

# Operating Room Staffing and Allocation

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# Operating Room Staffing and Allocation



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# Financial Disclosure

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- Employment
  - I am employed by the University of Iowa, in part, to consult and analyze data for hospitals, anesthesia groups, and companies
  - Department of Anesthesia bills for my time
    - I receive no funds other than from the University of Iowa, including no travel reimbursement or honorarium
    - I own no healthcare stocks (other than indirectly through mutual funds)
    - I have tenure with no incentive program

# Sequence of the Talk Based on Review Article

- What precisely is OR efficiency?
- OR efficiency applies to existing workload
- Teach principles using scenarios
- Service-specific staffing based on OR efficiency
  - Important to use the statistical methods
  - How to use the statistical methods



# Sequence of the Talk Based on Review Article

- McIntosh C, Dexter F, Epstein RH. [Impact of service-specific staffing, case scheduling, turnovers, and first-case starts on anesthesia group and operating room productivity: tutorial using data from an Australian hospital.](#)  
Anesthesia & Analgesia 103: 1499-1516, 2006



# Sequence of the Talk

- What precisely is OR efficiency?
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  - Service-specific staffing based on OR efficiency
    - Important to use the statistical methods
    - How to use the statistical methods



# Example of a Decision on Operating Room Staffing

- How many operating room teams should we plan in the Fall, on Mondays, in the "main surgical suite," for orthopedics between 7 AM and 5 PM?



# Example of a Decision on Operating Room Staffing

- How many operating room teams should we plan in the Fall, on Mondays, in the "main surgical suite," for orthopedics between 7 AM and 5 PM?

Focus in on these words



# Example of a Decision on Operating Room Allocation

- How many operating room teams should we plan in the Fall, on Mondays, in the "main surgical suite," for orthopedics between 7 AM and 5 PM?

All of the other words are the same for OR allocation



# *Staffing and OR Allocation* are Synonymous

- If staff are present to do a case in an OR, then the OR time has been allocated
  - OR time that is staffed but not allocated to a service has effectively been allocated to the unblocked, open, first-come, first-served OTHER service
    - Different names at different facilities



# *Staffing and OR Allocation* are Synonymous

- If staff are present to do a case in an OR, then the OR time has been allocated
  - OR time that is staffed but not allocated to a **service** has effectively been allocated to the unblocked, open, first-come, first-served OTHER service

Next definition



# *Service* Is the Unit of Operating Room Allocation

- *Service* can represent a ...
  - Surgical group
  - Department
  - Specialty
  - Surgeon
  - Any combination of the above
- If one or more surgeons is allocated OR time, he, she, or they is (are) a service



# *Service* Is the Unit of Operating Room Allocation

- *Service* can represent a ...
  - Surgical group
  - Department
  - Specialty
  - Surgeon
  - Any combination of the above
- If one or more surgeons is allocated OR time, he, she, or they is (are) a service
- Focus of talk is service-specific staffing



# Example of *Under-Utilized OR Time*

- Staffing is planned from 7 AM to 3 PM
- An OR's last case of the day ends at 1 PM
- There are 2 hr of *under-utilized OR time*
  - Under-utilized time is from 1 PM to 3 PM



# Under-Utilized OR Time Affects Adjusted Utilization

- Adjusted utilization =  $100\% - \frac{(\text{hours of under-utilized OR time})}{(\text{staffed hours of OR time})}$
- Just as adjusted utilization cannot exceed 100%, average hours of under-utilized OR time does not equal the OR allocation minus the average hours of cases



# Example of *Over-Utilized OR Time*

- OR staffing is planned from 7 AM to 3 PM
- OR's last case of the day ends at 6 PM
- There are 3 hr of *over-utilized OR time*
  - Over-utilized OR time is from 3 PM to 6 PM

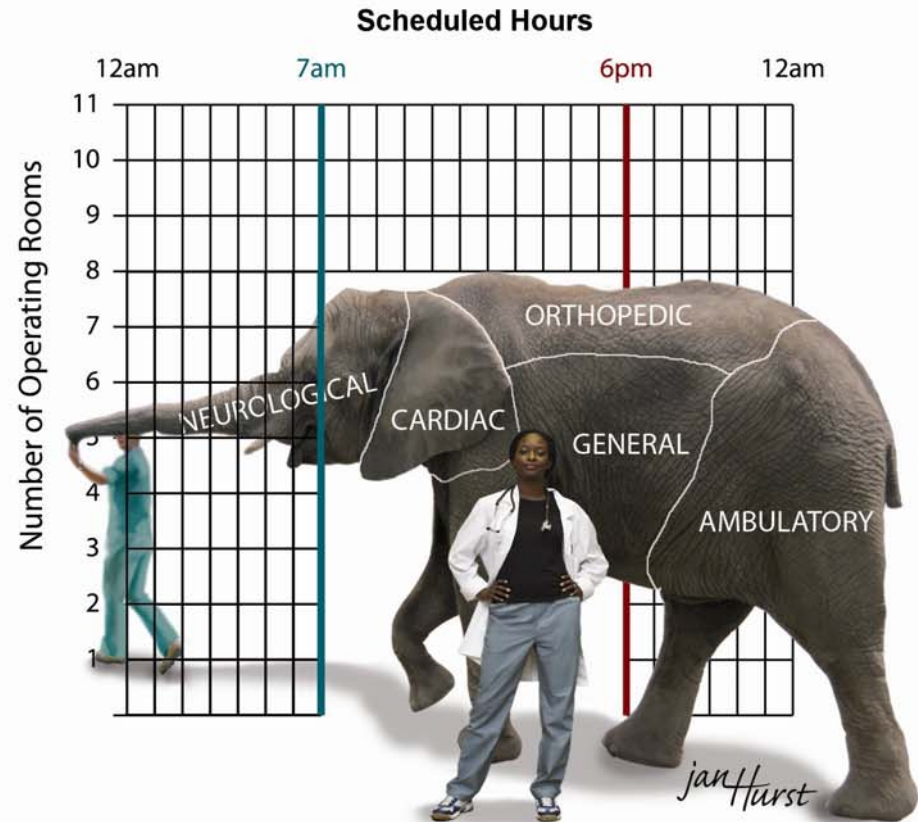
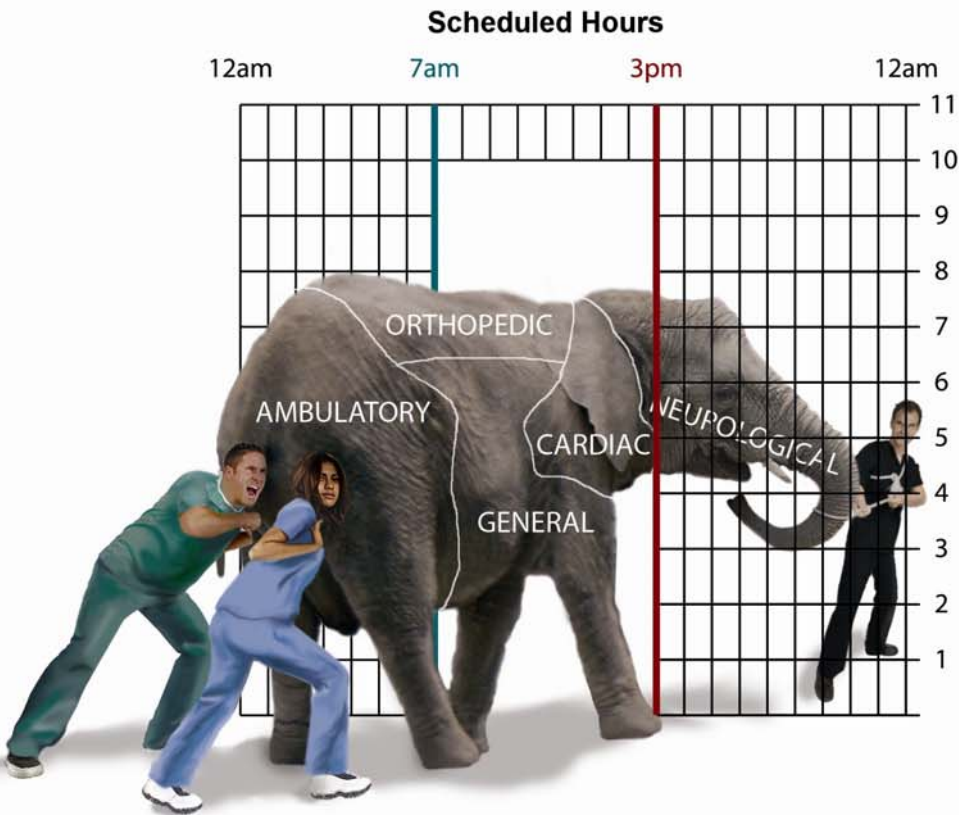


# Precise Meaning of *Maximize OR Efficiency*

Inefficiency of use of OR time (\$) =  
(Cost per hour of under-utilized OR time)  
× (hours of under-utilized OR time)  
+ (Cost per hour of over-utilized OR time)  
× (hours of over-utilized OR time)

Strum DP et al. J Med Syst 1997





“You are not going to get the elephant to shrink or change its size. You need to face the fact that the elephant is 8 OR tall and 11 hr wide.”

Steven Shafer, MD

# Sequence of the Talk

- What precisely is OR efficiency?
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# Allocating OR Time is a Two-Stage Process

- Tactical decisions determine initial increases in OR time allocations for each subspecialty
  - Rarely reductions, just increases or no changes
- Operational decisions based on OR efficiency fill the OR time once actual workload known
  - Schedule cases based on OR efficiency
  - Release allocated but unused OR time
  - Adjust staffing

Dexter F et al. Anesth Analg 2005



# OR Efficiency Applies to Operational Decision Making

- Operational decision making
  - How to get the existing cases done
  - Making decisions on the day of surgery
  - Scheduling cases
  - Planning staffing and OR allocations
- Operational decision making is almost never made based on financial criteria



# OR Efficiency Does Not Apply to Tactical Decision Making

- Tactical decision making
  - Decisions over many months to years
  - Invariably includes financial criteria
  - That is a different talk



# Planning Fixed “Blocks” of OR Time and Resources

- Based on total hours of cases (i.e., utilization)
- Based on revenue and variable costs
- Conceptual model for tactical decision making
- Very rarely used in practice for operational OR management decision making
  - Reason: Fixed hours means *literally* fixed
  - This does not and should not match the reality of operational decision making

Dexter F et al. Anesthesiology 1999



# OR Staffing, OR Allocation, and OR Efficiency

- Service has  $9.5 \pm 3$  hr (SD) of elective cases including turnover times on Mondays
- Why the cases are done is irrelevant, as OR allocation problem is whether to staff for 8 hr, 10 hr, 13 hr, or 16 hr
- OR efficiency differs depending on the OR staffing and allocation, not the workload
  - OR efficiency is an operational concept, not related to tactical decision making



# Surgeons Have Open Access to OR Time on Any Future Workday

- From an operational perspective, surgeons schedule cases on any future workday
- Major limitation is what can be done safely
- Future slides will show that *in practice* this is what is used almost everywhere for *operational* OR management decisions



# Open Access Case Scheduling Is Current Practice (Example 1)

- Dr. Jones has been allocated 8 hours of OR time every Friday for the past decade
  - Staffed hours are 7 AM to 3 PM
- Dr. Jones always underestimates the durations of his cases
- Dr. Jones never finishes before 5 PM and usually ends between 6 PM and 7 PM



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- Make a list of services at your facility who schedule cases like Dr. Jones



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- Dr. Jones is, in practice, scheduling his cases on any workday



# Open Access Case Scheduling Is Current Practice (Example 1)

- Planning staffing from 7 AM – 7 PM, instead of 7 AM – 3 PM, increases OR efficiency
  - Reduction in hours of over-utilized OR time
  - No increase in hours of under-utilized OR time
- This is not providing increased OR resources (OR time) to Dr. Jones
  - Doing so would be tactical, not operational
  - Open Access changes *when* a case gets done, not total workload



# Open Access Case Scheduling Is Current Practice (Example 2)

- University Hospital's staffing for General Surgery is 2 ORs, 7 AM to 5 PM Mon-Fri
- No case is scheduled unless it will fit into the 10 hr based on historical case duration data
- General Surgery schedules 20% of its cases as add-on or urgent
  - Yet, patients could safely wait days for surgery



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  - Yet, patients could safely wait days for surgery
- Make a list of services at your facility who schedule cases like General Surgery



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- No case is scheduled unless it will fit into the 10 hr based on historical case duration data
- General Surgery schedules 20% of its cases as add-on or urgent
  - Yet, patients could safely wait days for surgery
- General Surgery is, in practice, scheduling its cases on any workday



# Open Access Case Scheduling Is Current Practice (Example 2)

- Increase OR allocations (staffing) to match the reality of existing OR workload
  - Reduces over-utilized OR time with minimal or no increase in under-utilized OR time
  - Increases OR efficiency
- Operational change, not tactical
  - Open Access changes *when* a case gets done, not total workload



# Open Access Case Scheduling Is Current Practice (Example 3)

- Physicians at a hospital are salaried employees of the health care system
- Staffing is planned from 8 AM to 5 PM
- As per official policy, surgeons schedule almost all cases for 8 AM to 5 PM
  - Unlike General Surgery of Example 2, the surgeons' add-on cases are truly urgent



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- Make a list of services at your facility who schedule cases like these physicians



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- Staffing is planned from 8 AM to 5 PM
- As per official policy, surgeons schedule almost all cases for 8 AM to 5 PM
  - Unlike General Surgery of Example 2, the surgeons' add-on cases are truly urgent
- The surgeons are, in practice, scheduling their elective cases on any workday



# Open Access Case Scheduling Is Current Practice (Example 3)

- Implication
  - Open Access for operational decision-making applies even at facilities that only do elective cases during limited hours



# Open Access Case Scheduling Makes Economic Sense in US

- Hospital 1 with annual loss \$114 million
- Hospital 2 with positive operating margin

Macario A et al. Anesth Analg 2001

Dexter F et al. Anesth Analg 2002

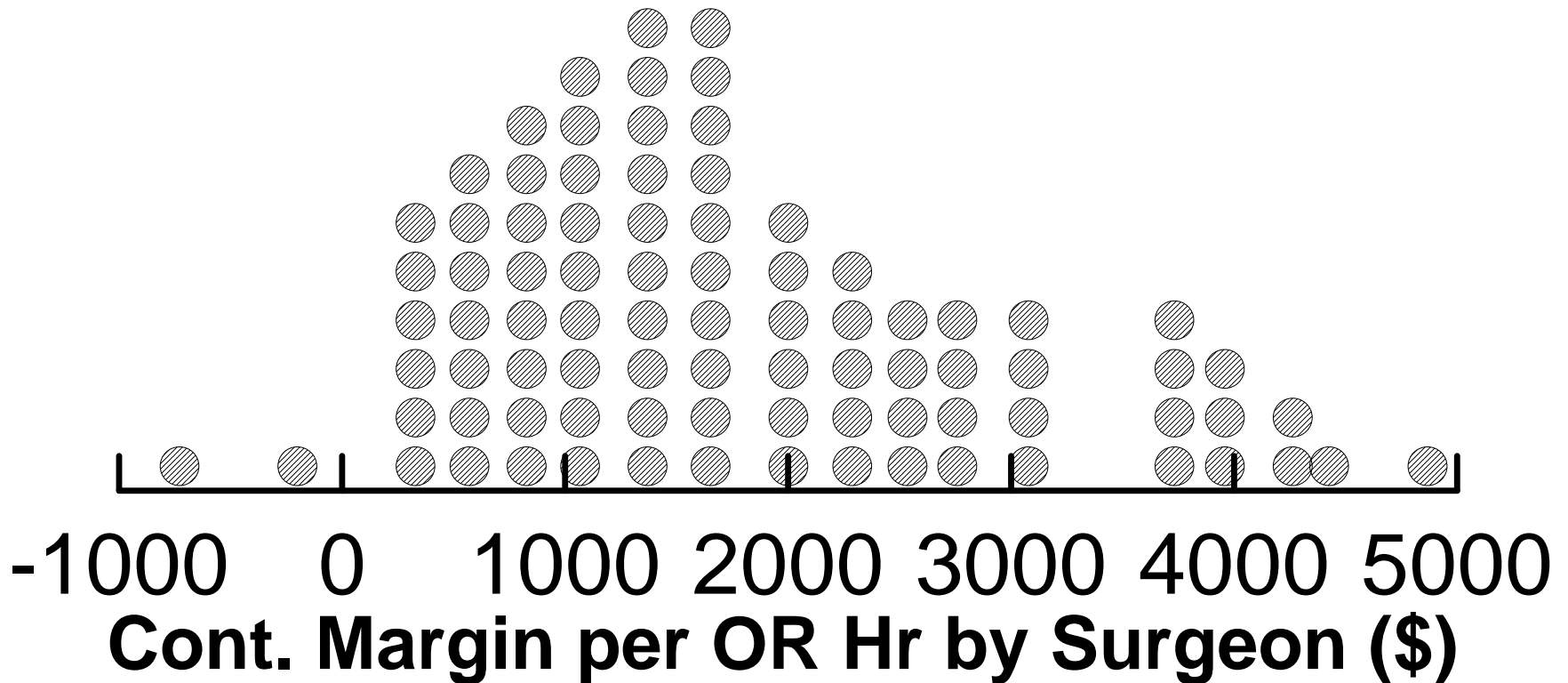


# Open Access Case Scheduling Makes Economic Sense in US

- Methodology
  - Limit to outpatient and same day admit cases, since once patient is admitted want no delay
  - Operating room time used by each surgeon from operating room information system
  - Overall contribution margin for each surgeon from hospital accounting information system
  - Make a graph with one circle for each surgeon

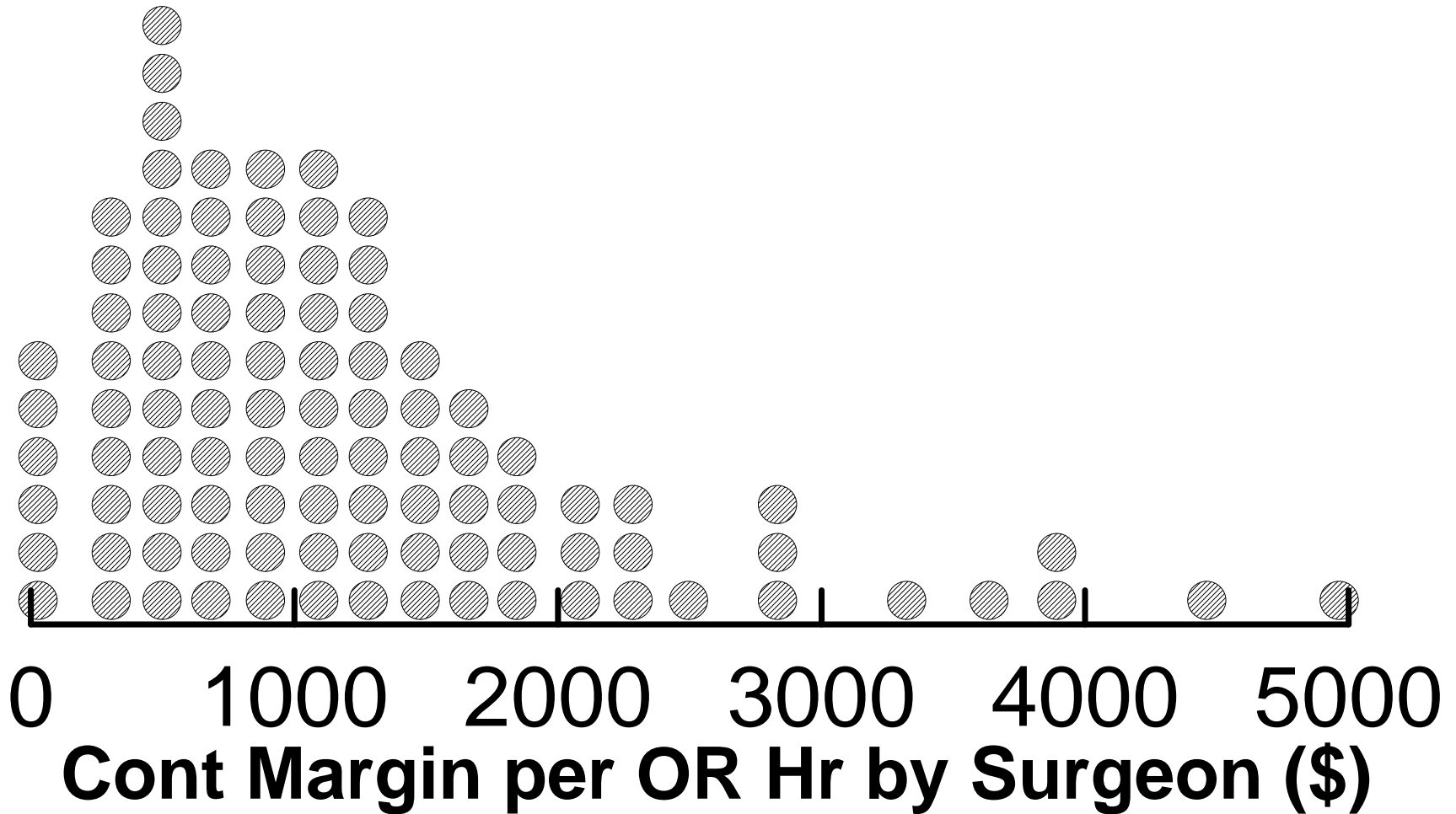


# Hospital Losing Money Has + Cont. Margin For 97% Surgeons



**Cont. Margin = Revenue - Variable Costs**

# Other Hospital Positive Contribution Margin all Surgeons



# There Are Exceptions For Some Procedures

- At some hospitals, for some surgeons, contribution margin is consistently negative for some procedures because of implants
- Time and the place to address this is not at the OR nursing desk when Mrs. Jones is being scheduled as an add-on case
  - Since operational decision-making is not based on financial criteria, it needs to be economically rationale for the average case



# Interpretation of Finding for Operational Decision-Making

- Since contribution margin is positive, it makes economic sense to do cases
  - If you can do the case safely, do the case



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- However, safety is a large practical limit



# Interpretation of Finding for Operational Decision-Making

- Since contribution margin is positive, it makes economic sense to do cases
  - If you can do the case safely, do the case
- However, safety is a large practical limit
  - Safety includes limited ICU beds, hospital ward beds, PACU beds, fluoroscopy equipment, non-fatigued staff, implants, ...
  - ***Tactical planning*** sets these and other capital planning (capacity) constraints



# Allocating OR Time 1<sup>st</sup> Tactically and 2<sup>nd</sup> Operationally (Example 1)

- Tactical – different lecture
  - Dr. Jones, 1 OR every Friday
  - Has financial implications (do by surgeon)
  - Affects surgical practices' schedules and growth
- Operational – this lecture
  - Nursing and anesthesia staffing planned to 7 PM to match Dr. Jones' workload
- If operational decisions were affecting Dr. Jones, he would usually be done by 3 PM



# Understanding Operational Decision Making Is Important

- Implication for operations research is that staffing is appropriately planned separately for each combination of surgical suite, service, and day of the week
  - At most outpatient facilities and smaller hospitals, the staffing decision involves only 1 to 3 choices
    - Staff an OR for 8 hr, 10 hr, or 12 hr



# Understanding Operational Decision Making Is Important

- Most of the surgeons in a department are away at their national conference
- There is substantial under-utilized OR time
- Who is responsible for the poor OR efficiency?
  - Is this an example of the surgeons' lack of responsibility for hospital resources?
  - Is this an example of bad management?



# Understanding Operational Decision Making Is Important

- Fixed hours of OR time (tactical perspective)
  - Surgeons are responsible for increasing OR efficiency by *scheduling* their cases into their block time
- Maximizing OR efficiency (operational)
  - Managers are responsible for increasing OR efficiency by adjusting *staffing* to match the surgeons' and patients' hours (e.g., 8 or 13 hr)
  - Managers have responsibility and authority



# Understanding Operational Decision Making Is Important

- Fixed hours of OR time
  - Surgeons are responsible for increasing OR efficiency by *scheduling* their cases into their block time
- Maximizing OR efficiency
  - Managers are responsible for increasing OR efficiency by adjusting *staffing* to match the surgeons' and patients' hours (e.g., 8 or 13 hr)
  - Managers have responsibility and authority

Rest of talk



# Sequence of the Talk

- What precisely is OR efficiency?
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  - How to use the statistical methods



# Use Scenarios to Teach Organizations Decision Making

- Listed in order of priority
  1. Patient safety and quality of care are preeminent
  2. Every surgeon has open access to OR time on *Any* future *Workday*
  3. Maximize OR efficiency
  4. Reducing patient waiting on the day of surgery
  5. Professional satisfaction



# Ordered Priorities Can be Applied to ...

- Staffing and OR allocations
- Scheduling elective cases
- Sequencing elective cases
- Releasing allocated OR time
- Scheduling delays between surgeons' cases
- Choosing patient arrival times
- Scheduling add-on cases
- Assigning and relieving staff
- Moving cases on the day of surgery
- Sequencing urgent cases



# *Statement is Not Intuitively Obvious – Why do Math*

- Staffing and OR allocations
- Scheduling elective cases
- Sequencing elective cases
- Releasing allocated OR time
- Scheduling delays between surgeons' cases
- Choosing patient arrival times
- Scheduling add-on cases
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# Next Several Slides Show Over-Simplified Scenarios

- Scenarios will not seem like your facility
- Scenarios ignore uncertainty in case duration
- Lecture is not how scenarios are truly used
  - Although the concepts apply everywhere, every facility is an exception to a description
  - Customize to provide appropriate employee types, OR names, times of the day, units of OR allocation, surgeon names, equipment limiting what cases can be scheduled, etc.



# Generate Adapted Scenarios for Organizations

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## Surgical suite

Export 3-12 months of OR information system data

## Science

100+ scenarios, with explanations, showing how to make decisions based on the ordered priorities

# Generate Adapted Scenarios for Organizations

## Surgical suite

Export 3-12 months of OR information system data



## Math

Pick appropriate ORs, names, blocks, & times for each scenario

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# Generate Adapted Scenarios for Organizations

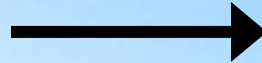
## Surgical suite

Export 3-12 months of OR information system data



## Math

Pick appropriate ORs, names, blocks, & times for each scenario



## Science

100+ scenarios, with explanations, showing how to make decisions based on the ordered priorities

## Examples with cues

Adapted educational materials

# Scenario 1 – Can Working Fast Increase OR Efficiency?

- OR nurses, nurse anesthetists, and anesthesiologists are full-time employees
- Staffing is planned from 7 AM to 3 PM
- There is estimated to be 9 hr of cases
- Anesthesiologist gets every IV first stick, A lines and C lines first stick, and does a fiberoptic intubation in 8 minutes
- The OR finishes at 3 PM
- Has anesthesiologist increased OR efficiency?



# Scenario 1 – Can Working Fast Increase OR Efficiency?

- OR nurses, nurse anesthetists, and anesthesiologists are full-time employees
- On the day of surgery, the cost of an hour of under-utilized OR time is negligible relative to the cost of an hour of over-utilized OR time



# Meaning of Maximizing OR Efficiency on Day of Surgery

Inefficiency of use of OR time (\$)  $\cong$   
~~(Cost per hour of under-utilized OR time)~~  
× (hours of under-utilized OR time)  
+ (Cost per hour of over-utilized OR time)  
× (hours of over-utilized OR time)

Dexter F, Traub RD. Anesth Analg 2002



# Meaning of Maximizing OR Efficiency on Day of Surgery

Inefficiency of use of OR time (\$)  $\cong$   
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# Meaning of Maximizing OR Efficiency on Day of Surgery

Inefficiency of use of OR time (\$)  $\cong$

~~(Cost per hour of over utilized OR time)~~

$\times$  (hours of over-utilized OR time)

Constant



# Meaning of Maximizing OR Efficiency on Day of Surgery

Inefficiency of use of OR time (\$)  $\cong$

~~(Cost per hour of over utilized OR time)~~  
 $\times$  (hours of over-utilized OR time)

Constant

- Implication
  - Maximize OR efficiency on the day of surgery by minimizing hours of over-utilized OR time



# Meaning of Maximizing OR Efficiency on Day of Surgery

Inefficiency of use of OR time (\$)  $\cong$

~~(Cost per hour of over utilized OR time)~~  
 $\times$  (hours of over-utilized OR time)

Constant

- Implication

- Maximize OR efficiency *on the day of surgery* by minimizing hours of over-utilized OR time



# Scenario 1 – Can Working Fast Increase OR Efficiency?

- Scenario
  - Staffing is planned from 7 AM to 3 PM
  - Fast anesthesiologist finished cases in 8 hr instead of in the expected 9 hr
  - Fast anesthesiologist increased OR efficiency by preventing 1 hr of over-utilized OR time



# Scenario 1 – Can Working Fast Increase OR Efficiency?

- OR nurses, nurse anesthetists, and anesthesiologists are full-time employees
- Staffing is planned from **7 AM to ~~3 PM~~ 5 PM**
- There is estimated to be 9 hr of cases
- Anesthesiologist gets every IV first stick, A lines and C lines first stick, and does a fiberoptic intubation in 8 minutes
- The OR finishes at 3 PM
- **Has anesthesiologist increased OR efficiency?**



# Scenario 1 – Can Working Fast Increase OR Efficiency?

- Scenario
  - Staffing is planned from ~~7 AM to 3 PM~~ **5 PM**
  - Fast anesthesiologist finished cases in 8 hr instead of in the expected 9 hr
  - Fast anesthesiologist ~~increased~~ *did not increase* OR efficiency



# Scenario 1 – Can Working Fast Increase OR Efficiency?

- Scenario
  - Staffing is planned from ~~7 AM to 3 PM~~ **5 PM**
  - Fast anesthesiologist finished cases in 8 hr instead of in the expected 9 hr
  - Fast anesthesiologist ~~increased~~ *did not increase* OR efficiency

Good (rational) OR management operational decision-making is highly sensitive to the service-specific staffing, and requires knowing the service-specific staffing

# Scenario 2 – Anesthesiologist Reduces Turnover Times

- Staffing is planned from 7 AM to 3 PM
- Anesthesiologist is assigned to supervise resident physicians in OR 1 and OR 2
- These ORs have just finished their first cases
- The last case of the day in OR 1 is expected to be finished at 2:30 PM
- The last case of the day in OR 2 is expected to be finished at 4:30 PM
- Which OR should anesthesiologist start next?



# Scenario 2 – Anesthesiologist Reduces Turnover Times

- *Patient safety* is unaffected by decision
- Open *access* is unaffected by the decision
- *OR efficiency*
  - OR 1 expected 0 over-utilized hours
  - OR 2 expected 1.5 over-utilized hours
- If the patient for OR 2 is ready, the anesthesiologist should start OR 2 first



# Scenario 2 – Anesthesiologist Reduces Turnover Times

- Staffing is planned from 7 AM to ~~3 PM~~ **5 PM**
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- The last case of the day in OR 2 is expected to be finished at 4:30 PM
- Which OR should anesthesiologist start next?



# Scenario 2 – Anesthesiologist Reduces Turnover Times

- *Patient safety* is unaffected decision
- Open *access* is unaffected by decision
- *OR efficiency* is unaffected by decision
  - OR 1 expected 0 over-utilized hours
  - OR 2 expected ~~1.5~~ 0 over-utilized hours
- *Patient waiting* is unaffected by decision
  - Last case of the day in both ORs
- *Professional satisfaction* may be affected
  - Whatever anesthesiologist thinks best



# Scenario 2 – Anesthesiologist Reduces Turnover Times

- Moral
  - Good (rational) OR management operational decision-making is highly sensitive to the service-specific staffing, and requires knowing the service-specific staffing
  - System fails well-intentioned individuals if it does not provide them with the information that they need to make good decisions



# Scenario 3 – Which OR Should Housekeeper Clean First?

- Right when two ORs are finishing their first cases of the day, only one person is free to clean the two ORs
- Last case of the day in OR 1 is expected to end at 2 PM
- Last case of the day in OR 2 is expected to end at 4:30 PM
- Staffing is planned from 7 AM to 3 PM
- Which OR should housekeeper clean first?



# Scenario 3 – Which OR Should Housekeeper Clean First?

- *Patient safety* is unaffected by the decision
- Open *access* is unaffected by the decision
- *OR efficiency* is affected by the decision
  - OR 1 expected 0 over-utilized hours
  - OR 2 expected 1.5 over-utilized hours
- Cleaning OR 2 first is likely to increase OR efficiency



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- Staffing is planned from 7 AM to ~~3 PM~~ **5 PM**
- Which OR should housekeeper clean first?



# Scenario 3 – Which OR Should Housekeeper Clean First?

- *Patient safety* is unaffected by the decision
- Open *access* is unaffected by the decision
- *OR efficiency* is unaffected by the decision
  - OR 1 expected 0 over-utilized hours
  - OR 2 expected ~~1.5~~ **0** over-utilized hours
- *Patient waiting* is unaffected by the decision
  - Last case of the day in each OR
- *Professional satisfaction* is basis for decision



# Scenario 4 – Decision Based on Patient Safety

- At 12:15, one OR is finished its elective cases
- All other ORs are scheduled to be full until 5 PM, the end of planned staffed hours
- Orthopedic surgeon called three hours ago for repair of a patient's fractured hip
- Vascular surgeon has a ruptured AAA
- What should be the sequence of cases based on the ordered priorities?



# Scenario 4 – Decision Based on Patient Safety

- *Patient safety* is affected by decision
  - Ruptured AAA is done first



# Scenario 5 – Case Scheduling to Maximize OR Efficiency

- Staffing planned for Ophthalmology Associates is OR 1 and OR 2 from 7 AM to 3 PM
- Dr. Smith has scheduled cases in OR 1 that are scheduled to finish at 2 PM
- OR 2 is empty
- Dr. Reynolds wants an afternoon start
  - She asks to start an elective 3-hour case at 2:30 PM in OR 1
- Schedule the case into OR 1?



# Scenario 5 – Case Scheduling to Maximize OR Efficiency

- Starting the case at 3 PM would be expected to result in over-utilized OR time, thereby reducing OR efficiency
- Options available to Dr. Reynolds:
  - Take first-case of the day start in OR 2
  - Choose a different workday



# Scenario 5 – Case Scheduling to Maximize OR Efficiency

- Starting the case at 3 PM would be expected to result in over-utilized OR time, thereby reducing OR efficiency
- Options available to Dr. Reynolds:
  - Take first-case of the day start in OR 2
  - Choose a different workday



# Scenario 5 – Case Scheduling to Maximize OR Efficiency

- Starting the case at 3 PM would be expected to result in over-utilized OR time, thereby reducing OR efficiency
- Options available to Dr. Reynolds:
  - Take first-case of the day start in OR 2
    - Most facilities do not schedule an OR over-utilized while other allocated OR is empty
    - Choose a different workday



# Scenario 5 – Case Scheduling to Maximize OR Efficiency

- Starting the case at 3 PM would be expected to result in over-utilized OR time, thereby reducing OR efficiency
- Options available to Dr. Reynolds:
  - Take first-case of the day start in OR 2
  - Choose a different workday
    - She has OR time available every workday



# Scenario 6 – Reduce Turnover Times to Increase OR Efficiency?

- Outpatient Surgery Center with 6 ORs, all staffed from 7 AM to 5 PM
- Mean ORs in use before intervention
  - 2 PM – 6 ORs
  - 3 PM – 5 ORs
  - 4 PM – 2 ORs
  - 5 PM – 0.2 ORs
- Mean ORs in use after intervention
  - 2 PM – 5 ORs
  - 3 PM – 4 ORs
  - 4 PM – 1 ORs
  - 5 PM – 0 ORs
- Increased OR efficiency?



# Scenario 6 – Reduce Turnover Times to Increase OR Efficiency?

- No impact on OR efficiency, because hours of over-utilized OR time are the same
- Decision making on the day of surgery has a negligible impact on OR efficiency if there are no hours of over-utilized OR time

Dexter F et al. Anesth Analg 2003



# Scenario 6 – Reduce Turnover Times to Increase OR Efficiency?

- No impact on OR efficiency, because hours of over-utilized OR time are the same
- Decision making on the day of surgery has a negligible impact on OR efficiency if there are no hours of over-utilized OR time
- Because principal determinant of OR efficiency is OR staffing, the impact of other interventions is highly sensitive to the service-specific staffing



# You Cannot Have Made These Decisions Based on Utilization



**Utilization**

# Scenario 7 – OR Allocation Markedly Affects OR Efficiency

- Staffing is planned from 7 AM to 5 PM
- Anesthesiologist arrives at 6 AM, and works fast and non-stop until his list is done
- Some days he finishes at 2 PM, some days at 8 PM, average is 5 PM
- What has been the anesthesiologist's impact on OR efficiency?



# Scenario 7 – OR Allocation Markedly Affects OR Efficiency

- Staffing is planned from 7 AM to 5 PM
- Some days he finishes at 2 PM
  - Under-utilized OR time = 3 hours
- Some days he finishes at 8 PM
  - Over-utilized OR time = 3 hours



# Scenario 7 – OR Allocation Markedly Affects OR Efficiency

- Staffing is planned from 7 AM to 5 PM
- Some days he finishes at 2 PM
  - Under-utilized OR time = 3 hours
- Some days he finishes at 8 PM
  - Over-utilized OR time = 3 hours
- Valiant and noble effort, but of no substantive impact on OR efficiency



# Scenario 7 – OR Allocation

## Markedly Affects OR Efficiency

- Staffing is planned from 7 AM to 5 PM
- Some days he finishes at 2 PM
  - Under-utilized OR time = 3 hours
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  - Over-utilized OR time = 3 hours
- Valiant and noble effort, but of no substantive impact on OR efficiency

★ If OR staffing is chosen poorly, actions on day of surgery have little to no benefit ★

# Sequence of the Talk

- What precisely is OR efficiency?
- OR efficiency applies to existing workload
- Teach principles using scenarios
- Service-specific staffing based on OR efficiency
  - Important to use the statistical methods
  - How to use the statistical methods



# Tiny Example of Allocating OR Time to Maximize OR Efficiency

- Example of the calculations
  - On three Mondays a service did 12, 7, and 15 hours of cases including turnover times
  - Staff plan an 8-hour scheduled day
  - $1.75 =$  relative cost of 1 hour of over-utilized OR time to 1 hour of under-utilized OR time



# Cost of Inefficient Use of OR Time with Different Staffing

- Weekly values: 12, 7, and 15 hours of work
- If staff 1 OR for 8 hours for the service
  - $20.25 \text{ hr} = (0 + 1 + 0) + 1.75 \times (4 + 0 + 7)$
- If staff 2 OR for 8 hours for the service
  - $14.00 \text{ hr} = (4 + 9 + 1) + 1.75 \times (0 + 0 + 0)$
- If staff 3 OR for 8 hours for the service
  - $38.00 \text{ hr} = (12 + 17 + 9) + 1.75 \times (0 + 0 + 0)$



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# Not Same Process to Allocate Based on OR Utilization

- Allocation based on OR utilization:
  - starts with a goal OR utilization
    - OR efficiency gives the answer based on the existing OR workload
  - considers just the under-utilized OR time
    - Larger concern is over-utilized OR time
  - ignores variation among weeks in workload
    - Average workload not used to calculate under-utilized and over-utilized OR time



# Why Not Same Result Based on OR Utilization?

- Why not same result based on OR utilization?
  - If a service has 80% adjusted utilization, should there be under-utilized OR time and no over-utilized OR time?
    - Under what conditions does this not hold?



# Sequence of the Talk

- What precisely is OR efficiency?
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- Service-specific staffing based on OR efficiency
  - Important to use the statistical methods
    - How to use the statistical methods



# Example of “Real World” OR Allocation (Staffing) Problem

- Officially, on paper, a service has been allocated three ORs for 8 hr Mon-Fri
- In reality, its total hours of elective cases including turnover times each day of the week averages 29 hours, with a range of 26 hours to 32 hours
- OR allocation based on maximizing OR efficiency adjusts staffing to match reality



# Example of “Real World” OR Allocation (Staffing) Problem

- Staff work 5 days a week for 8 hr, 4 days a week for 10 hr, or 3 days a week for 13 hr
- Reasonable allocation choices:
  - Two OR for 13 hr
  - One OR for 8 hr + two for 10 hr
  - Two OR for 8 hr + one for 13 hr
  - Three OR for 10 hr
  - One OR for 8 hr + one for 10 hr + one for 13 hr
  - Four OR for 8 hr
  - Two OR for 10 hr + one for 13 hr



# Example of “Real World” OR Allocation (Staffing) Problem

- Based on 2002 mean US compensation, the range in annual OR & anesthesia costs among allocations is \$245,000 per year

Abouleish AE et al. Anesth Analg 2003

Kuehl NK. AORN J 2003



# Example of “Real World” OR Allocation (Staffing) Problem

- Based on 2002 mean US compensation, the range in annual OR & anesthesia costs among allocations is \$245,000 per year
- My interpretation of the message
  - Implementation means using the statistics
  - As for any statistics problem, **be sure** that you are getting the correct answer



# Examples of Applying Statistical Method to Anesthesia Staffing

- For 11 of 13 suites, statistical method found a staffing plan with costs at least 10% less than that being used by the managers
  - Managers did not have right number of staff, working the right number of hours, on the right days of the week, for specific surgical services

Dexter F et al. Anesth Analg 2001

Abouleish AE et al. Anesth Analg 2003

Freytag S et al. Der Chirurg 2005

McIntosh C et al. Anesth Analg 2006



# Experimental Studies Explain Why Method Apparently Unused

- Two psychological biases
  - Anchor on mean demand
    - Essentially plan staffing based on relative cost ratio of 1.10 instead of 1.75
  - Ignore analysis of 9 months of data in lieu of service's usage during past 2 weeks
    - Recency bias

Wachtel RE, Dexter F. Anesth Analg 2010



# Experimental Studies Explain Why Method Apparently Unused

- Two psychological biases
  - Anchor on mean demand
    - Essentially plan staffing based on relative cost ratio of 1.10 instead of 1.75
  - Ignore analysis of 9 months of data in lieu of service's usage during past 2 weeks
    - Recency bias
- Issue is psychology, not politics, culture, buy in, personalities, or organizational inertia



# Experimental Studies Explain Why Method Apparently Unused

- Two psychological biases
  - Factors with little or no impact
    - More frequent feedback
    - Graphical user interface
    - Information in reports
    - Education
    - Experience

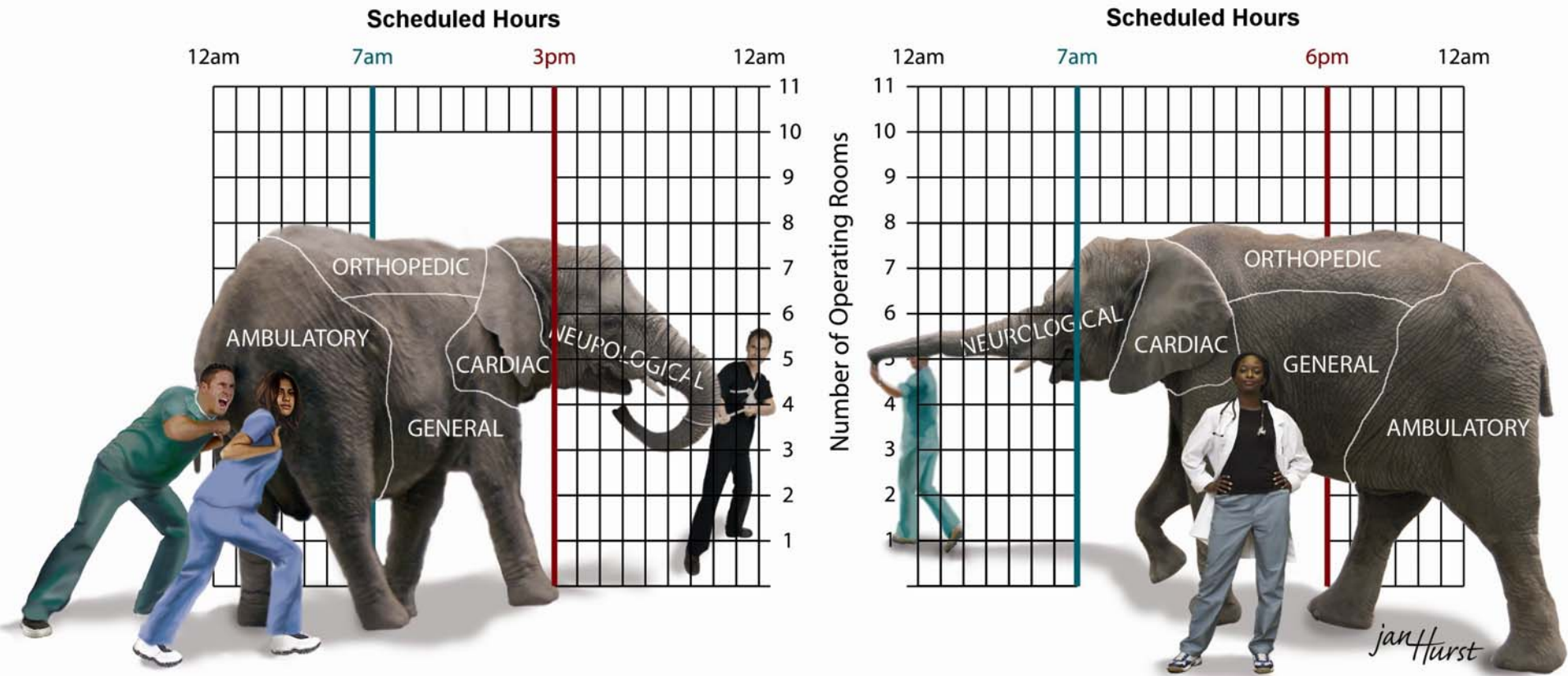


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- Implementation is the mathematics

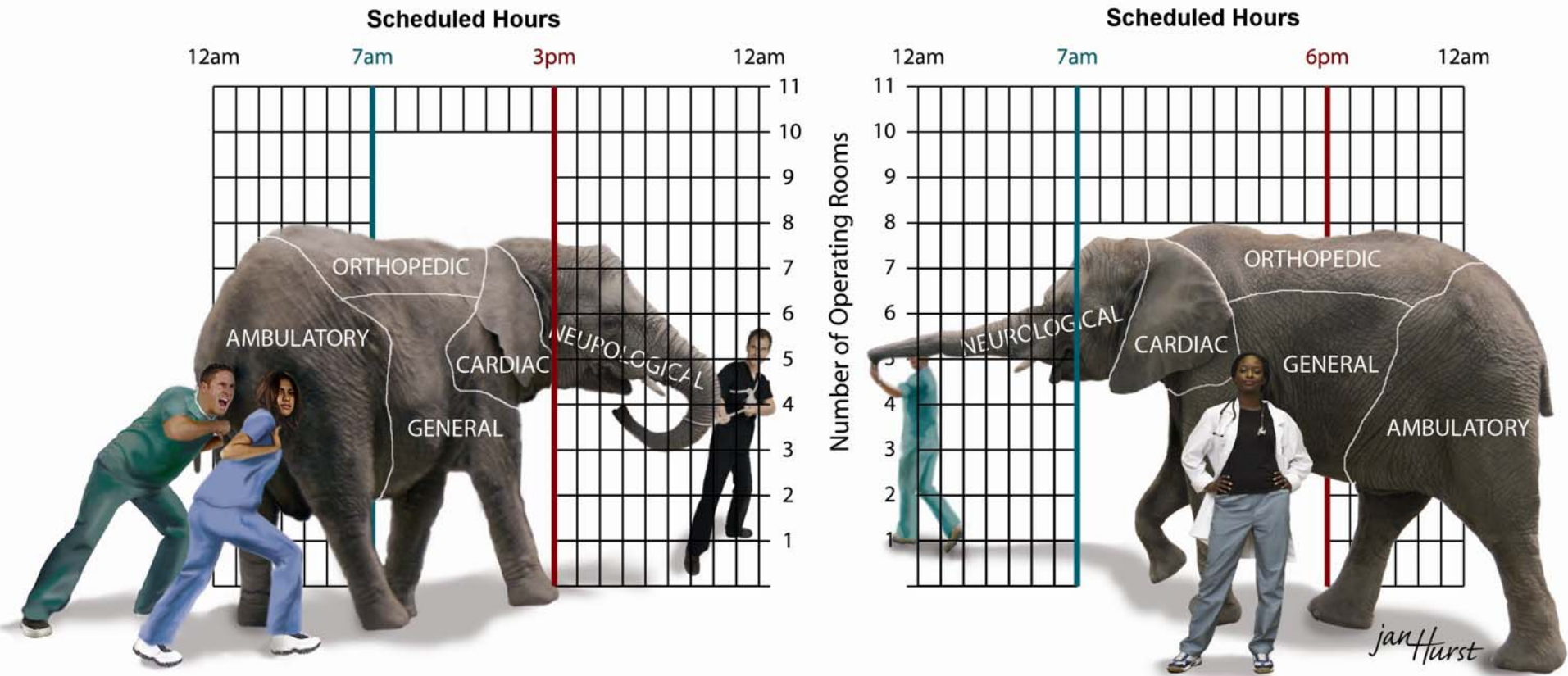


# Experimental Studies Explain Why Method Apparently Unused



Large hospital reported to me how my review article changed their organization: all their ORs now staffed 7 AM to 6 PM

# Experimental Studies Explain Why Method Apparently Unused



➤ Implementation is the mathematics


# Sequence of the Talk







- What precisely is OR efficiency?
- OR efficiency applies to existing workload
- Teach principles using scenarios
- Service-specific staffing based on OR efficiency
  - Important to use the statistical methods
    - How to use the statistical methods
      - Types of data
      - Seasonal variation in OR workload
      - How many months of data to use



# OR Information System, AIMS, or Anesthesia Billing Data

Microsoft Excel - XLSInputDataSample.xls

File Edit View Insert Format Tools Data Window Help 

     100% 

N29 =

	A	B	C	D	E	F	G	H	I
1	Room	DateIn	TimeIn	DateOut	TimeOut	Service	NoAnesthesia	Urgent	Holiday
2	1	1/1/1998	8:09	1/1/1998	9:04	ORT			X
3	1	1/1/1998	23:00	1/2/1998	1:12	SUR			X
4	1	1/2/1998	9:13	1/2/1998	10:37	GYN			
5	1	1/2/1998	16:30	1/2/1998	18:37	POD			
6	2	1/2/1998	7:36	1/2/1998	7:59	GYN			
7	2	1/2/1998	8:16	1/2/1998	9:11	GYN			
8	2	1/2/1998	10:37	1/2/1998	11:02	POD			
9	2	1/2/1998	11:20	1/2/1998	12:23	POD			
10	2	1/2/1998	12:38	1/2/1998	13:58	POD			
11	2	1/2/1998	14:17	1/2/1998	16:15	POD			
12	3	1/2/1998	8:44	1/2/1998	9:00	ENT			
13	3	1/2/1998	8:10	1/2/1998	8:30	ENT			
14	3	1/2/1998	11:30	1/2/1998	12:02	ENT			
15	3	1/2/1998	9:14	1/2/1998	9:46	ENT			
16	3	1/2/1998	10:05	1/2/1998	11:21	ENT			
17	3	1/2/1998	12:20	1/2/1998	13:40	ENT			

# If Many Data Options, Why Not Used Widely?

- Service-specific staffing
  - Implementable with many types of data
    - Lack of data is not valid reason for lack of implementation
  - Minimally affects customers, because matching staffing to workload
- What then are barriers to implementation?
  - What do you “see” if a problem at your site?
  - Who precisely will “do” the work?



# Seasonal Variation Does Not Need to be Considered Routinely

- Statistical methods assume that trends affect total group workload slowly
  - Little systematic variation month to month
  - Instead, change occurs year to year
- Is this simplification appropriate for most anesthesia groups and surgical suites?

Dexter F, Traub RD. Anesth Analg 2000

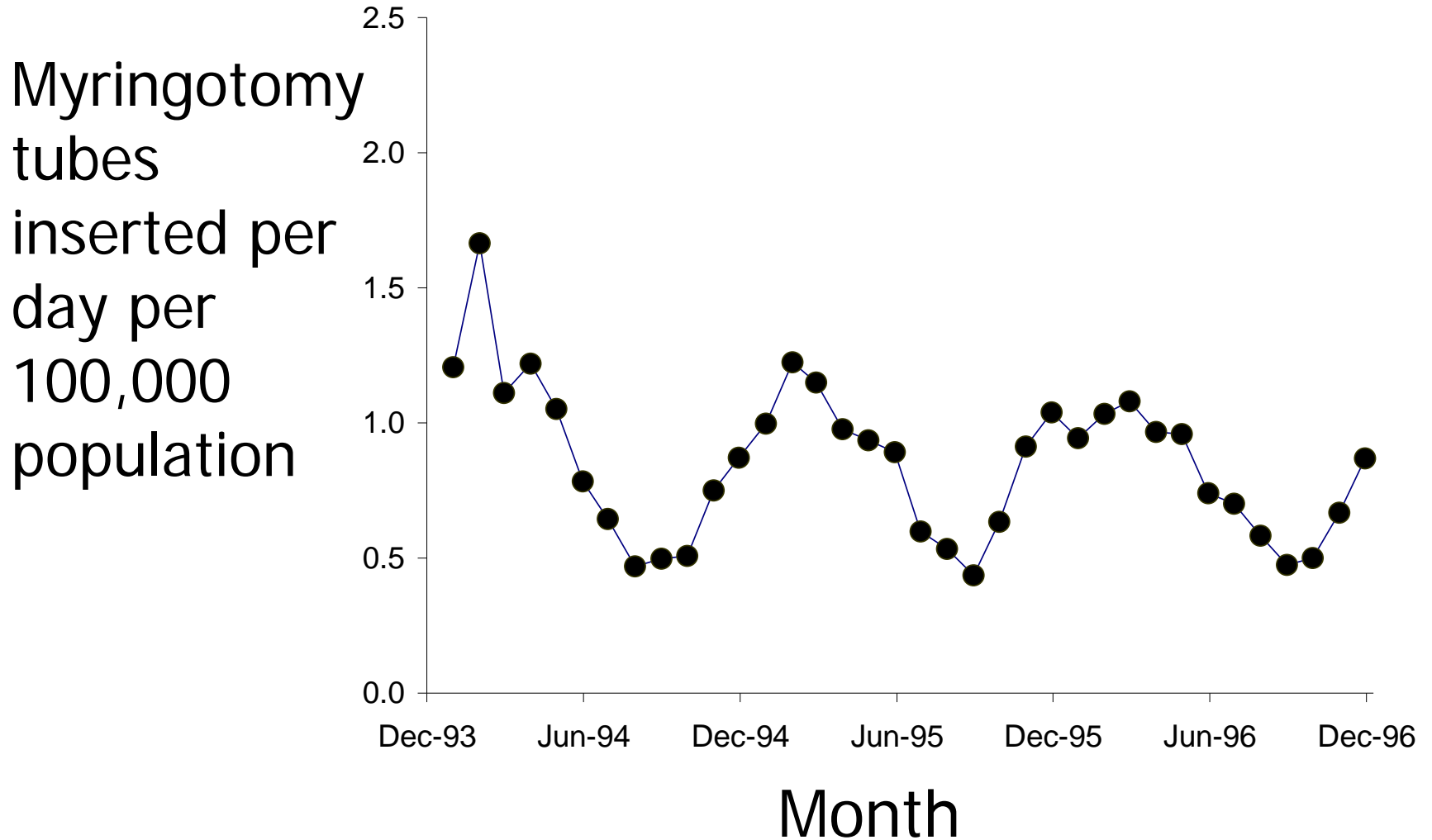


# Seasonal Variation Does Not Need to be Considered Routinely

- Analyze data from the US National Survey of Ambulatory Surgery (1994 – 1996)
- Expect anesthesia workload not to vary systematically over 11-month periods
- Positive control
  - Myringotomy tube placement
  - Incidence of otitis media peaks toward the end of winter

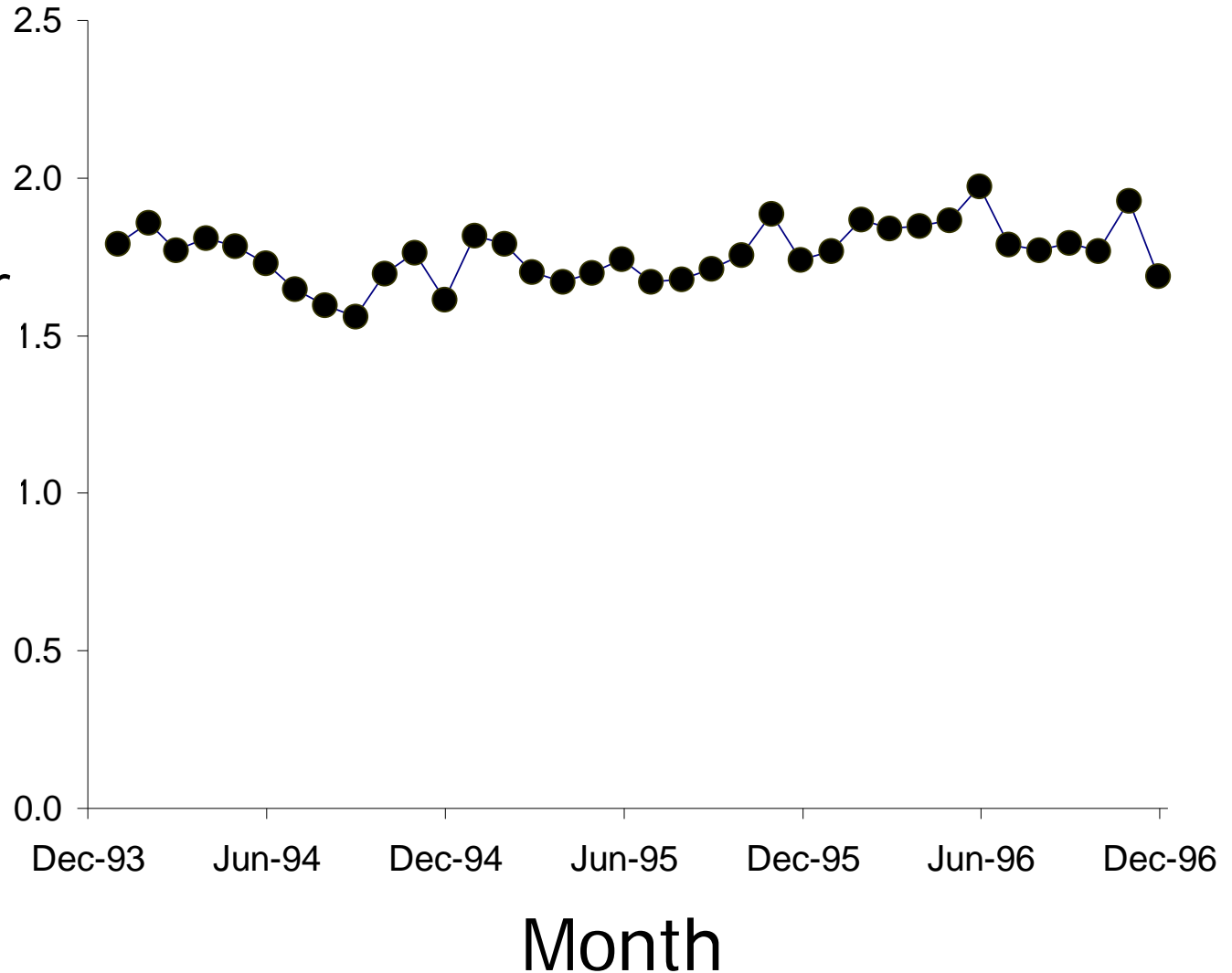


# Positive Control – Seasonal Variation in Myringotomy Tubes



# Anesthesia Caseload Does Not Vary Systematically Over < 1 Yr

Cases with anesthesia provider per day per 10,000 population



# Months of Data for Accurate OR Allocations

- Use two years of data from a 7 OR, community, multiple specialty hospital
- Divide the 507 workdays of data into:
  - Training dataset to identify staffing solution
    - From 30 to 270 consecutive workdays
  - Testing dataset to evaluate its performance
  - Repeat the process hundreds of times

Epstein RH, Dexter F. Anesth Analg 2002

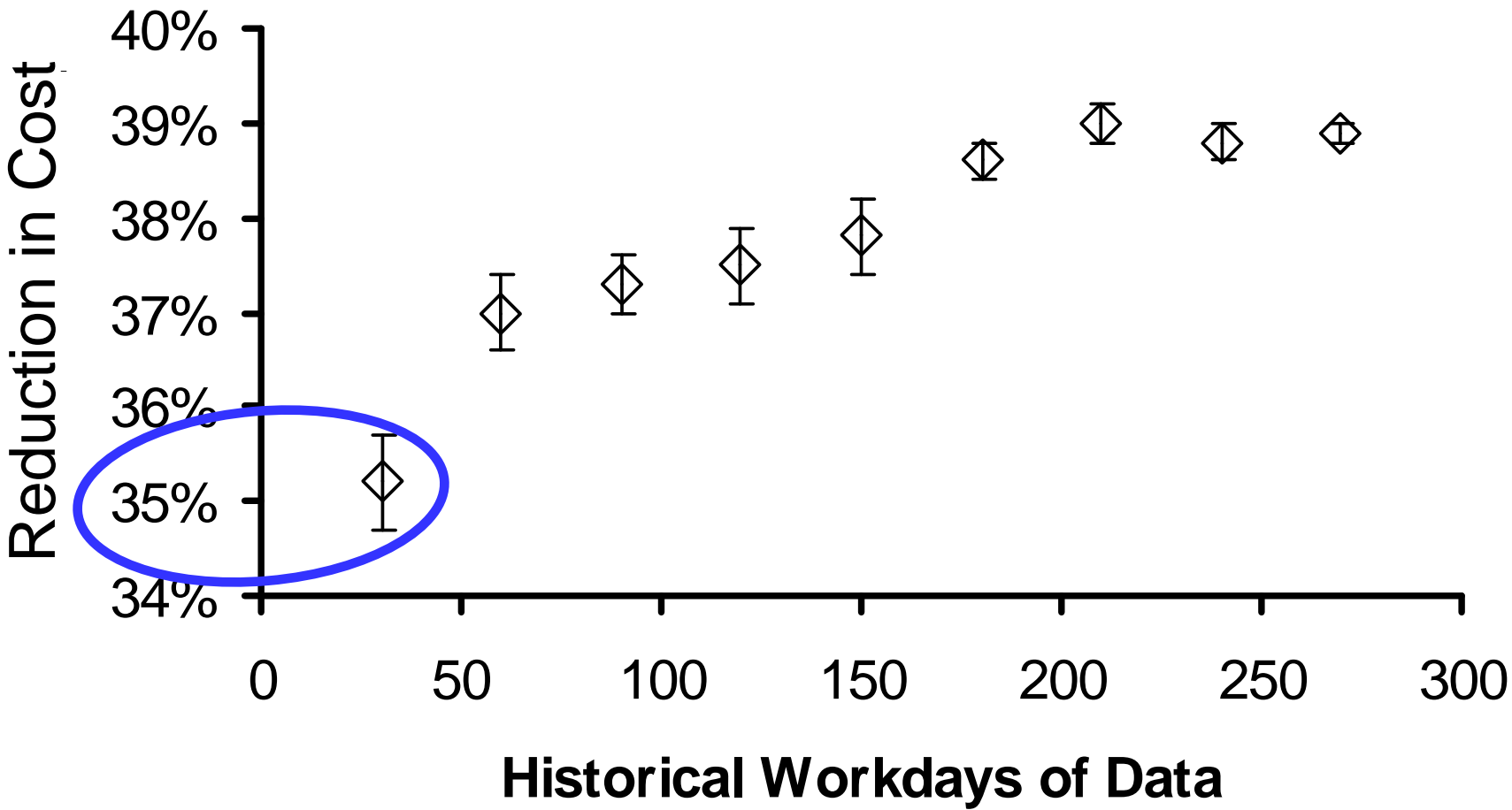


# Least Amount of Data for OR Allocations and Staffing

- Suppose install a new information system
  - Operating room
  - Anesthesia electronic medical record
  - Anesthesia billing
- Data will be used partly to adjust OR staffing (allocations) based on OR efficiency
- How soon can the data be used, so that a return on investment can be achieved?



# Staffing Solutions to ↓ Staffing Cost Identified with 30 Workdays of Data

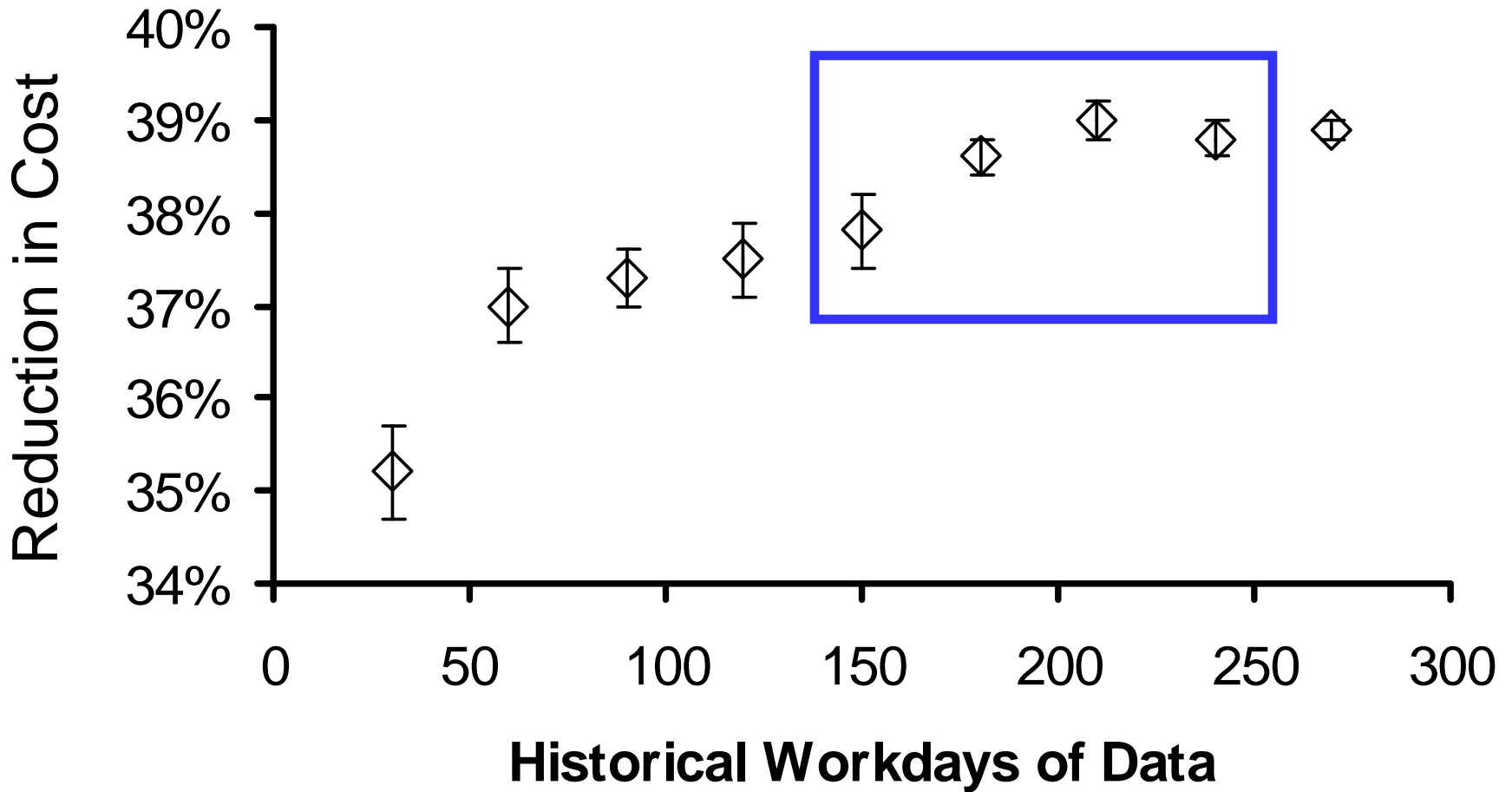


# Months of Data to Use Routinely for OR Allocation

- Staffing is re-evaluated quarterly
- How many months of OR workload data should be used in the calculations?
  - If too brief, results may be spurious due to events such as surgeon illness, holidays, etc.
  - If too long, results may not reflect trends in workload, such as recruitment of new surgeon



# No Significant ↓ Staffing Cost by Using More > 9 Months of Data

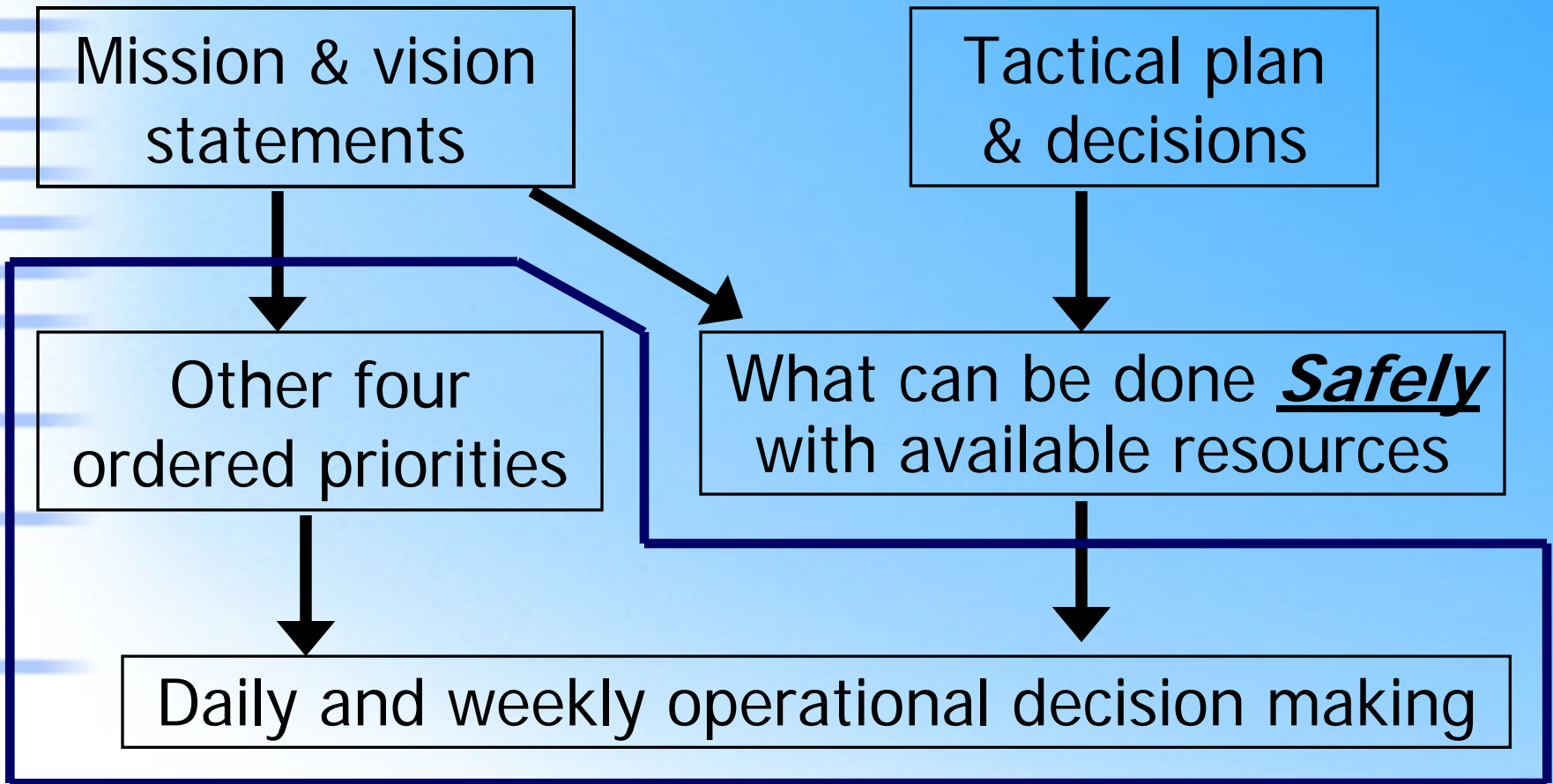


# Review – Topics of the Talk

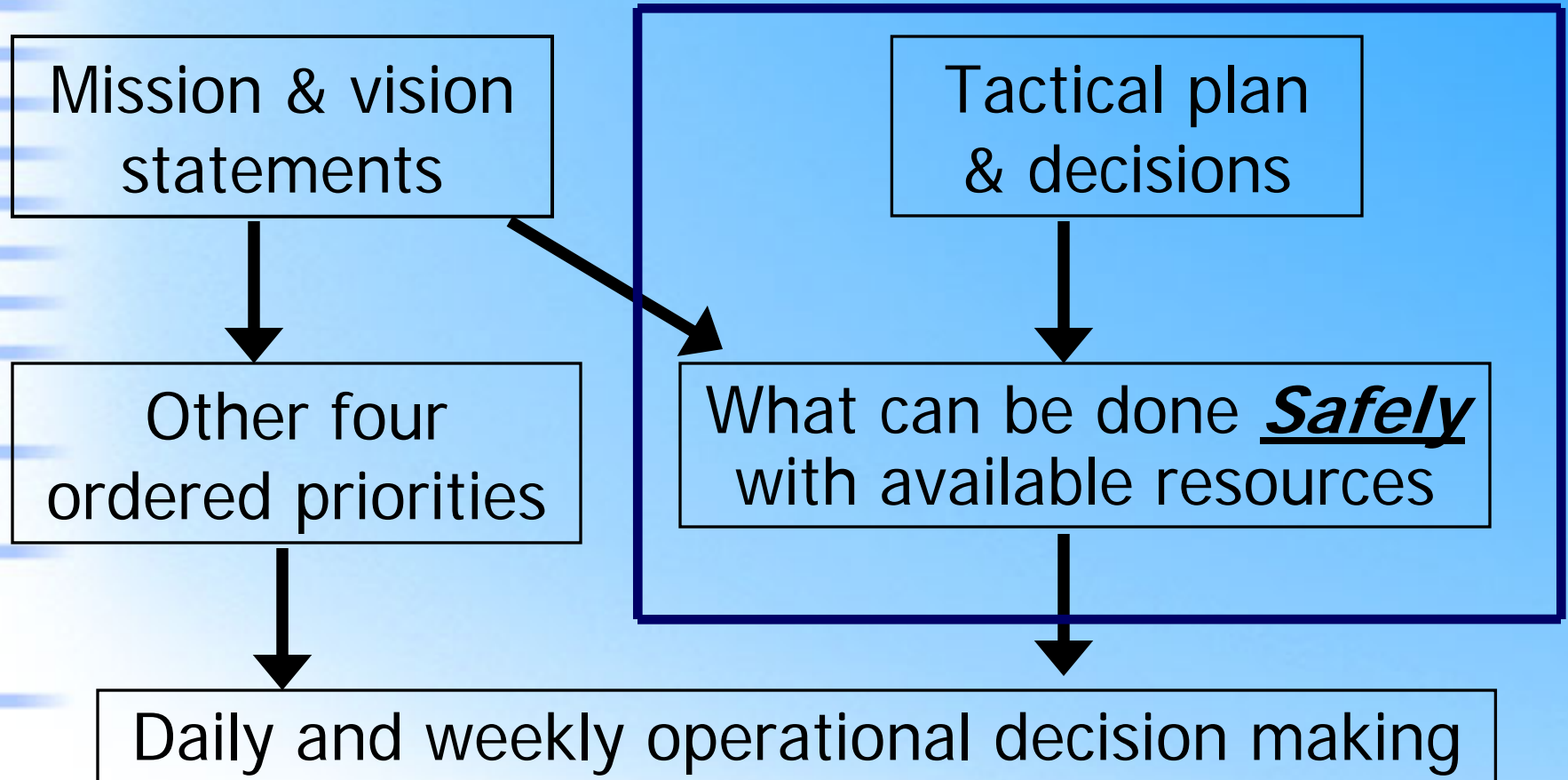
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# Reminder – Topic of Talk Was Operational Decision Making



# Tactical Decision Making is Other Talk (e.g., # ORs & ICUs)



- Such tactical issues limit how much work gets done

# Additional Information on Operating Room Management

- McIntosh C, Dexter F, Epstein RH. [Impact of service-specific staffing, case scheduling, turnovers, and first-case starts on anesthesia group and operating room productivity: tutorial using data from an Australian hospital.](#)  
Anesthesia & Analgesia 103: 1499-1516, 2006



# Additional Information on Operating Room Management

- [www.FranklinDexter.net](http://www.FranklinDexter.net)
  - Comprehensive bibliography of peer reviewed articles in operating room and anesthesia group management
  - Lectures on drug and supply costs, day of surgery decision making, PACU staffing, anesthesia staffing, financial analysis, comparing surgical services among hospitals, and strategic decision making
  - Contact information

