Towards More Resilient Performance of Emergency Departments

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1. BACKGROUND

Crisis in Emergency Departments (EDs)

The ED is a complex, dynamic system that copes with:
- Limited time and resources,
- Uncertain demands,
- Risks of causing high-consequence of medical errors, and
- Economic pressure due to competitive market and federal mandate.

(e.g., Emergency Medical Treatment and Labor Act or EMTALA)

EDs are at a Brittle Point

- Growing influx of ER patients.
- ED shutdowns are increasing.
- Crowding/dumping patients becomes common.
- Chronic shortage of physicians and nurses.


2. RESILIENT ED RESPONSES

Four Types of Resilient ED Responses

Responsive capacity of EDs is finite and limited in time and quality of staff, availability of technology, processes, equipment and facility.

<table>
<thead>
<tr>
<th>Type</th>
<th>Demand Level</th>
<th>Response Pattern</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matched</td>
<td>Below max. capacity</td>
<td>'Eat up' existing resources</td>
<td>Routine emergency cases, e.g., single car crash</td>
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<tr>
<td>Extended</td>
<td>Slightly over max. capacity</td>
<td>Consume additional resources</td>
<td>Unusual but expectable cases, e.g., multiple car accidents</td>
</tr>
<tr>
<td>Sustained</td>
<td>Moderately over max. capacity</td>
<td>Stay 'extended' for a longer period or 'free fall'</td>
<td>Rare and unexpected instances, e.g., train derailment</td>
</tr>
<tr>
<td>Transformed</td>
<td>Largely over max. capacity</td>
<td>Change its behavior in a radical way</td>
<td>Mass casualty incident, e.g., suicide bombing</td>
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3. REPRESENTATION OF RESILIENCE

Representation of Resilience of EDs

Resilience is a tacit, covert property of a system. Hence, visualization efforts help understand some of dimensions it possesses.

1. State-Space Model

- Normal state
- Regular Reduced Functioning
- Irregular Reduced Functioning
- Disturbed Functioning
- Suspended Functioning

Cons:
- Limited in explaining temporal changes.
- State transition occurs between adjacent states.

2. Stress-Strain Curve

- Resilience is a physical property of a material.
- A system can be viewed resilient or brittle.
- A system reaches a failure when it uses up all the adaptive capacity.

Cons:
- Same as for State-Space Model.

3. Discrete Temporal Model

- Illustrate how system’s performance elongates or shrinks against varying demands.

4. Variety Space Diagram

- A system can function in various states and is controlled by two ends.
  - Sharp end (e.g. nurses)
  - Blunt end (e.g., hospital management).

Interaction between two ends comes along as the system sustains.

In extreme events, e.g., MCI neither sharp nor blunt end has control actions available to them.

5. Stretched Dynamics Model

- A system’s operating capacity expands with dynamic interplay among opposing forces:
  - Economic pressure
  - Workload release
  - Safety effort

As these forces push the system near and over the operating boundary, accidents, mishaps and near-misses take place.

This model can display multiplicity of disruption – response patterns.

4. STRATEGIES FOR RESILIENCE

4 S’s: Staff, Supplies, Structure and Sequencer

1. Staff

- Defensive
  - By blocking inflow of patients
- Autonomous
  - By assigning staff to a specific role
- Cooperative
  - By sharing a common staff pool

2. Supplies

- Medical apparatus, equipment and pharmaceuticals
  - Stockpile a cache of essential commodities
  - Substituting between functionally compatible tools
- Support restriction on a certain therapy
  - Rationing proper cleaning and sterilization
- Adapt for purposes for they are not intended
- Reallocate to those in the largest needs


1) Intra-departmental tactics
  - Sharing among similar units (ED-OR-ICU)
  - Borrowing from dissimilar units

2) Inter-departmental tactics
  - Allocating scarce resources among departments
  - Displacing non-critical patients to other units earlier than needed.

4. Sequence: work processes, steps involved in the responses.

- Skipping: some life-threatening cases directly admitted to OR and jump paperwork.
- Expediting: Displacing non-critical patients to other units earlier than needed.
- Rescheduling: put less urgent surgery, e.g., cosmetic, orthopedic, later than cardiac, abdominal ones.
- Sacrificing: Choosing more critical patients over those with lesser injury.

5. PATH FORWARD

1. Observation studies: some of theoretical and hypothetical arguments need to validated in the real hospital settings.
2. Measuring resilience: patterns of resilient performance must be defined in operational terms for future improvement in e.g., process and interface design.
3. Develop and test resilience-based design principles for healthcare applications

REFERENCES