Contextual Factors Affecting the Success of a Medication Safety Intervention to Decrease Acute Kidney Injury

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Background and Objectives

- Nephrotoxic medication exposure (NTMx) is a common cause of acute kidney injury (AKI) in hospitalized children.
- The Nephrotoxic Injury Negated by Just-in-Time Action (NINJA) safety program seeks to reduce AKI via weekday screening of hospitalized patients for high NTMx.
- Pilot study reduced NTMx-associated AKI by 62% at one hospital center.
- Dissemination of NINJA to 9 collaborative partners avoided an estimated 644 high NTMx exposures and 346 NTMx-AKI episodes over 2 years of study.
- Significant AKI reduction at 5 of 9 hospital centers.
- Research questions: What contextual factors are associated with NINJA’s success at these 5 centers? What issues should hospitals consider when implementing NINJA? Are there necessary or sufficient conditions for achieving significant AKI reduction?
Collaborative Network and Data Collection

**• 9 pediatric hospitals from 8 U.S. states**
  - structurally diverse: free-standing children’s hospitals vs “children’s hospital within a hospital”

**• Data collection**
  - Weekday screenings for high NTMx of non-ICU patients without urinary tract infection (NINJA intervention)
  - Bi-weekly reports of NTMx and AKI rates
  - Quarterly web-based survey of:
    (a) participation in dissemination program
    (b) personnel resources dedicated to NINJA
    (c) progress and impediments in implementing NINJA automated trigger tool
  - Semi-structured interviews with NINJA team members
Outcome and Explanatory Conditions

- **Outcome:** Significant Decrease in AKI rate
  - presence/absence of a downward centerline shift in NTMx-related AKI per 1000 non-ICU patient-days
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- **Explanatory Conditions**
  - Based on Model for Understanding Success in Quality (MUSIQ)
  - Network participation
  - Implementation factors
  - Contextual factors
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- **Explanatory Conditions**
  - Based on Model for Understanding Success in Quality (MUSIQ)
  - Network participation
    - Participation in monthly webinars
    - Submission of monthly data
  - Implementation factors
  - Contextual factors
Outcome and Explanatory Conditions

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- **Explanatory Conditions**
  - Based on Model for Understanding Success in Quality (MUSIQ)
  - Network participation
  - Implementation factors
    - Initial NTMx-related AKI rate
    - Progress in building automated trigger-tool
  - Contextual factors
Outcome and Explanatory Conditions

- **Outcome:** Significant Decrease in AKI rate
  - presence/absence of a downward centerline shift in NTMx-related AKI per 1000 non-ICU patient-days

- **Explanatory Conditions**
  - Based on Model for Understanding Success in Quality (MUSIQ)
  - Network participation
  - Implementation factors
  - Contextual factors
    - Competing organizational priorities and delay severity
    - Assigned personnel:
      - Presence & hours of pharmacist, QI, and data champions
      - Number of dedicated pharmacists
Methodology and Data Calibration

- **Method**: inductive csQCA w/panel data (cf. Ragin 2014)
- **Measures and Calibrations**:
  - Starting AKI centerline >1.0, >2.0
  - Initial period (first six months)
    - delay due to other organizational priorities reported in either of first two quarterly surveys
    - for all other conditions, used 2nd quarterly survey
  - Established period
    - period until first AKI centerline downshift or end of study
    - condition is “generally present” when hospital reported its presence on at least 75% of quarterly surveys
## Results and Interpretation

### Necessary conditions

<table>
<thead>
<tr>
<th></th>
<th>ncon</th>
<th>ncov</th>
<th># hospitals w/nec cond</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1 Initial centerline &gt; 1.0</td>
<td>1.0</td>
<td>0.83</td>
<td>6</td>
</tr>
<tr>
<td>N2 Report build in progress w/in 6 mos</td>
<td>1.0</td>
<td>0.63</td>
<td>8</td>
</tr>
<tr>
<td>Solution</td>
<td>1.0</td>
<td>0.83</td>
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</tbody>
</table>

### Sufficient conditions

<table>
<thead>
<tr>
<th></th>
<th>scon</th>
<th>scov</th>
<th># hospitals w/suf cond</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1 Pharmacist champion w/ hours, and Consistent report build, and 2+ pharmacists assigned</td>
<td>1.0</td>
<td>0.8</td>
<td>4</td>
</tr>
<tr>
<td>S2 No pharmacist champion, and No assigned pharmacists, and No QI or data champion, and No consistent report build, but No consistent report build, but No other organizational priorities</td>
<td>1.0</td>
<td>0.2</td>
<td>1</td>
</tr>
<tr>
<td>Solution</td>
<td>1.0</td>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>

* Core conditions in **bold**
QCA and (Very) Small-N Research

• Most QCA projects are 15-50+ observations and 5-12 conditions
  – a challenge for diversity-oriented research with few observations is that each observation carries great weight

• Some QCA researchers argue that number of observations (N) limits number of conditions (C) — “too many conditions; too few cases”

• Such a directive betrays a conventional statistical perspective that assumes the independence of variables (conditions)

• In fact, QCA is helpful for managing the complexity associated with high C/N ratios

• QCA views cases as holistic configurations and configurations as combinations of conditions

• QCA seeks to identify meaningful set-theoretic relations: consistency, coverage, truth tables, etc are but means to this end
QCA and Longitudinal Research

• How to measure change set theoretically?
  
• Strategy 1: Embed measure of change into conditions
  – Ragin 2014
  – Outcome: Improvement in AKI rate

• Strategy 2: Define separate conditions for different time periods
  – Initial period vs established period

• Strategy 3: Use set coincidence to measure how sets or truth tables change over time
  – e.g., Rubinson and Mueller 2016