Threats & Strategies in Critical Care Nursing

Frank Durso

Georgia Tech
Overview

• Where I’m coming from
• Threat-Strategy Interview
• PICU Threats
• PICU Strategies
• A threatening threat
Collaborators

• Sadaf Kazi
• Ashley Ferguson
• Christina Ryan (MSN, RN), CHOA
• Charlene Cunningham (MSN, RN, CCRN), CHOA
• Rebecca Cogburn (CEN, CCRN-P, RN), MCCG
Science and application are bound together like fruit and the tree that bears it.
Without theory, practice is but routine born of habit.

The opposite of a profound truth may well be another profound truth.

If I find 10,000 ways something won’t work, I haven’t failed... every wrong attempt discarded is a step forward.

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</table>
SA & Comprehension

- Cause of motor vehicle accidents & CFITs
- Distinguishes among OJT ratings
- Distinguishes expert pilots and novices
- Distinguishes active involvement from passive monitoring
- Predicts efficiency
- Measuring comprehension predicts ATC errors even after cognitive traits and personality are accounted
Management is central to behavior in dynamic environments

• Seek information to
• Understand “situation” in order to
• Change strategy and
• Maintain high performance, low workload
  – Helson’s (1949) Par hypothesis
Workload & Situation awareness

1. Error or other Performance Threat

Workload Subsystem
• WL measures

Situation Understanding Subsystem
• Residual Situation Image
• recalled measures of SA

Management Subsystem
• Goals
• Strategy Selection
• Strategy Prioritization

Performance Level

Increase in complexity:
Pilot enters approach; ATC push

Error or other Workload Threat

Goal management:
“high performance”
“manageable workload”
MANAGING THREATS
Threat-Strategy Interview

• Identify threat
• What strategy would you use?
• What cues suggest that strategy?
• Why this strategy and not that?
• Participants
  – Pediatric intensive care nurses
  – Airline pilots [automation]
  – Air traffic controllers
  – Locomotive conductors
  – GT undergraduates [registration]
Task: Child in respiratory distress while on ventilator support
Patient agitation

Patient is thrashing, kicking, biting down breathing tube

Patient is thrashing head from side to side

Patient is able to move towards breathing tube with their arms

When they wake up from anesthesia, if they start fighting with the breathing tube

Patient has a breathing tube in

Patient is coming out of anesthesia

Restraints on their wrists agitate them

Secretions in the breathing tube

The machine alarms

You are able to suction out secretions in the breathing tube

If the patient is quiet, but is still not getting a good enough volume, it’s not agitation EXIT THREAT

After the physical exam, if there is a specific finding to treat, like their breath sounds are not equal

If there’s nothing that’s saying, “Hey, there’s a blockage in the breathing tube”, or “the reason they’re not breathing good is this”

If you found something on your physical exam that you need to take care of

Depending on where the patient is in the coming out of anesthesia regime

If everything else you’ve done has not worked

Based on the patient’s history and diagnosis

They have to be adequately medicated before you do that (paralyze the patient)

If there’s a certain diagnosis where you know that this child cannot ventilate
Threat: Patient agitation

- Patient is thrashing, kicking, biting down breathing tube
- Patient is thrashing head from side to side
- Patient is able to move towards breathing tube with their arms

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They have to be adequately medicated before you do that (paralyze the patient)
If there’s a certain diagnosis where you know that this child cannot ventilate

Patient has pain
You can tell if the patient is splinting
Patient is not breathing deeply / has shallow breathing
Patient is feeling extremely uncomfortable
Patient is thrashing, kicking, biting down breathing tube

Patient is thrashing head from side to side

Patient is able to move towards breathing tube with their arms

If there’s nothing that’s saying, “Hey, there’s a blockage in the breathing tube”, or “the reason they’re not breathing good is this”

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They have to be adequately medicated before you do that (paralyze the patient)

If there’s a certain diagnosis where you know that this child cannot ventilate

Patient has pain

You can tell if the patient is splinting

Patient is not breathing deeply / has shallow breathing

Patient is fresh post-op so they have pain
Task: Child in respiratory distress while on ventilator support

- Change in respiration status is from agitation; not something obstructing the patient's breathing tube
- Patient is old enough to be scared and not understand why
- After surgery
- Patient is flailing arms
  When they wake up from anesthesia, if they start fighting with the breathing tube
- Patient has a breathing tube in
- Patient is coming out of anesthesia
- Restraints on their wrists agitate them
- Secretions in the breathing tube

Contingency Plan:
- Physical restraint (fingertip pulse oximetry)
  - Patting their back
  - Holding them in position
  - Putting them face-down on their belly
- Verbal lidocaine
- Talk to the child
Task: Child in respiratory distress while on ventilator support

- Change in respiration status is from agitation; not something obstructing the patient’s breathing tube
  - Patient is old enough to be scared and not understand why
- After surgery
- Patient is flailing arms
- When they wake up from anesthesia, if they start fighting with the breathing tube
- Patient has a breathing tube in
- Patient is coming out of anesthesia
- Restraints on their wrists agitate them
- Secretions in the breathing tube
- Getting started
- Getting ready
Threat: Patient agitation

If the patient is quiet, but is still not getting a good enough volume, it’s not agitation. EXIT THREAT

After the physical exam, if there is a specific finding to treat, like their breath sounds are not equal

If there’s nothing that’s saying, “Hey, there’s a blockage in the breathing tube”, or “the reason they’re not breathing good is this”

If you found something on your physical exam that you need to take care of

Depending on where the patient is in the coming out of anesthesia regime

If everything else you’ve done has not worked
Threat: Patient agitation

If the patient is quiet, but is still not getting a good enough volume, it's not agitation. EXIT THREAT.

Other potential indicators:

- Patient is old enough to be scared and not understand why
- After surgery
- Patient is flailing arms
- When they wake up from anesthesia, if they start fighting with the breathing tube
- Patient has a breathing tube in
- Patient is coming out of anesthesia
- Restraints on their wrists agitate them
- Secretions in the breathing tube
- The machine alarms
- You are able to suction out secretions in the breathing tube

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Depending on where the patient is in the coming out of anesthesia regime

If everything else you've done has not worked
Cues

- Mostly patient oriented
- Mostly perceptual/memorial
- Cues to both threat & strategy
- Exit cues
- Investigative cues (Implicit/Explicit)
- Blocker cues
THREATS
• Do threats change your cognitive landscape?
Pathfinder Scaling Algorithm

• Man walks into a bar and asks for a glass of water. The bartender points a shotgun at the man. The man says “Thank you,” and walks out.
Task only; No threats

- Restraints
  - Assess
  - Desatting
    - Ventilator
    - Sedation
    - Physician
    - Family
    - ET. Tube
    - Paralytic
    - Respiratory Therapist
    - Ambu bag & mask
    - Get Help
    - Code Button
    - Charge Nurse

Median: distance from here is 2 links
Inadequate Sedation

- Sedation
  - ET. Tube
    - Paralytic
  - Ventilator
  - Respiratory Therapist
    - Physician
  - Charge Nurse
    - Family
  - Ambu Bag & Mask
  - Code Button
  - Get Help
  - Asses
    - Restraints
      - Desatting
• Threats change the cognitive landscape
• They reorganize thinking; recenter it
Classifying Threats

- Staffing-related
- Patient-related
- Technology-related
- System-related
- Environment-related
- Patient-Tech
- Tech-System
Threats

- Staff: 9
- Patient: 6
- Pat-Tech: 9
- Tech: 11
- Tech-Sys: 7
- System: 4
- Environment: 4
Threats

- 53% Threats involve technology
STRATEGIES
Strategies

• A plan or method for achieving a goal
• Cockpit Task management
• Workload management
• Aviate-Navigate-Communicate
  – Airway-Breathing-Circulation
• SOPs
Example Interviewed Threats

- Staff (3): Inadequate support staff
- Patient (5): Inadequate sedation
- Pat-Tech (2): ET tube dislodged
- Tech (5): Ventilator malfunction
- Tech-Sys (1): Ambu bag missing
- System (6): No patient history
- Environment (1): Overstimulation from family
<table>
<thead>
<tr>
<th>Strategy Actions</th>
<th>Check for bag in morning</th>
<th>Start CPR</th>
<th>Press code button</th>
<th>Go to Omni Cell to get bag &amp; mask</th>
<th>Leave the kid to go get a bag</th>
<th>Get RT to work on ventilator while you get bag</th>
<th>Yell for someone to get a bag</th>
<th>Yell to a colleague that you need help</th>
<th>Get a nurse to get a therapist</th>
<th>A RT would come see what the problem is</th>
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EXIT THREAT

After the physical exam, if there is a specific finding to treat, like their breath sounds are not equal.

If there's nothing that's saying, "Hey, there's a blockage in the breathing tube", or "the reason they're not breathing good is this".

If you found something on your physical exam that you need to take care of.

Depending on where the patient is in the coming out of anesthesia regime.

If everything else you've done has not worked.

Based on the patient's history and diagnosis.

They have to be adequately medicated before you do that (paralyze the patient).

If there's a certain diagnosis where you know that this child cannot ventilate.

Patient has pain.

You can tell if the patient is splinting.

Patient is not breathing deeply / has shallow breathing.

Patient is fresh post-op so they have pain.

Physical exam

Checking for signs and the breathing tube and the automated devices.

Medication

- Sedative
- Sedative + Paralytic
- Pain medication
Strategies per Threat

Mean Strategies per Threat

- Inadequate support staff
- Inadequate sedation
- ET Tube dislodged
- Ventilator failure
- Ambu bag missing
- No patient history
- Overstim from family
General Strategy Classification

– Preventative strategies—before the threat
– Mitigating strategies—deal directly with the threat
– Ignore threat—continues as if there is no threat
– Work around strategies—not aimed at threat, but takes the threat into account
General Strategy Classification

Mean Number of Strategies per Threat

Preventative   Workaround   Mitigation   Ignore

0.5 3.5 3.5 0
ICU Strategy Classification

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<th>Threat</th>
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MAPPING STRATEGIES TO THREATS
## General Strategy per Threat

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<tr>
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</table>
## ICU Strategy per Threat

Entires are means per nurse;
a strategy could fall into more than one category

<table>
<thead>
<tr>
<th>Threats</th>
<th>Strategies</th>
<th>Staff</th>
<th>Patnt</th>
<th>Tech</th>
<th>Sys</th>
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Nurse’s Bag of Strategies

- Threats were often dealt with by a variety of strategies; staff, patient, technology strategies were common.
- Strategies for managing the system were rare.
- Strategies usually managed same resources as those that characterized the threat.
- Many strategies dealt directly with the threat.
- Nurses “worked around” Tech & System threats.
EVALUATING STRATEGIC ARSENALS
Evaluating Arsenals

Rating (High is good)

Frequency  Mental Effort  Time to choose  Time to implement  Workload  Understanding  Performance  Effective
Evaluating Arsenals

Rating (High is good)
# Arsenals

<table>
<thead>
<tr>
<th>Threat</th>
<th>Type</th>
<th>Mean of all strategies</th>
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<td>Ambu bag missing</td>
<td>Tech-System</td>
<td>4.9</td>
<td>5.3</td>
</tr>
<tr>
<td>Inadequate sedation</td>
<td>Patient</td>
<td>4.1</td>
<td>5.5</td>
</tr>
<tr>
<td>Patient agitation</td>
<td>Patient</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>ET tube dislodged</td>
<td>Tech-Pat</td>
<td>3.8</td>
<td>5.0</td>
</tr>
<tr>
<td>Inadequate support staff</td>
<td>Staffing</td>
<td>2.9</td>
<td>5.4</td>
</tr>
<tr>
<td>Overstimulation from family</td>
<td>Environment</td>
<td>2.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Physician unavailable</td>
<td>Staffing</td>
<td>1.5</td>
<td>3.3</td>
</tr>
</tbody>
</table>
A Gap in the Strategic Arsenal?

OVERSTIMULATION FROM FAMILY
Task only;
No threats

- Restraints
- Assess
- Desatting
- Ventilator
- Sedation
- Physician
- Family
- Code Button
- Get Help
- Charge Nurse
- Respiratory Therapist
- Ambu bag & mask
- ET. Tube
- Paralytic
Task only; No threats

- Ventilator
- Sedation
- Physician
- Family
- Restraints
- Assess
- Desatting
- Respiratory Therapist
- ET. Tube
- Paralytic
- Ambu bag & mask
- Get Help
- Code Button
- Charge Nurse

Most eccentric
Task only; No threats

- Restraints
- Assess
- Desatting
- Get Help
- Code Button
- Charge Nurse
- Ambu bag & mask
- Respiratory Therapist
- ET. Tube
- Paralytic
- Ventilator
- Sedation
- Physician
- Family

average distance 4.4 links

Most links

Most links
Overstimulation from Family

Sedation

Code

Paralytic

ET. Tube

Charge Nurse

Get Help

Respiratory Therapist

Physician

Assess

Family

Desatting

Restraints

Ambu Bag & Mask
Inadequate Sedation

- Sedation
  - ET. Tube
    - Paralytic
    - Ambu Bag & Mask
    - Code Button
    - Physician
      - Charge Nurse
      - Family
  - Respiratory Therapist
    - Get Help
  - Ventilator
    - Assess
      - Restraints
      - Desatting
    - Physician
The *Family* Concept

**Overstimulation from family**
- FAMILY now part of the graph
  - 2 links from median
  - 2.8 on average
  - 4 max (charge nurse, restraints)

**Inadequate sedation**
- FAMILY again eccentric
  - 4 links from median
  - 4.7 links on average
  - 7 max (diameter w/desatting & restraints)

\[ r = -0.12 \]
Overstimulation from Family

• 60 strategies across 10 expert PICU nurses
Overstimulation from Family

- Call a physician
- Sedation
- Let parents assist in patient care
- Use your colleagues to back you up
- Communicate with the family
  - Discuss with the family
  - Set goals with the family
- Get the respiratory therapist (RT) and physician
• 19 ineffective
• 27 were effective but required high effort
• 5 were effective but required moderate effort
• Only 9 both effective and low effort
Best strategies—Nurse 8

![Graph showing ratings for different strategies]

- Paired Pat
- Overstim

Rating (High is good)
“Good” strategies

<table>
<thead>
<tr>
<th>Nurse</th>
<th>Effective &amp; Low work</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt;</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Partnership (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Explain (5)</td>
<td>Ask not to touch (4)</td>
<td>Ask to sit down (1)</td>
</tr>
<tr>
<td>4</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Get director (5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Sedate (5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Assess patient (5)</td>
<td>Get superior (4)</td>
<td>Communicate w/parent (3)</td>
</tr>
</tbody>
</table>
• Only 5 nurses had any “good” strategy
• Only 2 nurses had more than 1 “good” strategy
• Experience and quality of strategy were uncorrelated ($r = .03$)
TAKE HOME
Take home messages

• Nurses manage threats:
  – Threats change the nurses cognitive landscape

• By processing patient oriented, perceptual and memorial cues to . . .

• Select strategies
  – To remove the threat or to
  – Work around system & technology threats
How good are these strategies?

• Nurses are resilient!
• Sometimes forced to choose between quick but ineffective strategies and effective but intensely effortful strategies
• For some nurses, for some threats, like Overstimulation from Family, there are too few good strategies
• Solutions may be in nontechnical training
More insightful take home messages

Never express yourself more clearly than you are able to think

Chance favors the prepared mind

Hell, there are no rules here, we’re trying to accomplish something

No job is too big, no fee is too big
"I was just rubbing sticks together for fun — I didn’t realize I was doing basic research."
Thank you
Pasteur in his quadrant

• **Basic:** tartaric vs. paratartaric acid
  – all *organic* crystals rotate light
• **Applied:** Contamination in fermentation
  – Crystals rotate light → fermentation was organic (Germ theory)
• **Basic:** Germ theory → experiments
  – Swan necks & beef broth
• **Applied:** beer, wine, silkworms, pasteurization, antiseptics
• **Basic (Analogy):** Fermentation:::contagious disease
• **Applied:** Vaccinations
Strategy Profiles

• Assessment of strategy on:
  – Frequency of use
  – Mental effort
  – Time to choose
  – Time to Implement
  – Workload
  – Situation Awareness
  – Performance
  – Effectiveness
Evaluating strategy profiles

- Comfort measures
- Restraints

Rating vs. metric:
- Frequency
- Mental effort
- Time to choose
- Time to implement
- Reduces workload
- Improves understanding
- Improves performance
- Effective at dealing with threat
How often & how effective?

- Effectiveness & Frequency of use are uncorrelated (.05)
- Workload/effort $\rightarrow$ frequency
- SA & Performance $\rightarrow$ Effectiveness
Hospitals

- 5,754 hospitals (941,995 beds; 37M admissions; $751B)
  - 2904 not for profit nongovernment
  - 1013 for profit
  - 1068 state and local government
Nursing

- 5 million nurses and support staff
- 2.5 million RNs
  - 503,000 critical care
  - 230,000 in xICU

- Supply 35% of patient’s direct care
- 25%-30% of the nurses’ time on direct care
- 45 years old; 20% turnover rate projected
- 1-2 high acuity patients (4-6 patients)
ATC strategies

• Derived from ATC-based taxonomies (Durso & Alexander, 2010; Koros, Della Rocco, Panjwani, Ingurgio, & D’Arcy, 2006; Loft, Sanderson, Neal, & Mooij, 2007)
  – Planning
  – Monitoring
  – Workload management
  – Situation Awareness
  – Coordination
  – Performance enhancement
  – Simplify
  – Precision
  – Problem resolution
  – Information gathering
  – Unclassified
<table>
<thead>
<tr>
<th><strong>Planning</strong></th>
<th><strong>Risk assessment</strong></th>
<th><strong>Formulating a backup plan</strong></th>
<th><strong>Anticipate pushbacks</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Monitoring</strong></td>
<td><strong>Problem detection</strong></td>
<td><strong>Attend to critical points where problems have occurred</strong>/ <strong>Focus on potential trouble areas</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Workload management</strong></td>
<td><strong>Adding more positions/Decombine</strong></td>
<td><strong>Request a gap in traffic</strong></td>
<td><strong>Anticipate workload peaks</strong></td>
</tr>
<tr>
<td><strong>Explicit SA enhancement/Maintain SA (Loft)</strong></td>
<td><strong>Actively heighten SA</strong></td>
<td><strong>Actively attempt to get the other guy’s SA</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Performance enhancement</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Simplify</strong></td>
<td><strong>Amalgamation</strong></td>
<td><strong>Use heuristics that minimize control</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Group streams</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Precision</strong></td>
<td><strong>Differentiation</strong></td>
<td><strong>Weight dimensions</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Problem resolution</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Nominal strategies</strong></td>
<td><strong>Resolve problems immediately</strong></td>
<td><strong>Rely on past experience</strong></td>
<td><strong>SOPs</strong></td>
</tr>
<tr>
<td><strong>Off-nominal strategies</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Information gathering</strong></td>
<td><strong>Rely on observations</strong></td>
<td><strong>Rely on pilot reports</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Coordinating</strong></td>
<td><strong>More effective communication</strong></td>
<td><strong>Providing others sufficient information</strong></td>
<td><strong>Ground control prepares</strong></td>
</tr>
<tr>
<td><strong>Unclassified strategies</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Expedite</strong></td>
<td><strong>Slowing down</strong></td>
<td><strong>Eliminate threat</strong></td>
<td><strong>Mitigate threat</strong></td>
</tr>
<tr>
<td><strong>Maintain control of frequencies</strong></td>
<td><strong>Prioritize</strong></td>
<td><strong>Get a better view</strong></td>
<td></td>
</tr>
</tbody>
</table>
Predicting frequency estimates

- Performance + Time-to-implement = Frequency