Using Failure Mode & Effects Analysis to Improve Hospital Intensive Care Evacuations

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Barbara Bisset, PhD MPH MS RN EMT

Emergency Services Institute

WakeMed

Health & Hospitals

Raleigh, North Carolina

Objectives

- Awareness of the process and results when using the Failure Mode Effects Analysis (FMEA) for evaluating hospital intensive care unit evacuations
  - Process
  - Findings
  - Action Plan
  - Resulting changes to plans and processes
  - Deliverables
    - Manager's Toolkit
    - Training Plan
  - Reduction in risk

What is an FMEA?

- A proactive approach to identify and resolve potential problems in products or processes, before they occur, prioritizing potential failures, and determining steps to take to reduce or eliminate the associated risks or defects

- An FMEA is not like a root cause analysis (RCA), which focuses on avoiding the reoccurrence of adverse events

Why Use FMEAs in Healthcare?

- Other industries have used FMEA with great success
- The Joint Commission requires the proactive risk assessment of at least one high-risk process per year
- Goal is to reduce risks, improve patient safety, and enhance patient satisfaction

FMEA Nine Step Process

1. Define project scope
2. Develop flow chart
3. Identify all ways process could fail
4. Rate each failure mode
5. Determine the risk score
6. Calculate primary outcome measure
7. Identify failure modes greater than a designated score and develop action plan
8. Propose steps to implement action plan
9. Rescore the primary outcome measure

Step 1: Define the Project Scope

- Emergent Evacuation from the Critical Care Units at WakeMed's Trauma Center - Raleigh Campus
- Intensive Care Units include
  - Cardio-Thoracic Surgical (12 beds) (2nd Fl)
  - Coronary Care (26 beds) (2nd Fl)
  - Intensive Care –Neonate (36 beds) (4th Fl)
  - Medical Intensive Care (9 beds) (2nd Fl)
  - Neuro Intensive Care (8 beds) (2nd Fl)
  - Pediatric Intensive Care (8 beds) (4th Fl)
  - Surgical Intensive Care (9 beds) (2nd Fl)

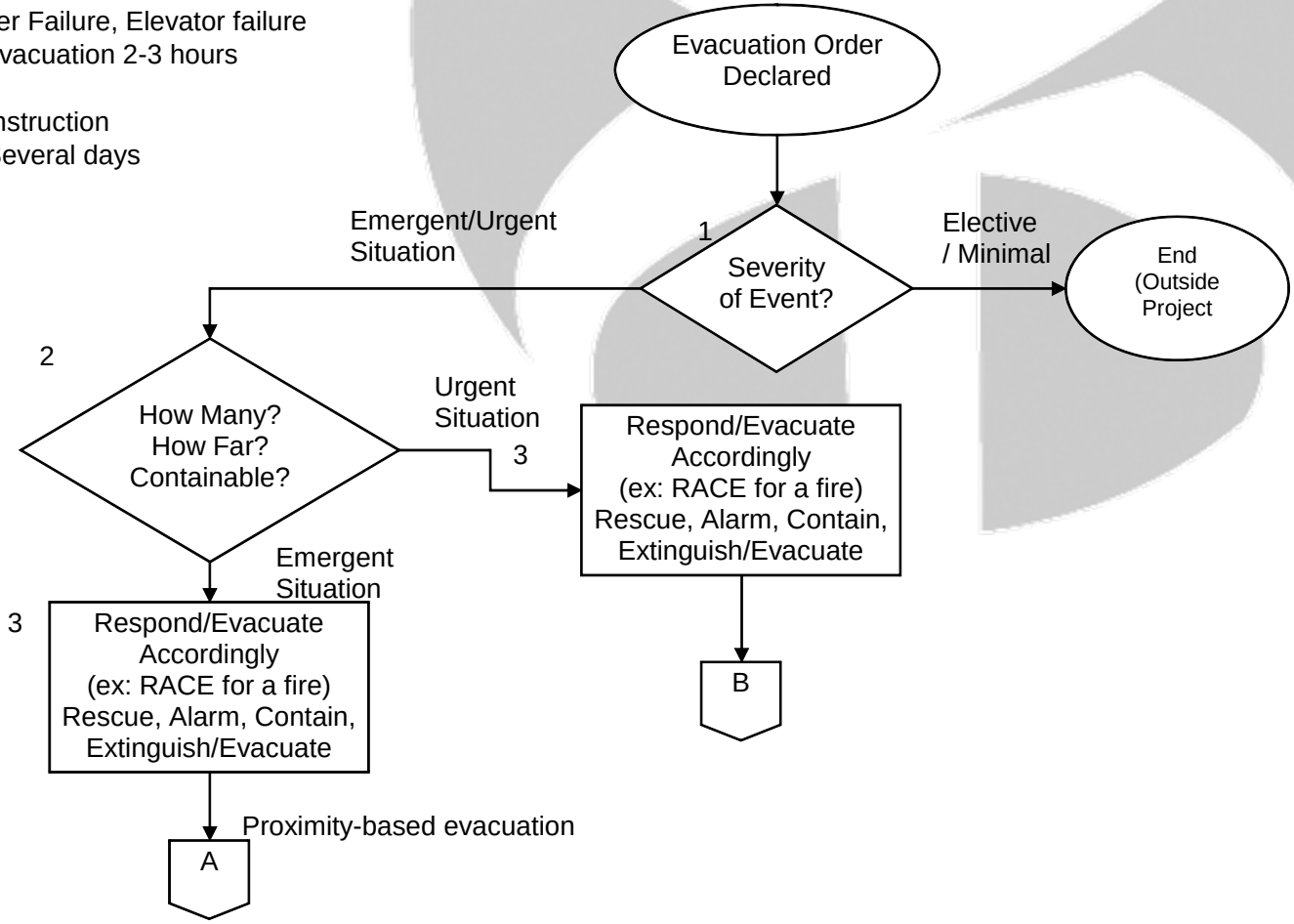
  Total: 108 beds

Step 2: Evacuation Flowchart

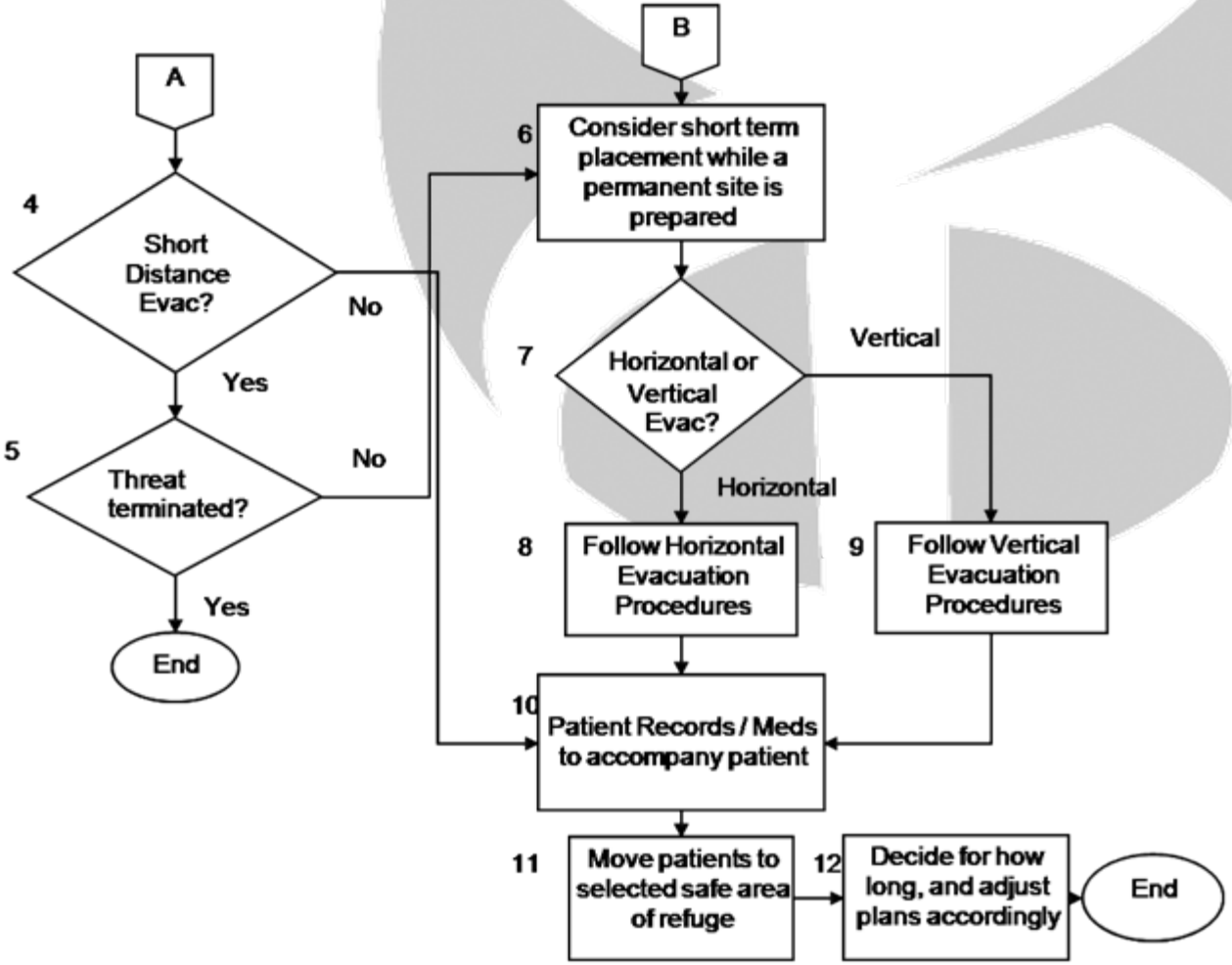
Emergent - Hazmat, Fire, Building Collapse, Med Gas Failure, Plumbing
Timeframe: immediate evacuation, <= 15 minutes

Urgent - Power Failure, Elevator failure
Timeframe: evacuation 2-3 hours

Elective - Construction
Timeframe: Several days



Step 2: Evacuation Flowchart



Step 3: Potential Failure Modes, Causes and Effects

- Identify what “could”[1] go wrong at each of the process steps on the flow chart
- Identify “why it might happen”
- The causes of those failures
- The effects of those failures

[1] These are referred to as the “Failure Modes”

Step 3: Process Failure Modes Findings

- Misidentification of evacuation distance needed
- Insufficient staff for unit evacuation
- Insufficient oxygen tanks to support evacuation
- Insufficient monitoring capability at designated safe areas
- Inadequate access to defibrillators during patient transport to safe area
- Insufficient space to maintain patient at final evacuation location
- Shortage of medications at safe area

Step 3: Process Failure Modes Findings (continued)

- Shortage of specialized supplies at safe area
- Insufficient electrical/med gas infrastructure for patient support at safe area location(s)
- Patient movement issues: vertical evacuation
- Insufficient equipment for vertical evacuation
- Insufficient staffing for vertical evacuation
- Safe areas for evacuation not identified
- Evacuation route blocked
- Traffic jams when moving patients in their beds
- Automatic doors may not work (incoming help)

Step 3: Process Failure Modes Findings (continued)

- Insufficient suction equipment to support unit evacuation
- Insufficient portable monitors to support unit evacuation
- Elevator nearest evacuation point not available – may be type of event in which elevators cannot be used or may be in use by fire department
- Failure to correctly assess containment of the event

Step 3: Process Failure Modes Findings (continued)

- If elevators can be used, elevator evacuation not planned
- RACE or ECAR procedure not followed
- Misidentification of event response urgency
- Misidentification of # of patients impacted
- Insufficient lighting for patient evacuation
- Lack of knowledge re: alternate stairwells for vertical evacuation
- Patient records not accessible

Step 4: Rate Each Failure Mode

Three factors: Severity, Probability of Occurrence, and Detection Capability

- *The "severity" is the consequence of the failure should it occur*
- *The "probability of occurrence" is the likelihood of a failure mode occurring*
- *The "detection rating" is the ability to catch the error before causing patient harm*

Step 5: Determine the Risk Score

Risk Priority Number =

Severity x Occurrence x Detect ability

Scores are 1-10;
The resulting number is 1-1000

(Minor problem: RPN <= 100)

Step 5: Risk Score

- Example, “Insufficient Staff for Patient Evacuation” was scored at 300

  Severity of the potential effects was rated a “10” (Very High Severity)

  Probability was rated a “10” (Certain probability if an evacuation order is declared)

  Detection was rated a “3” (Moderate)

  RPN for this failure mode: 10 x 10 x 3 = “300” (High Concern)

Step 5: Ranked Failure Mode RPN Scores

Misidentify evacuation distance needed	320
Insufficient staff for unit evacuation	300
Insufficient oxygen tanks to support unit evacuation	300
Insufficient monitoring capability at safe area	300
Inadequate access to defibrillators during patient transport to safe area	300
Insufficient space to maintain patient at final evacuation location	300
Shortage of meds at safe area	300
Shortage of specialized supplies in safe area	300
Insufficient electrical/med gas infrastructure for patient support at evacuation location(s)	300
Patient movement issues: vertical evac.	300
Insufficient equipment for vertical evac.	300
Insufficient staffing for vertical evac.	300
Medication support insufficient: vertical evac.	300
Safe areas for evacuation not identified	300
Evacuation route blocked	240

Step 5: Ranked Failure Mode RPN Scores (continued)

Traffic jams when moving patients in their beds	240
Automatic doors may not work (incoming help)	240
Insufficient suction equipment to support unit evacuation	210
Insufficient portable monitors to support unit evacuation	180
Elevator nearest evacuation point not available - in use by fire dept.	150
Failure to correctly assess containability of the event	120
Elevator evacuation not planned	120
RACE procedure not followed	81
Misidentification of event response urgency	80
Misidentification of # of patients impacted	80
Automatic doors may not work (leaving)	60
Insufficient lighting for patient evacuation	48
Lack of knowledge re: alternate stairwells for vertical evacuation	45
Patient records not accessible	27
Medication support insufficient: horizontal evac.	27

Step 6: Primary Outcome Measure: Calculate the Total RPN Score

- Add the totals of all RPN scores to get a grand total

(6,168)

- Score provided a baseline for comparison

Steps 7: Identify Action Plan

- Identify the failure modes that have an RPN Score of 100 or higher. These are the items requiring the greatest attention.

- Develop an action plan to address each of these high-hazard score failure modes. The action plan should include who, what, when, why, etc.

Step 8: Implement Action Plan

- Identified safe areas of refuge on the 2nd and 4th floors
- Identified primary and secondary evacuation routes
- Updated the WakeMed Emergency Evacuation Operations Plan
- Evaluated and purchased evacuation equipment

Step 8: Implement Action Plan

- Identified evacuation and receiving team membership
  - Multi-disciplinary
  - Identified in incident command structure
  - Job Action Sheets
- Created a master equipment inventory list
- Conducted assessments of infrastructure capability at identified receiving areas

Step 8: Implement Action Plan

- Purchased emergency supplies in event of electrical failure
- Assessed ingress/egress capability in intensive care areas (secured units)
- Developed Manager's Evacuation Document Toolkits
- Developed unit-based emergency evacuation "quick response" guides

Step 8: Implement Action Plan

- Staff Training
  - Modules
    - Frontline Staff
    - Managers
    - Response Teams
    - Incident Command
  - Vertical Evacuation Simulation Training (VEST)
- Staff required to walk horizontal and vertical evacuation routes on a regular basis

Step 9: Determine FMEA Project Success

- Recalculate the RPN scores after implementing the action plan
- Compare with the first FMEA analysis
- Address any items with a recalculated RPN Score of 100 or higher

Results

- Baseline score: 6168
- Final score: 1657
- Reduction in scored risk assessment: 73.1%

Evacuation Manager's Toolbox

- Evacuation Preparedness Instructions
- Assessment Tool
- Receiving Areas Equipment & Supplies
- Department Evacuation Plan Template
- Training Guide
- Quick Response Guides
  - Evacuation and Areas of Refuge
  - Employees
  - Managers
  - Special Populations
  - Patient Equipment Management in Vertical Evacuations
  - Evacuation Equipment / Person Carries

Project Limitations

- Time factors for processes not assessed
- Clinical status changes when moving patients
- Staff stressors during evacuation
- Due to time frame of recent completion of project, drill has not yet been conducted to formally evaluate staff's performance
- Bias of task force members

Next Steps

- Finalize staff training
- Conduct pilot drill
- Expand project through entire healthcare system
- Incorporate evacuation annual training into departments
- Study human simulator data to ascertain impact on patients
- Nursing Triage Study

Summary

- Awareness of FEMA process steps
- Awareness of action plan development
- Awareness of operational/plan changes
- Awareness of project’s limitations
- Awareness of next steps

FMEA ICU Team Acknowledgement

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- Sylvia Scholl
  Trauma Services
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  Cardiothoracic ICU
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  Neuro ICU
- Angie Bullock
  Surgical ICU
- Carolyn McKay
  Medical ICU
- Wanda Bowman
  Pediatrics ICU
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  Coronary Care
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References

ISMP Website, Example of a Health Care Failure Mode and Effects Analysis for IV Patient Controlled Analgesia (PCA), ISMP.Com

McDermott, Robin E., The Basics of FMEA, PRODUCTVITY, 1996.

Palady, Paul, FMEA: Author's Edition, PAL Publications, 1998.

The Basics of Healthcare Failure Modes and Effect Analysis, Videoconference Course, VA National Center for Patient Safety, 2001.

Understanding the Failure Modes and Effects Analysis, an on-line course, HCProfessor.com, 2002. Phone #: 800-650-6787.

Questions?

WakeMed Health & Hospitals

Raleigh, North Carolina