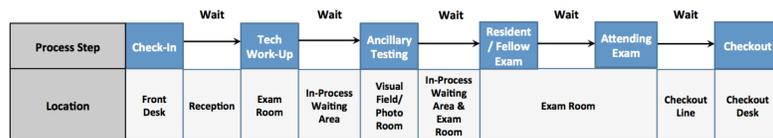


## Problem Statement

- Glaucoma is the second leading cause of blindness in the US, in part because half of glaucoma patients do not take the medications known to stop disease progression.
- Personalized education and counseling have been shown to improve chronic disease self-management, yet this has not been integrated into clinical care for glaucoma patients.
- Although physicians feel there is not enough time to educate patients, many patients feel they uselessly spend their time in the waiting room; a major complaint received at clinic revolves around long wait times during the appointment.

Figure 1. Clinic visit process.



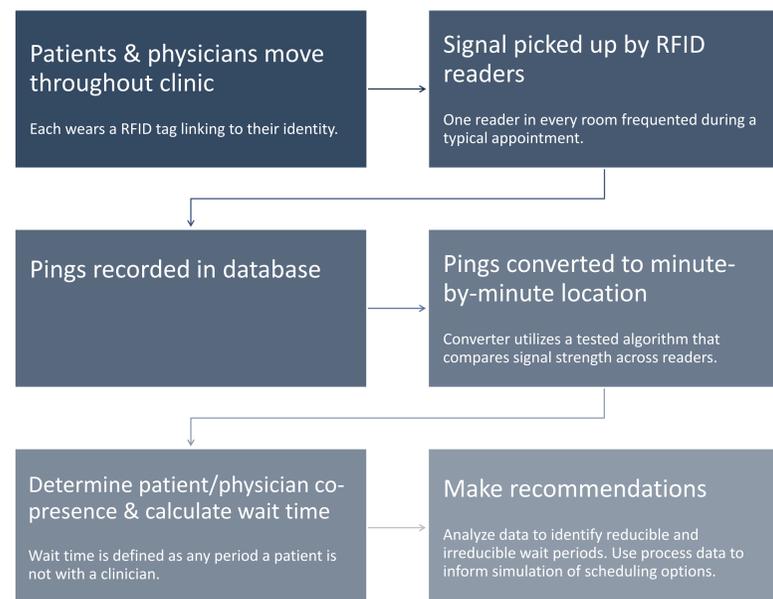
## Objective

To identify, quantify, and assess wait times, so that we may smooth reducible bottlenecks and introduce patient education in irreducible wait periods.

Such progress would enable the clinic to see more patients with better efficiency and effectiveness, increase adherence through patient education, and ultimately improve the overall patient experience.

## Solution Approach

Figure 2. Outline of project information flow.



## Impact/Results

Figure 3. Percentage wait time during appointment stratified by patient type. Return visits had a higher average percentage of wait time compared to new patient visits (49.4% vs 31.9%,  $p < 0.0001$ ).

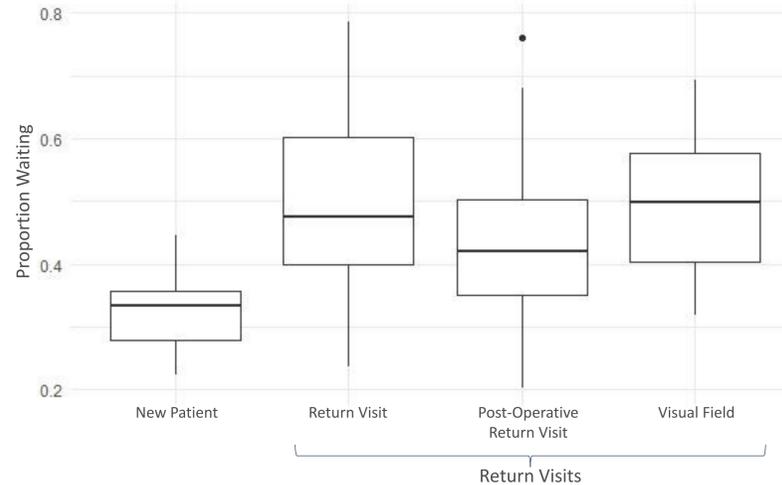


Figure 4. Patient wait times stratified by clinic visit process step, for both new patients and return visit patients.

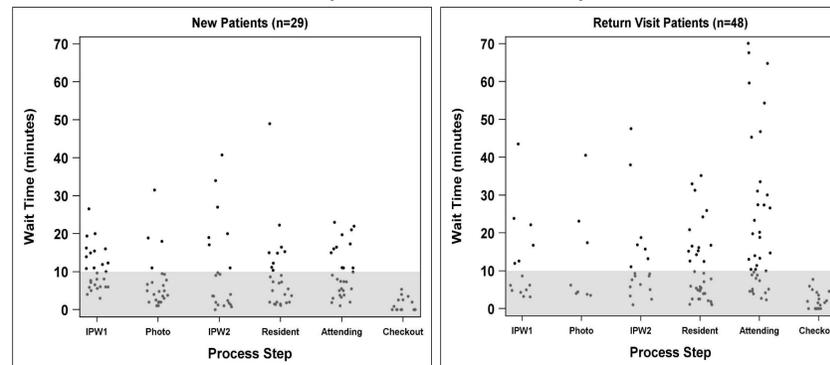


Figure 5. Clinic floorplan overlaid with clinic simulation. Blue squares show patient location in exam room, and signal icon shows location of RFID readers.

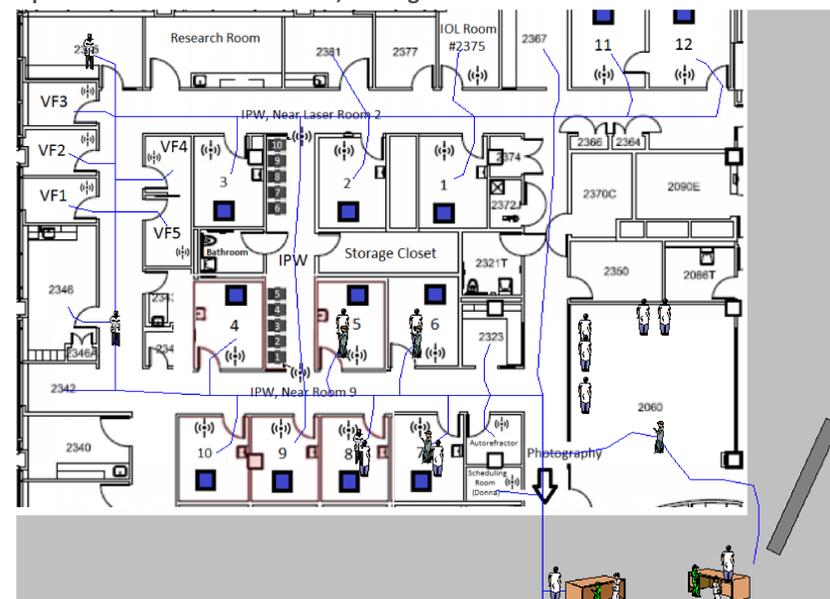


Table 1. Descriptions of problems encountered during study implementation, along with their respective solutions and results.

Relationships with clinic staff	
<b>Problem</b>	Physicians and others wary of their time and location being tracked.
<b>Solution</b>	Project leaders reinforced the goal is to reduce wait time, not to micromanage staff performance.
<b>Result</b>	Two physicians now are strong advocates and many more support efforts.
<b>Problem</b>	Check-out clerks dissatisfied with their role in study.
<b>Solution</b>	Reevaluated check-out process to reduce workload and unnecessary elements.
<b>Result</b>	Easier process for clerks to follow, resulting in greater buy-in and satisfaction.
<b>Problem</b>	Inadequate amount of data.
<b>Solution</b>	Involved check-in clerks in redesigning process to get patient participants.
<b>Result</b>	Easier process for clerks to follow, producing more consistent data collection.
Collaboration between engineering and medicine	
<b>Problem</b>	Data and database inaccessible without hospital network and VPN.
<b>Solution</b>	Develop relationships with healthcare IT staff, bringing them onto the team. Problem-solving to deal with technical issues as they arrive.
<b>Result</b>	Our lab is a pioneer and example at the University of Michigan of a cross-collaboration between engineering and medicine – a needed step toward enabling student engineers to work with health data and thereby contribute toward improvements.
<b>Problem</b>	Personal health information (PHI) collected during study.
<b>Solution</b>	Delete Clarity records for those who did not take part in the study. Trained all students in HIPAA and PEERRS. Ensure encryption of database.
<b>Result</b>	Significantly reduced risk of regulatory violations.

Translation of RFID signal to location

<b>Problem</b>	RFID tags sensed by multiple readers, making absolute location determination on a minute-by-minute basis difficult.
<b>Solution</b>	Shadow patients and physicians and compare minute-by-minute data to check accuracy. Test multiple different algorithm configurations.
<b>Result</b>	Algorithm that determines location with high degree of accuracy.

## Acknowledgements

Many thanks to contributing CHEPS students and Michigan Medicine collaborators. We also thank the following organizations for supporting this work:

