Review of Health Information System Evaluation Methodologies

Workshop Outline

<table>
<thead>
<tr>
<th>TIME</th>
<th>TOPIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0900</td>
<td>Introduction, Objectives and Expectations</td>
</tr>
<tr>
<td>0905</td>
<td>UVic eHealth Observatory – Models, Methods and Metrics, Part-1</td>
</tr>
<tr>
<td>0940</td>
<td>UVic eHealth Observatory – Models, Methods and Metrics, Part-2</td>
</tr>
<tr>
<td>1015</td>
<td>Nutritional Break</td>
</tr>
<tr>
<td>1030</td>
<td>Benefits Evaluation Experiences at Canada Health Infoway</td>
</tr>
<tr>
<td>1100</td>
<td>In-depth Case Study: PharmaNet-supported Medication Reconciliation</td>
</tr>
<tr>
<td>1130</td>
<td>Open Discussion on Experiences and Issues</td>
</tr>
</tbody>
</table>

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Introduction, Objectives, Expectations

- **Introduction**
  - Facilitator 1: Francis Lau, Health Information Science, UVic
  - Facilitator 2: Simon Hagens, Canada Health Infoway
  - Participant backgrounds?

- **Workshop Objectives**
  - Describe health information system (HIS) evaluation methodologies
  - Discuss HIS evaluation study findings, experiences and issues
  - Provide HIS evaluation resources and tools
  - Learn from each other

- **Participant Expectations?**
  - What (else) do you expect to get out of this workshop?
What is the UVic eHealth Observatory?

- Overall Aim
  - Monitor effects of HIS deployment and use in Canada

- Specific Objectives
  - Employ models/methods/metrics to evaluate HIS adoption/use/impact
  - Engage eHealth community in KT to synthesize/share/use knowledge
  - Build research capacity in HIS implementation/evaluation

- Program Scope
  - Medication management, EMR/EHR integration; care providers ...
  - Secondary use in performance management

- Contexts
  - System related: eDrug, EMR, lab and EHR in BC and elsewhere
  - Social/healthcare related: communities, organizations, domains
What are the HIS Evaluation Models?
Existing Infoway BE Framework

- **SYSTEM QUALITY**
  - Functionality
  - Performance
  - Security

- **INFORMATION QUALITY**
  - Content
  - Availability

- **SERVICE QUALITY**
  - Responsiveness

**USE**
- Use Behavior/Pattern
- Self Reported Use Intention to Use

**USER SATISFACTION**
- Competency
- User Satisfaction
- Ease of Use

**NET BENEFITS**

**QUALITY**
- Patient Safety
- Appropriateness/Effectiveness
- Health Outcomes

**ACCESS**
- Ability of Patients/Providers to Access Services
- Patient and Caregiver Participation

**PRODUCTIVITY**
- Efficiency
- Care Coordination
- Net Cost

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**Why the Need for Extension?**
- Original IS success model intended for stable information systems
- Out of scope for organizational and contextual
- Micro-view of HIS within an organization
- Contingent factors, e.g., development, implementation, culture
- Jurisdictions implementing HIS, with focus on adoption/use
- Missing socio-organizational/contextual aspects

**What Theories/Concepts/Ideas for Extensions?**
- Information technology interaction model by Silver et al. [3]
- Technology acceptance models by Chen, Vankatesh, others [4,5]
- Implementation research/managing change – Kotter, Pare, others [6,7]
- Socio-organizational and contextual issues

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Lau et al. 2006 [1], Adapted from DeLone & McLean 2003 [2]

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What are the HIS Evaluation Models?

**IT Interaction Model** by Silver et al. 1995 [3]

**Technology Acceptance Models** by Lee, etc [4]

What are the HIS Evaluation Models?


1. Establishing a Sense of Urgency
2. Forming a Powerful Guiding Coalition
3. Creating a Vision
4. Communicating the Vision
5. Empowering Others to Act on the Vision
6. Planning for and Creating Short-term Vision
7. Consolidating Improvements and Producing More Changes
8. Institutionalizing New Approaches

What are the HIS Evaluation Models?

HIS Project Risk Factors by Pare et al. 2008 [7]

- **Technological**
  - Introduction of new technology
  - Complex/unreliable technical infrastructure
  - Complex software solution
  - Poor software performance

- **Human/User**
  - Unrealistic expectations
  - Overall resistance to change
  - Lack of user cooperation/commitment
  - Poor computer skills
  - Prior negative experience with CIS projects

- **Usability**
  - Poor perceived system ease of use
  - Poor perceived system usefulness
  - Misalignment of system with local practice

- **Project Team**
  - Changes to membership on team
  - Poor project leadership
  - Lack of knowledge, role definitions
  - Negative attitude of team members

- **Project**
  - Large/complex project, ambiguity
  - Requirement changes, lack of resources
  - Lack of project management method

- **Organization**
  - Lack of upper management commitment
  - Organizational/environment instability
  - Lack of personnel knowledgeable in IT

- **Strategic/political**
  - Misalignment of objectives/stakes
  - Political games/conflicts
  - Unreliable partners
What are the HIS Evaluation Models?

Socio-organizational/Contextual Aspects

- Policy – Governance, accountability
- Legislations – PIPEDA, FOIPPA, e-Health Act, Health Information Act
- Standards – HL7v3/CDA, vocabularies, ISO-13606/27799, etc.
- Funding/Incentives – POSP, PITO, salary vs. fee-for-service
- Professional Practices – Nurse practitioners, pharmacist prescribing, primary health care charter, shared care
- Others

What are the Evaluation Models?

Proposed Infoway BE Framework Extensions

Extended Infoway BE Framework for HIS in Contexts [8]
What are the Evaluation Models?

Proposed Infoway BE Framework Extensions

Integrated Micro, Meso and Macro Views of HIS Deployment/Use

- **Micro View**
  - **HIS quality:** system, information and service quality
  - **Use/satisfaction:** use and user satisfaction
  - **Net benefits:** care quality, access and productivity

- **Meso View**
  - **People:** characteristics, performance/effort, social influence and facilitating conditions
  - **Organization:** type/fit of structure, culture, strategy, process and infrastructure
  - **Network:** range/depth of alliances, partners, affiliate and governance
  - **Implementation:** type/intensity of process, changes and risks

- **Macro View**
  - **Technology standard:** range of data, messaging and terminology standards
  - **Funding/incentive:** type of remuneration and investment available
  - **Legislation/policy:** legislative acts, regulations and policies on HIS design and use
  - **Professional practice:** roles/responsibilities and practice standards for HIS use

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What are the HIS Evaluation Methods?

- **Study Design Approaches**
  - Interventional: randomized vs. non-randomized trials
  - Observational: cross-sectional survey, case control, cohort studies
  - Others: descriptive, case studies/series, exploratory

- **Data Collection/Analysis Approaches**
  - Subjective vs. objective: satisfaction vs. lab results (e.g. hemoglobin)
  - Prospective vs. retrospective: using new vs. historical data
  - Quantitative vs. qualitative: e.g. 1, 2, 3.5 vs. “feeling depressed”
  - Data collection: survey (e.g. questionnaire, one-on-one or group interview), observation, focus group, parametric data (e.g. lab results, measurements)
  - Descriptive vs. inferential statistics: frequency counts vs. hypothesis testing
  - Qualitative analysis: thematic analysis, grounded theory
  - Others: simulation, economic evaluation, meta-analysis ....

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What are the HIS Evaluation Methods?

Interventional Trials – RCT Design

- Randomized controlled studies [9-12]
  - Individual vs. cluster randomization, by patient, family, provider, clinic ...
  - Allocation concealment: done by others at time of randomization
  - Blinding of subjects: early vs. delayed, or partial blinding
  - Follow-up/missing data: including dropouts, imputation for missing data
  - Sample size/power: based on events, clusters, dropouts, effect size
  - Statistical analysis: intention-to-treat principle

Continuous outcome
Discrete outcome

Patients by Test and Control Groups by Physician by Clinic

Clinic1
Clinic2
Clinic3
Clinic4

Control Group

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### Quasi-experimental Study Designs

<table>
<thead>
<tr>
<th></th>
<th>Quasi-experimental without control groups</th>
<th>Design Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1. One-group posttest-only</td>
<td>X O1</td>
</tr>
<tr>
<td></td>
<td>2. One-group pretest-posttest</td>
<td>O1 X O2</td>
</tr>
<tr>
<td></td>
<td>3. One-group pretest-posttest with double pretest</td>
<td>O1 O2 X O3</td>
</tr>
<tr>
<td></td>
<td>4. One-group pre-post, nonequivalent dependent variable</td>
<td>(O1a,O1b) X (O2a,O2b)</td>
</tr>
<tr>
<td></td>
<td>5. Removed-treatment</td>
<td>O1 X O2 O3 removeX O4</td>
</tr>
<tr>
<td></td>
<td>6. Repeated-treatment</td>
<td>O1 X O2 removeX O3 X O4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Quasi-experimental with control but no pretest</th>
<th>Intervention group: X O1</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>1. Posttest-only with nonequivalent groups</td>
<td>Control group: O2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Quasi-experimental with control groups and pretests</th>
<th>Intervention: O1a X O2a</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>1. Untreated control group, dependent pre-post samples</td>
<td>Control: O1b O2b</td>
</tr>
<tr>
<td></td>
<td>2. Untreated control, dependent pre-post, double pretest</td>
<td>Intervention: O1a O2a X O3a</td>
</tr>
<tr>
<td></td>
<td>3. Untreated control, dependent pre-post, with switching</td>
<td>Control: O1b O2b O3b</td>
</tr>
</tbody>
</table>

|   | Interrupted time-series | 01 O2 O3 O4 O5 X O6 O7 ... |

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### What are the HIS Evaluation Methods?

Rapid Response HIS valuation Methods

Assembling the HIS evaluation methodology toolkit

- **HIS Users**
  - Early Adopters
  - Advanced-users
  - Intermediate-users
  - Basic-users
  - Non-users
  - Late Adopters

- **HIS Lifecycle**
  - Telescopic Views

- **HIS Effects**
  - Usability Engineering
  - Process Evaluation

- **Requirements**
- **Deployment**
- **Use**
- **Adaptation**
  - Close-up
  - In-motion
  - Fixed-anchor
  - Wide-angle

- **Evaluation**
  - Impact Evaluation
  - Meta-analysis And Review

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What are the HIS Evaluation Metrics?
Infoway BE HIS Quality/Use Indicators [1]

System Quality
- Performance - response time for standard tasks, Reliability
- Integration with workflow
- User friendliness
- Security

Use
- Frequency of use
- Frequency of use by patient
- Intention to increase use

Information Quality
- Completeness / accuracy of information – medication profile, DI & lab results
- Timeliness and relevance of information

User Satisfaction
- Perceived usefulness and value
- Perceived impact on productivity and integration with workflow
- Perceived impact on quality of care

Service Quality
- Training and support

What are the HIS Evaluation Metrics?
Infoway BE HIS Net Benefits Indicators [2]

Change in patient safety
- Medication errors and Adverse Drug Events

Change in health system outcomes
- Readmission rates
- Efficiency of recovery
- Patient transfers

Change in access to services
- Volume of service provision
- Access to previously unavailable services
- Timeliness of DI services

Change in provider effectiveness / appropriateness of care
- Timeliness of service delivery, pharmacists, public health, referring physicians, radiologists
- Vaccination rates, Outbreak detection and intervention

Change in patient and caregiver participation
- Patient awareness and adherence

Change in provider efficiency
- Radiology Technologist and Radiologist efficiency
- Pharmacists and Lab technician callbacks
- Time to take medication history or assess patient
- Clinician workflow

Change in coordination of care
- Information sharing among different providers
- Management of outbreaks

Change in net costs
- Unnecessary events: radiology, lab tests, vaccinations

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What are the HIS Evaluation Metrics?

**Infoway BE Program Level Indicators, Others**

- **Diagnostic Imaging**
  - Efficiency improvements for staff
  - Improved turnaround time of test results
  - Reduced test duplications

- **Drug**
  - Improved medication patient assessment and history taking
  - Pharmacist call-back to prescribing physicians
  - Reduced medication errors and adverse drug events

- **Lab**
  - Improved turnaround time of test results
  - Reduced test duplications
  - Completeness of lab profiles

- **Other Indicators?**
  - Cusack et al. AHRQ Evaluation Toolkit Data Exchange Projects, n.d. [13]

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What are the HIS Evaluation Metrics?

**Statistical Significance, Power, Effect Size** [14]
What are the HIS Evaluation Metrics? *Odds Ratio, Relative Risk, Risk Difference* [15]

<table>
<thead>
<tr>
<th>Trial Result</th>
<th>Event</th>
<th>No event</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>A</td>
<td>B</td>
<td>N1 = A+B</td>
</tr>
<tr>
<td>Control</td>
<td>C</td>
<td>D</td>
<td>N2 = C+D</td>
</tr>
</tbody>
</table>

**OR, RR**

<table>
<thead>
<tr>
<th>Odds ratio =</th>
<th>Odds of event in intervention group =</th>
<th>A/B</th>
<th>AD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds of event in control group</td>
<td>C/D</td>
<td>BC</td>
</tr>
</tbody>
</table>

| Relative risk = | Risk of event in intervention group = | A/(A+B) |
|                | Risk of event in control group      | C/(C+D) |

**RD**

| Risk difference = | Risk of event in intervention group – risk of event in control group = | A/(A+B) – C/(C+D) |

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What are the HIS Evaluation Metrics? *Sensitivity, Specificity, LR +/-, PPV, NPV* [16]

<table>
<thead>
<tr>
<th>Test results</th>
<th>With disease</th>
<th>Without disease</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive test</td>
<td>True positives</td>
<td>False positives</td>
<td>Total positive</td>
</tr>
<tr>
<td>Negative test</td>
<td>False negatives</td>
<td>True negatives</td>
<td>Total negative</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diagnostic accuracy</th>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>No. of true positives / total with disease</td>
</tr>
<tr>
<td>Specificity</td>
<td>No. of true negatives / total without disease</td>
</tr>
<tr>
<td>Likelihood ratio +ve</td>
<td>Sensitivity / (1 - specificity)</td>
</tr>
<tr>
<td>Likelihood ratio -ve</td>
<td>(1 - sensitivity) / specificity</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>No. of true positives / total positive</td>
</tr>
<tr>
<td>Negative predictive value</td>
<td>No. of true negatives / total negative</td>
</tr>
</tbody>
</table>
Assembling the HIS evaluation methodology toolkit

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- Non-users
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**HIS Lifecycle**
- Requirements
- Deployment
- Use
- Adaptation

**Telescopic Views**
- Close-up
- In-motion
- Fixed-anchor
- Wide-angle

**HIS Effects**
- Usability Engineering
- Process Evaluation
- Impact Evaluation
- Meta-analysis And Review

**Usability Testing/Inspection**

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**Figure 1. Steps in the Usability-Based Assessment of Technology-Induced Error in Healthcare.**

<table>
<thead>
<tr>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step One</strong></td>
</tr>
<tr>
<td><strong>Step Two</strong></td>
</tr>
<tr>
<td><strong>Step Three</strong></td>
</tr>
<tr>
<td><strong>Step Four</strong></td>
</tr>
<tr>
<td><strong>Step Five</strong></td>
</tr>
<tr>
<td><strong>Step Six</strong></td>
</tr>
</tbody>
</table>


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1. **Data Collection**
   - PDA screens
   - Data Projector
   - Video Camera
   - User
   - Audio-Recording of “think aloud” (using a microphone)

2. **Data Analysis**
   - Coding of usability problems
   - Coding of prescription errors

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Rapid Response Evaluation Methods
Process Evaluation – Workflow Analysis


Figure 1. A function model of medication management. The major activities involved in medication management are shown as boxes. For each box, arrows on the left show the activity’s inputs, those on the right show its outputs, those above show information that may influence the activity’s performance, and those below show resources that the activity may occupy. This notation is based directly on the Integrated Definition for Functional Modeling (IDEF0). In addition, the shaded boxes indicate the potential unifying effects of system integration, making the same patient data available for activities. Bold shading or bold letters indicates an element that is mandatory for the particular activity. Gray shading indicates an element that is usually involved in the activity but is not mandatory; “e-Rx” is an abbreviation for electronic prescribing.

Rapid Response Evaluation Methods
Process Evaluation – Time-Motion Study


- Question/Scope
  - What is the impact of e-prescribing on workflow?
  - Comparison of time-efficiency of paper vs. e-prescribing for physician/staff in clinics

- Evaluation Design
  - Cross-sectional comparison of 3 sites at different stages of implementation
  - Time-motion techniques to compare prescribing times at 3 ambulatory care sites
  - Comparison between paper-based prescribing, desktop or laptop e-prescribing
  - Observer timed prescriber (n=27) and staff (n=42) tasks over 4-hours
  - For optional e-prescribing, >75% events were electronic

- Summary of Findings
  - e-prescribers spent less time writing; time-savings offset by increased computer tasks
  - e-prescribing tasks marginally longer than hand-written prescriptions
  - e-prescribing site nursing staff spent longer in computer tasks
  - e-prescribing not associated with increase in computer and writing time for prescribers
  - Careful implementation of e-prescribing will NOT disrupt workflow

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Table 1 | Characteristics of Prescribers, RNs/MAs, and Staff

<table>
<thead>
<tr>
<th></th>
<th>SL—Paper</th>
<th>HP—Desktop</th>
<th>SN—Laptop</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consent (%):</td>
<td>8/10 (80%)</td>
<td>11/15 (73%)</td>
<td>8/9 (100%)</td>
<td>27/32 (84%)</td>
</tr>
<tr>
<td>Specialty</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Practice</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>WIC</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Internal Med</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Females (%)</td>
<td>3 (30%)</td>
<td>3 (27%)</td>
<td>5 (63%)</td>
<td>11/27 (41%)</td>
</tr>
<tr>
<td>Mean Age In Years</td>
<td>44</td>
<td>46</td>
<td>46</td>
<td>45</td>
</tr>
<tr>
<td>Mean Hours Observed</td>
<td>3.54</td>
<td>3.61</td>
<td>3.81</td>
<td>3.66</td>
</tr>
<tr>
<td>Mean Time Unable to</td>
<td>9.8 mins</td>
<td>19.7 mins</td>
<td>7.7 mins</td>
<td>17.3 mins</td>
</tr>
<tr>
<td>Observe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RNs</td>
<td>RN: 7</td>
<td>RN: 12</td>
<td>RN: 3</td>
<td>RN: 22</td>
</tr>
<tr>
<td>MAs</td>
<td>MAs: 4</td>
<td>MAs: 9</td>
<td>MAs: 7</td>
<td>MAs: 10</td>
</tr>
<tr>
<td>Number Observed/Number of</td>
<td>11/21 (52%)</td>
<td>21/25 (84%)</td>
<td>10/13 (77%)</td>
<td>42/59 (71%)</td>
</tr>
<tr>
<td>Potential Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Female</td>
<td>11/11 (100%)</td>
<td>20/21 (99%)</td>
<td>10/10 (100%)</td>
<td>41/42 (98%)</td>
</tr>
<tr>
<td>Mean Age</td>
<td>44</td>
<td>32</td>
<td>49</td>
<td>43</td>
</tr>
<tr>
<td>Mean Hours Observed</td>
<td>3.52</td>
<td>3.61</td>
<td>3.77</td>
<td>3.62</td>
</tr>
<tr>
<td>Mean Time Unable to</td>
<td>1.0 mins</td>
<td>1.9 mins</td>
<td>0.5 mins</td>
<td>1.3 mins</td>
</tr>
<tr>
<td>Observe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MA = medical assistant; mins = minutes; RN = Registered nurse; WIC = Walk-in clinic; SL = Silver Lake; HP = Harbour Pointe; SN = Snouchim.

Table 2 | Prescribers’ Time Spent on Specific Task Categories

<table>
<thead>
<tr>
<th>Task Category</th>
<th>SL—Paper Mins. per Hr (n = 8)</th>
<th>HP—Desktop Mins. per Hr (n = 11)</th>
<th>SN—Laptop Mins. per Hr (n = 9)</th>
<th>Weighted Mean Difference (95% CI) Between e-prescribing and Paper-based Sites Mins. per Hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Tasks</td>
<td>3.8</td>
<td>7.4</td>
<td>8.1</td>
<td>2.9 (0.3, 7.5)*</td>
</tr>
<tr>
<td>Writing Tasks</td>
<td>8.7</td>
<td>5.5</td>
<td>5.9</td>
<td>-3.0 (-5.6, -0.2)*</td>
</tr>
<tr>
<td>Computer and Writing Tasks, combined</td>
<td>12.4</td>
<td>12.9</td>
<td>14.0</td>
<td>1.0 (-3.4, 5.5)</td>
</tr>
<tr>
<td>Talking to Patient or Family</td>
<td>19.0</td>
<td>17.8</td>
<td>20.3</td>
<td>-0.1 (-5.5, 5.2)</td>
</tr>
<tr>
<td>Talking Colleague/Other</td>
<td>6.6</td>
<td>11.6</td>
<td>8.2</td>
<td>3.6 (-0.2, 7.5)</td>
</tr>
<tr>
<td>Examining Patient</td>
<td>8.9</td>
<td>4.9</td>
<td>5.3</td>
<td>-3.8 (-5.8, -1.9)</td>
</tr>
<tr>
<td>Examine Chart/Other</td>
<td>6.1</td>
<td>5.7</td>
<td>5.3</td>
<td>-0.6 (-2.7, 1.5)</td>
</tr>
<tr>
<td>Other Tasks—Total</td>
<td></td>
<td></td>
<td></td>
<td>0.2 (-3.2, 3.6)</td>
</tr>
<tr>
<td>Procedure</td>
<td>2.1</td>
<td>1.5</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td>Phone Colleague/Other</td>
<td>0.5</td>
<td>1.0</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td>1.3</td>
<td>1.0</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Looking For</td>
<td>0.5</td>
<td>0.9</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Phone Patient</td>
<td>0.3</td>
<td>1.2</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>1.3</td>
<td>1.6</td>
<td>0.8</td>
<td></td>
</tr>
</tbody>
</table>

SL = Silver Lake; HP = Harbour Pointe; SN = Snouchim.

*We provide detail on task categories that took up ≥75% of time at one or more site. Other tasks are grouped as ‘other’. tp < 0.05.

Table 3 | Prescription-related Events (Prescribers)

<table>
<thead>
<tr>
<th></th>
<th>Hand Written Prescription Event Seconds per Event (s)</th>
<th>e-prescription Event Seconds per Event (s)</th>
<th>Adjusted Mean Difference*</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL—Paper</td>
<td>47.6 (68)</td>
<td>N/A (0)</td>
<td></td>
</tr>
<tr>
<td>HP—Desktop</td>
<td>38.1 (26)</td>
<td>43.6 (59)</td>
<td>9.5 (-9.8, 28.8)</td>
</tr>
<tr>
<td>SN—Laptop</td>
<td>62.5 (10)</td>
<td>72.5 (59)</td>
<td>9.8 (-23.4, 43.1)</td>
</tr>
<tr>
<td>All Sites</td>
<td>46.7 (104)</td>
<td>56.0 (138)</td>
<td>12.0 (-1.6, 25.6)</td>
</tr>
<tr>
<td>New Prescriptions</td>
<td>45.6 (68)</td>
<td>61.2 (80)</td>
<td>15.4 (-10.4, 41.2)</td>
</tr>
<tr>
<td>Renew Prescriptions</td>
<td>52.9 (16)</td>
<td>48.7 (58)</td>
<td>4.2 (-17.9, 26.3)</td>
</tr>
</tbody>
</table>

SL = Silver Lake; HP = Harbour Pointe; SN = Snouchim.

*Mean additional time spent for e-prescription compared to a handwritten prescription calculated from the linear mixed effects model adjusting for prescriber and type of prescription (long/short).

May 31, 2009
Rapid Response Evaluation Methods
Impact Evaluation — Randomized Trial


- **Question/Scope**
  - What is the impact of clinical reminders on diabetes+CAD care and physician attitudes?
  - Integrated patient-specific electronic clinical reminder system

- **Evaluation Design**
  - Randomized primary care clinics with EMR+reminders or usual care
  - 194 physicians, 4549 diabetic patients, 2199 CAD patients, 20 ambulatory clinics
  - Primary outcome: receipt of recommended care for diabetes and CAD
  - Summary outcome: odds of increased compliance, diabetes x5 and CAD x4 measures
  - Physician survey on attitudes towards reminder system

- **Summary of Findings**
  - Baseline adherence rates to quality measure were low
  - Reminders increased odds of recommended care, but individual impact variable
  - 3 of 9 reminders increased rates of recommended care
  - 76% physicians thought reminders improved quality of care
  - *Integrated electronic reminders led to variable improvement in diabetes+CAD care*
### Table 1: Baseline Patient and Physician Characteristics among Enrolled Patients with Overdue Recommendations

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Intervention (n = 294)</th>
<th>Control (n = 3319)</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patient characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean age, yr (± SD)</td>
<td>62.4 (± 144)</td>
<td>65.3 (± 144)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Male (%)</td>
<td>1201 (41)</td>
<td>1529 (48)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Race (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>1388 (54)</td>
<td>2114 (64)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Black</td>
<td>466 (16)</td>
<td>414 (12)</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>631 (22)</td>
<td>334 (9)</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>35 (1)</td>
<td>87 (3)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>49 (2)</td>
<td>56 (2)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>157 (5)</td>
<td>342 (10)</td>
<td></td>
</tr>
<tr>
<td><strong>Insurance (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medicare</td>
<td>1425 (48)</td>
<td>1750 (53)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Medicaid</td>
<td>501 (17)</td>
<td>345 (10)</td>
<td></td>
</tr>
<tr>
<td>Commercial</td>
<td>936 (32)</td>
<td>1157 (35)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>61 (2)</td>
<td>55 (2)</td>
<td></td>
</tr>
<tr>
<td><strong>Physician characteristics</strong></td>
<td>(n = 92)</td>
<td>(n = 102)</td>
<td></td>
</tr>
<tr>
<td>Mean age, yr (± SD)</td>
<td>39.2 (± 10)</td>
<td>41.4 (± 11)</td>
<td>0.15</td>
</tr>
<tr>
<td>Male (%)</td>
<td>32 (35)</td>
<td>49 (48)</td>
<td>0.06</td>
</tr>
</tbody>
</table>

SD = standard deviation.

### Table 2: Baseline Adherence Rates in the Entire Population and Impact of Electronic Reminders in the Enrolled Population for Diabetes and Coronary Artery Disease Care

<table>
<thead>
<tr>
<th>Condition</th>
<th>Baseline Adherence, No. (% of total population)</th>
<th>Enrolled Patient Population, No. (% of total population)</th>
<th>Hazard Ratio for Intervention (95% CI)</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diabetes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual cholesterol exam</td>
<td>4957 (58)</td>
<td>1185 (14)</td>
<td>1.14 (1.05-1.23)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Bental hemoglobin A1c exam</td>
<td>4668 (57)</td>
<td>2245 (26)</td>
<td>1.11 (1.02-1.20)</td>
<td>0.29</td>
</tr>
<tr>
<td>Annual dilated eye exam</td>
<td>1464 (17)</td>
<td>4049 (47)</td>
<td>1.38 (1.32-1.43)</td>
<td>0.25</td>
</tr>
<tr>
<td>Hypertension/ACE inhibitor use</td>
<td>2751 (62)</td>
<td>711 (16)</td>
<td>1.62 (1.52-1.72)</td>
<td>0.10</td>
</tr>
<tr>
<td>Statin use for LDL cholesterol ≥130 mg/dL</td>
<td>476 (31)</td>
<td>595 (58)</td>
<td>1.10 (1.05-1.15)</td>
<td>0.73</td>
</tr>
<tr>
<td><strong>Coronary artery disease</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual cholesterol exam</td>
<td>5039 (53)</td>
<td>1151 (12)</td>
<td>0.99 (0.85-1.13)</td>
<td>0.92</td>
</tr>
<tr>
<td>Aspirin use</td>
<td>2838 (41)</td>
<td>669 (9)</td>
<td>2.36 (1.37-4.07)</td>
<td>0.002</td>
</tr>
<tr>
<td>Beta-blocker use</td>
<td>2701 (38)</td>
<td>808 (11)</td>
<td>1.09 (0.72-1.63)</td>
<td>0.69</td>
</tr>
<tr>
<td>Statin use for LDL cholesterol ≥130 mg/dL</td>
<td>495 (26)</td>
<td>385 (21)</td>
<td>1.51 (1.05-2.17)</td>
<td>0.03</td>
</tr>
</tbody>
</table>

CI = confidence interval (adjust for baseline patient and physician characteristics, as well as for clustering within clinics and the presence of a paper reminder system); ACE = angiotensin-converting enzyme; LDL = low-density lipoprotein.

*This column includes baseline adherence data for the entire population of patients with diabetes or coronary artery disease. To be enrolled, patients had to meet the criteria of (1) nonadherence to at least one quality measure during the study period and (2) primary care physician receiving a reminder during the study period.

†This column includes combined (intervention and control arms) sample sizes for patients enrolled in the study, as well as the proportion of the total population represented by each sample size. Enrolled patients met the criteria of (1) nonadherence to at least one quality measure during the study period and (2) primary care physician receiving a reminder during the study period.

May 31, 2009
Rapid Response Evaluation Methods
Impact Evaluation – *Observational Cohorts*

- **Question/Scope**
  - Impact of computerized alerts on quality of lab monitoring of transplant patients?
  - Outpatient laboratory, liver transplant patients

- **Evaluation Design**
  - Observational study, traditional lab result reporting vs. computerized alerts
  - 356 outpatient liver transplant patients; alerts within EHR for clinicians
  - Alerts of new results, overdue orders for creatinine and immunosuppression drug levels

- **Summary of Findings**
  - Completeness of reporting increased from 66 to >99%
  - Positive predictive value of report including new info increased from 46 to >99%
  - Timeliness of reporting and clinician responses improved significantly (p<0.001)
  - Median times to receive/complete actions dropped from 33 to 9 hours
  - **Computerized alerts led to more efficient, complete and timely management of lab information**

---

**Table 2 • Timeliness of Traditional Process and Computerized Alerts for Reporting Outpatient Intermountain Healthcare Laboratory Results**

<table>
<thead>
<tr>
<th>Intermountain facility</th>
<th>Traditional reporting with faxes, printouts and mailed reports</th>
<th>Computerized alerts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>median # hrs</td>
</tr>
<tr>
<td>Reporting Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creatinine</td>
<td>46</td>
<td>1.5</td>
</tr>
<tr>
<td>LDS Hospital</td>
<td>29</td>
<td>7.2</td>
</tr>
<tr>
<td>Other</td>
<td>58</td>
<td>7</td>
</tr>
<tr>
<td>Tacrolimus</td>
<td>25</td>
<td>25.6</td>
</tr>
<tr>
<td>Other</td>
<td>72</td>
<td>23.8</td>
</tr>
<tr>
<td>Cyclosporin A</td>
<td>2</td>
<td>14.8</td>
</tr>
<tr>
<td>LDS Hospital</td>
<td>3</td>
<td>28</td>
</tr>
<tr>
<td>Other</td>
<td>13</td>
<td>14.8</td>
</tr>
<tr>
<td>Response Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creatinine</td>
<td>46</td>
<td>22.4</td>
</tr>
<tr>
<td>LDS Hospital</td>
<td>29</td>
<td>19.9</td>
</tr>
<tr>
<td>Other</td>
<td>58</td>
<td>24.9</td>
</tr>
<tr>
<td>Tacrolimus</td>
<td>25</td>
<td>11.6</td>
</tr>
<tr>
<td>Other</td>
<td>72</td>
<td>31.1</td>
</tr>
<tr>
<td>Cyclosporin A</td>
<td>2</td>
<td>33.7</td>
</tr>
</tbody>
</table>

*Reported ranges are interquartile ranges.
†For creatinine and tacrolimus tests, there was a significant difference in the paper-based reporting time from LDS Hospital vs. other Intermountain hospitals (p < 0.002).
‡There was no significant difference in the response time during paper-based reporting, by source of the report or type of lab test.
§Rising computerized alerts, there was a significant difference in the reporting time from LDS Hospital vs. other Intermountain hospitals for each lab test (p < 0.001) and there was a significant difference in the response time for creatinine and tacrolimus results (p<0.001).
Rapid Response Evaluation Methods
Meta-analysis / Systematic Review

<table>
<thead>
<tr>
<th>Topics</th>
<th>Reviews</th>
<th>HIS Features</th>
<th>Key Findings</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Outcomes</td>
<td>17</td>
<td>Reminders, CPOE, CDS, EPR, EHR, guidelines, nursing, eHealth</td>
<td>Improved compliance, safety, documentation, utilization, behavior</td>
<td>☑️ ☑️</td>
</tr>
<tr>
<td>Drugs</td>
<td>13</td>
<td>CPOE, CDS, drug dose, prescribing, safety, alert, event monitoring</td>
<td>Improved adherence, drug use and dosing; reduced errors, ADE, events, LOS</td>
<td>☑️ ☑️ ☑️</td>
</tr>
<tr>
<td>Health Conditions</td>
<td>7</td>
<td>Diabetes, chronic illness, hypertension, acute chest pain/abdomen</td>
<td>Improved diagnosis, LOS, adherence, referral/follow-up, monitoring</td>
<td>☑️ ☑️</td>
</tr>
<tr>
<td>Data/Service Quality</td>
<td>5</td>
<td>Administrative registers, EPR, EMR, laboratory</td>
<td>Variable data quality, lacking gold standard; improved lab service</td>
<td>☑️</td>
</tr>
<tr>
<td>Preventive Care</td>
<td>4</td>
<td>Reminders</td>
<td>Improved screening and vaccination</td>
<td>☑️ ☑️ ☑️</td>
</tr>
<tr>
<td><strong>Total = 46 reviews</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

May 31, 2009

- **Objective/Scope**
  - Relative risk reduction on medication error and adverse drug events (ADE)
  - All computerized physician order entry (CPOE) systems, drugs and clinical settings

- **Review Method**
  - Included only controlled and pretest-posttest studies
  - Calculated risk ratio with 95% confidence interval, i.e. relative risk reduction (RRR)
  - Subgroup categories by care level, patient group, drug type, system type/functionality, comparison group type, study design, method for detecting errors

- **Summary of Findings**
  - 23 of 25 studies showed significant RRR 13-99% of medication error rate
  - 6 of 9 studies showed significant RRR 35-98% of potential ADEs
  - 4 of 7 studies showed significant RRR 30-84% of ADEs
  - Higher RRR in home-grown systems, e-prescribing vs. handwriting, manual chart review
  - *e-Prescribing can reduce risk for medication errors and ADE*

May 31, 2009
Figure 2. Risk ratios of 25 studies analyzing the effect of electronic prescribing on medication errors.

Figure 3. Risk ratios of nine studies analyzing the effect of electronic prescribing on potential ADEs.

Figure 4. Risk ratios of seven studies analyzing the effect of electronic prescribing on ADEs. Shulman was excluded, because there was no event in either the intervention group or the comparison group.
• Objective/Scope
  – Effects of CDSS on practitioner performance and patient outcomes
  – Identifying study characteristics that predict benefit

• Review Method
  – Included only randomized/nonrandomized trials compared with care without CDSS
  – 10 pt quality scale 5 bias: allocation method, allocation unit, baseline differences, blinded outcomes, follow-up
  – CDSS success defined as improvement in ≥50% of all outcomes, with 2-sided p<0.5

• Summary of Findings
  – 100 studies met inclusion criteria; study quality improved over time
  – 62 of 97 (64%) studies had improved practitioner performance
  – 4/10 diagnostic, 16/21 reminder, 23/37 disease management, 19/29 drug dosing
  – 7 of 52 (13%) studies had improved patient outcomes
  – Improved performance with auto-prompts and authors as CDSS developers
  – CDSS improve practitioner performance, but effects on patient outcomes inconsistent

---

Table 5. Trials of Computer-Assisted Management for Other Active Health Conditions

<table>
<thead>
<tr>
<th>Source</th>
<th>Methods</th>
<th>No. of Sites</th>
<th>Indication</th>
<th>Performance Outcomes</th>
<th>Patient Outcomes</th>
<th>Improvement in Practitioner Performance</th>
<th>Improvement in Patient Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petruzz et al. 1991</td>
<td>2</td>
<td>Recommendations for nurse management of urinary incontinence in nursing homes</td>
<td>Nurse knowledge of incontinence</td>
<td>Rate of urinary incontinence</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Rubenstein et al. 1995</td>
<td>8</td>
<td>Detection and management of functional status impairments in outpatients; patient self-report information was collected for computer-assisted system</td>
<td>Physician recognition of functional status problems, recommended interventions undertaken to improve patient functioning</td>
<td>Functional status (physical, psychological, and social at time measured by questionnaire)</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Sillan et al. 1995</td>
<td>6</td>
<td>Screening, treatment, and management recommendations for outpatients with human immunodeficiency virus infection</td>
<td>Vaccination, ophthalmologic referral, CD4 cell count and blood cell count, Pneumocystis prophylaxis</td>
<td>Need for physician visits; emergency and hospital admission; mortality</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Dexter et al. 1998</td>
<td>10</td>
<td>Reminders to discuss and complete advanced directives in outpatients</td>
<td>Rates of discussions and documentation</td>
<td>…</td>
<td>Yes</td>
<td>…</td>
<td></td>
</tr>
<tr>
<td>Font et al. 1999</td>
<td>10</td>
<td>Mechanical ventilation management in patients with acute respiratory distress syndrome</td>
<td>…</td>
<td>Curated to hospital discharge, intubation care unit length of stay, treatment score (improved), mortality (improved)</td>
<td>…</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Kupperman et al. 1999</td>
<td>6</td>
<td>Automated physician alert via pager for critical laboratory results for hospital inpatients</td>
<td>Time to ordering of treatment for critical laboratory value, time to resolution of alerting condition</td>
<td>Adverse events (death, cardiac arrest, transfer to intensive care unit, stroke, renal impairment within 48 h of alerting event</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

May 31, 2009
### Table 7. Trial of Computer-Assisted Anticoagulant Dosing

<table>
<thead>
<tr>
<th>Source</th>
<th>Methods</th>
<th>No. of Sites</th>
<th>Indication</th>
<th>Practitioner Performance Outcome</th>
<th>Patient Outcome</th>
<th>Improvement in Practitioner Performance</th>
<th>Improvement in Patient Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warthin et al., 1992</td>
<td>6</td>
<td>1</td>
<td>Warfarin initiation in postoperative cardio surgery patients</td>
<td>Proportion of days in therapeutic range, average number of days to achieve therapeutic INR</td>
<td>...</td>
<td>Yes</td>
<td>...</td>
</tr>
<tr>
<td>Carter et al., 1997</td>
<td>6</td>
<td>1</td>
<td>Warfarin initiation for hospital inpatients</td>
<td>Time to achieve therapeutic stable INR</td>
<td>Time to hospital discharge after first dose</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>White et al., 1997</td>
<td>8</td>
<td>2</td>
<td>Warfarin initiation for hospital inpatients</td>
<td>Time to achieve therapeutic stable INR, time to reach stable INR</td>
<td>Bleeding complications, hospital length of stay (improved)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>White and Mungall, 1991</td>
<td>8</td>
<td>1</td>
<td>Warfarin maintenance for outpatients</td>
<td>Proportion of time with therapeutic INR, need for follow-up appointments for anticoagulation adjustment</td>
<td>...</td>
<td>No</td>
<td>...</td>
</tr>
<tr>
<td>Poller et al., 1996</td>
<td>8</td>
<td>1</td>
<td>Warfarin maintenance for inpatients</td>
<td>Proportion achieving target INR, average follow-up time for appointments needed for anticoagulation</td>
<td>Bleeding complications, mortality</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Filmore et al., 1995</td>
<td>6</td>
<td>2</td>
<td>Warfarin maintenance for outpatients</td>
<td>Proportion of time with therapeutic INR, number of follow-up appointments needed to adjust anticoagulation</td>
<td>Mortality, bleeding, and thrombotic complications</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Vaher et al., 1997</td>
<td>6</td>
<td>1</td>
<td>Warfarin initiation and maintenance for inpatients</td>
<td>Time to achieve therapeutic INR, time with therapeutic INR, number of supratherapeutic and subtherapeutic INR</td>
<td>Bleeding and thrombotic complications</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Vaher et al., 1997</td>
<td>6</td>
<td>1</td>
<td>Warfarin maintenance for outpatients; system used by nurse practitioner compared with training physicians</td>
<td>Proportion of time with therapeutic INR, number of days between INR testing, number of test measurements</td>
<td>Thrombotic episodes, bleeding complications</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Case Study: PharmaNet-supported Medication Reconciliation - Background

- Medication History Errors
  - Tam’s review on medication history errors during hospital admission [25]
  - 22 studies on 3755 patients had med history errors in 67% cases
  - 5 studies had ≥1 med history error in 27-54% of cases, 19-75% unintentional
  - 6 studies had 11-59% med history errors were clinically significant

- Need for Medication Reconciliation
  - Process to arrive at an accurate and complete medication list for patient
  - Done during handoff or transition: admission/transfer/discharge
  - 2005 Safer Healthcare Now! Campaign: improve patient safety by preventing adverse drug events (ADEs) at care interfaces [26]

- PharmaNet-supported MedRec, or PharmaNet-MedRec
  - PharmaNet1: a province-wide drug dispensing info system in BC
  - Used in hospitals during admission to reconcile patient’s medications
  - New PharmaNet2 being developed with enhanced e-prescribing features

Case Study: PharmaNet-supported Medication Reconciliation – Error Types [27,28]

Diagram of error types:
- Discrepancies
  - Intentional
    - Documented
    - Undocumented
  - Unintentional
    - Potential for harm
    - No potential for harm
- History Error
- Reconciliation Error
- Admission
  - Discharge
- Omission
- Dose
- Frequency
- Route
- Substitution
- Additional Meds
- Formulation
- Other

May 31, 2009
Case Study: PharmaNet-supported Medication Reconciliation – Evaluation Study

- **Study Questions**
  - Overall: Impact of PharmaNet-MedRec on quality of care?
  - Can it improve detection of discrepancies and reduce likelihood of ADEs?
  - What effect on provider productivity in efficiency and coordination?

- **Evaluation Design**
  - *Time series*: to compare discrepancies in 2 groups w/o PharmaNet-MedRec
  - *Usability engineering*: to examine workflow and usability issues
  - *Expert consensus*: to identify potential ADEs

- **Data Collection/Analysis**
  - Electronic MedRec tool for pharmacists/technicians
  - Record meds, reconcile meds, print lists, record discrepancies
  - Expert consensus to identify potential ADEs

May 31, 2009
Case Study: PharmaNet-supported Medication Reconciliation - Design

PharmaNet-MedRec Study Phases – 6 months each

<table>
<thead>
<tr>
<th>Baseline</th>
<th>Implementation-1</th>
<th>Implementation-2</th>
<th>Followup-1</th>
<th>Followup-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>No PharmaNet</td>
<td>PharmaNet1</td>
<td>PharmaNet2</td>
<td>PharmaNet1/2</td>
<td></td>
</tr>
</tbody>
</table>

PharmaNet-

MedRec

Study Phases – 6 months each

<table>
<thead>
<tr>
<th>Site-3</th>
<th>Site-2</th>
<th>Site-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>No MedRec Control Group</td>
<td>MedRec Intervention Group</td>
<td></td>
</tr>
</tbody>
</table>

Admission

Time series cohort design

Usability engineering

MedRec-1

(Un)/Intentional Discrepancies

Discharge

Site-1

Site-2

Site-3

Potential Adverse Drug Events

Expert consensus

The Impact of PharmaNet-Supported Medication Reconciliation on Patient Care
DATA COLLECTION PROCESS
No Formal MedRec Process

May 31, 2009
Case Study: PharmaNet-supported Medication Reconciliation - Scenarios

- **Retrospective, no MedRec, only able to extract historical med orders from PharmaNet and Hospital Pharmacy Info System for comparison to gold standard available.**

- **Retrospective, formal MedRec done post-admission (prior to discharge) as gold standard med history. Extract med orders from MedRec tool, PharmaNet and Hospital Pharmacy Info System for comparison to gold standard. Expect to see discrepancies and potential ADEs.**

- **Prospective, PharmaNet-MedRec done as part of admission. Gold Standard Med History on admission MedRec extracts med orders from MedRec tool, PharmaNet and Hospital Pharmacy Info System for comparisons. Expected reduction in discrepancies and potential ADEs.**
Case Study: PharmaNet-supported Medication Reconciliation - *Metrics*

<table>
<thead>
<tr>
<th>Patient Safety Outcomes</th>
<th>Provider Productivity Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quantitative metrics</strong></td>
<td></td>
</tr>
<tr>
<td>No. Of documented ADEs</td>
<td>System use log – freq/type/duration of use</td>
</tr>
<tr>
<td>%patient reconciled at admission/discharge Med discrepancies – freq/type un/intentional Mean no. Discrepancies resolved per patient %patient with ≥1 unintentional discrepancies % acceptable med orders (success index)</td>
<td>Usability errors – freq/type/severity of errors Workflow change – % time change in process</td>
</tr>
<tr>
<td><strong>Qualitative metrics</strong></td>
<td></td>
</tr>
<tr>
<td>Agreement by users with ADEs found Perception of MedRec impact by users</td>
<td>Perception of change in coordination by users Perception of change in workflow efficiency Perception of system usage/support</td>
</tr>
</tbody>
</table>

Case Study: PharmaNet-supported Medication Reconciliation – *Data Sources*

- **Data Collection and Analysis**
  - *Best Possible Medication History* (BPMHx) data, electronic medication orders
  - Tabulation/comparison of discrepancies, expert consensus on potential ADEs
  - Thematic analysis on usability/workflow related data

- **Estimated Sample Size**
  - Published discrepancy rates: “25% potential harmful discrepancies (PHD) [25,27]
  - PHD cases: 25% of 100 patients, with 90% detection rate, we expect (100x25%/90%) = 28 of 100 pts with PHD
  - Admission/yr at 3 sites: (a) PAC MedRec 615 pts/6mths = 18% non-ER adm, or ~1200 pts/yr; (b) CSPAC ~800 pts/yr; (c) ~3000 ER adm/wkdays = ~17% ER visits/yr ... total adm ~5000 pts/yr [30]
  - Expert meetings on PHD cases: 2hrs/2x/mth or 4hrs/mth for 10mths/yr, with ~40hrs/yr available, at 10min review/case = 6 cases/hr x 40hrs/yr = 240 cases/yr. For 240 cases/yr at 25% discrepancy and 90% detection rates, need (240x4)/90% = 1000 cases/yr, or 1000 pts/yr needed to detect 25% PHD
  - Sample: ~40% of 5000 adms/yr or ~2000 pts/yr, 50% with expert review
Case Study: PharmaNet-supported Medication Reconciliation – Next Steps

- Ministry approval of MedRec evaluation plan
- Implementing e-MedRec data collection tool in VIHA
- Starting phase 1 of the evaluation study
- Considering replication with other Health Authorities
- Hosting a KT workshop to share experience, ideas, lessons

- Feedback and questions?

Open Discussion on Experiences and Issues

- Are you involved with HIS evaluation? What? How? Where?
- How would you plan/conduct HIS evaluation studies? Why?
- What are your experiences, issues and needs?
- What further suggestions/insights do you have?

And finally ..... Would you like to be part of our eHealth evaluation forum?
References

3. Silver et al. The IT interaction model: a foundation for MBA core course. MISQ 1995;Sep 262.

May 31, 2009