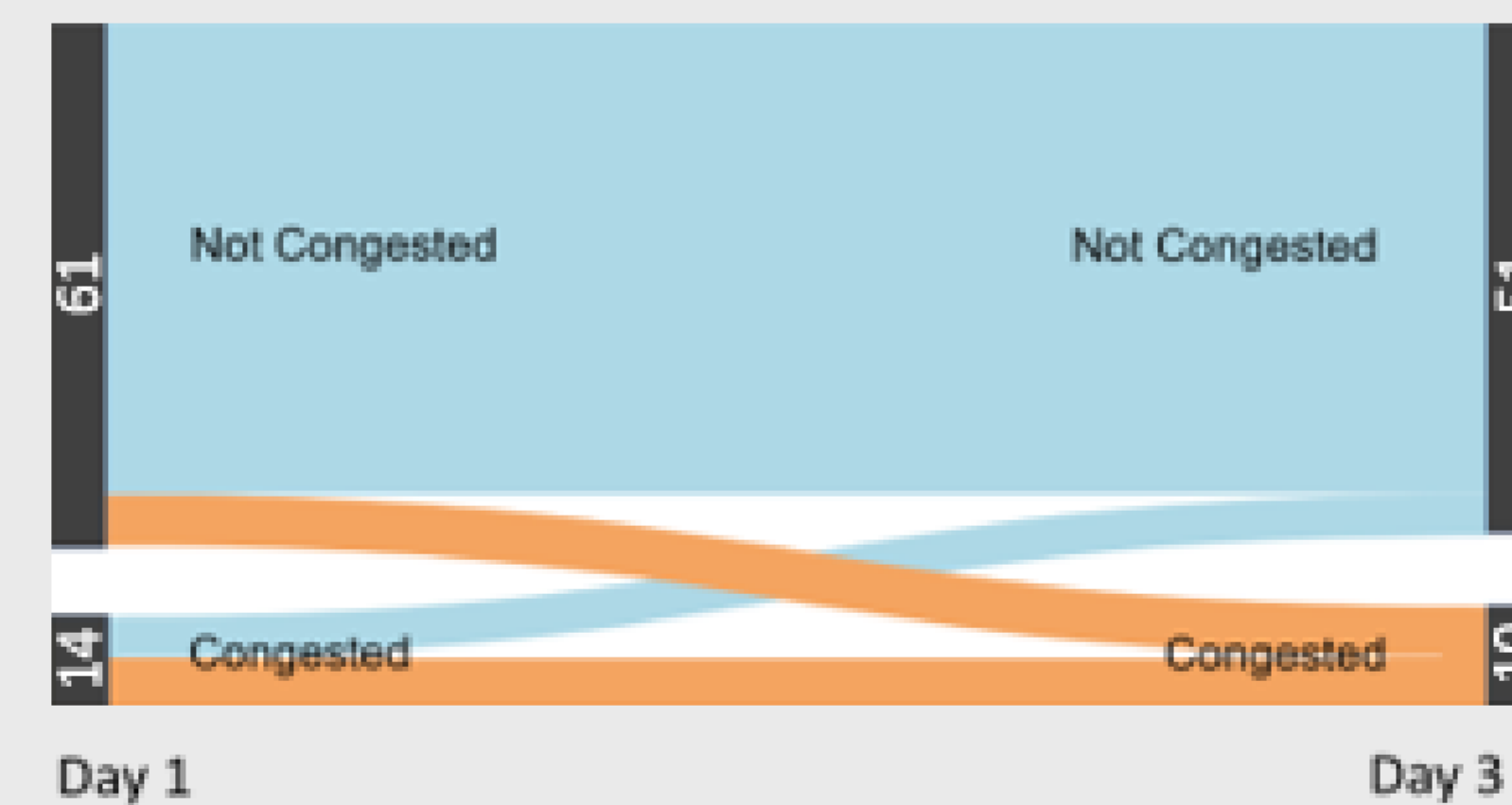


Figure 1 | Alluvian graph showing the natural history of venous congestion between Day 1 and Day 3

CONCLUSION

It is feasible to conduct a prospective definitive study of venous congestion association with outcomes in septic shock.

- Venous congestion is also associated with biventricular dysfunction & cardiovascular disease.
- Venous congestion measured by VEXUS may be associated with increased risk of RRT or death.
- Fluid balance differences are associated with changes in congestion for patients. Venous congestion results from an **interplay between cardiovascular status and fluid balance**.
- Increasing urgency to understand this complex physiologic process to optimize its safe and effective implementation into practice.
- Future studies are required to determine whether venous congestion is **independently** associated with clinical outcomes.

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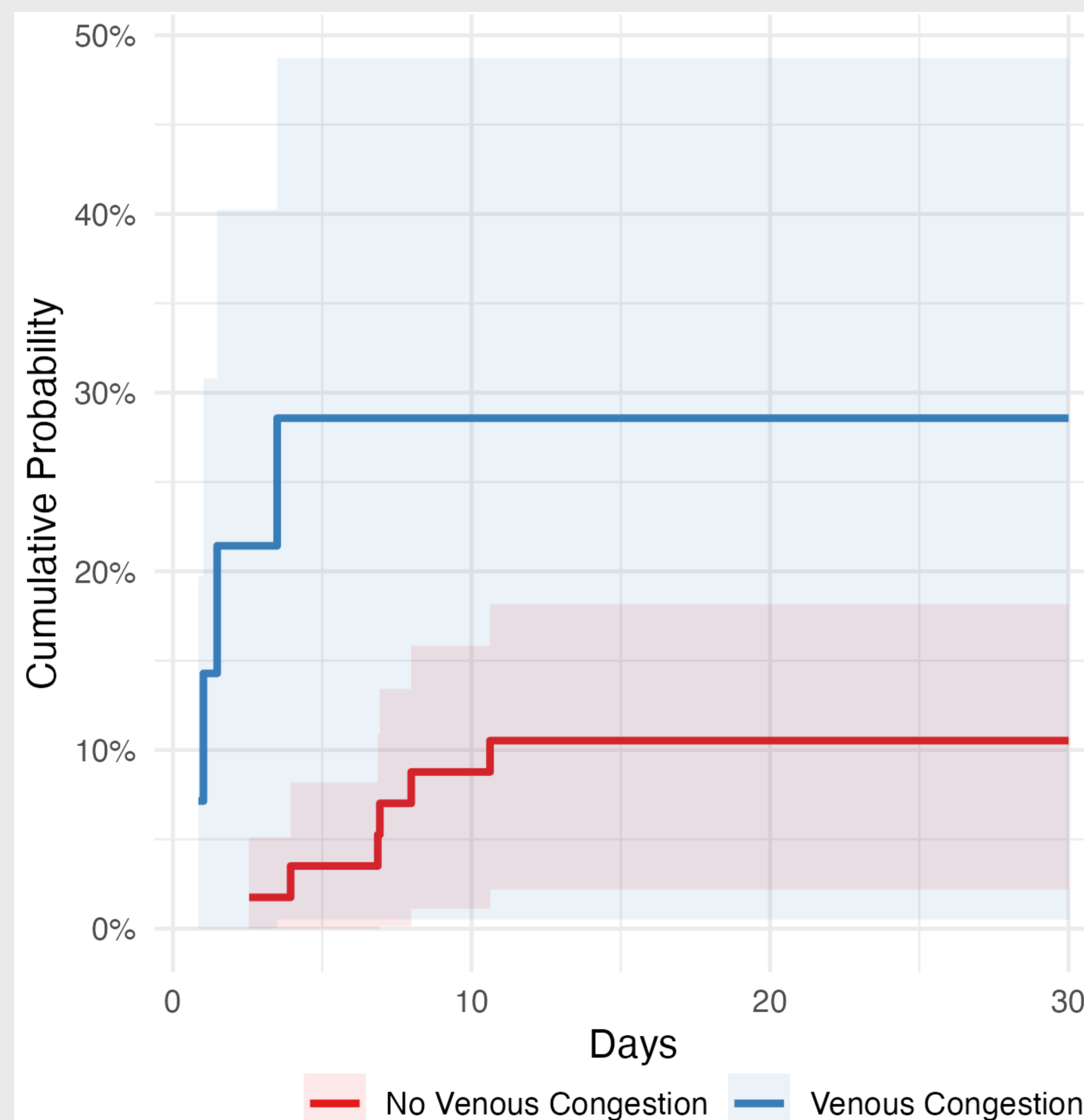


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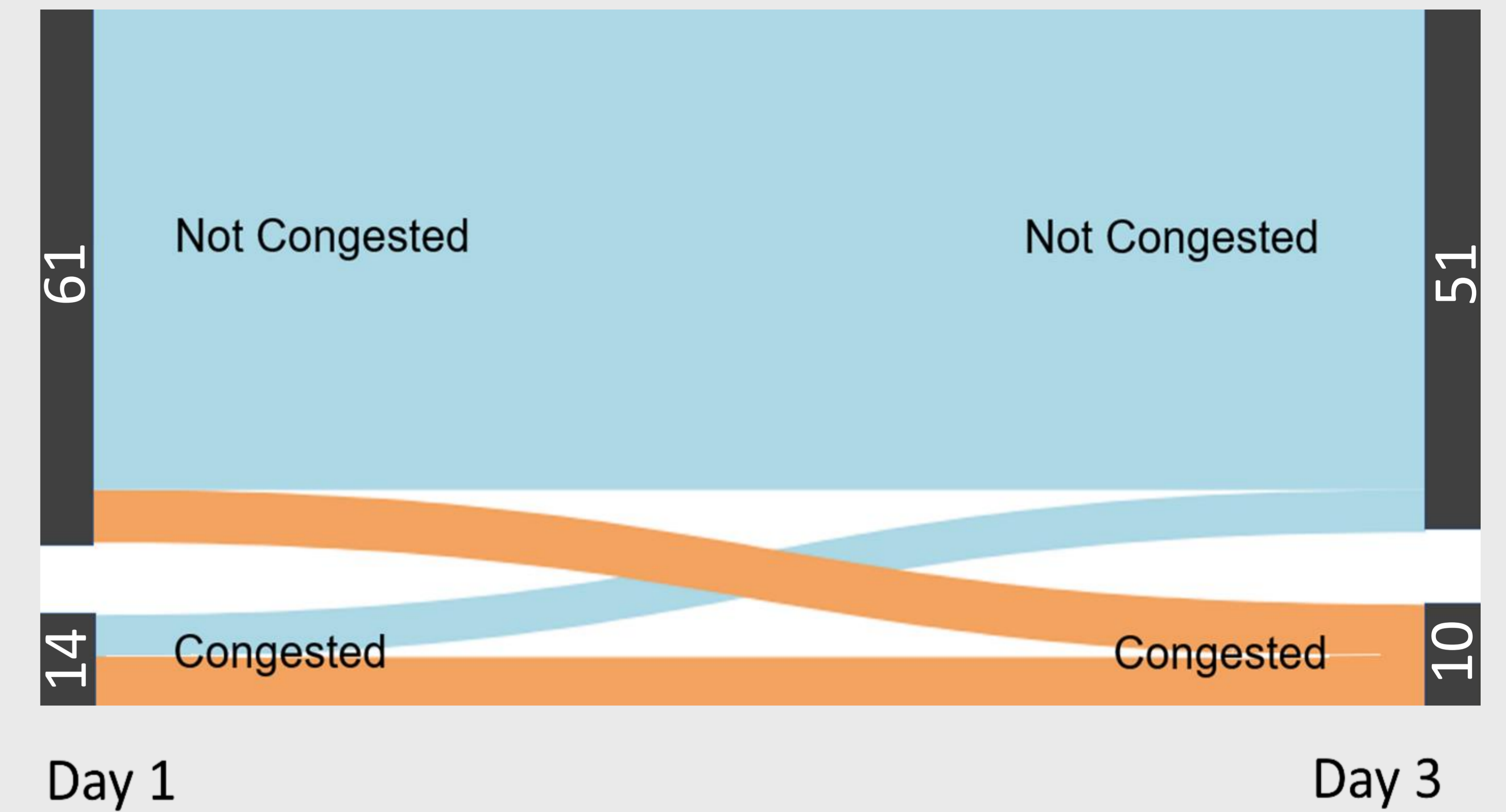


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