Classifying and Reducing Patient Wait Time Using Radio-frequency Identification (RFID) Technology

Trevor Hoffman
Dr. Paula Anne Newman-Casey
Professor Amy Cohn
IISE
May 22, 2018
Acknowledgements

Center for Healthcare Engineering & Patient Safety

Amy Cohn
Rachel Moeckel
Abhilash Rao
Summer Li
Michelle Chen
Catherine Xu
Cameron Misko
All of the other past student researchers

Michigan Medicine Kellogg Eye Center

Paula Anne Newman-Casey
Leslie Niziol
John Musser
Clerks and all of the clinical staff and providers
Background

- Glaucoma is one of the **leading causes of blindness**
- Treatment often requires **lengthy clinic visits** with multiple steps
- Patient wait time is a **significant complaint** in many clinical environments
- Our research goal is to **reduce wait times** incurred by patients in the Glaucoma clinic at the Kellogg Eye Center
What is Glaucoma?

- Eye fluid pressure slowly rises
- Over 3 million people in the United States affected

http://www.insightvisioncenter.com/treating-and-controlling-glaucoma/
Key Goals

- Collect data on patients in Glaucoma Clinic
- Reduce patient wait time
- Better manage non-reducible wait time
Project Plan

- Map process flow
- Collect data with Radio Frequency Identification (RFID) technology
- Optimize schedule
- Simulate performance
Implementation Plan

- Conduct time studies
- Map process flows
- Test and install RFID readers
- Collect data
Return Visit: 102.5 ± 45 minutes
   – 49% of time spent waiting

New Visit: 187.4 ± 44.2 minutes
   – 32% of time spent waiting
RFID Data Collection

- Need to know when and where patients are during their time with and without providers (e.g. physicians, technicians, residents, etc.)

- RFID can be used as a low-cost, portable, and passive way of tracking people

- Can give RFID tags to both patients and providers to measure wait time
RFID Signal Test

Mean Signal Strength (dBm) over 5 trials of 1 min vs. Distance from RFID Reader (feet)

- Clinic/.5s Sampling
- Clinic/Max Sampling
- Driveway/.5s Sampling
- Driveway/Max Sampling
RFID Interference Test

![Graph showing signal strength (dBm) over time (seconds) with patients in chair and slit lamp interference.]
RFID Cross-talk Test
Data Collection Steps

- Rigorous testing for RFID readers
- Create a TracerPlus app to write RFID tags for clerks at check-in
- Install 24 Astra-Ex RFID readers throughout clinic
- Data exists in Michigan Medicine
Patient checks in and receives RFID tag

RFID tags ping readers throughout visit

Patient returns RFID tag to check-out at end of visit
Data Analysis

Weekly Quality Checks

- Number of pings per day per reader
- Number of patients recruited per day
- Comparison of CSNs of patients in clinic vs. CSNs recorded via RFID tags
- Malfunction Emails – when readers go down
In theory, RFID originally presented as a straightforward, non-complex method of collecting data.

In reality, putting the pieces in place has been more of a challenge than previously thought.
# Challenges and Lessons Learned

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hardware</strong></td>
<td>• Obtrusive</td>
</tr>
<tr>
<td></td>
<td>• Warning signs</td>
</tr>
<tr>
<td><strong>Software</strong></td>
<td>• Reader malfunctions</td>
</tr>
<tr>
<td></td>
<td>• Tag writing app</td>
</tr>
<tr>
<td></td>
<td>• Address when readers go down</td>
</tr>
<tr>
<td></td>
<td>• Discrepancies between tags</td>
</tr>
</tbody>
</table>
### Challenges and Lessons Learned

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>People</strong></td>
<td><strong>Not everyone wants to participate</strong>&lt;br&gt;<strong>Tuesdays are heavy</strong>&lt;br&gt;<strong>App must not hinder check-in process</strong></td>
</tr>
<tr>
<td>• Patient consent&lt;br&gt;• Number of patients per day</td>
<td></td>
</tr>
<tr>
<td><strong>Data</strong></td>
<td><strong>Need an early start to obtain permissions for new team members</strong>&lt;br&gt;<strong>Must remain HIPAA compliant</strong></td>
</tr>
<tr>
<td>• Protected Health Information (PHI)&lt;br&gt;• Access to Michigan Medicine database</td>
<td></td>
</tr>
</tbody>
</table>
What Comes Next

- Significant bottleneck with visual field tests
- Simulation models with RFID data to see impact on patient wait-time
- Optimize schedules to avoid bottlenecks
Questions?

Trevor Hoffman: troffman@umich.edu

Amy Cohn: amycohn@med.umich.edu

Paula Anne Newman-Casey: panewman@umich.edu