Operation Management

运营管理

Matching supply and demand

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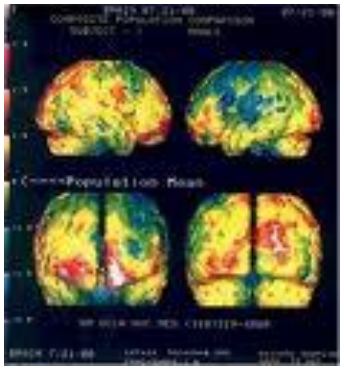
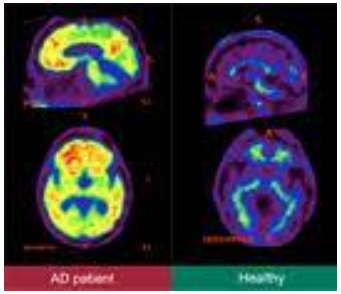
CASE 2

Quinte MRI: Relieving the Bottleneck

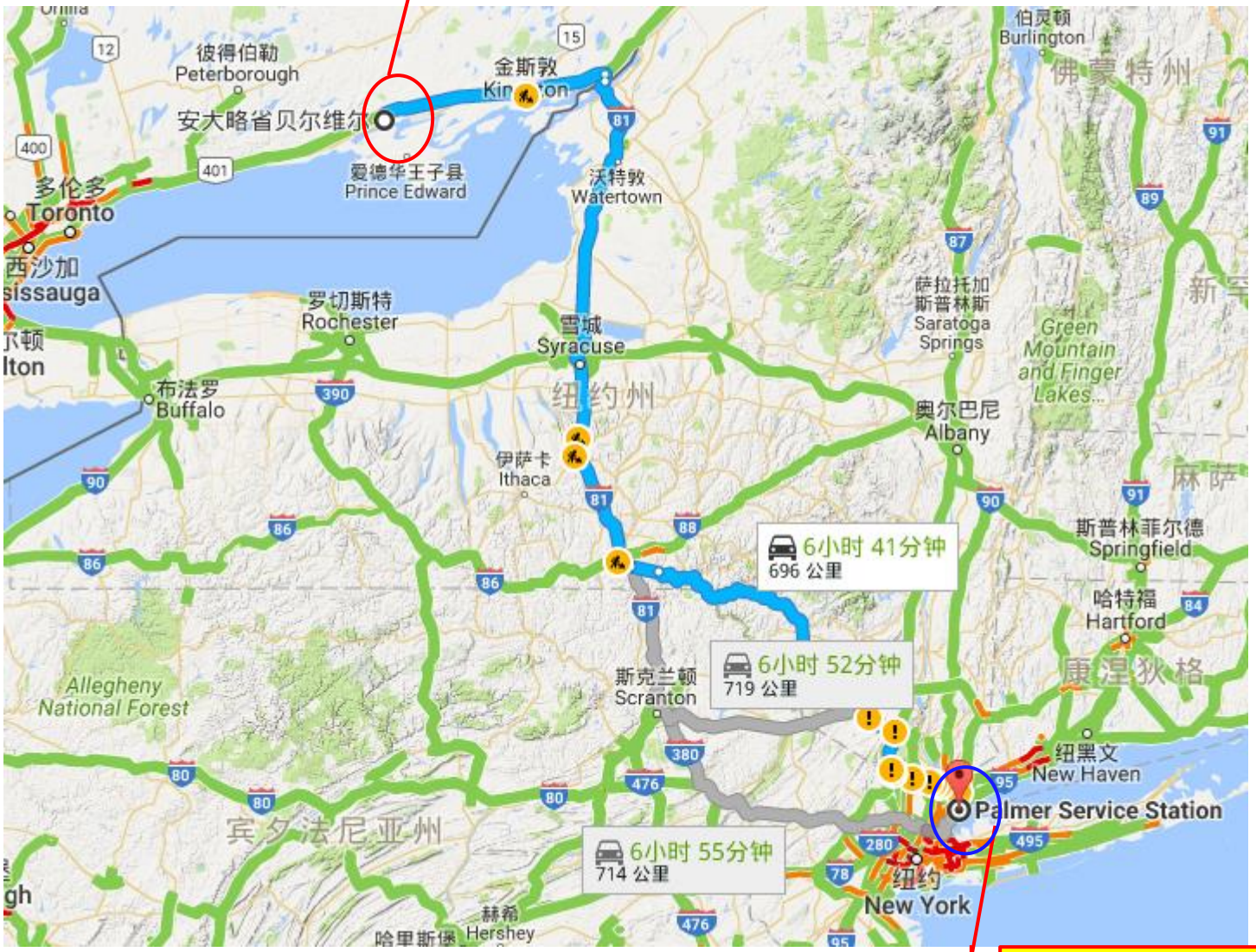
单光子发射计算机断层成像术(Single-Photon Emission Computed Tomography，*SPECT*)





正电子发射断层成像术(Positron Emission Tomography，PET)

Belleville,Ontario



Palmer, New York

Is There Enough Demand?

- Annual average scan rate = 68/1,000 people
- Considering Palmer only:
  - Population of Palmer = 16,000
  - Palmer's expected demand = 1,088 scans/year
  - Maybe higher due to higher cancer rate in county
- Considering Adelaide County
  - County population = 118,000 people
  - Total county demand: 8,024 scans / year
- Clearly, BCMC counts on demand from people from other areas of the county
  - In fact, yearly forecast for BCMC ~ 2,200 scans/year

Is There Enough Demand? (Cont.)

Variable Costs

Revenue		$700
Radiologist	($140)	
Supplies	($50)	
Scheduling	($5)	
Contribution		$505

Fixed Costs

- $690,000 / year

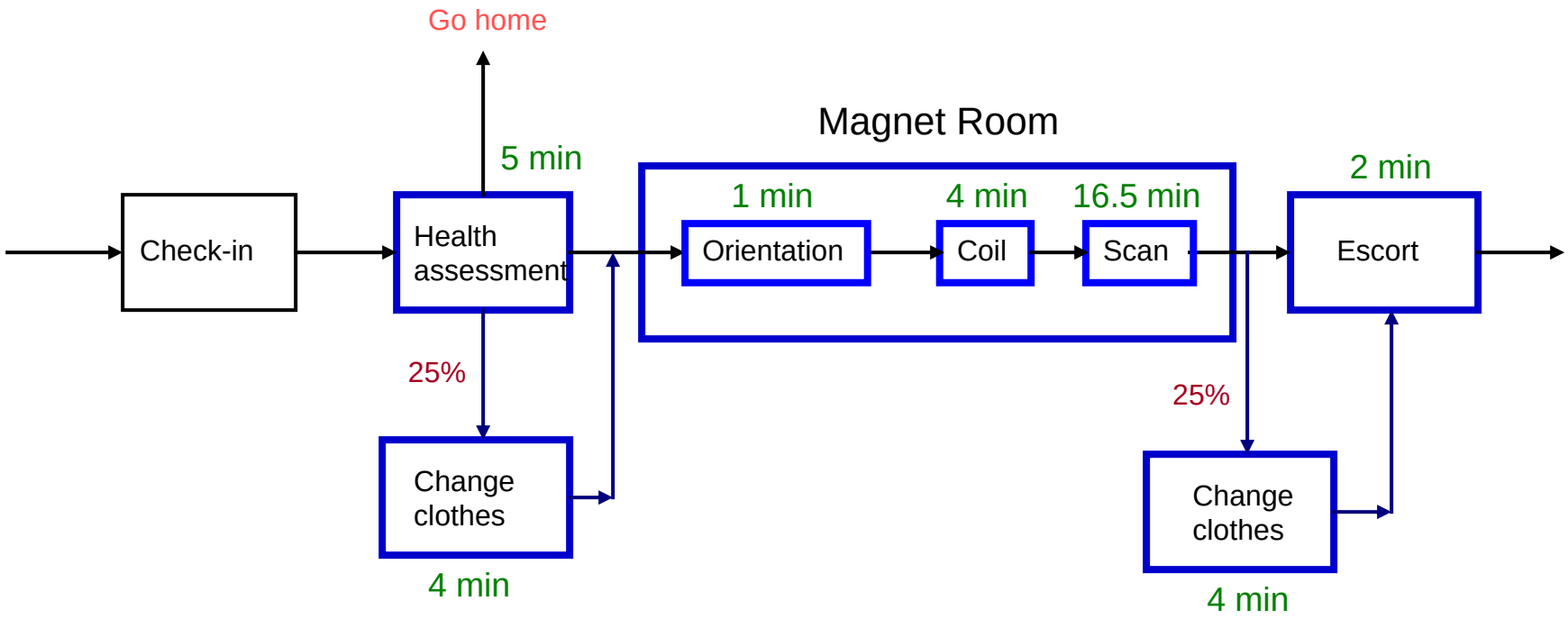
Breakeven Point:

- $690,000 / $505 = 1,367 scans / year
- So, there was plenty of demand for a third machine
- Also, growth rate of 15% per year

公司的客户群体

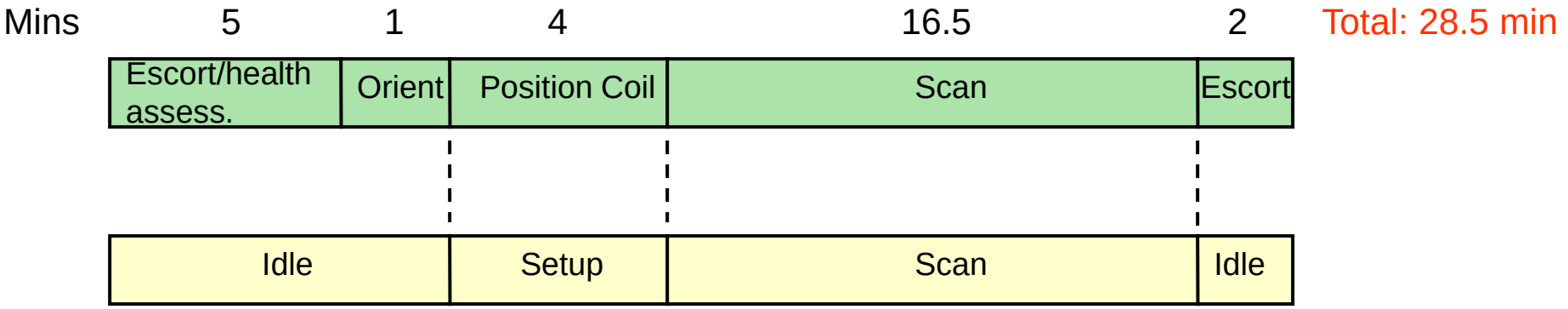
1. 试图将诊断影像服务外包的医院
2. 想要成为独立诊断成像中心的合伙人的医师
3. 想要经营自己的诊断成像中心的个人

Process Flow Diagram: Locating the Bottleneck

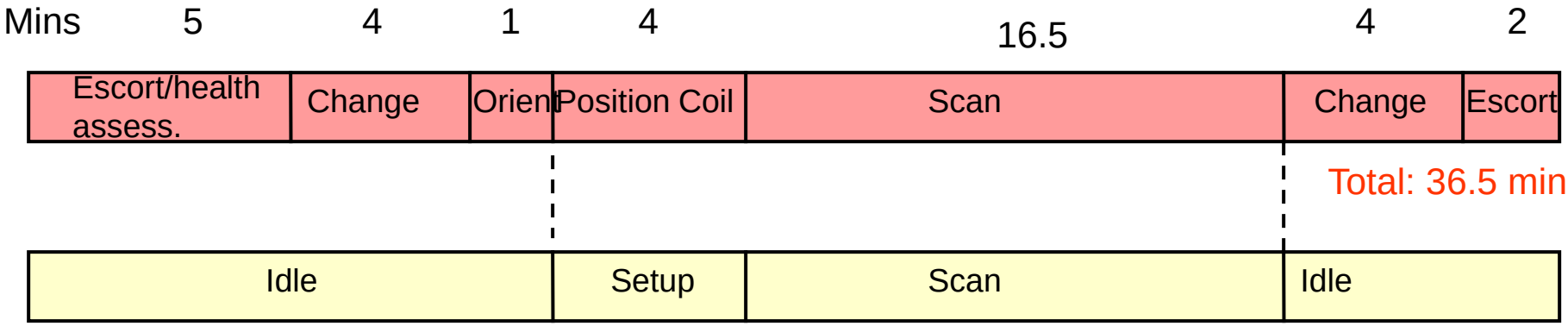


Multiple Activity Time Chart: 30 min Scan

The Technologist and the MRI Machine (in yellow) when no change of clothes required



The Technologist and the MRI Machine (in yellow) when change of clothes required



Determining Capacity of the Technologist

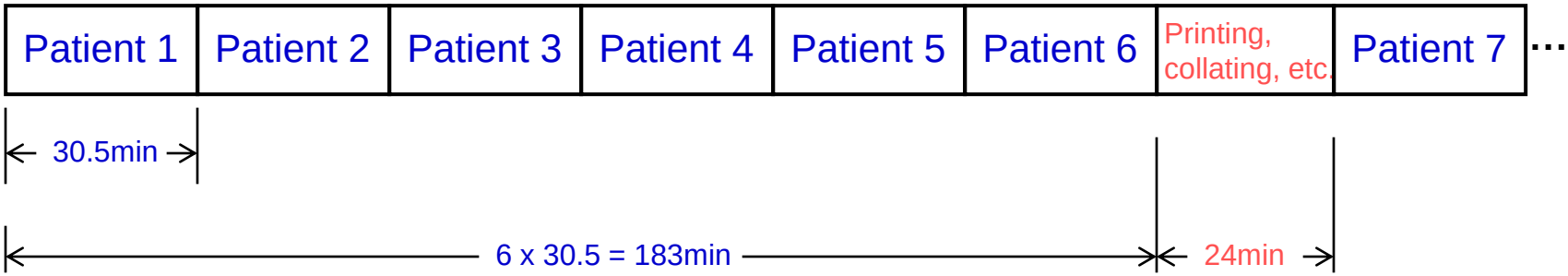
Average Activity Time for 1 Patient = 0.75*28.5 + 0.25*36.5 = 30.5 min

Capacity of the Technologist = 60/ 30.5 = 1.98 patients/hr

The Goal = 2 patients/hr

What Else?

What about printing, collating, sorting, labeling and sending reports?

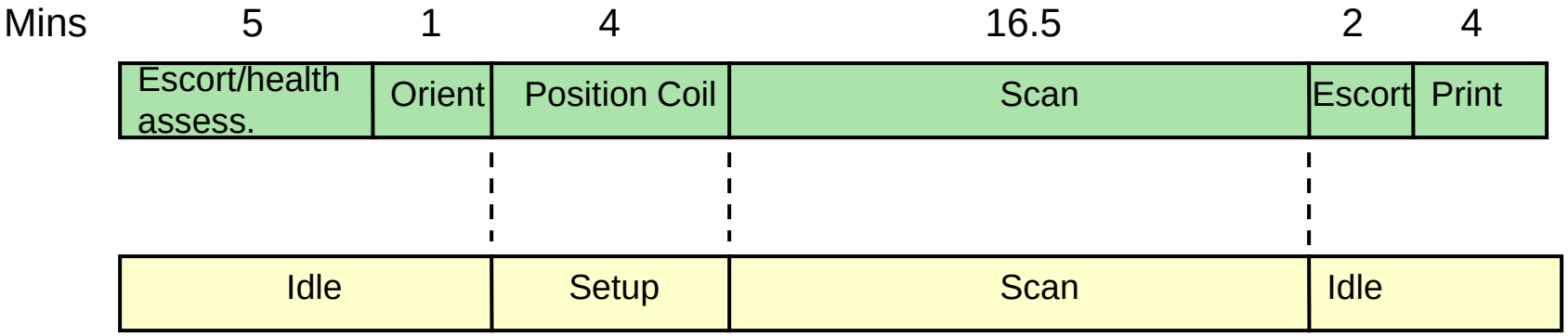


$$\text{Capacity} = \frac{B}{S + B \times p} = \frac{6}{24 + 6 \times 30.5} \times 60 = 1.73 \text{ patient/hr}$$

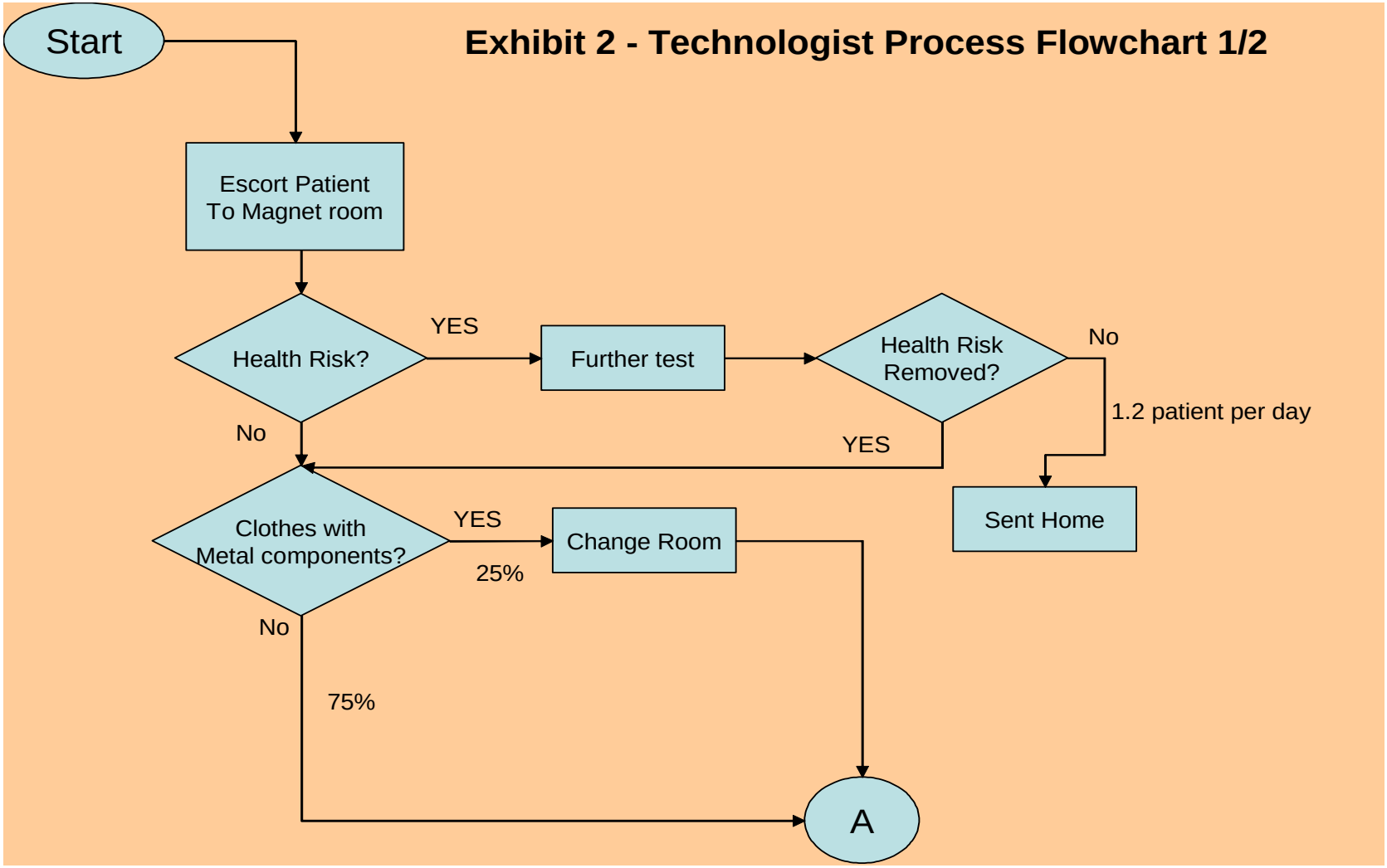
The Goal = 2 patients/hr

Multiple Activity Time Chart with Printing

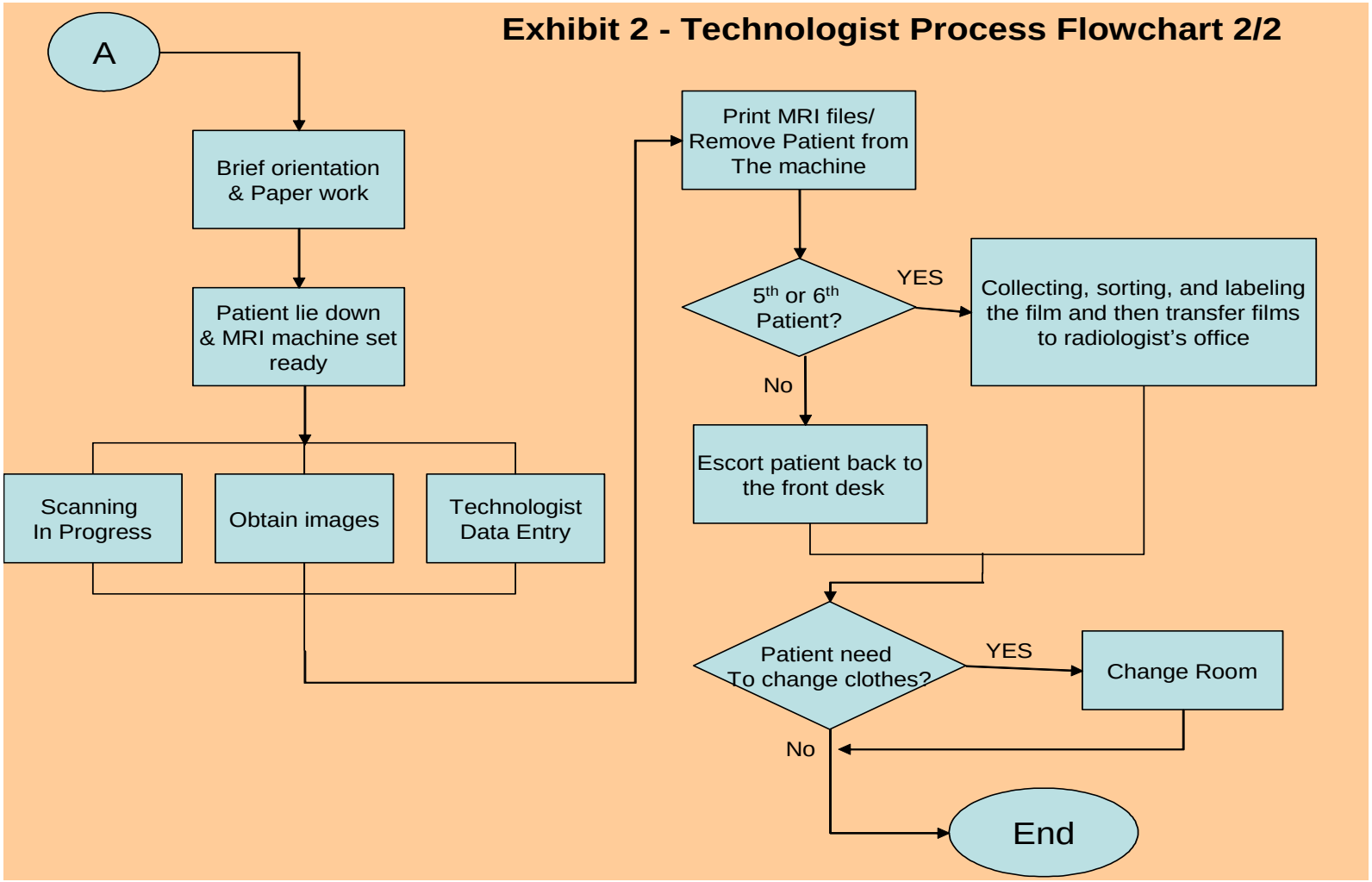
The Technologist and the MRI Machine when no change of clothes required



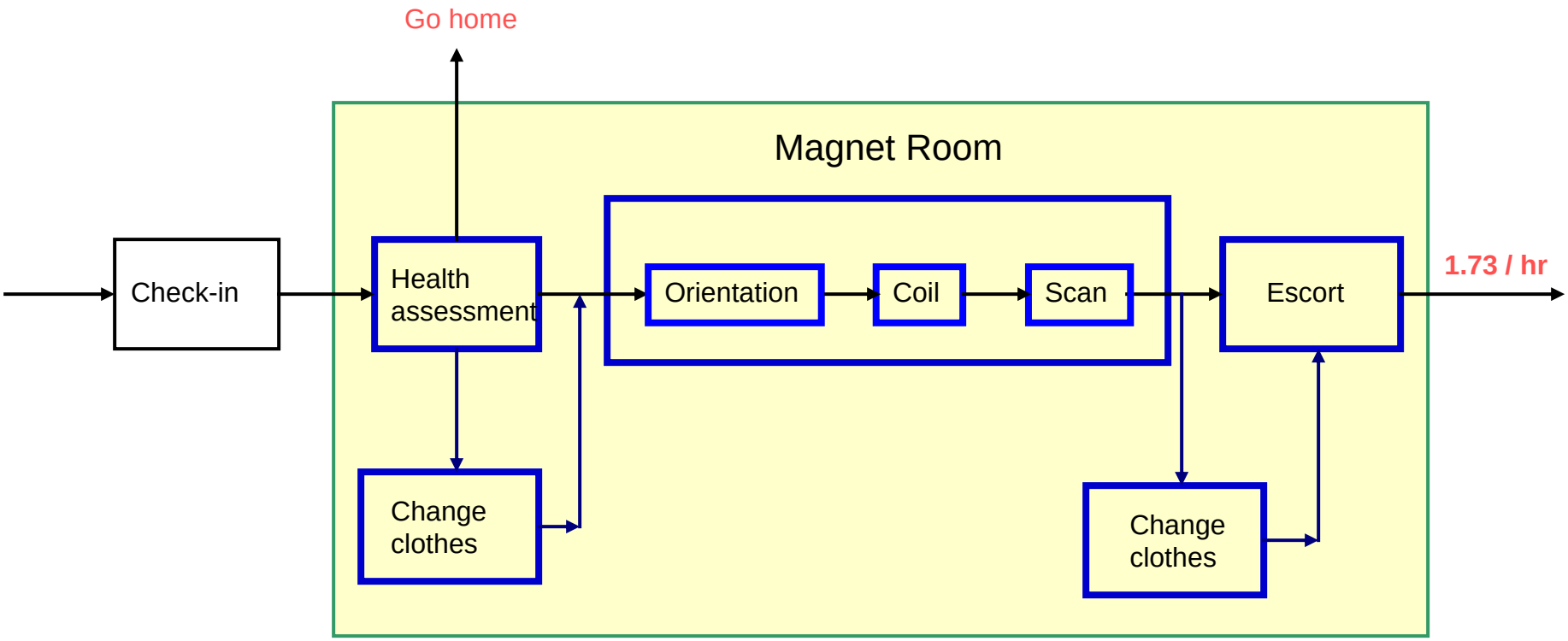
Technologist Flow Chart Part 1



Technologist Flow Chart Part 2



Process Capacity



Capacity per day = 1.73*8 = 13.85 patients/day

Target = 16 patients/day

Possible Solutions for Improvement

- Add capacity to bottleneck ➔ technologist
- Take ownership of employee scheduling
- Confirm appointments a day earlier
  - Use these phone calls to remind patients to not wear clothes with metal accessories
  - Do some pre-screening regarding health risks
- Educate doctors about risks with MRI
  - 1.2 patients per day rejected
  - Doctors should not refer patients with metal objects inside body such as pacemakers

(i) Adding a Second Shift Technologist

- Cost: $38/hr + 20% benefits; 8 hr/day, 250 days/year = $ 91,200
- Needs additional 91,200/505 = 181 patients per year to break even

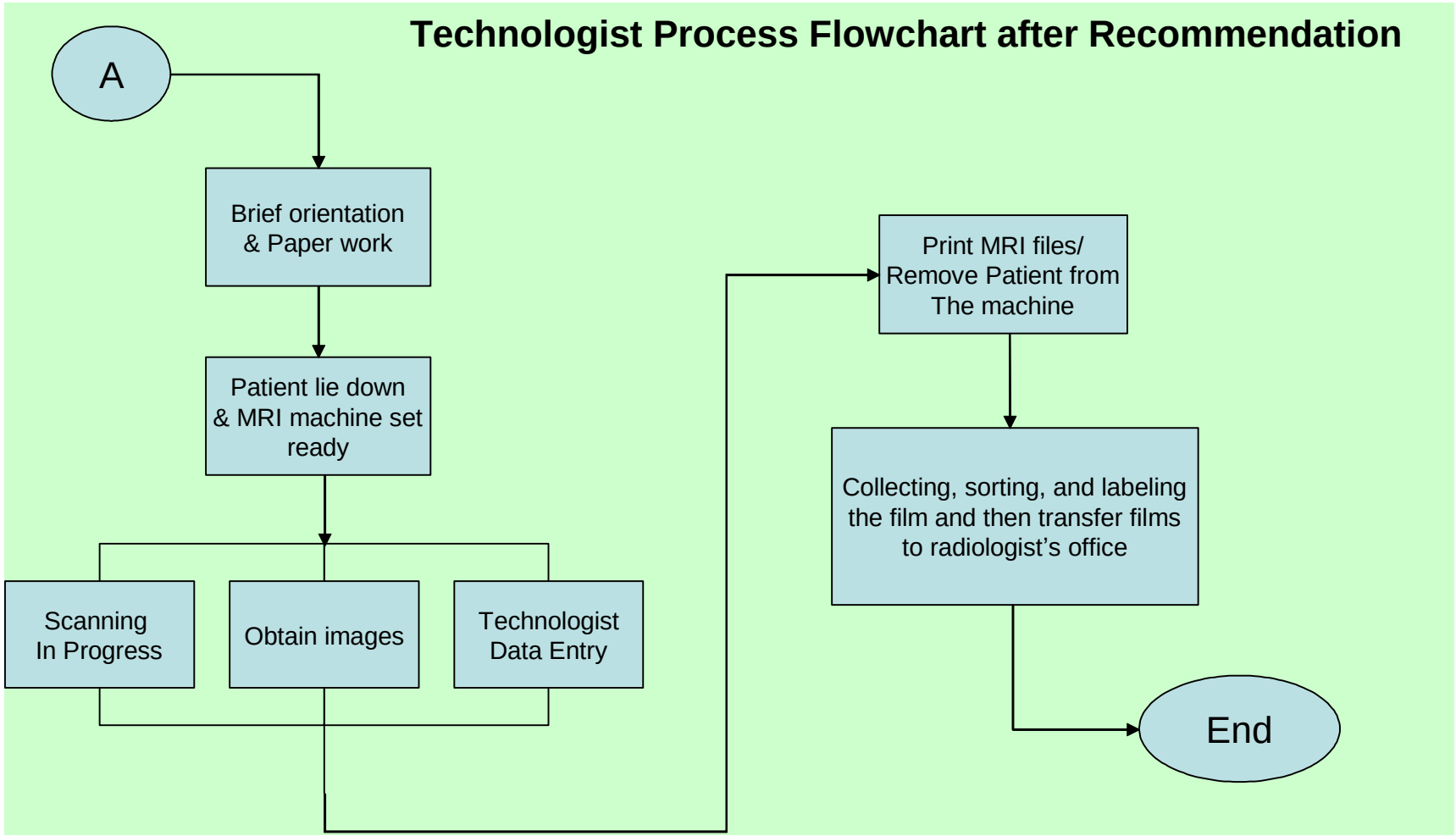
- Pros
  - Can substitute Sinclair if he is sick or in vacation
  - Increases system capacity
  - Additional capacity for future growth

- Cons
  - More expensive
  - Will be idle for a significant portion of the time

(ii) Adding an Assistant to Technologist

- Would perform “non-value” added activities currently performed by Sinclair
  - Greet patients at reception; escorting to/from room; wait for patient to change; take film to radiologist
  - Could also call patients, pre-screening, help educate doctors
- Would also allow Sinclair to develop film for each patient (instead of waiting for 6)
- Reduces technologist’s throughput time to 27.5 minutes, achieving objective of 2 patients/hr
- New system capacity = 8 / (27.5/60) = 17.4 pat./day
- Cost = $10/hr +20% benefits ➔ $24,000/year
- Needs $24,000 / $505 = 48 patients / year to break even, or 0.2 patients per day, so it **pays off**

Technologist's Flow Chart After Hiring Assistant



Capacity vis-à-vis Incoming Flow

Current Demand Forecast = 200 patients / month

Assume 20 working days per month

Current Demand Forecast = 10 patients / day

Current Capacity = 13 patients / day!

What Explains the 14 Day Backlog???

What Explains the 14 Day Backlog?

- Variability!!!
  - Incoming flow variability
  - Service time variability
    - The nature of scan
    - Variability of the technologist
    - …

Takeaways

- The notion of activity times and resources can be very different in manufacturing and service settings
  - Mobile resources doing many activities in a service sector
- Adding *partial* resources (an *assistant* Technologist as against a *full* Technologist), and then *re-allocating* activities to offload (relax) the bottleneck
  - Notion of “Line Balancing”, i.e., is, removing activities that do not require the bottleneck’s skills and moving to another resource
- Impact of setups on process capacity
- Capacity analysis is the “first cut”. It may not explain all the symptoms of the problem. But it is necessary to conduct capacity analysis first
  - Capacity problem augmented by high variability in this setting