# Scheduling of staff and patients for a Pre-Surgical Screening clinic

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# The Sir Mortimer B. Davis Jewish General Hospital

- **A full service university affiliated medical center**
  - **Provides a broad range of inpatient and outpatient services**
  - **Has major tertiary & quaternary cardiovascular, neurosciences, oncology(including robotic surgery) and colo-rectal programmes**

- **13,000- 15,000 operative procedures per year; this number is expected to grow at least 2% per year through 2015**

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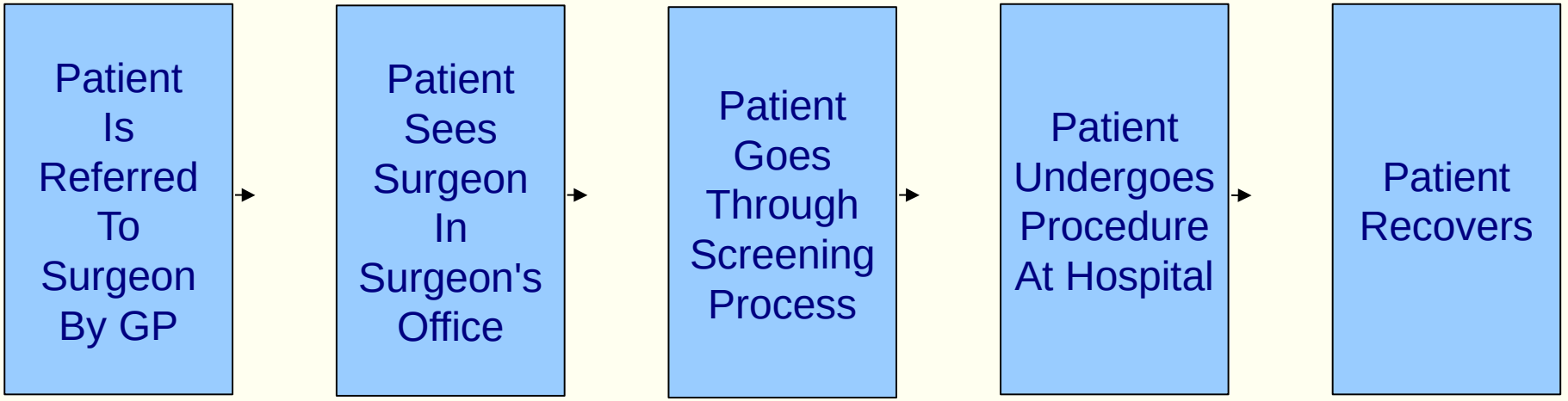
# A Simplified View Of The Peri-Operative Process

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# Pre-Admission Testing Clinic Activities

- **Patient logistical preparations (phone call)**
  - **When to arrive to the clinic**
  - **Expected wait time at the clinic**
  - **Information/Preparation on the day of the visit**
- **Administrative – register and submit insurance information**
- **Medical**
  - **Perform Medical/Surgical History and obtain Physical Exam**
  - **In some cases adjust medications**
  - **Obtain ECG and other required tests**
  - **Refer all abnormal results to the Surgeon to perform follow ups**

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# Existing Clinic Issues

- Not enough space:
  - Waiting area (wheelchair access)
  - Exam rooms, individual training rooms
  - Administrative work area
- Not enough staff (i.e. nurses and admin techs)
- Teaching provided to minimum number of patients (SDS only)
- Inefficient flow of patient and high wait time
- Inconsistent medication adjustments
- Dealing with abnormal results?
- Completing charts on-time and adequate follow-up

# Analysis of the Existing Clinic

- **Literature - lack of comprehensive services increases post-op complications**

- **Analysis of existing clinic suggested that it should:**
  - **Include more services (ex: pharmacist, group teaching sessions)**
  - **Have adequate staffing (nurses, doctors)**
  - **Streamline patients**
  - **Screen and identify patients with infection precaution or allergies (ex. MRSA exposure, latex allergies)**
  - **Manage abnormal results**
  - **Complete charts at least 72 hours before the day of procedure**

# Pre-Surgical Screening Clinic Tasks

- **Up to 35 patients/day will need to do some of the following:**
  - **Register for the clinic**
  - **Submit insurance information**
  - **Watch a DVD based video orientation at the start of visit**
  - **See pharmacist**
  - **Change into a gown**
  - **Have ECG taken**
  - **See GP**
  - **See Internist**
  - **Get dressed**
  - **Provide blood and urine samples**
  - **Receive group training**
  - **Receive individual training**
  - **Undergo X-rays test**

# Management Challenges

- **Patients having differing needs**
- **Space requirements**
- **Staffing costs (including overtime costs)**
- **Physician idleness**
- **Excessive patient waiting**

# Complicating Factors

- **Uncertainty of patient profile mix**
- **Uncertainty about times needed for each task**
- **A few patients need to see pharmacist before seeing physician**
- **No shows and cancellations**
- **Making sure that staff get breaks and lunch**

# Management Decisions

- **Scheduling:**
  - **Staff**
  - **Patients**



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# Tool Set

- **Discrete Event Simulation**
- **Optimization**
- **Simulation based optimization**

# Simulation Model Challenges

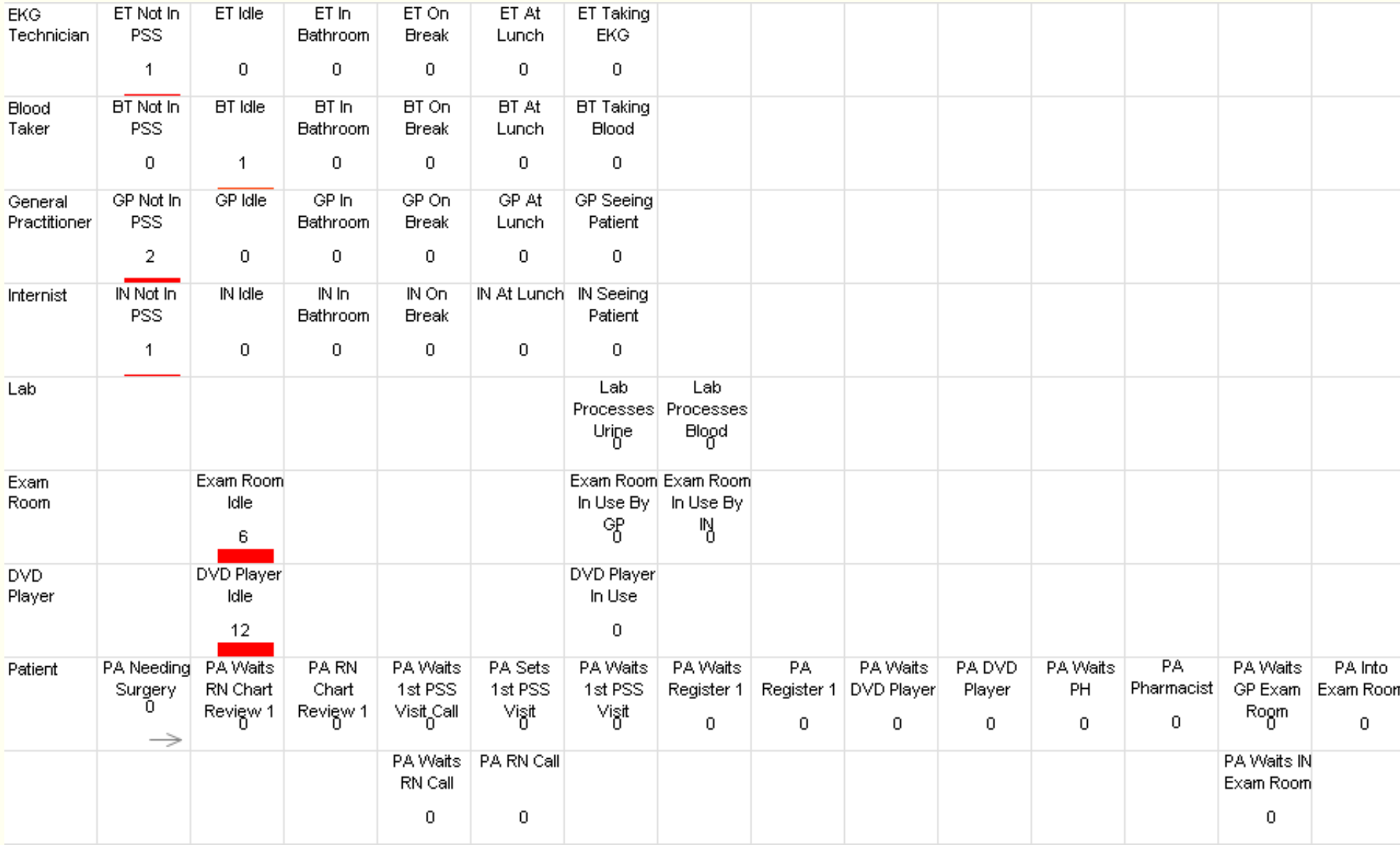
- **Modelling entities as entities as opposed to resources (to facilitate decision making such as when a nurse could go home)**
  - **Physicians**
  - **Nurses**
  - **ECG Technicians**

- **Modelling activities involving different entities (i.e. coordination of multiple entities involved in the same activity)**
  - **Patients need to be in an exam room to change into their gown**
  - **Patients need to be in a gown before having their ECG taken**

# Simulation Modeling Approach

- Could have treated:
  - Patients as entities
  - Staff as resources
  - Exam rooms, DVD players, . . . as resources
- Wanted more flexibility for simulating staff
- Treated patients, staff and physical resources all as entities
- Visual display of model as a console of states for each entity type
- Simulation logic is used to handle
  - Events
  - Logic of entity flow

# Simulation Model Animation



# Simulation Model Data Requirements

- **Tasks needed for each patient profile**
- **Patient profile distribution**
- **Service time distributions**
- **Count of tasks needing to be done each day**

# Actual Simulation Model Data

- **Patient profiles**
  - **Guesstimates from subject matter experts in existing (PAT) clinic**
- **Service time distributions**
  - **Triangular distribution guesstimates from subject matter experts**
  - **Patient self-time studies (in progress)**
- **Count of tasks needing to be done each day**
  - **Use patient profiles and tasks associated with each profile**

# Simulation Model Miscellaneous Issues

- Needed to determine rooms allocated to each type of physician
  - Can not pool rooms when GP and Internist work at same time
  - For Internist
    - When alone allocate all of the rooms
    - When with GP, allocate 2 for each Internist

# Validating The Simulation Model

- Was difficult
  - Plan for PSS is in flux
  - Incomplete data
- Received feedback from management
  - PSS Clinic Nursing Coordinator
  - The Chief Of Surgical Services
  - Associate Director Of Professional Services
- Tested against schedule with deterministic service times
- It was known that results were sensitive to service time distribution estimates which were at best guesstimates

# Optimization Issues

- **Need to start day early to get everyone done by 21:00**
- **Certain staff had to arrive before other staff**
- **Breaks and lunches had to fit into 8 hour day**

# Optimization Problem – Objective Function

- **Minimize sum of costs of:**
  - **Physician idle time**
  - **Staff overtime**
  - **Excessive patient waiting time**

# Optimization Problem - Constraints

- **Subject to**
  - **Getting patients done by the end of the day (21:00)**
  - **Staff break and lunch times are respected**
  - **Both general practitioners work in the morning**
  - **The sole internist works in the afternoon**
  - **At least 8 people in group training sessions**
  - **Sending staff home at end of their shift if there is another staff member who can finish up for them**

# Optimization Algorithm

- Initially Optquest - objective only included physician idle time
- To facilitate distribution, current using simple neighbourhood search
  - Set initial values for each arrival time variable
  - Set upper and lower bounds for each arrival time variable
  - Select initial time increment
  - Repeat forever
    - Loop through variables one at a time
      - Change variable positively and then negatively by time increment
      - If solution is feasible evaluate average of total simulated cost over a pre-determined number of days
      - Keep if it is an improvement
    - Gradually decrease magnitude of time increment

# Optimization Challenges

- **Finishing all patients by 21:00**
- **Minimum group size of 8**
- **Sending staff home at end of their shift if there is another staff member who can finish up for them**
- **Determining what excessive patient waiting time is**
- **The internist in the afternoon**

# Best Decision Variable Values Found To Date

- Depends on time distributions
- Using preliminary guesstimates (based on small study of existing PSS)
- Using guesstimates from ECG machine salesman
- Using slower dressing times

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# Optquest Solution

| | Arrival time |
|---|---|
| Admission staff | 07:00(2) |
| Clerk | 08:00(4) |
| RN | 08:20(1) 08:50(1) 09:20(1) |
| Pharmacist | 07:30(1) |
| EKG technician | 07:30(1) |
| Blood taker | 08:00(1) |
| GP | 08:00(1) |
| Internist | 12:00(1) |
| Patients | 07:00(35) |

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# Newer Solution (Using Neighbourhood Search)

| | Arrival time |
|---|---|
| Admission staff | 06:15(1) 06:45(1) |
| Clerk | 08:00(4) |
| RN | 08:00(3) |
| Pharmacist | 07:15(1) |
| EKG technician | 07:30(1) |
| Blood taker | 08:00(1) |
| GP | 07:30(1) 07:45(1) |
| Internist | 12:30(1) |
| GP Patients | 06:00(3) 06:15(4) 06:30(6) 06:45(4) 07:00(2) 07:15(1) 07:30(3) 07:45(2) |
| Internist Patients | 10:00 AM(2), 10:15AM(2), 11:15 AM(1) |
| Nurse Only Patients | 6:30AM(2), 6:45AM(2), 7:15AM(1) |

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# To Do – Short Term

- Change definition of excessive patient waiting time
- Include staff break and lunch times as decision variables
- Consider moving all three physicians to the morning
- Multiple schedules to handle different patient profile mixes

# To Do – Medium Term

- **Improve quality of data – possibly by using RTLS to track times**
- **Analyze data to try to identify correlation between task times for patients, possibly based on their age, preliminary surgeon evaluation, . . .**
- **Revise list of decision variables using updated data**

# To Do – Longer Term

- Address changing patient profile mix
- Address no shows and cancellations
- Adapt for other clinics
- Adjust break and lunch schedule dynamically within day