**OBJECTIVE**

To estimate the cost-effectiveness of CPOE versus traditional paper-based prescribing in reducing medication errors and ADEs in a large medical group.

- The American Recovery and Reinvestment Act is a seminal healthcare reform legislation
- Includes the Health Information Technology for Economic & Clinical Health provision which provides incentives for adoption of electronic health records (EHRs)\(^2\)
- A key component of an EHR is a Computerized Prescriber Order Entry system (CPOE)
- CPOE has been shown to reduce the risk of medication errors by 55-86%\(^3\)
- No study to date has estimated long-term costs of CPOE relative to their safety benefits in the ambulatory care setting

The Everett Clinic (TEC) is the largest independent physician group in Washington State, comprised of 400+ clinicians who provide care for 300,000 patients and write 2.7 million prescriptions annually.

Between 2004 and 2006, TEC added CPOE to their homegrown EHR system

**METHODS – MODELING**

- **Model:** Deterministic and a probabilistic decision analytic models
  - Reference: Prescriptions hand-written prior to implementation of the CPOE system
  - New Technology: CPOE system with electronic prescribing
  - Assumptions: Clinic perspective, 5 year time horizon (2010-14), discount rate of 3%

**Scenario Analyses:**

- 1a: Base case
- 1b: Base case w/CPOE costs doubled
- 2a: No reduction in chart pulls after implementation
- 2b: No reduction in chart pulls with cost estimates doubles
- 3a: 10% Annual decrease in chart pulls
- 3b: 10% Annual decrease in chart pulls w/CPOE costs doubled

**Sensitivity Analyses:** One-way and probabilistic sensitivity analyses

- **Inputs:**
  - Costs: Collected from TEC
  - Error Probabilities: Study conducted at TEC\(^4\)

**CONCLUSION**

Our experience suggests that provider groups who adopt CPOE and commit to eliminating paper prescribing have the potential to rapidly improve the safety of their patients while reducing costs to the healthcare system.

**DISCUSSION**

- For groups unable to implement a full EHR, CPOE can be an important first step.
- Our model is based on conservative estimates of costs
- Only chart pulls for medication refills were considered for the administration cost component of the model. This input was a major driver of the outcome of this model
- Time for prescribing by physicians was reflective of prescribing in the examination room, which took longer than prescribing at clinic workstations
- **Study Limitations:**
  - This is a case study – generalizability is limited
  - Few errors caused ADEs and the difference in the number of ADEs between paper and CPOE was not significant. This led to much uncertainty in the ADE analyses.
  - TEC’s CPOE system was homegrown and its costs considerably less when compared to purchasing a complete EHR system

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**Table 1: Model Inputs**

<table>
<thead>
<tr>
<th>Total CPOE Costs</th>
<th>PAPER SYSTEM (Range)</th>
<th>CPOE SYSTEM (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total CPOE hardware, software and maintenance costs (millions)</td>
<td>N/A</td>
<td>$1.8 ($1.7 - $1.9)</td>
</tr>
<tr>
<td>Personnel costs (CliniTech(^2) and TEC employees) (millions)</td>
<td>N/A</td>
<td>$8.7 ($2.8 - $3.3)</td>
</tr>
<tr>
<td>Indirect Costs (%)</td>
<td>N/A</td>
<td>3% of CPOE System/Personnel Costs</td>
</tr>
<tr>
<td>TOTAL CPOE prescriptions written per year, (millions)</td>
<td>2.7 (2.65 - 2.84)</td>
<td></td>
</tr>
<tr>
<td>Chart Pulls</td>
<td>Charts pulled per day per provider</td>
<td>10 (5 - 12)</td>
</tr>
<tr>
<td>Cost per chart pull</td>
<td>$5 ($3 - $7)</td>
<td></td>
</tr>
<tr>
<td><strong>Prescribing Costs</strong></td>
<td>Hourly Salary(^5)</td>
<td>Primary Care Provider (n=129)</td>
</tr>
<tr>
<td></td>
<td>Mid Level Provider (n=25)</td>
<td>$65 ($56 - $76)</td>
</tr>
<tr>
<td></td>
<td>Nurse (RN)</td>
<td>$36 ($32 - $40)</td>
</tr>
<tr>
<td></td>
<td>Medical Assistant (MA)</td>
<td>$57 ($51 - $58)</td>
</tr>
<tr>
<td><strong>Prescription Queue</strong></td>
<td>RN Time per Rx (seconds)</td>
<td>83.2 (70.6 - 96.1)</td>
</tr>
<tr>
<td></td>
<td>MA Time per Rx (seconds)</td>
<td>114.1 (96.8 - 131.4)</td>
</tr>
<tr>
<td><strong>Total Meanful Use Incentives, per prescriber</strong></td>
<td>N/A</td>
<td>$42,000</td>
</tr>
<tr>
<td><strong>Office visits per year, (thousands)</strong></td>
<td>CMS Reimbursement, per visit</td>
<td>650 (625 - 675)</td>
</tr>
<tr>
<td></td>
<td>10 minute Visit (5% of visits)</td>
<td>$40 ($36 - $44)</td>
</tr>
<tr>
<td></td>
<td>15 minute Visit (35% of visits)</td>
<td>$65 ($58 - $71)</td>
</tr>
<tr>
<td></td>
<td>20 minute Visit (40% of visits)</td>
<td>$98 ($88 - $108)</td>
</tr>
<tr>
<td></td>
<td>40 minute Visit (10% of visits)</td>
<td>$133 ($120 - $146)</td>
</tr>
</tbody>
</table>

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**Table 2: Deterministic Model Results**

**Figure 1: Decision Tree with Probabilities**

**Figure 2: Probabilistic Model Results (10,000 Simulations)**

**Figure 3: Cost-Effectiveness Acceptability Curve and Scatter Plot on ADEs Avoided**

**Figure 4: One-Way Sensitivity Analyses of Base Case Cost Inputs**

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References:
4. Centers for Medicare & Medicaid Services. Physician Fee Schedule. [https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/PhysicianFeeSched/index.html](https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/PhysicianFeeSched/index.html)

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**PAPER SYSTEM**

- **Baseline Costs Doubled:** No change
- **Costs Decreased:** 10% reduction

**CPOE SYSTEM**

- **Baseline Costs Doubled:** No change
- **Costs Decreased:** 10% reduction

**Total ADEs (thousands)**

- **Paper:** 21.8 (19.7 to 24.8)
- **CPOE:** 7.3 (4.9 to 10.4)
- **Difference:** -14.5 (-21.2 to 18.9)