# Reducing Patient Wait Time Using Radio-Frequency Identification (RFID) Technology

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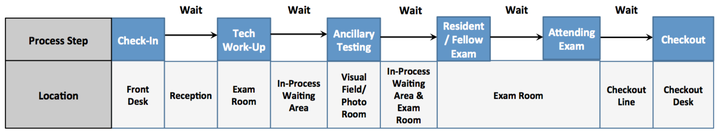
## Background

- Glaucoma is the second leading cause of blindness in the U.S. and affects over 3 million people in the U.S.
- Physicians feel there is not enough time to educate patients. Many patients feel that they spend too much time in the waiting room and not enough time with their physician.
- Several factors such as limited staff and exam room availability can create schedule bottlenecks in which wait times dramatically increase.

**Figure 1. Clinic visit process.**




## Purpose

The purpose of our project is to reduce patient wait times through use of a simulation to optimize clinic flow. To accomplish this, we use passive RFID data based time-motion studies to inform clinical operations and scheduling.

## Methods

- Patients and providers wear RFID tags while in clinic
- Tags ping RFID readers twice per second
- Wait time measured as time patients are not with providers

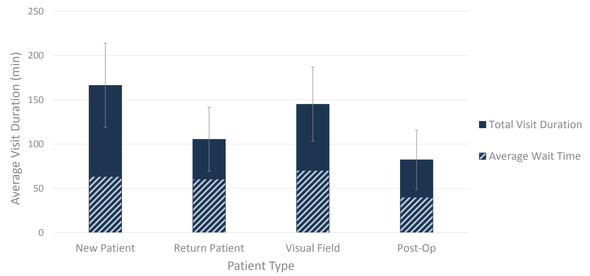
**Figure 2. RFID readers, tag scanner and individual tags used in clinic**


- Data is collected and stored in a secure database that is directly accessible by the project team
- The following data points were analyzed from the raw data
  - Patient visit durations
  - Patient process times
  - Patient wait time
- The data were collected between 1/5/18-7/3/18
- The simulation was designed with the following configurations:
  - Clinic open time- 7:30am
  - Number of simulations- 20,000
  - Python Version- 3.6.5
  - SimPy- 3.0.10

## Results: RFID Data

### Patient Visit Duration and Wait Time Data

**Figure 3. Average Visit Duration and Wait Times for All Patient Types**




Over 2,000 patient participants were studied. Patients spend a large percentage of their visit waiting for providers (New 38.2%, Return 57.5%, Visual Field (VF) 48.6%, and Post-Op 48.9%).

## Results: Simulation

### Simulation Inputs

| Type of Provider | Count |
|---|---|
| Check-in Clerks* | 2 |
| Technicians | 5 |
| Visual Field MAs | 3 |
| Photographers | 4 |
| Residents | 1 |
| Fellows | 0 |
| Physicians | 3 |
| Check-out Clerks* | 4 |
| **Resource shared with Retina Clinic* | |

| Type of Patient | Count |
|---|---|
| New Patient | 8 |
| Return Patient | 30 |
| Post-Op | 11 |
| Visual Field | 27 |
| Laser | 3 |
| Urgent | 1 |
| **Total** | 80 |

### Queuing Visualizations to Identify Bottlenecks

**Figure 4. Patients Waiting for Technician**

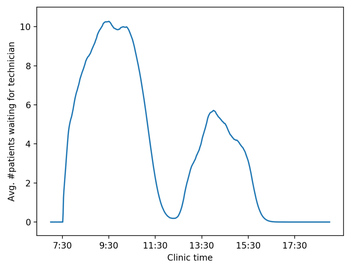



**Figure 5. Patients Waiting for Visual Field Test**

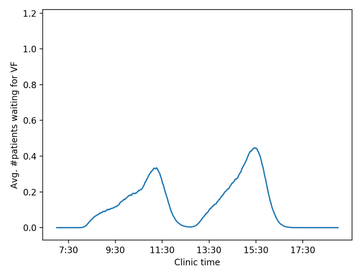
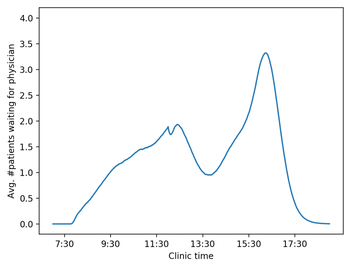



**Figure 6. Patients Waiting for Physician**

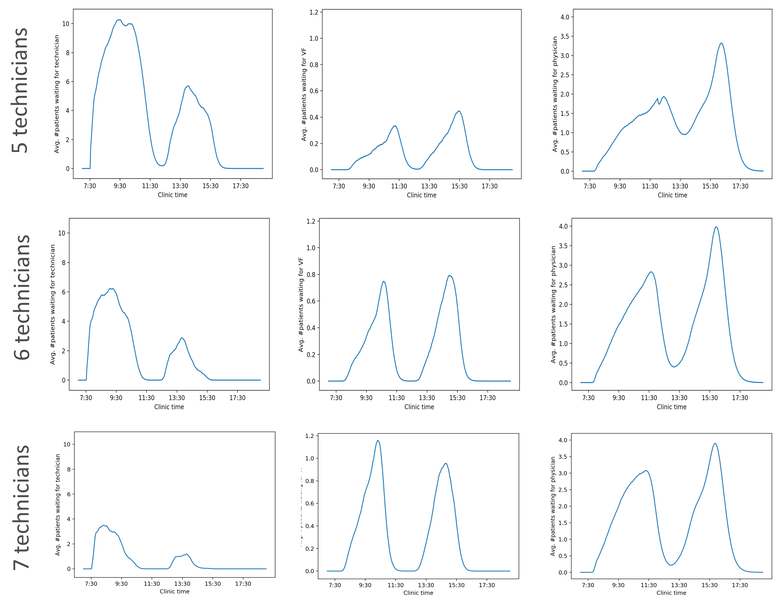



- Many bottlenecks occur with patients waiting for technicians
- One possible solution may be to hire additional technicians in the clinic to decrease these wait times

## Results: Technician Simulation

### Simulated Effects of Adding Technicians

**Figure 7. Simulated Patient Wait Times with Additional Technicians**




Hiring additional technicians does address the identified bottleneck, however, wait times for VF testing and physicians subsequently increase according to our simulation.

## Conclusions

- Low cost and passivity of RFID system allows collection of vast amounts of data to inform clinical operations
- Tracking patient wait time is an important metric to assess the value to the patient
- The deployment of RFID technology serves as the analytic backbone of Lean Clinical Improvements in this pilot study

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