NORTH YORK GENERAL

Making a World of Difference

Applying Discrete-Event Simulation to Produce Measurable Change

Arun Dixit, Talha Hussain, Millicent Brown, Andrea Ennis, Sandy Marangos, Dr. Ryan Margau, Dr. Bonnie O'Hayon, Mike Sharma, Ann Shook, Dr. Kuldeep Sidhu, Jennifer Zadravec, Jennifer Quaglietta

Presentation objectives:

1. Introduce Discrete Event Simulation (DES)

2. Describe the process for DES development

3. Share lessons learned

North York General Hospital: General Site

410 Acute care beds	**Catchment area population of over 400,000**	**Over 110,000 ED visits annually**

Project background and goal:

Wait times for emergency department patients is an important area of focus

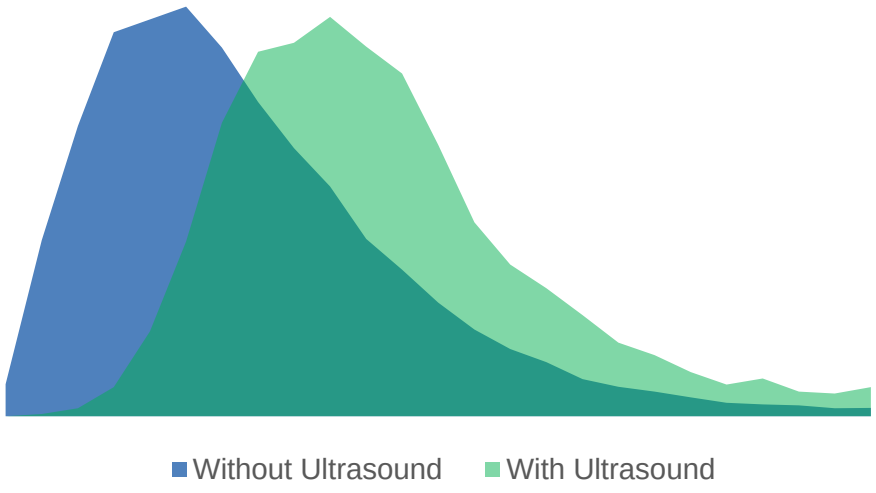
Annual emergency department visits increase by **3-5%**

10% of high-acuity, non-admitted patients and **15%** of admitted patients receive an ultrasound exam

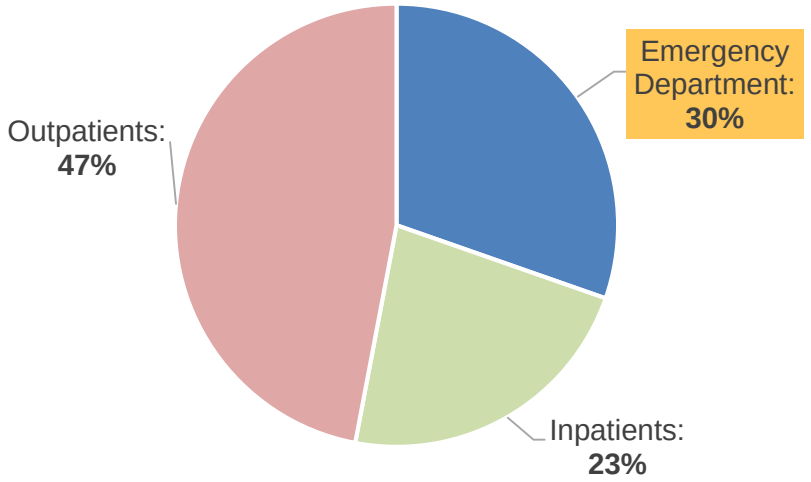
Goal: Reduce wait times for ultrasound exams for patients visiting the Charlotte and Lewis Steinberg Emergency Department

Project rationale and motivation:

Non-admitted, high acuity length of stay with and without ultrasound imaging



Ultrasound exam requests by patient type



Quality improvement impact:

- Safe !
- Effective ✓
- Patient- and Family-Centred &
- Efficient %
- Timely
- Equitable =

Aim of Quality

- Provider Experience
- Patient Experience
- Better Outcomes
- Cost Efficiency

Current state process:

For a patient in the emergency department requiring an ultrasound exam (US):

Patient arrives in the emergency department

US exam ordered for a patient

Order is reviewed by techs and prioritized

Patient is called to the US department

Patient's US exam is completed

US exam is read and dictated by the radiologist

Simulation overview:

Computer-aided simulation…

- Is a computer model that behaves like a real-life system
- Can re-create complex systems with high accuracy
- Can model systems with many interacting, random processes

Simulation is useful for…

- Conducting “what-if” analyses in a low-risk environment
- Analyzing prospective changes to complex systems
- Performing many trials in a short period of time

Discrete Event Simulation:

Discrete Event Simulation

What it is:

- A process model depicting a system as a sequence of specific activities

Use case:

- Modeling wait times for ultrasound imaging exams

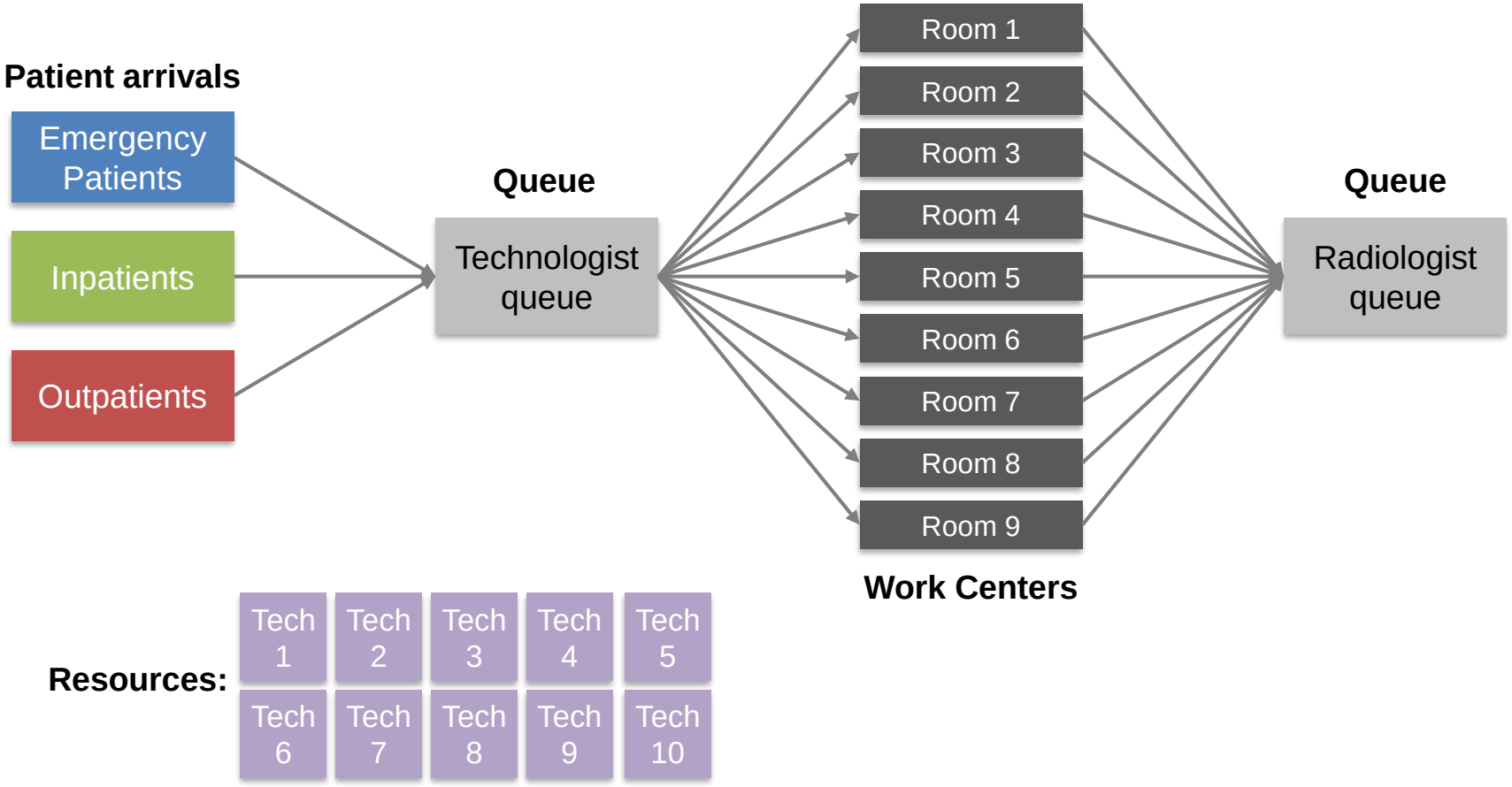
Event: A patient's arrival or departure into the system

Queues: A sequence of patients awaiting processing at a work center

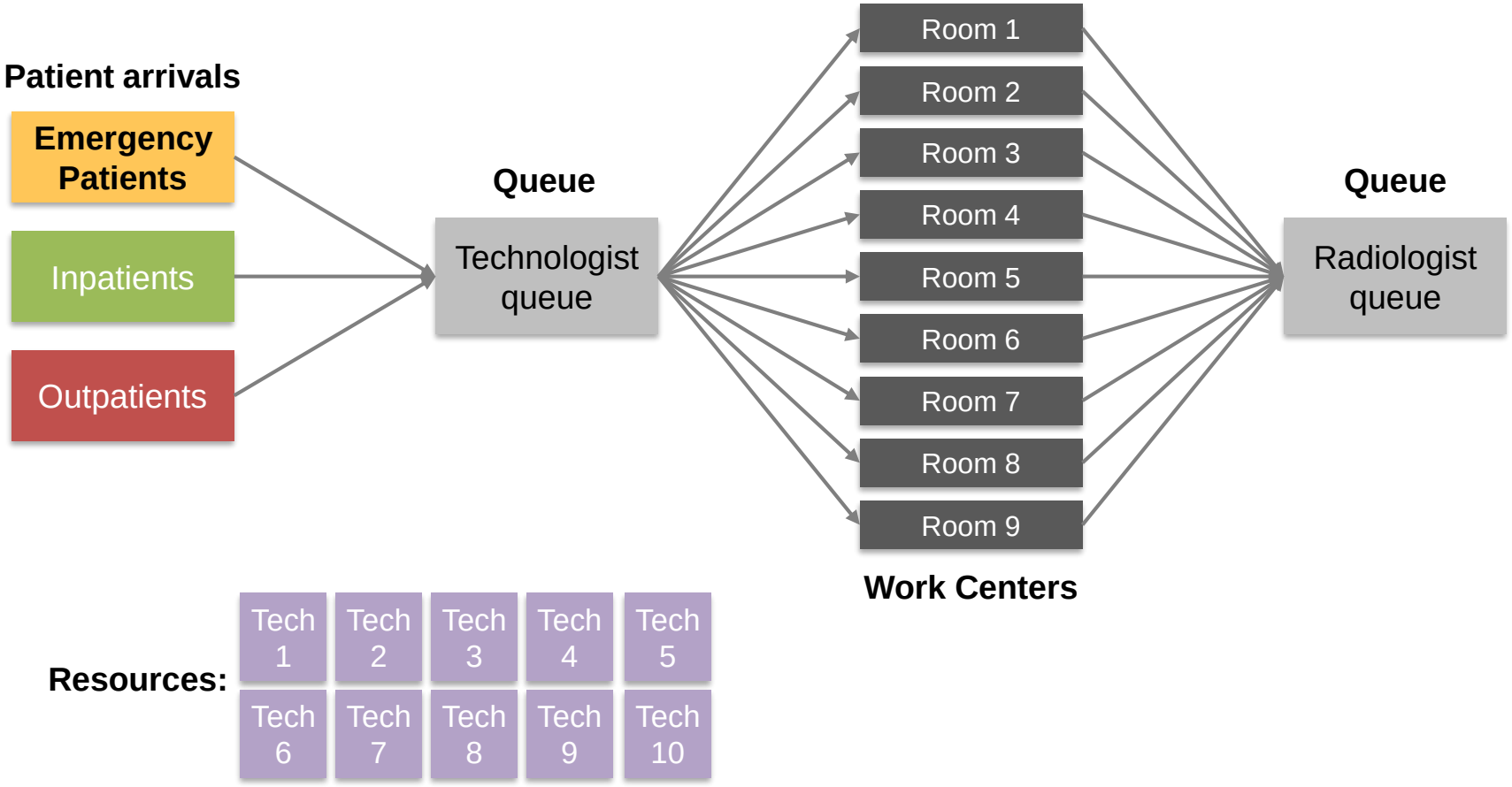
Servers: Resources available to service patients at the work centers

Work Centers: Locations where processing takes place

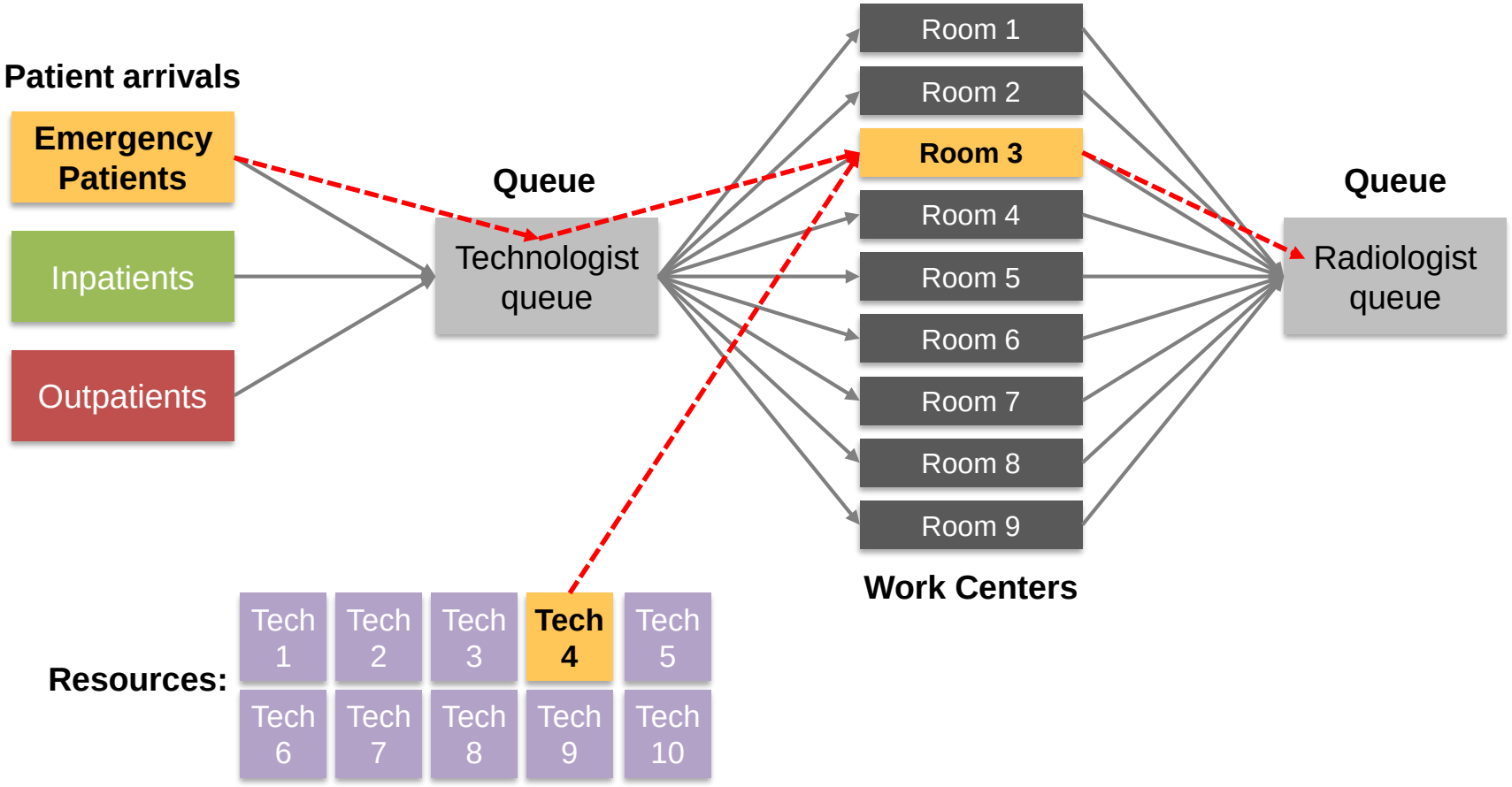
Ultrasound service simulation model:



Ultrasound service simulation model:



Ultrasound service simulation model:



Simulation model development process:

01: Define scope

- Test impacts of scheduling changes for the ultrasound service at North York General Hospital

02: Metrics

Desired outcome:
- Reduce wait times for ED patients

Balancing factors:
- Wait times for inpatients and outpatients

03: Collect data

- **2** years' of ultrasound exam data for all patient types

04: Build model

- Leverage clinical expertise and knowledge to develop model

Simulation model development process:

05: Test model

- **8** iterations of the model were built and evaluated with clinical input

06: Run scenarios

- **11** different schedule scenarios were evaluated

07: Plan live trial

- Implementation plan developed based on model output

08: Approvals

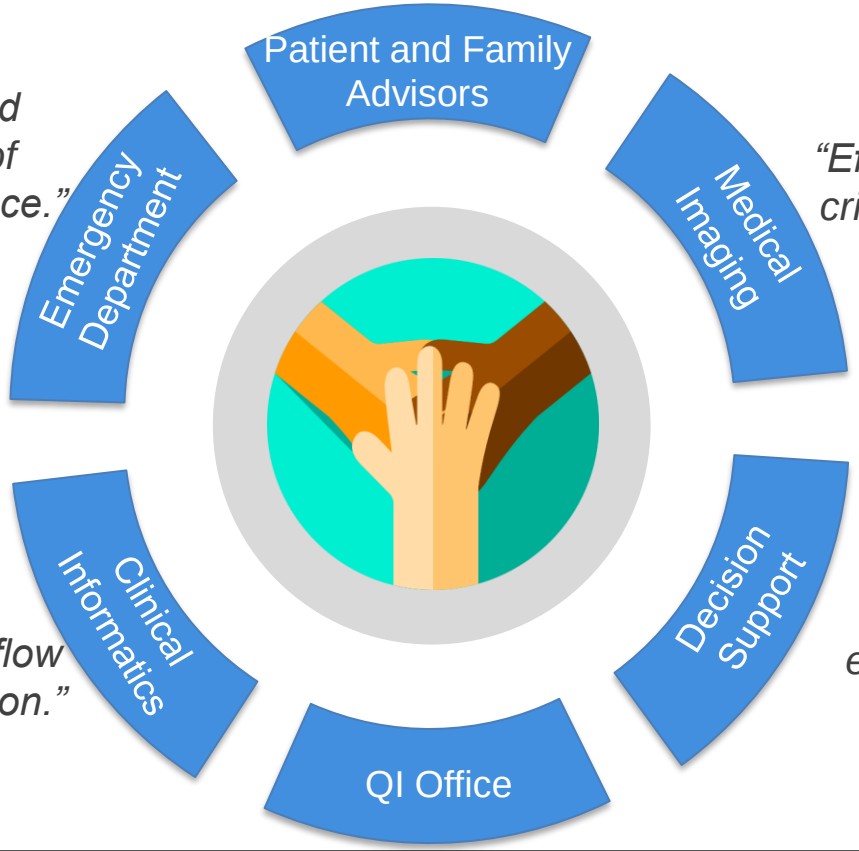
- Recommendations presented for feedback and approval

Project team participants:

"I want timely access to safe care and treatment."

"Wait times for ultrasound exams are a key driver of patient safety and experience."

"Effective resource planning is critical to ensure we meet our patients' needs."



"Understanding user workflow helps with data interpretation."

"Validating system data is essential when building the simulation model."

Summary of changes:

Process Changes:

- Tech. schedules better aligned to meet ED demand
- Team Attendants support patient flow

Test Period:

- Initial period: **June – July**
- Test period extended to September

Monitoring Plan

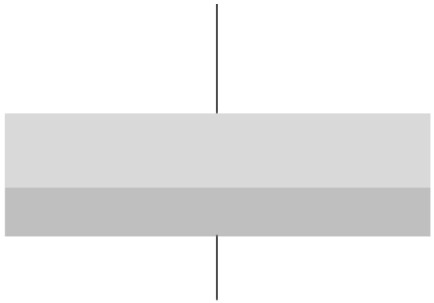
- Regular meetings to monitor process
- Process dashboard shared weekly

Wait times for inpatients and outpatients were not expected to be impacted by these changes

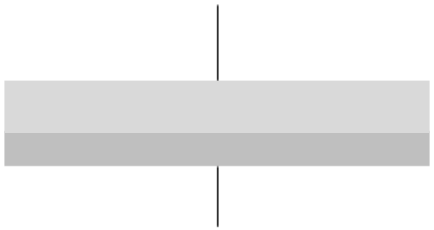
Summary of results:

Metric	Trial Period
Median wait time	**9% reduction**
90th percentile wait time	**17% reduction**
Average weekly exam volume	**No change**

Baseline boxplot:



Trial period boxplot:



Lessons learned and strategies for success:

- Clearly define your research question
- **Build the model to answer your research question!**

- Model building is a highly iterative process
- **Model building is highly multi-disciplinary and collaborative!**

- Understand the process before turning on the computer
- **Engage with patients throughout the entire process!**

Next steps

- **Modify the model to test improvement strategies for inpatients**
- **Employ simulation modeling for other areas of the hospital including:**
  - Other Medical Imaging modalities
  - Laboratory Medicine
- **Explore other methods of simulation (Agent-Based, System Dynamics)**

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THANK YOU