Objectives

- Discuss the current landscape of pharmacy and medication in US healthcare
- Introduce human factors and cognitive engineering models provide examples in pharmacy practice
- Describe current and future research focused on pharmacist work and medication safety

Scope of Medication Safety

- World Health Organization (WHO) estimates $42 billion in annual costs
- Nearly 700,000 ED visits and 100,000 hospitalizations each year in US
- Progress has been painstakingly slow

Improving healthcare

- Better Outcomes
- Provider well-being
- Patient experience
- Lower Costs
Pharmacy as a work system

Life cycle of a prescription

National Pharmacist Workforce Survey (2014)
Cognitive engineering approach to data science

Abstraction & Aggregation Hierarchy

Application in prescription processing and medication adherence
Effects of Automatic Prescription Refills

![Diagram showing the process of initiating automatic or manual prescription refills and the impact on dispensing time and patient counseling/prescription pickup.]

Resilient healthcare

- Avoid (anticipation)
- Withstand (absorption)
- Adapt To (reconfiguration)
- Recover From (restoration)

RESILIENCE


### Table 1
Prescription pickup lag for each refill type

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mean ± SD</th>
<th>Median</th>
<th>Interquartile range</th>
<th>Pooled log₁₀ p</th>
<th>Pooled log₁₀ χ²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto refill</td>
<td>8.7 ± 3.4</td>
<td>1</td>
<td>3-12</td>
<td>13.4</td>
<td>15.6</td>
</tr>
<tr>
<td>Manual refill</td>
<td>5.1 ± 2.6</td>
<td>1</td>
<td>3-12</td>
<td>11.4</td>
<td>14.8</td>
</tr>
<tr>
<td>Non-registration refill</td>
<td>10.1 ± 3.8</td>
<td>1</td>
<td>3-12</td>
<td>13.4</td>
<td>15.6</td>
</tr>
<tr>
<td>Auto refill</td>
<td>5.8 ± 3.8</td>
<td>1</td>
<td>3-12</td>
<td>11.4</td>
<td>14.8</td>
</tr>
<tr>
<td>Manual refill</td>
<td>3.4 ± 1.3</td>
<td>1</td>
<td>3-12</td>
<td>11.4</td>
<td>14.8</td>
</tr>
<tr>
<td>Overall</td>
<td>4.9 ± 3.4</td>
<td>1</td>
<td>3-12</td>
<td>11.4</td>
<td>14.8</td>
</tr>
</tbody>
</table>

### Table 2
Multivariate Adjusted Odds Ratios of Being Adherent by Adherence Metric

<table>
<thead>
<tr>
<th>Metric Type</th>
<th>Adjusted Odds Ratio</th>
<th>95% CI</th>
<th>Adjusted Odds Ratio</th>
<th>95% CI</th>
<th>Adjusted Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missed pill</td>
<td>1.32</td>
<td>1.28-1.37</td>
<td>1.32</td>
<td>1.28-1.37</td>
<td>1.32</td>
<td>1.28-1.37</td>
</tr>
<tr>
<td>Delay</td>
<td>1.50</td>
<td>1.45-1.55</td>
<td>1.50</td>
<td>1.45-1.55</td>
<td>1.50</td>
<td>1.45-1.55</td>
</tr>
</tbody>
</table>

Note: Standard error and 95% confidence intervals are given for adjusted odds ratios.
Application in patient experience

Topics in Yelp! Review content of pharmacies

Application in medication errors

Proposed medication error framework
The future of pharmacists’ work

### Human factors approach to improve performance

| Most Reliable | \- Forming functions or physical steps that prevent incorrect actions (such as regulators that are incompatible among dispense-gates)
| \- Computerizando steps (such as procedural steps incorporated into smart infusion pump) which do not allow a medication to be infused at rates that are too high or too low
\- Human-machine vulnerability such as the redundant type of visually checking medications and then storing medication bar codes so that a computer can check the medications as well.
| Somewhat Reliable | \- Checklists for high-risk procedures (such as inserting a central line)
| \- Feedback as a process to receive feedback and advice for example, line-out to prevent wrong-site surgery
| \- Checklists for example, critical decision support is electronic medical records that requires a physician of a patient's increase when prescribing decisions
| \- Standardization of equipment and supplies across the organization
| \- Planned error-recovery opportunities in which providers build time in the process to self-check or double-check another person's work (such as requiring two nurses to separately calculate chemotherapy doses or continuous heparin infusion rates)
| Least Reliable | \- Education and training

### Prevalence of Indication Included on Prescription over Time

![Graph showing the prevalence of indication included on prescription over time](image)

**Implementation of "as needed" order requirement**

### Location of Indication on Prescription by Scheduled and As Needed Dosing

![Graph showing the location of indication on prescription by scheduled and as needed dosing](image)

**Type of prescription**
- Scheduled
- As Needed

**Indication Location**
- Oral
- Global
- Parenteral
- Intravenous
- Handwritten
- Transcription

**Percentage**
- 3.1%
- 2.8%
- 1.6%
- 0.57%
- 0.42%
- 0.25%
- 0.15%
- 0.12%
- 0.05%
- 0.04%
Pharmacists’ Patient Care Process

Collect
The pharmacist assesses the collection of data required to determine the presence of the patient in a way that ensures the exclusion of the pharmacist’s personal health outcomes and clinician-related data from the practice.

Assess
The pharmacist assesses the health outcomes and clinician-related data that the pharmacist is involved in and the exclusion of the pharmacist’s personal health outcomes and clinician-related data from the practice.

Plan
The pharmacist develops a personalized patient care plan that includes the selection of the pharmacist’s personal health outcomes and clinician-related data from the practice.

Implement
The pharmacist implements the care plan in collaboration with the patient and the pharmacist’s personal health outcomes and clinician-related data from the practice.

Follow-up: Monitor and Evaluate
The pharmacist monitors and evaluates the effectiveness of the care plan and submits the plan to a qualified pharmacist for further evaluation.

Patient outcome
Cognitive work
Drug therapy decisions
Organization of existing knowledge

Risk of Adverse drug event
Response to treatment
Predict likely health outcome

Previous patient

Thank you
Corey Lester
lesterca@umich.edu