

Anesthesiology Protocols for Environmental Emergencies

Jacobs School of Medicine and Biomedical Sciences – Department of Anesthesiology

Joseph R. Current; Peter Natalzia, MD; Stacey A. Watt, MD, MBA, MHPE, FASA



Figure 1 - PGY1 anesthesia resident clears a path to a vehicle buried in snow during a whiteout

Background

Natural disasters are the leading cause of mass casualty events (MCEs) over human-induced disasters (i.e. gun violence, bombings, or terrorism). The historic winter storm affecting Buffalo, NY in December 2022 caused (Figure 1):

- Hospital oversaturation (abrupt strain on hospital space, supplies, and staff)
- Decreased staff-to-patient ratios
- Poor quality of care with increased adverse events

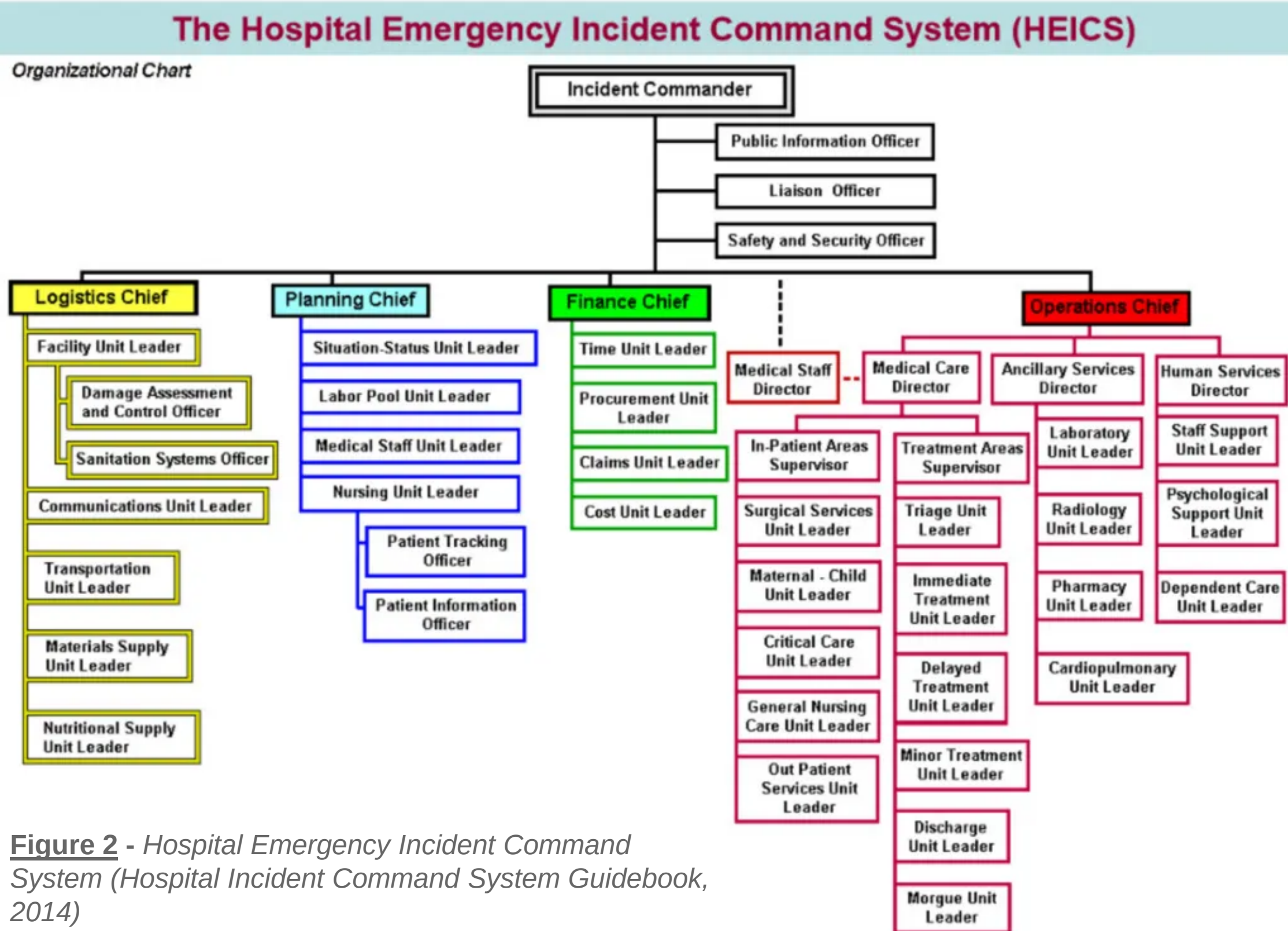
Winter storms increase the incidence of cold-related injuries:

- Frostbite
- Non-freezing cold injuries (chilblains, trenchfoot, etc.)
- Hypothermia
- Snow burial
- Drowning
- Sudden cardiac death

Complications of cold-related injuries:

- Inflammation and edema
- Thrombosis and ischemia
- Hypoxia and asphyxiation
- Tissue necrosis and reperfusion injury
- Peripheral neuropathy
- Cardiac arrest

Anesthesiologists play an important role in winter storms due to their expertise in triaging and treating patients with cold injuries by managing hemodynamics, obtaining/utilizing vascular access, maintaining airway patency, resuscitating, delivering anesthesia, and providing pain management to patients.



Emergency Interventions

Preparation

- Stockpiling additional provisions
- Using a Hospital Incident Command Systems (HICS) to organize emergency response – Figure 2
- Training for mass casualty response during employee onboarding and with regular refreshers

Reaction

- Conserving/Improvising resources
- Cancelling elective surgeries
- Closing hospital clinics
- Delegating tasks appropriately to advanced practice providers (APPs) and ancillary staff

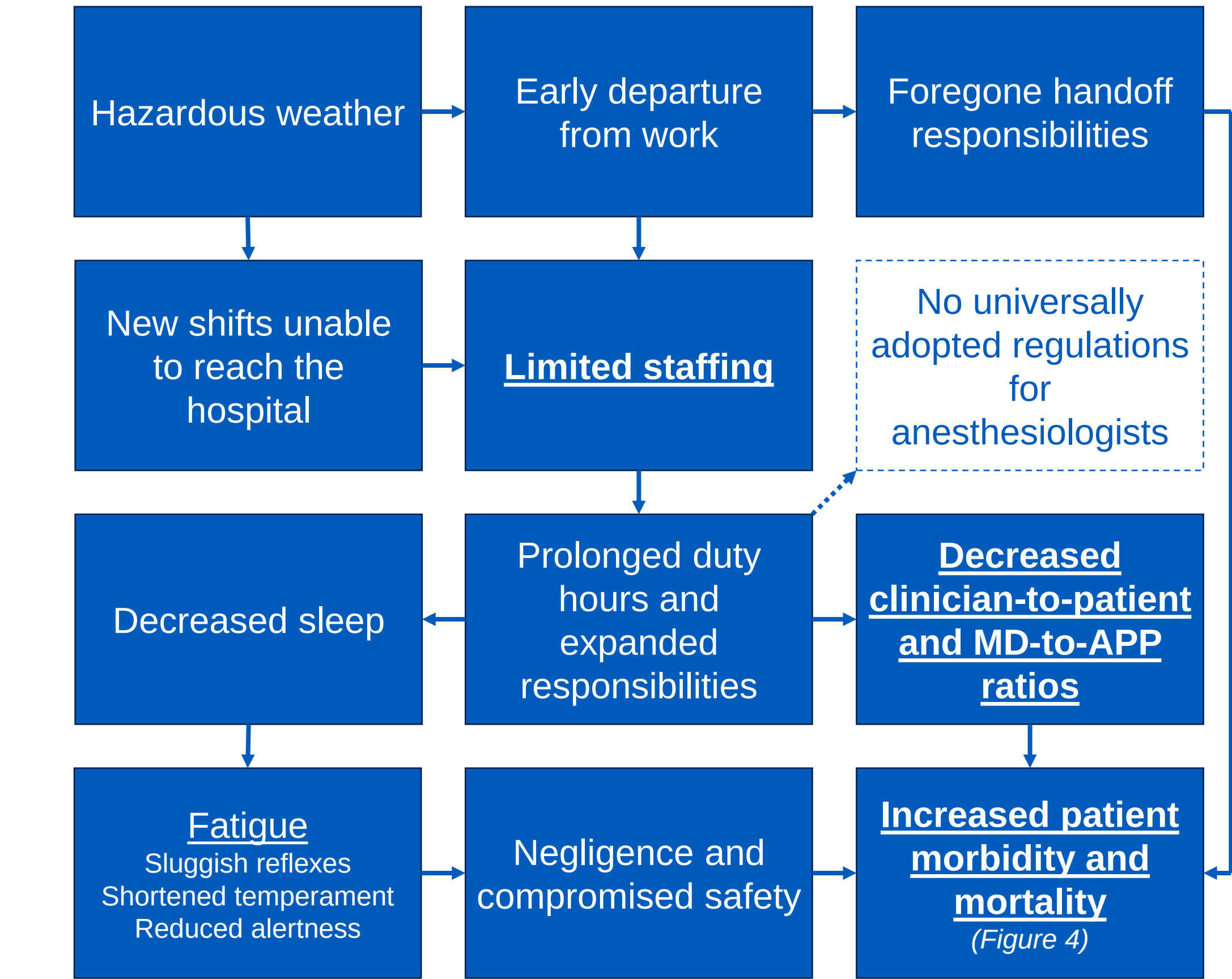
Improvisation

- Adjusting coverage schedules to ensure rest time
- Reassigning resources and staff to essential departments
- Taking on non-traditional roles/responsibilities
- Using unconventional equipment (limited number of ventilators, anesthesia machines, imaging equipment, etc.) – Figure 3
- Improvising medical/surgical interventions (i.e. different drugs, routes of administration, dosages, etc.)
- Using battery-powered equipment and paper charts in event of power failure

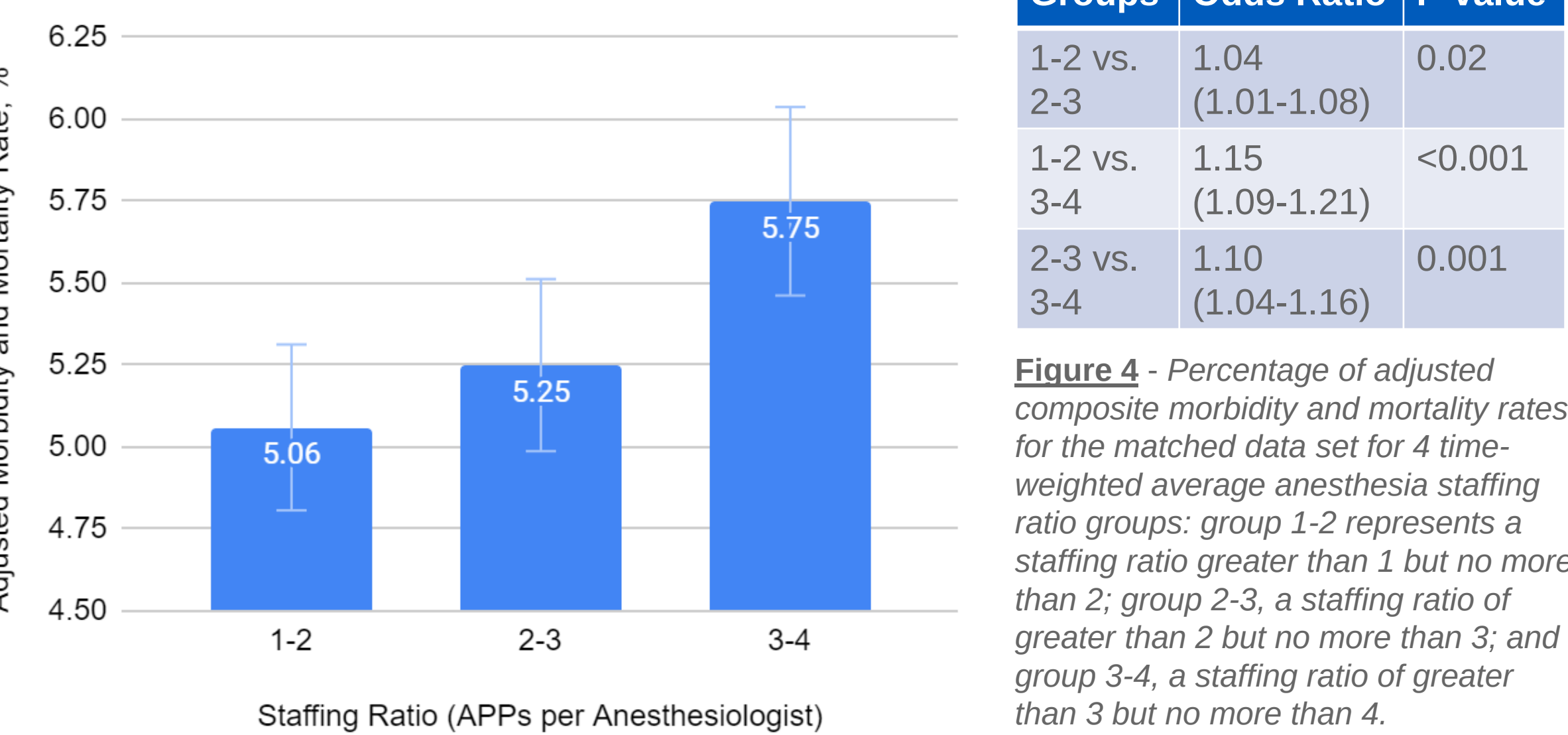


Figure 3 - Makeshift sleeping arrangements in a storage closet during the storm

Pitfalls of Staffing During Environmental Emergencies



Anesthesiology Staffing Ratios vs. Morbidity and Mortality Rates



Conflicts of Interest

The authors have no conflicts of interest to disclose.

Staffing for Winter Storms and Other MCEs in Buffalo, NY

Solutions to Minimizing Adverse Events

- Establish a department command for care coordination and scheduling
- Assess staff availability (total count and stratified by training level)
- Create teams of providers with balanced numbers and training levels
- Abide by minimum monitoring standards for APPs and delegate cases appropriately to providers with higher and lower levels of training
- Create a ceiling for working hours per day/week with documented rest periods between shifts
- Establish appropriate shift changes to balance adequate rest with sufficient patient coverage, rotating on a 24-hour schedule to ensure coverage
- Incentivize clinicians to adopt modified MCE schedules and maintain flexibility

Creating three anesthesia teams is optimal to provide maximal hospital coverage with limited staffing (Figure 5). At a minimum, hospitals must deploy two teams to safely provide continuous anesthesia services (Figure 6).

Hours	0000-0200	0200-0400	0400-0600	0600-0800	0800-1000	1000-1200	1200-1400	1400-1600	1600-1800	1800-2000	2000-2200	2200-2400
Essential Department Coverage	Team 1	Team 1	Team 1	Team 1	Team 2	Team 2	Team 2	Team 2	Team 3	Team 3	Team 3	Team 3
Emergency On-Call/Non-essential Department Coverage	Team 3	Team 3	Team 3	Team 2	Team 1	Team 1	Team 1	Team 3	Team 2	Team 2	Team 2	Team 1
Rest	Team 2	Team 2	Team 2	Team 3	Team 3	Team 3	Team 3	Team 1	Team 1	Team 1	Team 1	Team 2

Figure 5 - Short-Term Schedule for 3-Team Anesthesiology Department Rotation

Hours	0000-0400	0400-0800	0800-1200	1200-1600	1600-2000	2000-2400
Essential Department Coverage	Team 1	Team 1	Team 1	Team 2	Team 2	Team 2
Rest	Team 2	Team 2	Team 2	Team 1	Team 1	Team 1

Figure 6 - Suggested Schedule for 2-Team Anesthesiology Department Rotation

References

1. Burns ML, et al. Association of Anesthesiologist Staffing Ratio With Surgical Patient Morbidity and Mortality. *JAMA Surgery*. 2022;157(9):807-815.
2. Kuza CM, McIsaac, JH. 3rd. Emergency Preparedness and Mass Casualty Considerations for Anesthesiologists. *Advances in Anesthesia*. 2018;36(1):39-66.
3. Castellani JW, et al. ACSM Expert Consensus Statement: Injury Prevention and Exercise Performance during Cold-Weather Exercise. *Current Sports Medicine Reports*. 2021;20(11):594-607.
4. McIntosh SE, et al. Wilderness Medical Society Clinical Practice Guidelines for the Prevention and Treatment of Frostbite: 2019 Update. *Wilderness and Environmental Medicine*. 2019;30(4s):s19-s32.
5. Trikha A, Singh PM. Maximum working hours and minimum monitoring standards - need for both to be mandatory. *Journal of Anaesthesiology Clinical Pharmacology*. 2013;29(2):149-50.