Evaluation of Clinical Information Systems Expectations and Experience

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Funding Support: AHRQ – THQIT Implementation #1 UC1HS015196-01
University of Missouri Center for Health Care Quality
Overview

- Background/Purpose
- Method
- Results
- Implications
Background

- Implementing EHR and CPOE can act as drivers to change work processes and work flow.

- Question: How does EHR and CPOE implementation influence staff perceptions regarding work processes and flow, and quality?

- Needed is a measure to assess staff perceptions regarding EHR and CPOE expectations and experiences regarding changes in work flow and quality.

- This presentation describes an instrument designed to assess these expectations and experiences.
Instrument Development: Section I

- Perceptions of Changes in Work Process
- Brainstorming, face validity, pilot testing
- Five Focus Areas:
  - Provider-Patient Communication
  - Inter-Provider Communication
  - Inter-Organizational Communication
  - Work Life
  - Improved Care
- Scale: Much Worse (-3) to No Change (0) to Much Improved (+3)
Section I: Pre vs. Post-Implementation Assessment

- **Pre**: “Please indicate the extent to which you think that the following areas will be either: Worsened (-3, -2, -1), Stay the Same (0), or be Improved (+1, +2, +3) after the new clinical information systems are implemented. In answering each item assume that you have been using the new clinical information systems for 3 months.”

- **Post**: “Please indicate the extent to which you think that the following areas have either: Worsened (-3, -2, -1), Stay the Same (0), or be Improved (+1, +2, +3) after the new clinical information systems were implemented.”
Instrument Development: Section II

- Two focus areas:
  - Implementation Strategy – 8 items
  - Nine Rights of Quality Patient Care – 9 items
- Scale: Strongly Disagree (1) to Strongly Agree (6)
Section II: Implementation Strategy & Quality

- **Implementation Strategy:** “Please indicate the extent to which you agree with the following statements”

- **Quality:** “Please indicate the extent to which you agree with the following statement. The new clinical information systems will improve our ability to give patient care:”… Right Treatment, Patient, Time, Amount/Dose, Way, Person, Information, Location

- Questions phrased in **future tense** for Pre- and **past tense** for Post-Assessment use.
Method

- **Participants**
  - RNs from a large Midwestern rural referral hospital
    - N = 331 pre, 116 post
  - Mean of 16.3 (SD = 9.5) years experience in healthcare
  - 53 indicated previous experience with EMR or CPOE
    - Mean of 4.3 (SD = 4.8) years experience with EMR or CPOE

- **Survey distributed pre- and post-EMR/CPOE implementation**
  - Pre: first day of training
    - Focuses on Future State
  - Post: ~6 months after launch of technology
    - Focuses on Current / Past Experience
Results: Item Analysis

- Participants used full range of responses

- Pre-implementation items highly negatively skewed; post scores less skewed
  - Participants were optimistic about changes when considering future implementation
  - Example: Item 22 “Communication at the end of shift handoffs”
    - Pre: Mean = 4.90, Median = 5.00, Mode = 6.00
    - Post: Mean = 4.17, Median = 4.00, Mode = 4.00

- 12 items dropped from Section I because they cross-loaded onto other factors. Retained for other analyses.

- Final scale used for following analyses included 19 items in Section I and 17 items in Section II
Section I Factor Analysis Results

- Confirmatory factor analysis supported five-factor structure for 17 items in Section I
  - Proposed factors: Provider-Patient Communication (PP), Inter-Provider Communication (IP), Inter-Organizational Communication (IO), Worklife Changes (WL), Improved Care (IC)

- Weaker fit for pre-implementation data
  - $\chi^2$ (142) = 666.58, NNFI = .87, CFI = .89, RMSEA = .11
  - Non-normality of data tends to reduce fit
  - *Projection into future / Expectations may have reduced fit*

- Excellent fit for post-implementation data
  - $\chi^2$ (142) = 151.47, NNFI = .99, CFI = .99, RMSEA = .032
  - Based on 6 months of experience with the technology
Final Measure Section I – Perceptions of Changes in Work Process

- Provider-Patient Communication (3 items, pre $\alpha = .82$, post $\alpha = .81$)
  - “How often patients are asked the same questions”

- Inter-provider Communication (3 items, pre $\alpha = .86$, post $\alpha = .85$)
  - “Communication at the end of shift handoffs”

- Inter-Organizational Communication (2 items, pre $\alpha = .83$, post $\alpha = .83$)
  - “Communication when patients are transferred to other facilities”

- Worklife Changes (4 items, pre $\alpha = .88$, post $\alpha = .83$)
  - “The amount of professional satisfaction I get out of my job”

- Improved Care (7 items, pre $\alpha = .90$, post $\alpha = .91$)
  - “The timeliness with which patient care services are provided”
Results: Pre/Post Comparison

- Overall, scores were lower for post-implementation perception scores across all five subscales in Section I.

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Mean Score Pre</th>
<th>Mean Score Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP = Provider-Patient Communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IP = Inter-Provider Communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IO = Inter-Organizational Communication</td>
<td></td>
<td></td>
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<tr>
<td>WL = Work Life</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC = Improved Care</td>
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</tbody>
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![Bar Chart Showing Mean Scores for Pre and Post Implementation](chart.png)
Results: Section I Pre/Post Experience with Technology

- Generally **similar pre-implementation expectations** re: future for those with vs. those without previous technology experience
- Post-implementation perceptions **consistently lowest for those without** previous technology experience

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Mean Score</th>
<th>Pre No Experience</th>
<th>Pre Experience</th>
<th>Post No Experience</th>
<th>Post Experience</th>
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</thead>
<tbody>
<tr>
<td>PP</td>
<td>0</td>
<td>2</td>
<td>-1</td>
<td>1</td>
<td>0</td>
</tr>
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<td>IP</td>
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<tr>
<td>IC</td>
<td>-2</td>
<td>1</td>
<td>1</td>
<td>1</td>
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</tr>
</tbody>
</table>

**PP** = Provider-Patient Communication  
**IP** = Inter-Provider Communication  
**IO** = Inter-Organizational Communication  
**WL** = Work Life  
**IC** = Improved Care
Section II Factor Analysis Results

- Confirmatory factor analysis supported two-factor structures
- Proposed factors: Implementation Strategy (IM) and Nine Rights of Quality Patient Care (NR)

- Excellent fit for pre-implementation data
  - $\chi^2 (47) = 54.50$, NNFI = .99, CFI = .99, RMSEA = .022

- Excellent fit for post-implementation data
  - $\chi^2 (47) = 54.24$, NNFI = .99, CFI = .99, RMSEA = .039
Final Measure Section II – Implementation Strategy and Quality

- **Implementation Strategy** (8 items, pre $\alpha = .88$, post $\alpha = .87$)
  - “I support the planned change in current clinical information systems”

- **Nine Rights of Quality Patient Care** (9 items, pre $\alpha = .99$, post $\alpha = .97$)
  - “The new clinical information systems will improve our ability to give patient care…”
    - “To the Right Patient”

- $\alpha =$ Cronbach’s Alpha
Results: Pre/Post Comparison

- Overall, scores were lower for post implementation perceptions / experience scores across both Section II subscales

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<thead>
<tr>
<th>Subscale</th>
<th>Mean Score</th>
<th>Pre</th>
<th>Post</th>
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<tbody>
<tr>
<td>IM</td>
<td>5.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NR</td>
<td>4.8</td>
<td></td>
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Results: Section II Pre/Post Experience with Technology

- Generally *similar pre-implementation expectations* re: future for those with vs. those without previous technology experience.
- Post-implementation perceptions *lower for the NR subscale for those without* previous technology experience.

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IM = Implementation Strategy
NR = Nine Rights of Quality Patient Care
Implications

- Measure offers a potential mechanism for assessment of expectations and experiences with clinical technology implementation.
- Useful for health management/informatics researchers seeking to test theories of technology adoption and reaction.
Management Implications

- Maybe useful for organizations seeking to assess changes as a result of technology implementation and target areas for training and work redesign

- For example, *expectations for the future* for Inter-Provider Communication were *much higher than perceptions related to experiences*
  - Suggests Inter-Provider Communication as an area to target through implementation and beyond in order to meet initial levels of expected improvement

- Worklife changes were lower than other factors both pre- and post-
  - Suggests an area of improvement to develop higher expectations and better experiences
Limitations

- Small sample size, particularly for post-implementation data
- Limited to one study site
- Single occupational group
Future Research

- Further examination of measure’s psychometric properties
- Replication in additional samples
- Effectiveness as a tool to guide technology implementation in organizations has not been tested
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