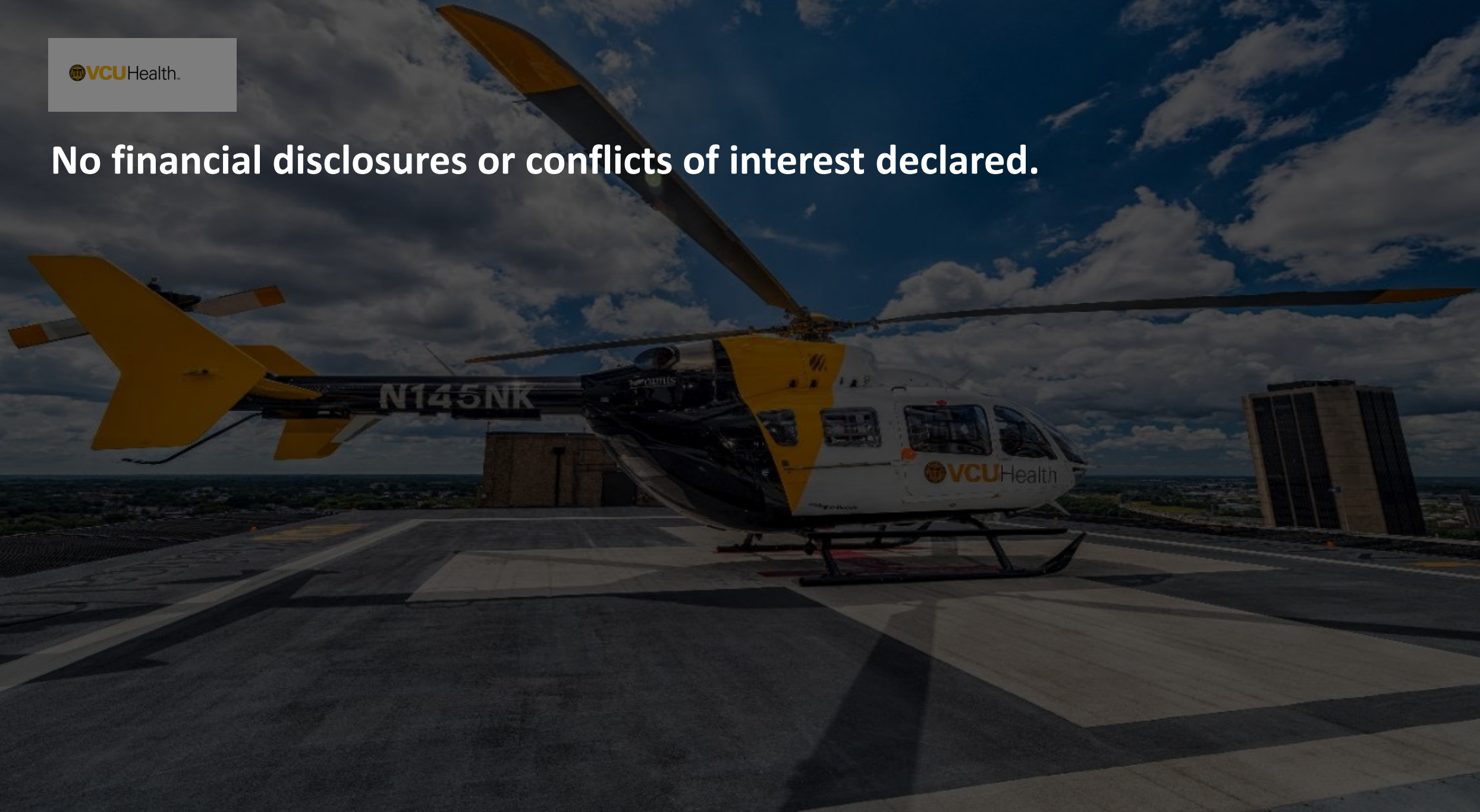


Saline and Crystalloid Shortage

Anesthesia and Perioperative Responses to a Crisis
Building Provider and System-Level Resilience

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Normal saline is part of a hidden infrastructure. Critical supply to deliver meds.

0.9%

NaCl is used for fluid, carriers, flushes, medication dilution, and blood compatibility workflows

**SVP (<250 mL,
<500 mL).**

Small-volume parenterals are often medication infrastructure, not “extra fluid”

OR + ICU

Shortages move quickly from supply chain issue to bedside safety issue

- A saline shortage changes how anesthesia teams mix, deliver, and substitute medications.
- Resilience means turning adaptive behavior into controlled, pharmacy-supported processes.
- Crisis can lead to unstandardized workaround, but can be a system-level risk .

Talk focus

What happened during Maria (2017), how clinicians adapted, and what systems should build before the next shock (other talk and in general).



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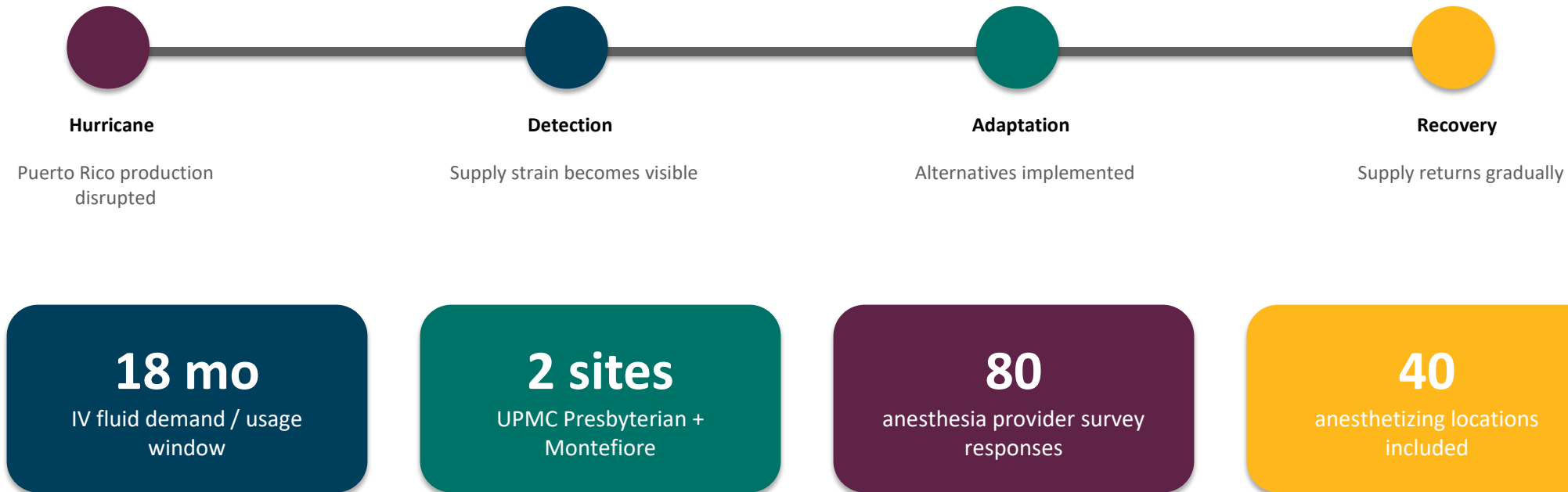
Disruption of normal saline supply chain due to a disaster: an analysis of the impact of normal saline shortage on anesthesia practice in a large hospital system and models toward resiliency

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Hurricane Maria exposed a perioperative dependency. Mixed methods.

Sept 16–Oct 2, 2017



What changed in the OR?

1,652 → 0

Small-volume IV bags supplied to
PUH/MUH ORs from Oct to Nov 2017

60%

Respondents used small saline
bags daily

53.75%

Selected Plasma-Lyte as alternative
crystalloid for larger saline bags

- Small bags were commonly used for remifentanyl, antibiotics, insulin, ketamine, vasopressors, magnesium, and general dilution.
- – “We often have medication shortages that result in my using either non-optimal drugs or drugs that I am less familiar with to treat our patients.” (Survey Response)
- Large-volume normal saline was less strained, but practice shifted toward balanced crystalloids.
- Elective OR load temporarily decreased and pharmacy-prepared alternatives became part of the response.

Clinical translation

The shortage did not just remove bags — it disrupted medication preparation and anesthetic plans.

Anesthesia adaptation: useful, but risky if ungoverned

Substitute

- Balanced crystalloids
- Different carriers
- Alternative anesthetic plans

Standardize

- Pharmacy premixes
- Approved concentrations
- Case planning the day before

Protect

- Labeling + checks
- Avoid bedside dilution variability
- Escalate constraints early

Observed provider adaptations included bolus dosing medications previously used as infusions, making syringe-pump approaches, alternative meds, and relying on new pharmacy preparations.

Error risks from individual mixing outside a controlled pharmacy environment: dilution error and microbial contamination.

The safer adaptation was not “everyone improvises”; it was pharmacy oversight, standard preparations, and closed-loop planning but this came with delays and ultimately done with more common and shelf-stable medications IE Ketamine, Insulin. To this day, sometimes difficult to launch due to delays.

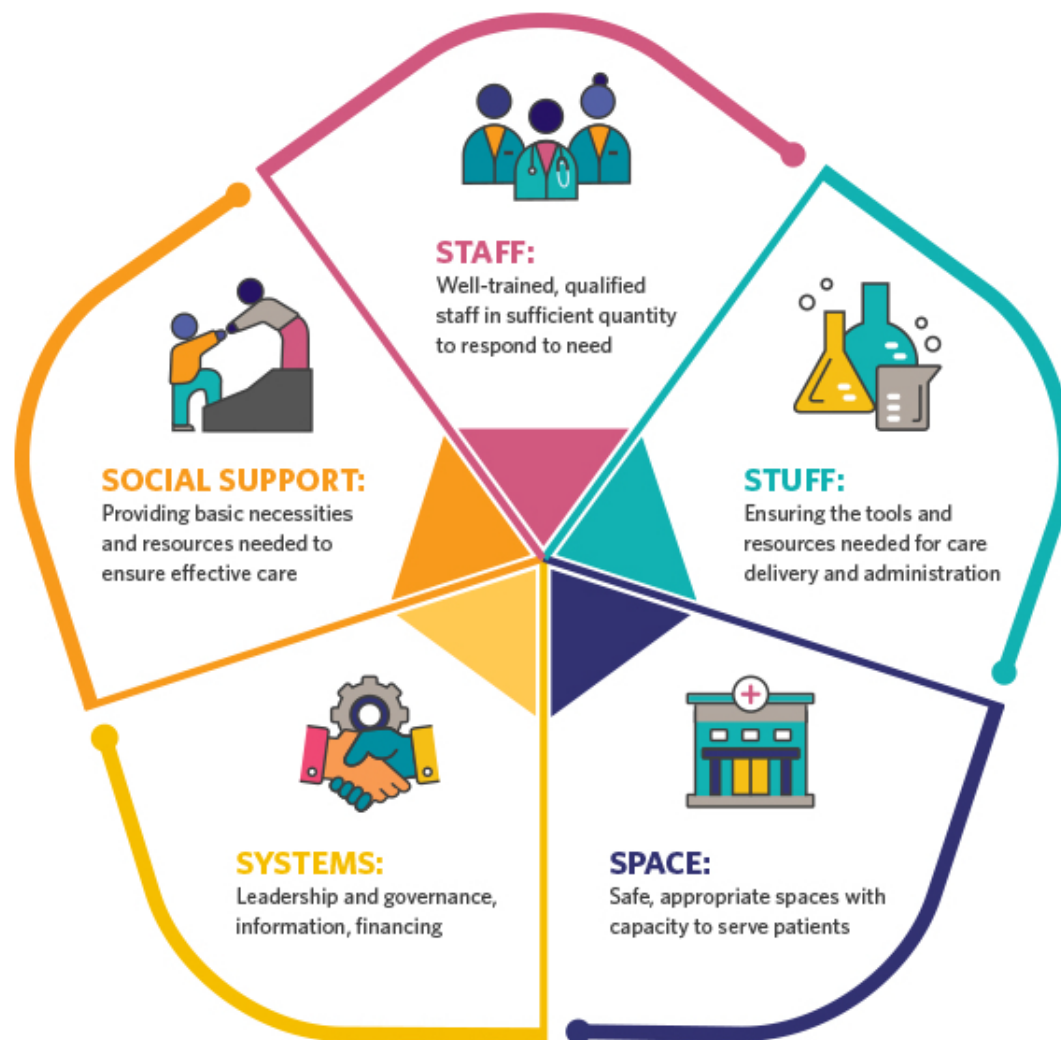


Figure 4: system-level + provider-level solutions

Solutions to IV Fluid and Medication Shortages

Challenge	Provider-Level Solutions	System-Level Solutions
IV Fluid (Normal Saline) Shortage	Substitute with alternative fluids (D5W, Plasma-Lyte, LR); Mix meds in available fluids; Use bolus dosing; Prepare syringe-pumps; Use pharmacy-prepared bags	Standardize solutions; Provide pre-mixed bags; Reduce surgical load; Scale alternative fluids; Plan scheduled cases; Raise awareness
Medication Shortages (Lidocaine, Narcotics, etc.)	Use of alternative medications; Adjust drug choices; Adapt and innovate in preparation	Compound alternatives in pharmacy; Plan drug availability; Coordinate with supply management
Medication Preparation (Remifentanyl, Ketamine, etc.)	Mixing medications in alternative fluids; Use pharmacy-prepared bags; Mix outside pharmacy if needed	Standardize pharmacy-prepared solutions; Adopt alternative protocols; Enhance oversight
General System Strain (Hypotension, Neuro-anesthesia, GI fluids)	Adjust clinical practices; Use alternative fluids/medications; Innovate delivery	Reduce elective cases; Allocate resources strategically; Implement alternative protocols

Figure 5: resilience model

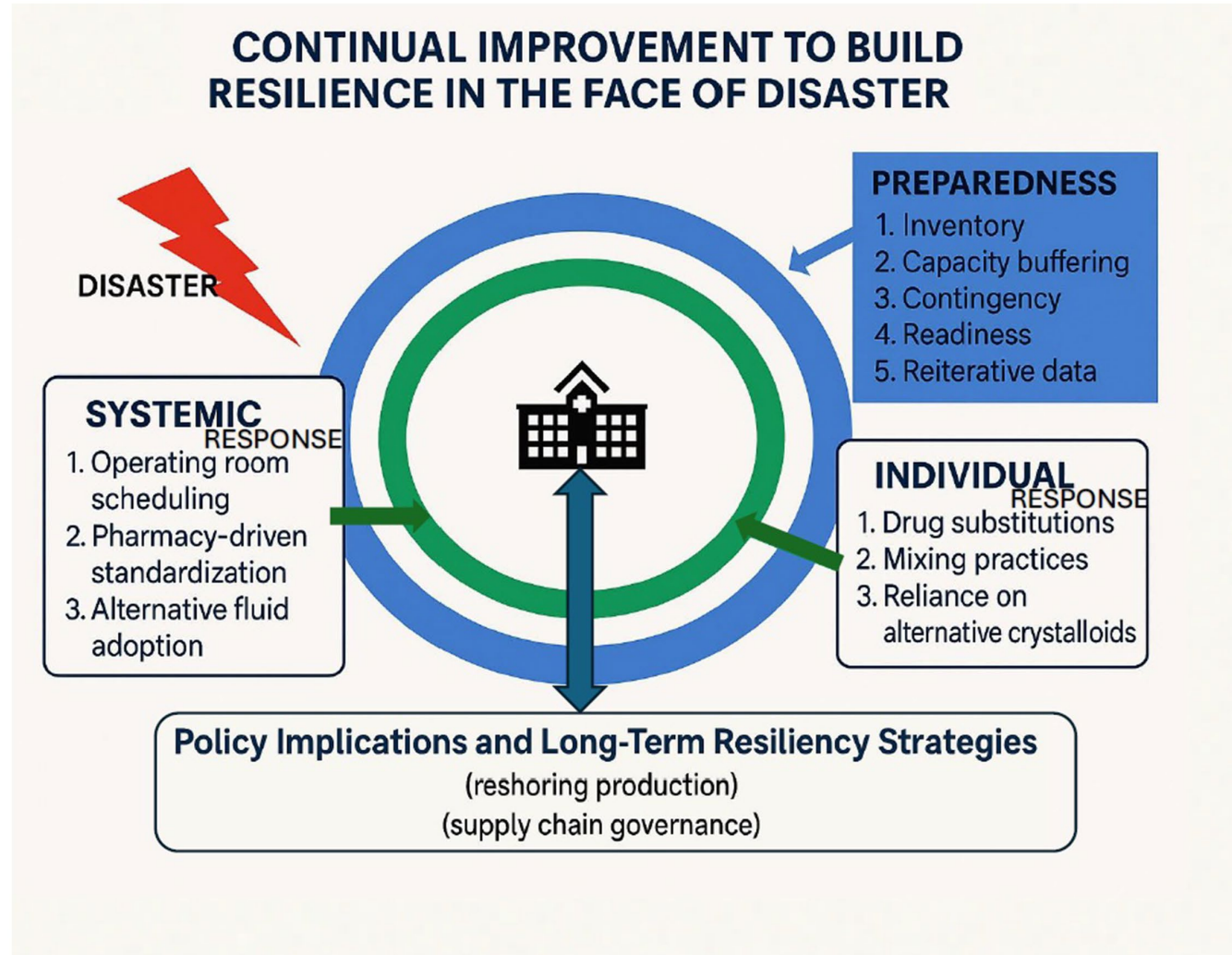


Figure 3: OR Case Load



This is not just a Maria story: Helene repeated the lesson

Oct 12, 2024

CDC HAN on PD + IV solution disruption after Baxter North Cove shutdown

Nov 25, 2024

ASHP/Utah guidance update for small- and large-volume fluid shortages

Aug 2025

FDA reported sodium chloride 0.9% injection shortage resolved, while other IV-fluid issues persisted

CDC guidance: assess inventory, conserve available IV solutions, plan mitigation, and include emergency/outpatient services.

ASHP guidance: organization-specific action plan, clinically equivalent interchanges, ethical interdisciplinary allocation, regular reassessment, rapid communication.

Pattern

Geographic concentration + limited buffers + essential low-margin products = recurrent clinical vulnerability.

Bedside playbook: conserve without improvising

Anesthesiology

Reserve saline for specific indications and compatibility needs.

Use balanced crystalloids when clinically appropriate.

Use pharmacy-prepared infusions and standard syringe concentrations.

Critical care

Review continuous infusions, carriers, KVO fluids, and medication routes.

Switch to oral/enteral hydration or medications where safe.

Coordinate ICU, pharmacy, dialysis, and supply chain daily.

Rule: if a workaround changes concentration, carrier, route, or preparation environment, it needs a protocol — not hallway consensus for the future.

System playbook: make the safe path the easy path

Visibility

Inventory + burn rate
by-product and care area

Governance

Shortage huddle
pharmacy + anesthesia + ICU + supply chain

Substitution

Approved alternatives
compatibility and concentration tables

Learning

Near-miss capture
after-action standardization

Questions for resilience planning

How should hospitals identify “critical low-cost products” whose absence creates high clinical risk?

What minimum visibility should clinicians have into product-specific inventory, allocations, and expected recovery?

Can shortage guidance be pre-built into order sets, medication libraries, and OR pharmacy workflows?

What incentives support redundancy and geographic diversification for essential sterile fluids?

My take-home

Anesthesiologists and intensivists should be part of shortage command early — because the bedside workaround is where supply failure becomes patient risk.

Closing: Just-in-time becomes too late when the resource is essential.

Small-volume saline bags are medication-delivery infrastructure.

Provider adaptation is necessary — it helped us survive in 2017, but standardization is what makes it safe.

Health-system resilience requires visibility, substitution pathways, governance, and learning.

For Discussion: AMA/USP Recommendations:

- (1) incentivizing advanced manufacturing technology and develop new continuous manufacturing technology for critical drugs and active pharmaceutical ingredients
- (2) improving the function and composition of the Strategic National Stockpile
- (3) improving multinational cooperation to minimize supply chain disruption

**Questions?
Thank you**

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