

# Anesthesiologist and Nurse Anesthetist Afternoon Staffing

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# Anesthesiologist and Nurse Anesthetist Afternoon Staffing

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# Financial Disclosure

- 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, and the income is used to fund our research
  - I receive no funds personally other than my salary and allowable expense reimbursements from the University of Iowa, and have tenure with no incentive program
  - I own no healthcare stocks (other than indirectly through mutual funds)

# Staffing to Finish On-Time, ↑ Productivity, and ↓ Costs

- Definitions of productivity and staffing costs
- Afternoon staffing to maximize productivity
- Other approaches for improving afternoons
  - Provide information to group members
  - Change day of surgery decision making
  - Change OR allocations and case scheduling
  - Adjust non-operating room responsibilities



# For What Groups Might This Talk Be Helpful

- Free-standing ambulatory surgery center with 6 ORs that finish between 1 PM and 3 PM
  - Anesthesia group has an agreement to provide 6 providers between 7 AM and 3 PM
  - No need to consider afternoon staffing
- Hospital surgical suite with 12 ORs, each finishing between 4 PM and 8 PM
  - At such a facility, focus on afternoon staffing is important for group productivity



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# Understand Staffing versus Staff Scheduling & Assignment

- Staffing
- Staff scheduling
- Assignment



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## ➤ Staffing

- Staff scheduling
- Assignment





# Definition of Staffing

- Number of anesthesia providers present at a specified day of the week and time of the day, whether scheduled or working late
- Example
  - 7 AM to 3 PM, plan 12 anesthesiologists
- Affects anesthesia group's productivity



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# Definition of Staff Scheduling

- Staff scheduling refers to the individual
- Example
  - Jan is working 7 AM to 6 PM, Mon-Thu
  - Jim is working 7 AM to 3 PM, Mon-Fri
- Staff scheduling affects individuals' productivity and earnings, but has no or little effect on that of the group
  - Will not consider again



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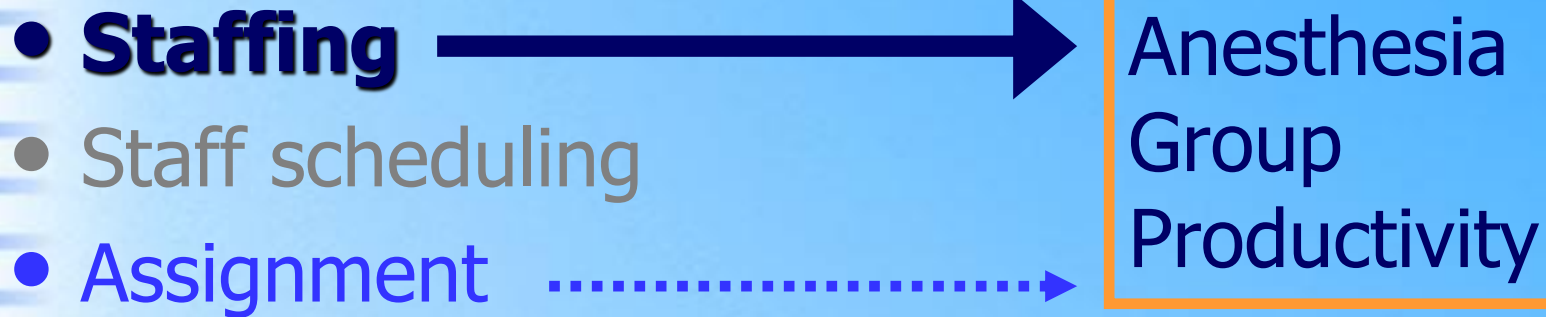


# Definition of Assignment

- Assignment specifies what the individual does on the day of surgery
- Example
  - Jan is working in OR 1 today
  - Jim is working in OR 2 today
- Assignment affects group's productivity, but has less effect than does staffing
  - Assignment will be considered after staffing



# Staffing Has a Large Effect on Anesthesia Group Productivity





# Definition of Anesthesia Group Productivity

(ASA RVG units of anesthesia care)

(Costs to provide the anesthesia care)



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American Society of Anesthesiologist's  
Relative Value Guide units –  
U.S. professional payment system



# Definition of Anesthesia Group Productivity

(ASA RVG units of anesthesia care)

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Three different  
types of costs



# Definition of Anesthesia Group Productivity

(ASA RVG units of anesthesia care)

(Direct + Indirect + Opportunity)



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(ASA RVG units of anesthesia care)

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Direct cost: \$ paid out in wages

Indirect cost: \$ of recruitment, retention

Opportunity cost: \$ could make elsewhere



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# Example of Direct Costs

- Hospital employs 12 nurse anesthetists
- Their average salary is \$175,000 per year
- Direct costs  $\cong$  \$2,100,000 per year

$$\$2,100,000 = 12 \times \$175,000$$



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# Example of Indirect Costs (Also Called *Intangible Costs*)

- A group of anesthesiologists' average monthly compensation is \$25,000
- Within a year, 4 anesthesiologists quit, frustrated with unpredictable, long hours
- With privileges, orientation, etc., essentially one month is lost for each new recruit
- Recruiter, moving, etc.  $\cong$  \$35,000 per hire
- Indirect costs  $\cong$  \$240,000 per year

$$\$240,000 = 4 \times (\$25,000 + \$35,000)$$



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Opportunity cost:   \$ could make elsewhere



# Example of Opportunity Costs

- A group of 20 anesthesiologists' average annual compensation is \$300,000
- The city (like most of the US) has a large shortage of anesthesiologists
- Opportunity costs  $\cong$  \$6,000,000 per year  
$$\$6,000,000 = 20 \times \$300,000$$



# Equation Applies Broadly Since Both Direct & Opportunity Costs

(ASA RVG units of anesthesia care)

(Direct + Indirect + Opportunity)

Direct cost:

\$ paid out in wages

Indirect cost:

\$ of recruitment, retention

Opportunity cost:

\$ could make elsewhere



# Value of the Numerator for Afternoon and Evening

*= Constant*

(ASA RVG units of anesthesia care)

(Direct + Indirect + Opportunity)



# Why Does Afternoon Staffing Not Affect the Numerator?

- Staffing in the afternoon and evening
  - Should not affect how many ORs are run
  - Should not affect surgeons
  - Should not affect number of base units billed
  - Should not affect number of time units billed



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  - Should not affect number of base units billed
  - Should not affect number of time units billed
  - Affects the costs of providing the care
    - Costs are in the denominator, not in the numerator



# Value of the Denominator for Afternoon and Evening

(ASA RVG units of anesthesia care)

(Direct + Indirect + Opportunity)

Direct cost: \$ paid out in wages

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# Contributors to Direct Costs

- Direct costs are proportional to a weighted combination of
  - Scheduled hours
  - Hours worked late



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  - Hospital employs nurse anesthetists on a full-time, hourly basis
  - \$80 per hour, 6:30 AM to 3 PM Mon-Fri
  - \$120 per hour, after 3 PM



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- Example
  - Two anesthesiologists stay late, on-call, after 3 PM each weekday, if needed
  - Before dividing profits, a bonus of \$150 per hour is paid for work done after 3 PM
    - Still, anesthesiologists quit citing being on-call too much, and recruitment is hard



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- Example
  - Anesthesiologists split group profits based on the hours that they are scheduled to work
  - Each day, one anesthesiologist works in-house from 5 PM to 7 AM the next morning
    - If the anesthesiologist's scheduled hours were not 5 PM to 7 AM, he or she would be available to do cases from 7 AM to 5 PM

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# Combine the Preceding Results to Simplify This Equation

(ASA RVG units of anesthesia care)

(Direct + Indirect + Opportunity)



# To Maximize Afternoon and Evening Staffing Productivity

(ASA RVG units of anesthesia care)

(Direct + Indirect + Opportunity)



# To Maximize Afternoon and Evening Staffing Productivity

Maximize the following ratio:

(ASA RVG units of anesthesia care)

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# To Maximize Afternoon and Evening Staffing Productivity

Maximize the following ratio:

~~(ASA RVG units of anesthesia care)~~

*= Constant*

(Direct + Indirect + Opportunity)



# To Maximize Afternoon and Evening Staffing Productivity

Maximize the following ratio:

~~(ASA RVG units of anesthesia care)~~

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(Scheduled hours +

{relative cost of 1 hour worked  
late to 1 scheduled hour} ×

Hours worked late)



# To Maximize Afternoon and Evening Staffing Productivity

Minimize costs in denominator:

Scheduled hours +

{relative cost of 1 hour worked  
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Hours worked late





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Dexter F, Traub RD. AANA J 2000

Dexter F et al. Anesth Analg 2001

Dexter F, Epstein RH. AORN J 2003



Some  
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this material

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# Steps Performed Independently for Each Specialty Call

- All subsequent steps are done independently for each anesthesia specialty with separate “call schedule” and more than one person potentially (practically) on call



# Steps Performed Independently for Each Specialty Call

- Example from academic hospital
  - For nurse anesthetist and resident staffing
    - Analysis performed using all anesthetics
  - For faculty staffing
    - Analysis repeated using all anesthetics except cardiac or liver transplant
      - Cardiac and liver transplant excluded, because each is known a priori to be one faculty anesthesiologist per day



# Choose Afternoon Staffing to Maximize Productivity

- Export anesthesia information system data



# Choose Afternoon Staffing to Maximize Productivity

- Export anesthesia information system data
  - Calculate the number of simultaneous anesthetics for each hour of each day



# Choose Afternoon Staffing to Maximize Productivity

- Export anesthesia information system data
- Calculate the number of simultaneous anesthetics for each hour of each day
- Determine staffing to minimize costs





# Choose Afternoon Staffing to Maximize Productivity

- Export anesthesia information system data
- Calculate the number of simultaneous anesthetics for each hour of each day
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- Repeat process for other times of the day



# Choose Afternoon Staffing to Maximize Productivity

- Export anesthesia information system data
- Calculate the number of simultaneous anesthetics for each hour of each day
- Determine staffing to minimize **costs**
  - **Cost** if no anesthesia provider scheduled
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- Make the selection yielding lowest cost
- Repeat process for other times of the day

How?



# Costs Are Given by Denominator of the Productivity Equation

Scheduled hours +

{relative cost of 1 hour worked  
late to 1 scheduled hour} ×

Hours worked late



# Costs Are Given by Denominator of the Productivity Equation

Scheduled hours +

{relative cost of 1 hour worked late to 1 scheduled hour} ×

Hours worked late

How is this value determined?



# Relative Cost of 1 Hour Worked Late to 1 Scheduled Hour

- Anesthesia provider stays late if needed
  - Relative cost of 1 hour worked late to 1 scheduled hour might be 2
    - An interpretation of 2 is 1.5 for direct costs plus 0.5 increment for indirect costs
    - An implication of 2 is that provider stays late if needed 1 day out of 3 and will not be needed 2 days out of 3 that on call

Strum DP et al. J Med Syst 1997



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    - An interpretation of 2 is 1.5 for direct costs plus 0.5 increment for indirect costs
    - An implication of 2 is that provider stays late if needed 1 day out of 3 and will not be needed 2 days out of 3 that on call
- Regardless of relative cost used (1.5, 2.0, etc.), results are very similar





# Relative Cost of 1 Hour Worked Late to 1 Scheduled Hour

- Anesthesia provider who unexpectedly has to stay late to finish a case
  - “Stuck” in an OR with no available relief
    - Misses child’s soccer game
  - Relative cost value might be 4
    - Implication is that if have a 5 day work week then work late 1 day a week



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- Anesthesia provider who unexpectedly has to stay late to finish a case
  - “Stuck” in an OR with no available relief
    - Misses child’s soccer game
  - Relative cost value might be 4
    - Implication is that if have a 5 day work week then work late 1 day a week
- Precise value (3.5, 4.0, etc.) has ***extremely*** little effect on the results



# Example of Applying Different Relative Costs to 5 PM – 7 PM

- Relative cost of 2 gives 3 providers
- Relative cost of 4 gives 5 providers
- 10 ORs are staffed from 7 AM to 5 PM



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Scheduled to work late



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Work late  
if needed

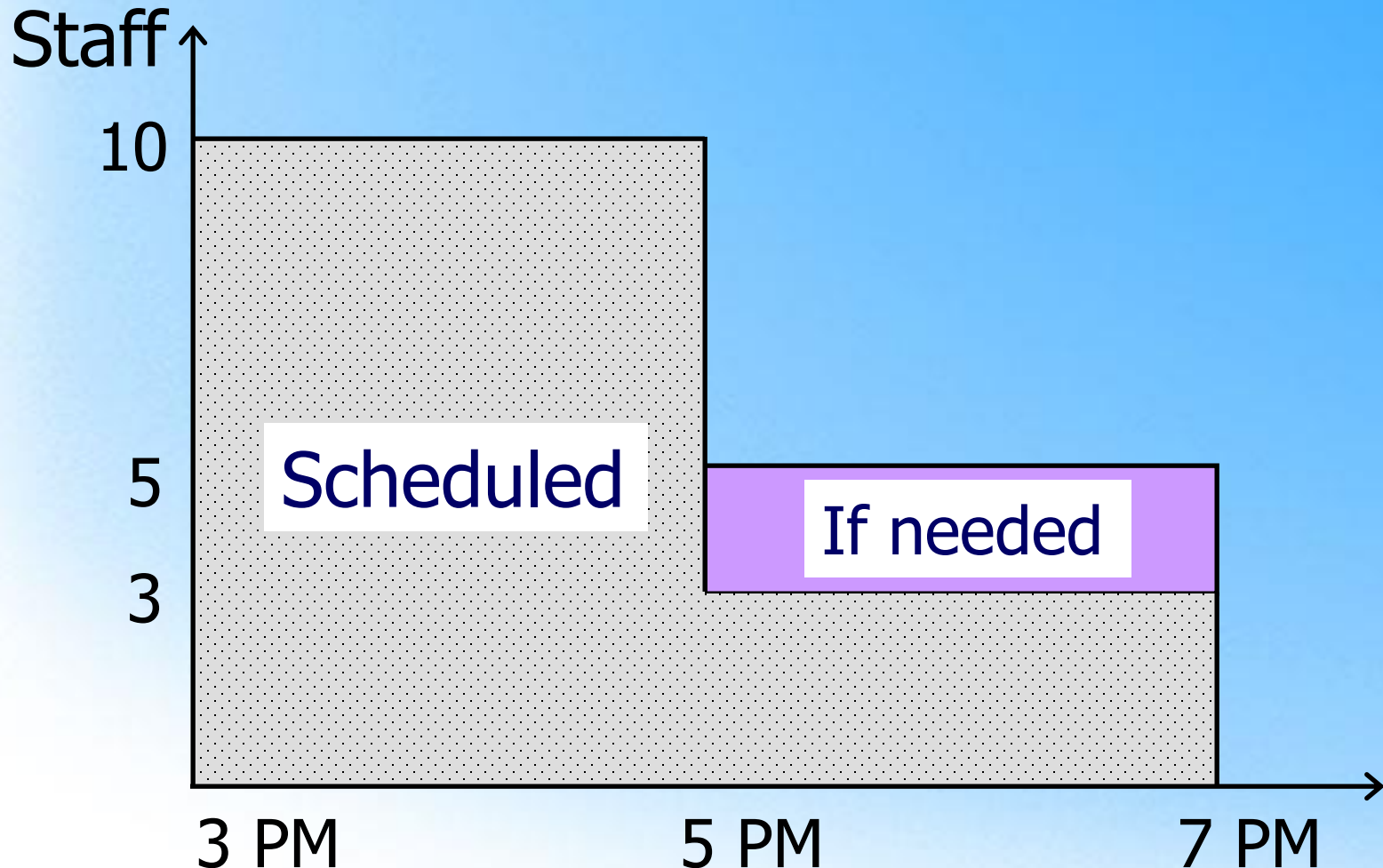


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- Choose what 7 AM to 7 PM staffing?



# Example of Applying Different Relative Costs to 5 PM – 7 PM



# Example of Applying Different Relative Costs to 5 PM – 7 PM

- Relative cost of 2 gives 3 providers
  - Relative cost of 4 gives 5 providers
  - 10 ORs are staffed from 7 AM to 5 PM
  - Choose what 7 AM to 7 PM staffing?
    - 3 providers are scheduled 7 AM to 7 PM
    - 2 providers are scheduled 7 AM to 5 PM, plus will stay late if necessary (on-call)
    - 5 providers are scheduled 7 AM to 5 PM, expecting to be done reliably by 5 PM
- Why?



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# Choose Afternoon Staffing to Maximize Productivity

- Export anesthesia information system data
- Calculate the number of simultaneous anesthetics for each hour of each day
- Determine staffing to minimize costs
  - Cost if no anesthesia provider scheduled
  - Cost if one anesthesia provider scheduled
  - Cost if two anesthesia providers scheduled
- Make the selection yielding lowest cost
- Repeat process for other times of the day

# Example – Repeating Process for Other Times of the Day

- Results using a ratio of 2
  - 7 AM to 3 PM, 22 anesthesia providers
  - 3 PM to 5 PM, 12 anesthesia providers
  - 5 PM to 7 PM, 6 anesthesia providers
  - 7 PM to 11 PM, 2 anesthesia providers
- How to convert this into a staffing plan



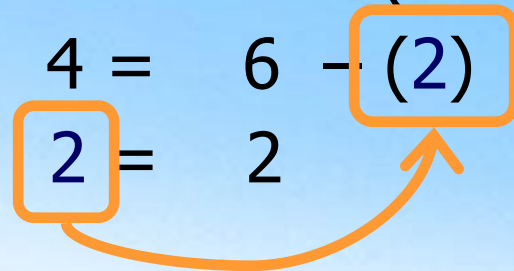
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  - 7 AM to 3 PM, 12 providers,  $12 = 22 - (6 + 4)$
  - 7 AM to 5 PM, 6 providers,  $6 = 12 - (4 + 2)$
  - 7 AM to 7 PM, 4 providers,  $4 = 6 - (2)$
  - 3 PM to 11 PM, 2 providers,  $2 = 2$

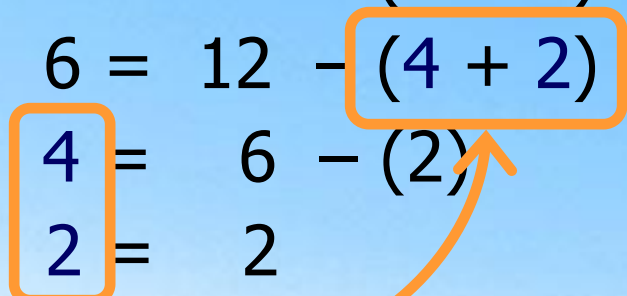


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# Sustainability of Adjusting Staffing Plans Over Time

- January 2014 through September 2020, which is 27 quarter years
- Planned relative cost ratio of 4.00
  - 20% anesthesiologists not on call work late
- Obtained mean 17.7% standard deviation 5.0%
  - 99% confidence interval 15.0% to 20.4%

Dexter F et al. J Clin Anesth 2021



# Staffing Plan Indicates When Group Should Consider Hiring

- Example
  - Currently, 12 anesthesiologists work 7 AM to whenever done, usually around 8 PM
  - Staffing plan to maximize productivity and minimize costs is as follows:
    - 7 AM to 4 PM, 10 anesthesiologists
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Extra beyond current staffing

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    - 7 AM to 4 PM, 10 anesthesiologists
    - 7 AM to 7 PM, 2 anesthesiologists
    - 3 PM to 11 PM, **2** anesthesiologists
  - Group would increase productivity and reduce its costs by hiring **2** more anesthesiologists

# Data Used for Analysis Are Case Start and End Times

- If use data from anesthesia billing system or electronic anesthesia record
  - Anesthesia start and end date/time
- If use data from OR information system
  - Time of entrance and exit of patient from his or her OR



# Data Used for Analysis Are Case Start and End Times

- There are slight but statistically significant differences in data among these systems
  - Anesthesia billing system
  - Anesthesia information system
  - OR information system (not anesthesia times)
- Yet, afternoon staffing answers are same

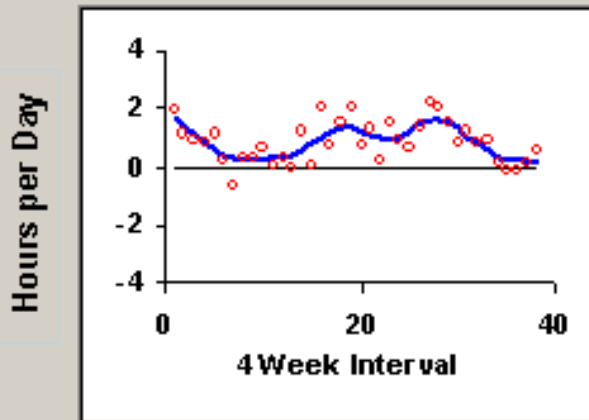
Junger A et al. Meth Inform Med 2002  
Dexter F, Epstein RH. AORN J 2003



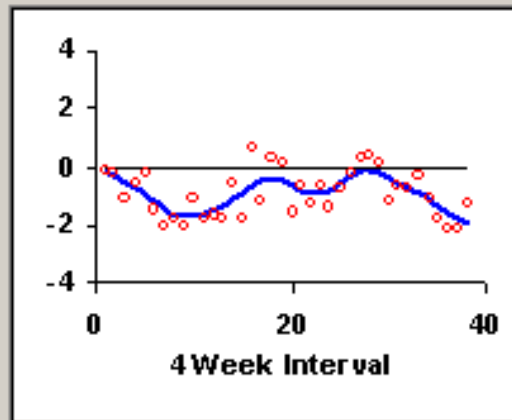
# Graphical Analysis Used Since Trends and Seasonality

## Number of Operating Rooms with 2nd Shift Staff

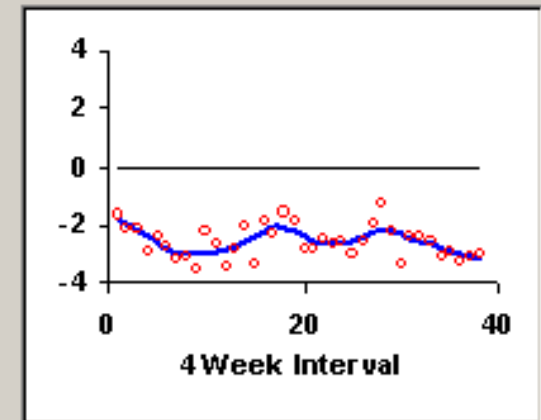
1 vs. 2



2 vs. 3



3 vs. 4



Allow Graph Editing?

Yes  No

Print



For this institution, a difference of 1 hour per day means an annual difference of \$40,000

**The selected graph indicates you should provide 2nd shift staff for either 1 or 2 ORs**

Check as Best Match that most closely straddles an Hours per Day difference of 0.

Close



# Graphical Analysis Used Since Trends and Seasonality

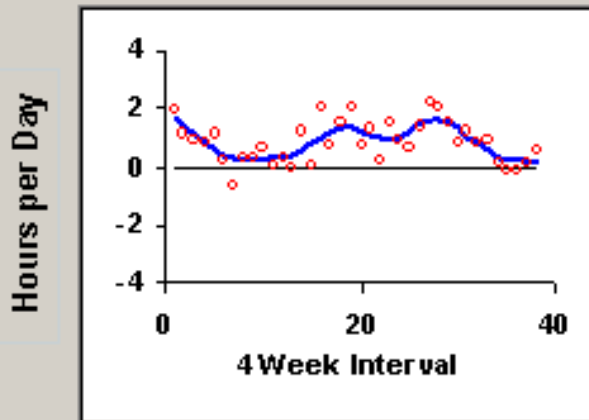
- Cropped screen shots are used for example showing how and why graphical analysis incorporates trend and seasonal variation
- Algorithms are published
  - U Iowa provided consultation to a company (Healthcare Data Analytics, Inc.) as they wrote the software shown
  - You do not need to use the product



# Graphical Analysis Used Since Trends and Seasonality

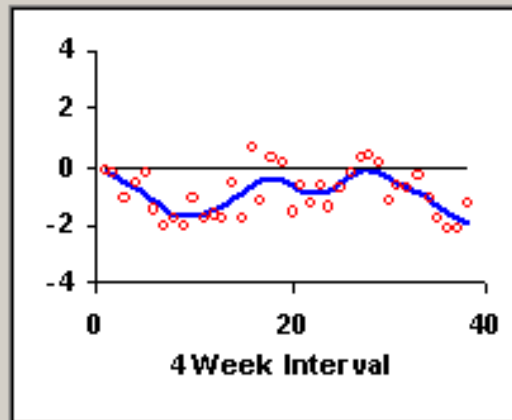
## Number of Operating Rooms with 2nd Shift Staff

1 vs. 2



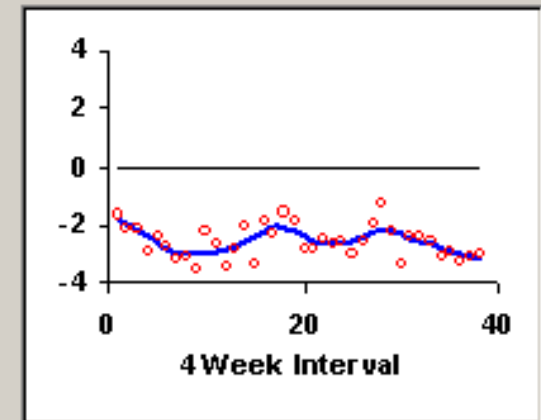
Best Match

2 vs. 3



Best Match

3 vs. 4



Best Match

Allow Graph Editing?

Yes  No

Print



For this institution, a difference of 1 hour per day means an annual difference of \$40,000

**The selected graph indicates you should provide 2nd shift staff for either 1 or 2 ORs**

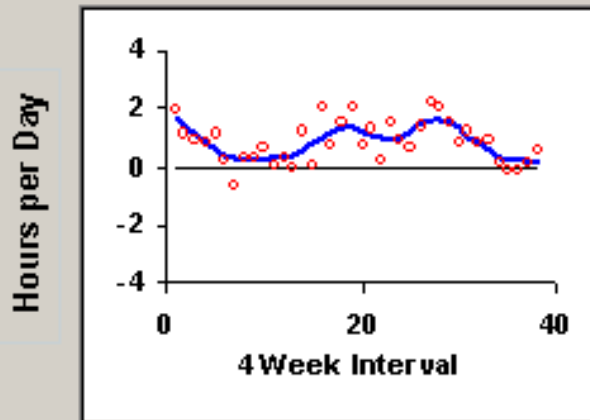
Check as Best Match that most closely straddles an Hours per Day difference of 0.

Close

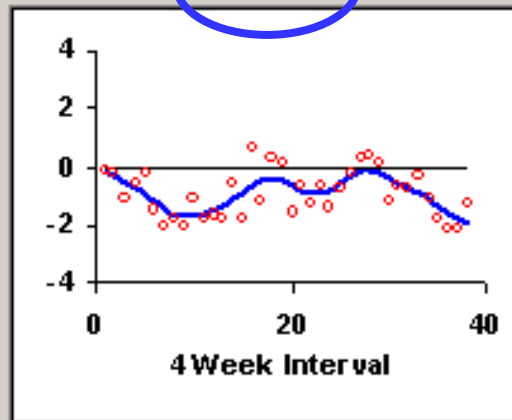
# Calculate Each Day's Pair Wise Difference in Staffing Cost

## Number of Operating Rooms with 2nd Shift Staff

1 vs. 2



2 vs. 3



Cost of  
staffing 2  
instead of 3  
anesthetics

Allow Graph Editing?

Yes  No

Print



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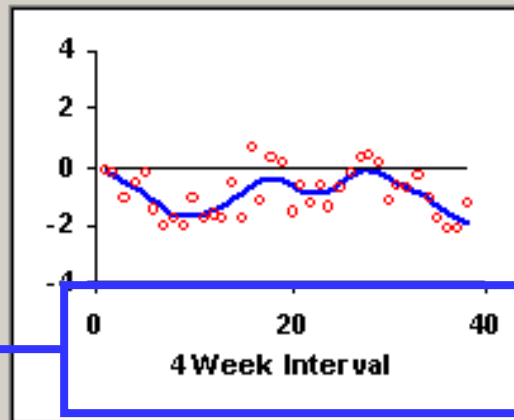
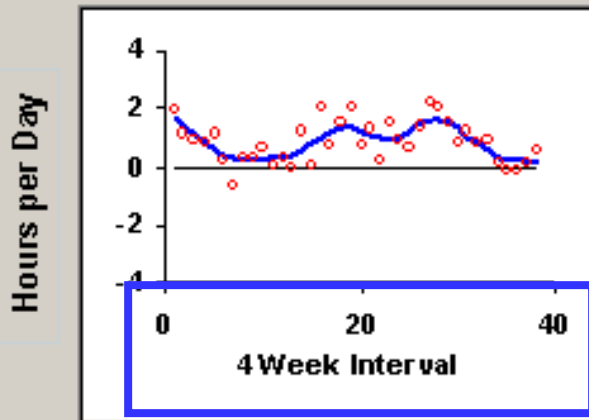
Close

# Average Daily Differences Over Successive Four-Week Periods

## Number of Operating Rooms with 2nd Shift Staff

1 vs. 2

2 vs. 3



39 four-week periods in example

Best Match

Best Match

Allow Graph Editing?

Yes  No

Print



For this institution, a difference of 1 hour per day means an annual difference of \$40,000

**The selected graph indicates you should provide 2nd shift staff for either 1 or 2 ORs**

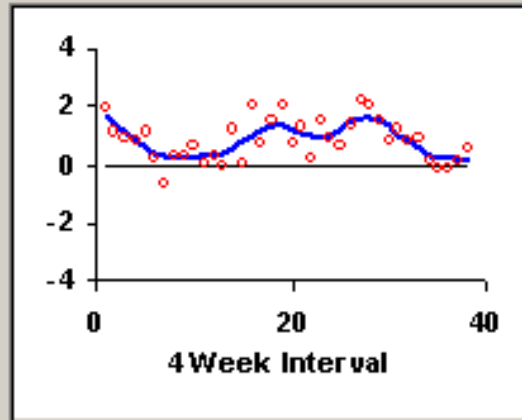
Check as Best Match that most closely straddles an Hours per Day difference of 0.

Close

# Best Staffing Pair Straddles Line of Zero Difference

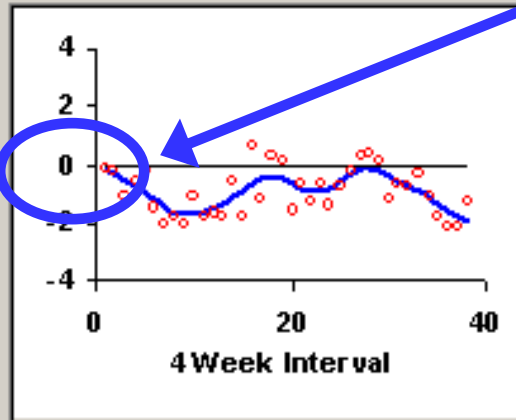
## Number of Operating Rooms with 2nd Shift Staff

1 vs. 2



Best Match

2 vs. 3



Best Match

Line of zero  
difference

Allow Graph Editing?

Yes  No

Print



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The selected graph indicates you should provide 2nd shift staff for either 1 or 2 ORs

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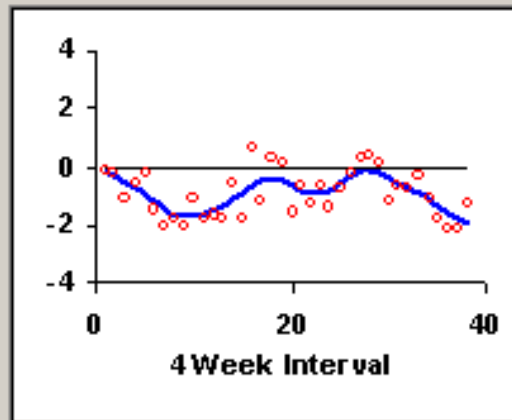
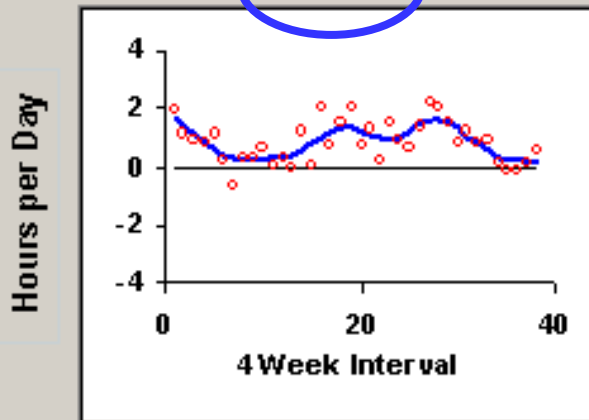
Close

# Greater Cost If Staff for One Anesthetic Instead of Two

## Number of Operating Rooms with 2nd Shift Staff

1 vs. 2

2 vs. 3



Difference in cost  $> 0$  for most 4 wk periods

Best Match

Best Match

Allow Graph Editing?

Yes  No

Print



For this institution, a difference of 1 hour per day means an annual difference of \$40,000

The selected graph indicates you should provide 2nd shift staff for either 1 or 2 ORs

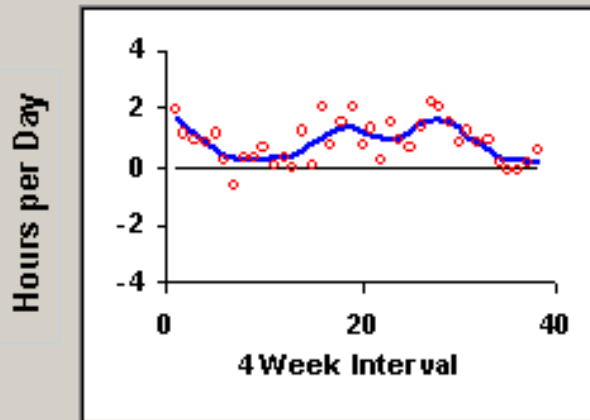
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Close

# Greater Cost If Staff For Three Anesthetics Instead of Two

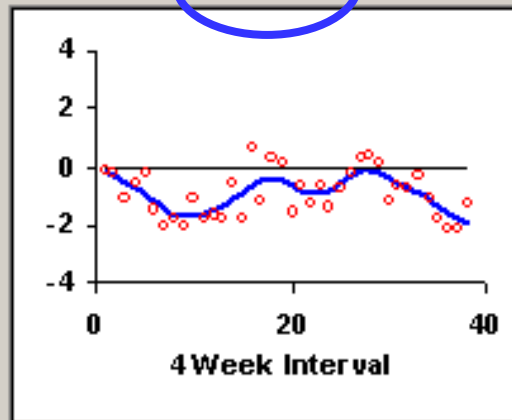
## Number of Operating Rooms with 2nd Shift Staff

1 vs. 2



Best Match

2 vs. 3



Best Match

Difference in cost  $< 0$  for most 4 wk periods

Allow Graph Editing?

Yes  No

Print



For this institution, a difference of 1 hour per day means an annual difference of \$40,000

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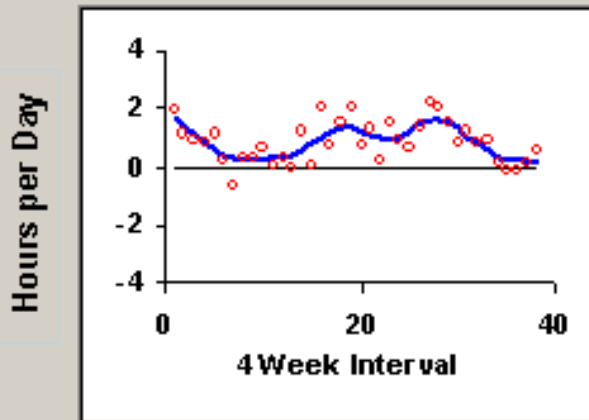
Check as Best Match that most closely straddles an Hours per Day difference of 0.

Close

# Result of Graphical Analysis For Trends and Seasonality

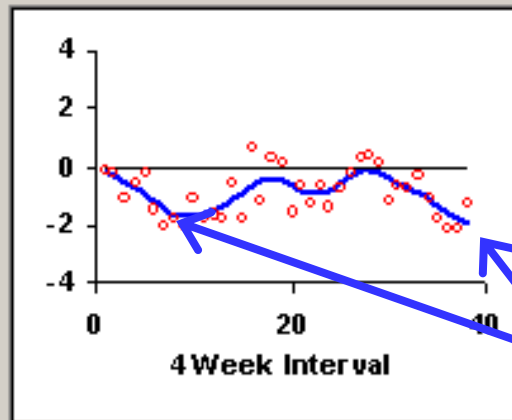
## Number of Operating Rooms with 2nd Shift Staff

1 vs. 2



Best Match

2 vs. 3



Best Match

Staff for 2  
Anesthetics  
Despite  
Oscillations

Allow Graph Editing?

Yes  No

Print



For this institution, a difference of 1 hour per day means an annual difference of \$40,000

**The selected graph indicates you should provide 2nd shift staff for either 1 or 2 ORs**

Check as Best Match that most closely straddles an Hours per Day difference of 0.

Close



# Do Plan on Seasonality

- Department had significant seasonality
  - Fewer ORs in use at 3:30 PM among elective cases January-March than July-September
    - Over 4 years from 1994 through 1998
  - Anesthesiologists not on call less often worked late during January-March than July-September
    - Mean 14.0% versus 21.6%,  $P = 0.0031$   
Over 7 years from 2014 through 2021

Dexter F et al. AANA J 2000

Dexter F et al. J Clin Anesth 2021



# Staffing to Finish On-Time, ↑ Productivity, and ↓ Costs

- Definitions of productivity and staffing costs
- Afternoon staffing to maximize productivity
- Other approaches for improving afternoons
  - Provide information to group members
  - Change day of surgery decision making
  - Change OR allocations and case scheduling
  - Adjust non-operating room responsibilities



# Review – Summarize the Facts of the Talk



# How Apply to Assess Performance of the Head of Anesthesia Group?



# How Apply to Assess Performance of the Head of Anesthesia Group?

- Controls the staffing?
- Controls the nurse anesthetists' and anesthesiologists' work hours?
- Can be evaluated by hospital without accessing the anesthesia billing data?
- What question ask about staffing and productivity to evaluate knowledge?
- What question ask about hiring to evaluate performance?

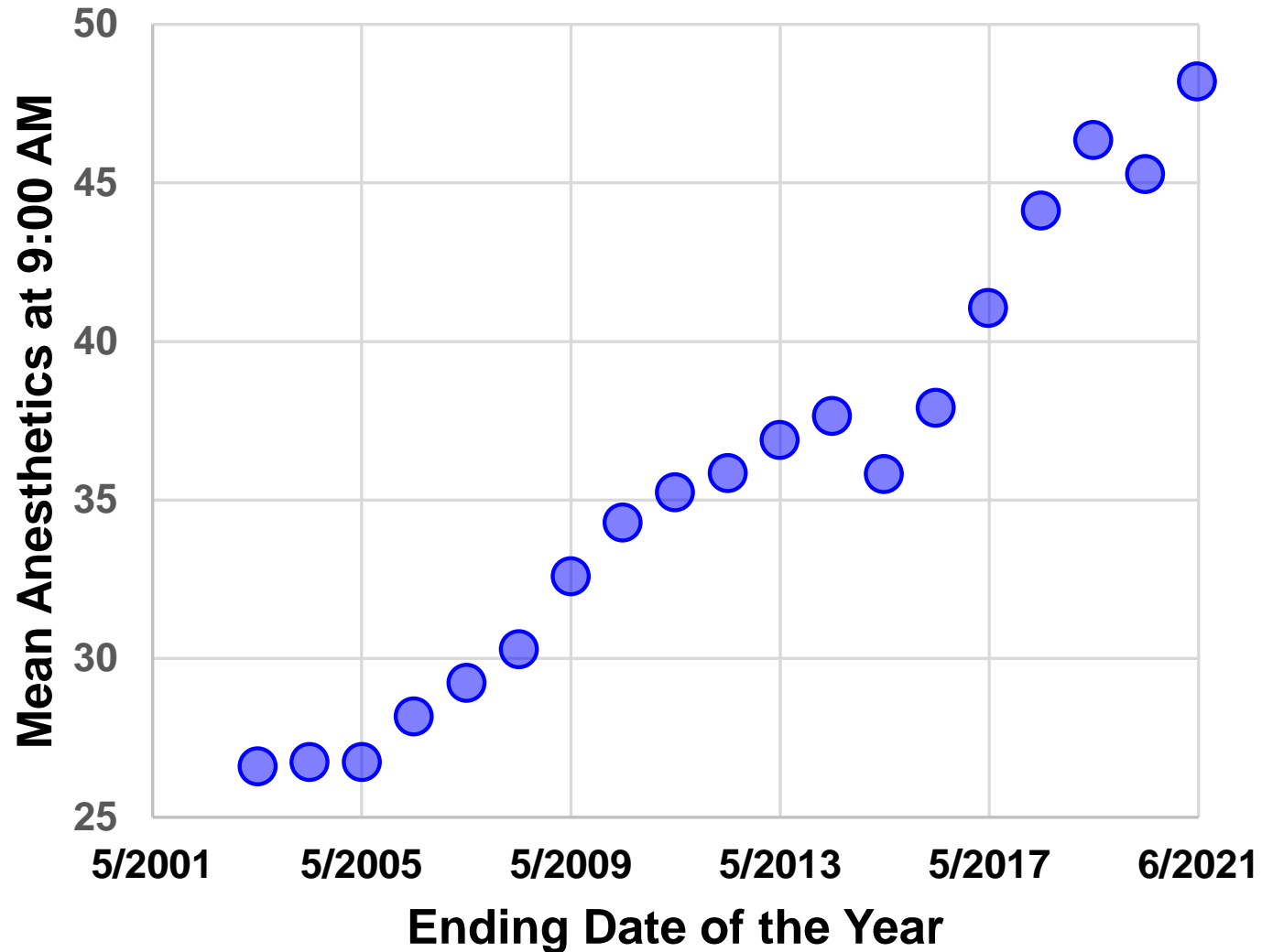


# Importance of Knowledge of the Head of Anesthesia Group?

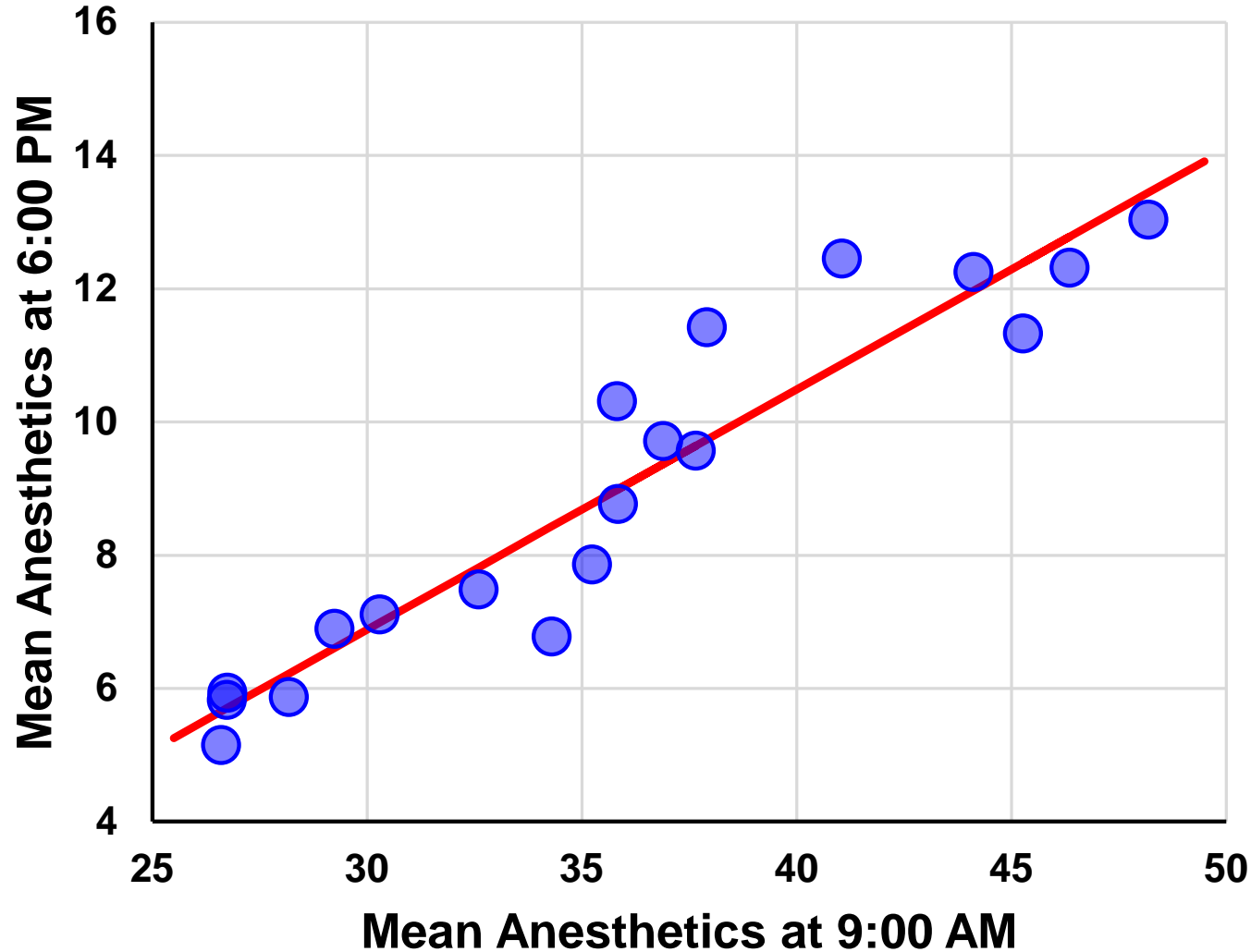
- At strategic time course, late afternoon caseload is overall proportional to morning caseload or independent?
  - If hiring more nurse anesthetists and anesthesiologists to cover more first case starts, change in afternoon staffing?



# Importance of Knowledge of the Head of Anesthesia Group



# Importance of Knowledge of the Head of Anesthesia Group





# Importance of Knowledge of the Head of Anesthesia Group?

- At strategic time course, late afternoon caseload is overall proportional to morning caseload or independent?
  - If hiring more nurse anesthetists and anesthesiologists to cover more first case starts, change in afternoon staffing?
- Consequence of not relying on the science is lesser productivity and staff working late



# Staffing to Finish On-Time, ↑ Productivity, and ↓ Costs

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# Scenario – Description of the Group

An all MD anesthesia group practices at a 10 OR surgical suite. For many years, the group has had a rotating scheduling with 1<sup>st</sup> out, 2<sup>nd</sup> out, 3<sup>rd</sup> out, ..., 9<sup>th</sup> out, 10<sup>th</sup> out, and then an 11<sup>th</sup> anesthesiologist who stays in-house overnight. Relief typically starts around 3 PM.



# Scenario – Description of the Group (cont.)

Most of the older anesthesiologists in the group have spouses not working outside of the home. The unpredictability of the time that they finished was not a major concern. Instead, total compensation and equality of workload for the compensation shared were the largest issues.



# Scenario – Description of the Group (cont.)

Most of the new younger members have working spouses. Predictability of hours is a major concern. Anesthesiologists are picking up their children from school activities after work – they need to know when they will be done. How should the group change its staffing and staff scheduling? What about the few anesthesiologists who would prefer to work more hours for more pay?



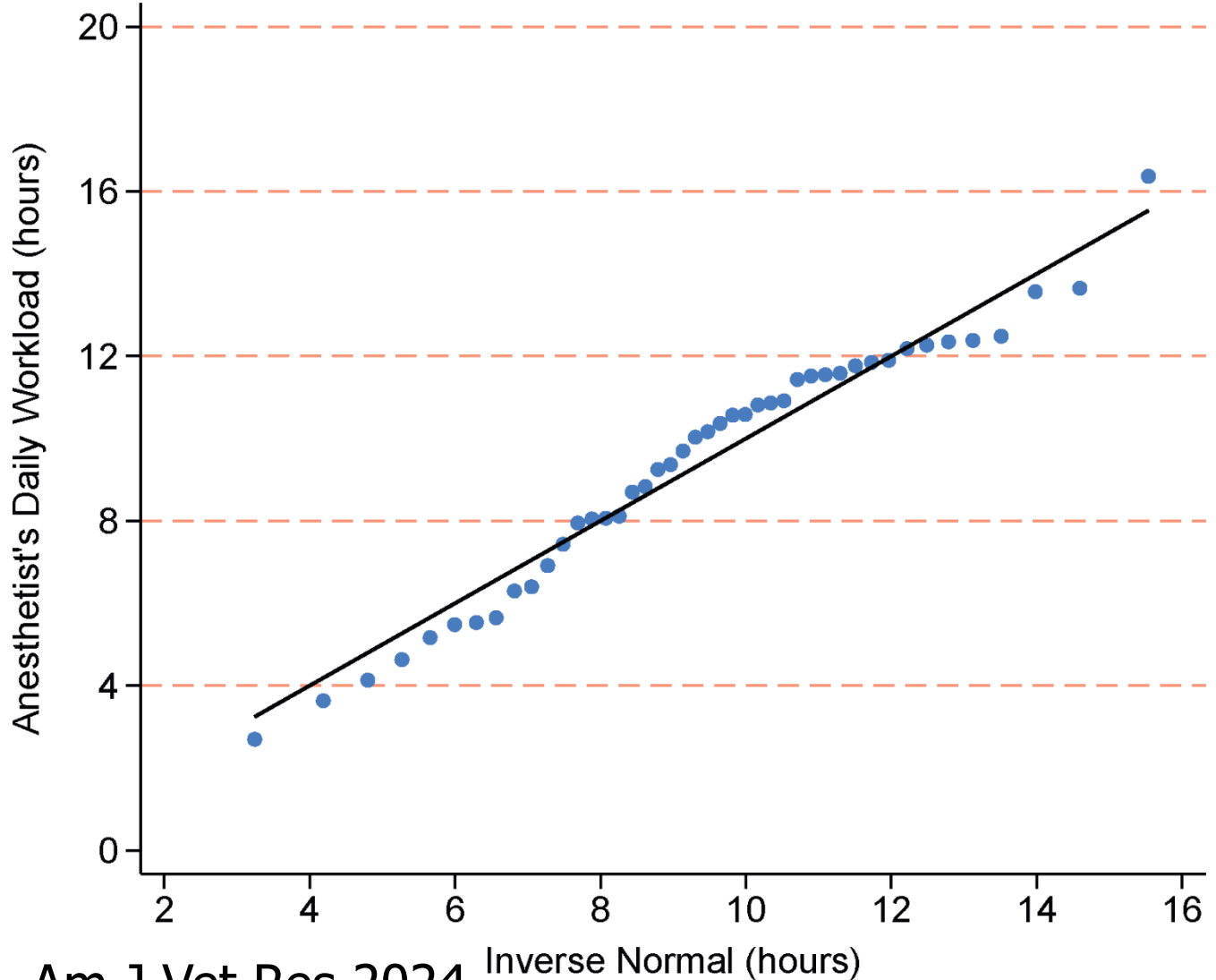
# Scenario – Data Used With Mathematics Just Described

Surgeon block time is from 7 AM to 3 PM.  
The numbers of ORs in use at different times of the day are as follows (mean  $\pm$  SD):

07:00 to 12:59	10
13:00 to 14:59	7 $\pm$ 1
15:00 to 15:59	5 $\pm$ 2
16:00 to 16:59	4 $\pm$ 2
17:00 to 17:59	2 $\pm$ 2
18:00 to 18:59	1 $\pm$ 1

# Scenario – Data Used With Mathematics Just Described

Normal distribution,  $P = 0.25$





# Scenario – Group Has Shifts By a Different Name

- Group has overlapping shifts, but they refer to them as 1<sup>st</sup> out, 2<sup>nd</sup> out, etc.
- Consider not calculating the number of anesthesiologists to work each shift
- Provide reliable data on the time at which the 3<sup>rd</sup> out, 6<sup>th</sup> out, etc. can expect to be done
  - Based on reality, not surgeon block time

Dexter F et al. Anesth Analg 2009

Dexter F et al. Am J Vet Res 2024



# Scenario – Analyze Data to Help Group Know Reality

- With a relative cost value of 4, MD should work late unexpectedly less than 1 time in 5
  - Let the group know time when have an 80% chance of being done for the day
  - Because probabilistic, and because there are 11 “outs”, results are not obvious (at all)

- Examples

3 <sup>rd</sup> out	15:30	4 <sup>th</sup> out	16:30
5 <sup>th</sup> out	17:15	6 <sup>th</sup> out	18:15
7 <sup>th</sup> out	18:30	8 <sup>th</sup> out	19:00

# Provide Information on Work Hours for Different Shifts

- 80<sup>th</sup> percentiles of earliest times when always running  $\leq 6$  ORs,  $\leq 4$  ORs, and  $\leq 2$  ORs
- Anesthesiologists who had taken these 4<sup>th</sup>, 3<sup>rd</sup>, and 2<sup>nd</sup> calls for years
- Mean absolute error of estimates was 60 min
  - Principally under-estimation
- 69% of estimates had error  $> 30$  min
  - Significantly more than half ( $P = 0.0003$ )

Dexter F et al. Anesth Analg 2009



# Provide Information on Work Hours for Different Shifts

- Information has value, because individuals differ in their choices of work hours
  - Incentive program added permitting each academic anesthesiologist to make more money by working more hours
  - Within several years, large variability among anesthesiologists in compensation
    - Different anesthesiologists had different goals for work hours and compensation

Miller RD, Cohen NH. Anesth Analg 2005



# Provide Information on Work Hours for Different Shifts

- Information has value, because individuals differ in their choices of work hours
  - For compensation to be salient, must truly be offering a decision (e.g., months in advance)
  - Most anesthesiologists (87%) considered an OR to run late if it finished after a specific time of the day, regardless of payment for hours worked after that time (100%)

Masursky D et al. Anesth Analg 2009



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Masursky D et al. Anesth Analg 2009



# Provide Information on Work Hours for Different Shifts

- When forecast 30 hours ahead that afternoon cases to exceed regularly scheduled staffing, email anesthesiologists working non-clinical if want to work clinical starting late afternoon
- Fill median 1 shift (interquartile range 1-2), principally on Wednesdays and Thursdays

Robertson AC et al. J Med Syst 2023





# Staffing to Finish On-Time, ↑ Productivity, and ↓ Costs

- Definitions of productivity and staffing costs
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# Anesthesia and Nursing Change Day of Surgery Decision Making

- Assignment to minimize staffing costs
- Follow the same ordered priorities for day of surgery (operational) decision making
- Have a common definition for scheduled OR hours
- Have the same maximum number of ORs that can be run safely for each specialty

Dexter F et al. Anesthesiology 2004



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# Assignment on Day of Surgery to Minimize Staffing Costs

- Perform relief in afternoons in sequence that maximizes group productivity
  - Groups typically do this now if all anesthesiologists, all nurse anesthetists, or anesthesiologists supervise only nurse anesthetists or only anesthesia trainees
- When  $\geq 2$  ORs to relieve, choose the OR that is likely to run the longest
  - Groups typically aim to do this now

# Assignment on Day of Surgery to Minimize Staffing Costs

- Improvement studied
  - What if the decision is based on analysis of historical case duration data?

Dexter F et al. Anesth Analg 1999

Dexter F et al. Anesthesiology 2004



# Assignment Using Historical Case Duration Data

- Estimate duration of each case using mean duration of historical cases of same surgeon, scheduled procedure, and type of anesthesia
  - If no such data, surgeon/scheduled procedure
    - If no such data, just scheduled procedure



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- Estimate duration of each case using mean duration of historical cases of same surgeon, scheduled procedure, and type of anesthesia
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- Go to OR with largest difference between estimate and time patient has been in OR





# Assignment Using Historical Case Duration Data

- Estimate duration of each case using mean duration of historical cases of same surgeon, scheduled procedure, and type of anesthesia
  - If no such data, surgeon/scheduled procedure
    - If no such data, just scheduled procedure
- Go to OR with largest difference between estimate and time patient has been in OR
- If the drapes are down, skip that OR and go to the OR with the next largest difference



# Assignment Rule Does Well at Minimizing Staffing Costs

- Compare hours worked late to that if manager knew in advance exactly how long each case would last
- Perfect retrospective knowledge would reduce time worked late by only 1.4 more minutes per case



# Assignment Rule Does Well at Minimizing Staffing Costs

- Compare hours worked late to that if manager knew in advance exactly how long each case would last
- Perfect retrospective knowledge would reduce time worked late by only 1.4 more minutes per case
- So small that can increase anesthesia group productivity and reduce staffing costs by making relief (assignment) decisions using historical case duration data



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# Ordered Priorities on the Day of Surgery

- Listed in order of priority
  1. Patient safety is preeminent
  2. Do not cancel a case other than for reasons of safety
  3. Minimize hours worked late
  4. Reduce patient waiting by reducing expected tardiness for elective cases and waiting for non-elective cases
  5. Professional satisfaction



# Summary from the Referenced Review Article

- Standard OR management operational decisions on the day of surgery are simply a consequence of the ordered priorities



# Summary from the Referenced Review Article

- Standard OR management operational decisions on the day of surgery are simply a consequence of the ordered priorities
  - Moving cases from one OR to another





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- Standard OR management operational decisions on the day of surgery are simply a consequence of the ordered priorities
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  - Assigning and relieving staff



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- Standard OR management operational decisions on the day of surgery are simply a consequence of the ordered priorities
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  - Assigning and relieving staff
  - Sequencing urgent cases



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# Summary from the Referenced Review Article

★ Standard OR management operational decisions on the day of surgery are simply a consequence of the ordered priorities ★

- Moving cases from one OR to another
- Assigning and relieving staff
- Sequencing urgent cases
- Scheduling add-on cases



# Ordered Priorities on the Day of Surgery

- If anesthesia and nursing make decisions on the day of surgery based on a different set of ordered priorities, they *will* make different OR management decisions
  - Result of the science is that *will*, not *may*



# Ordered Priorities on the Day of Surgery

- At a 3 OR ambulatory surgery center, an anesthesiologist medically directs 3 CRNAs
- At 2:30 PM, the last case in OR #1 finishes. The last patient from OR #2 is cared for by a different surgeon than the other cases. The surgeon wants the case moved into OR #1. The patient is available.
- Move the case?



# Ordered Priorities on the Day of Surgery

- At a 3 OR ambulatory surgery center, an anesthesiologist medically directs 3 CRNAs
- At 2:30 PM, the last case in OR #1 finishes. The last patient from OR #2 is cared for by a different surgeon than the other cases. The surgeon wants the case moved into OR #1. The patient is available.
- Move the case?
  - Not if staff in OR #1 are scheduled to finish working at 3 PM, whereas those in OR #2 are scheduled to 6 PM



# Anesthesia and Nursing Change Day of Surgery Decision Making

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# Definition of Scheduled OR Hours

- Example
  - Scheduled hours are 7 AM to 3 PM for all ORs in a surgical suite
  - An OR's last case of the day ends at 6 PM
    - There were 3 hours worked late



# Choosing Values for Scheduled OR Hours

- When operational decisions are made based on the five ordered priorities, scheduled hours are calculated based on reducing expected hours worked late

Dexter F et al. Anesthesiology 2004

McIntosh C et al. Anesth Analg 2006

Dexter F, Epstein RH. Periop Care Oper Room Manag 2024



# Choosing Values for Scheduled OR Hours

- The hours are chosen based on when ORs actually finish for the day
  - Not based on preferences of a committee



# Choosing Values for Scheduled OR Hours

- The hours are chosen based on when ORs actually finish for the day
  - Not based on preferences of a committee
- Conceptual description of approach



# Choosing Values for Scheduled OR Hours

- The hours are chosen based on when ORs actually finish for the day
  - Not based on preferences of a committee
- Conceptual description of approach
  - If relative cost of an OR ending 1 hour late is  $2 \times$  cost of it finishing 1 hour early, then  $2/3^{\text{rd}}$  ORs should be done by the end of the scheduled hours



# Why Common Definition for Scheduled Hours?

- If scheduled OR hours are defined differently (for example, 3 PM versus 5 PM), then efforts to reduce hours worked late assures that the actual decisions will differ



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- If scheduled OR hours are defined differently (for example, 3 PM versus 5 PM), then efforts to reduce hours worked late assures that the actual decisions ***will* differ, *not may***

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# Same Maximum Number of ORs for Each Specialty

- OR nursing has *three* cardiac surgery teams scheduled for the next Monday
- *Two* anesthesiologists with cardiac subspecialty training are scheduled for Monday
- Result is that decisions based on safety will differ between anesthesia and OR nursing



# Same Maximum Number of ORs for Each Specialty

- OR nursing has *three* cardiac surgery teams scheduled for the next Monday
- *Two* anesthesiologists with cardiac subspecialty training are scheduled for Monday
- Result is that decisions based on safety will differ between anesthesia and OR nursing
- Even if operational decisions are made based on the five ordered priorities, actual decisions will differ on the day of surgery



# Anesthesia and Nursing Change Day of Surgery Decision Making

- Assignment to minimize staffing costs
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# Anesthesia and Nursing Change Day of Surgery Decision Making

- Assignment to minimize staffing costs
- Follow the same ordered priorities for day of surgery (operational) decision making
- Have a common definition for scheduled OR hours
- Have the same maximum number of ORs that can be run safely for each specialty
- No decision overlaps with one to obtain desired numbers of ORs in use at some future time



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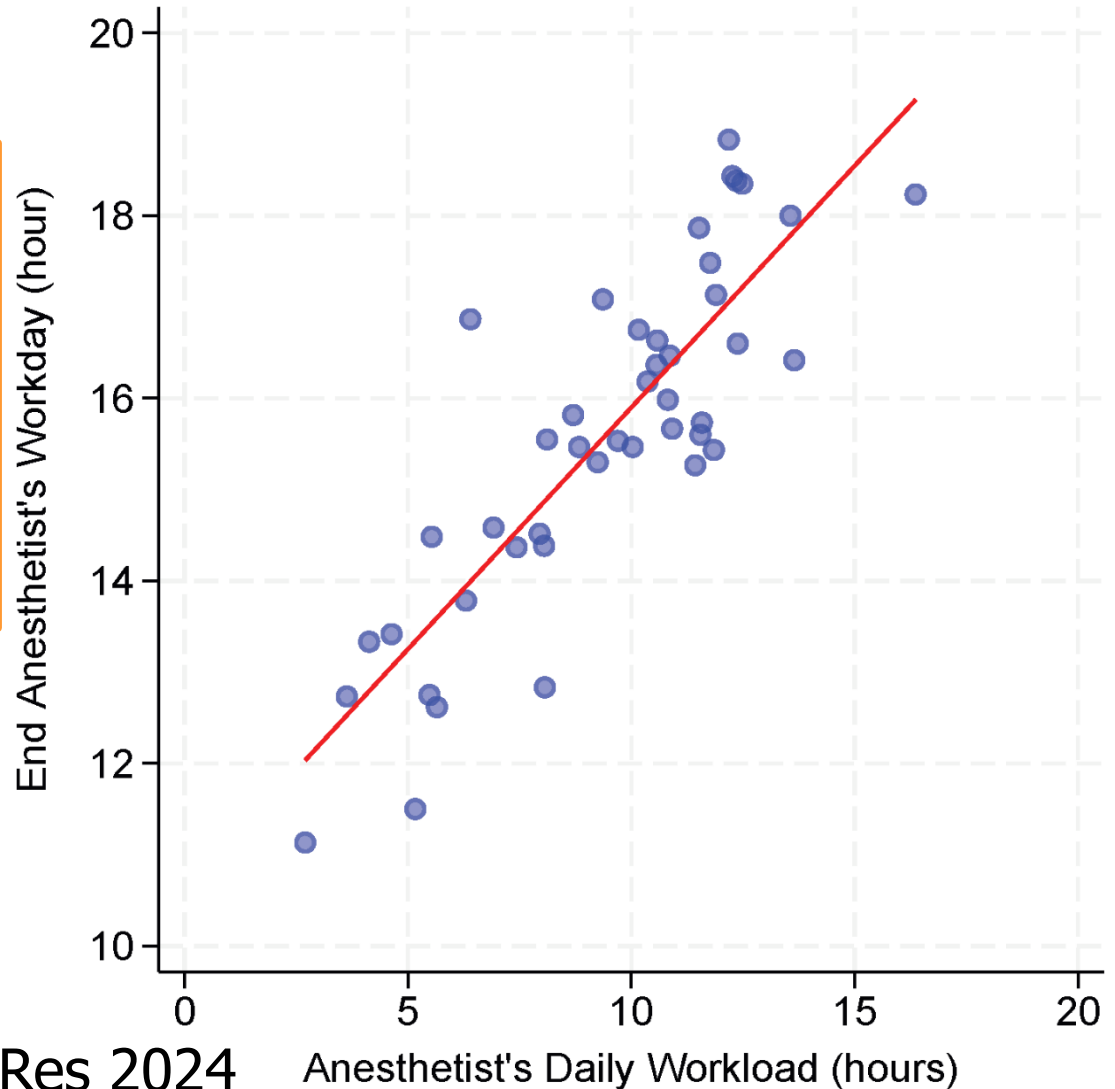
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# Change OR Allocations and Case Scheduling

Once control for daily workload ( $P < 0.0001$ ), no incremental predictive value to daily numbers of cases



# Change OR Allocations and Case Scheduling

- OR allocation (staffing) can be chosen to simultaneously:
  - Provide the surgeons with open access to OR time on any future workday
  - Reduce the hours worked late, since staff scheduling can be matched to the allocations
- Part of the ordered priorities shown earlier

McIntosh C et al. Anesth Analg 2006



# Improving OR Allocations Reduces Anesthesia Costs

- For 12 of 14 suites, statistical method found a staffing plan with costs at least 10% less than that being used by the managers

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

Lehtonen JM et al. Int J Health Care Qual Assur 2013

# Improving OR Allocations Reduces Anesthesia Costs

- For 12 of 14 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

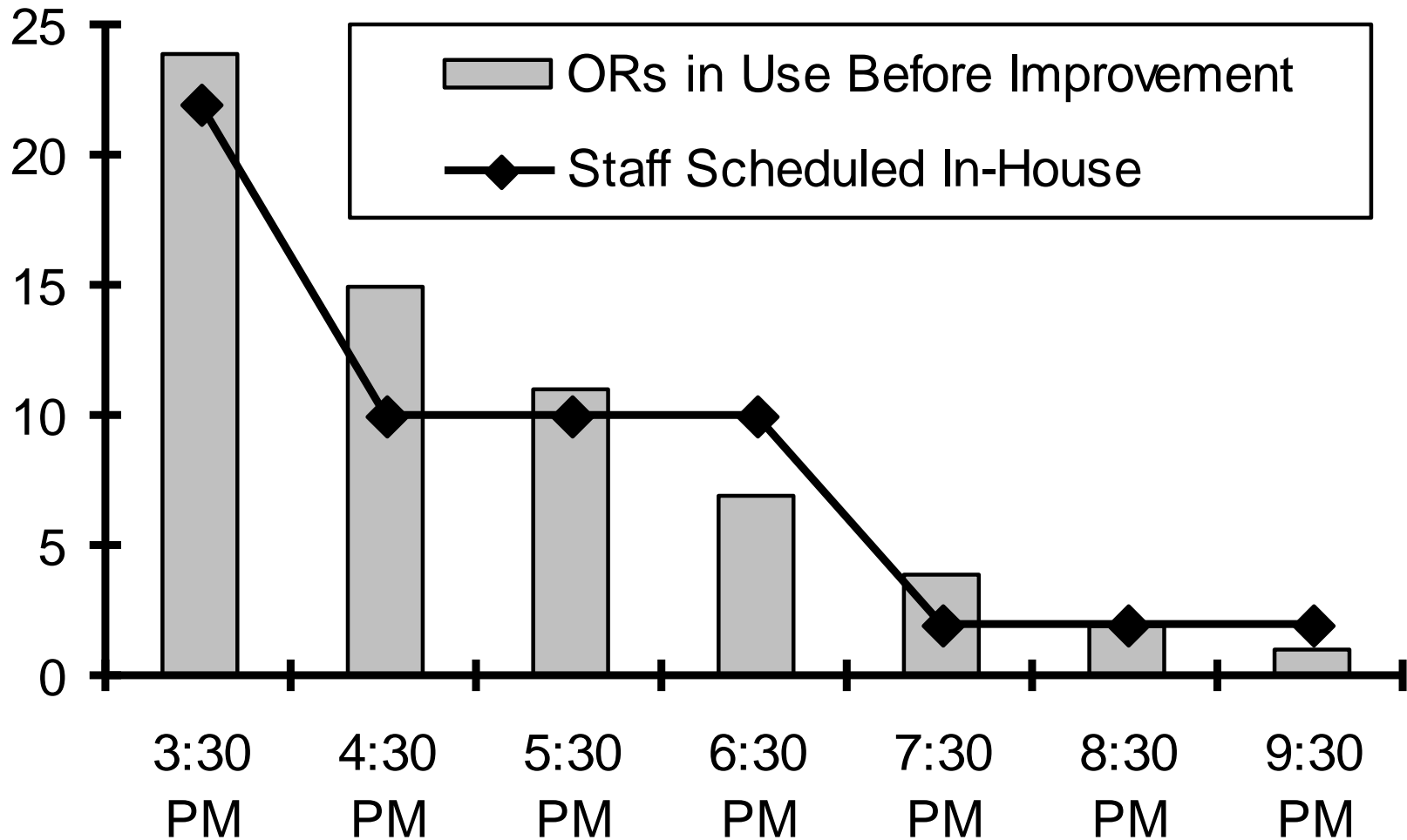


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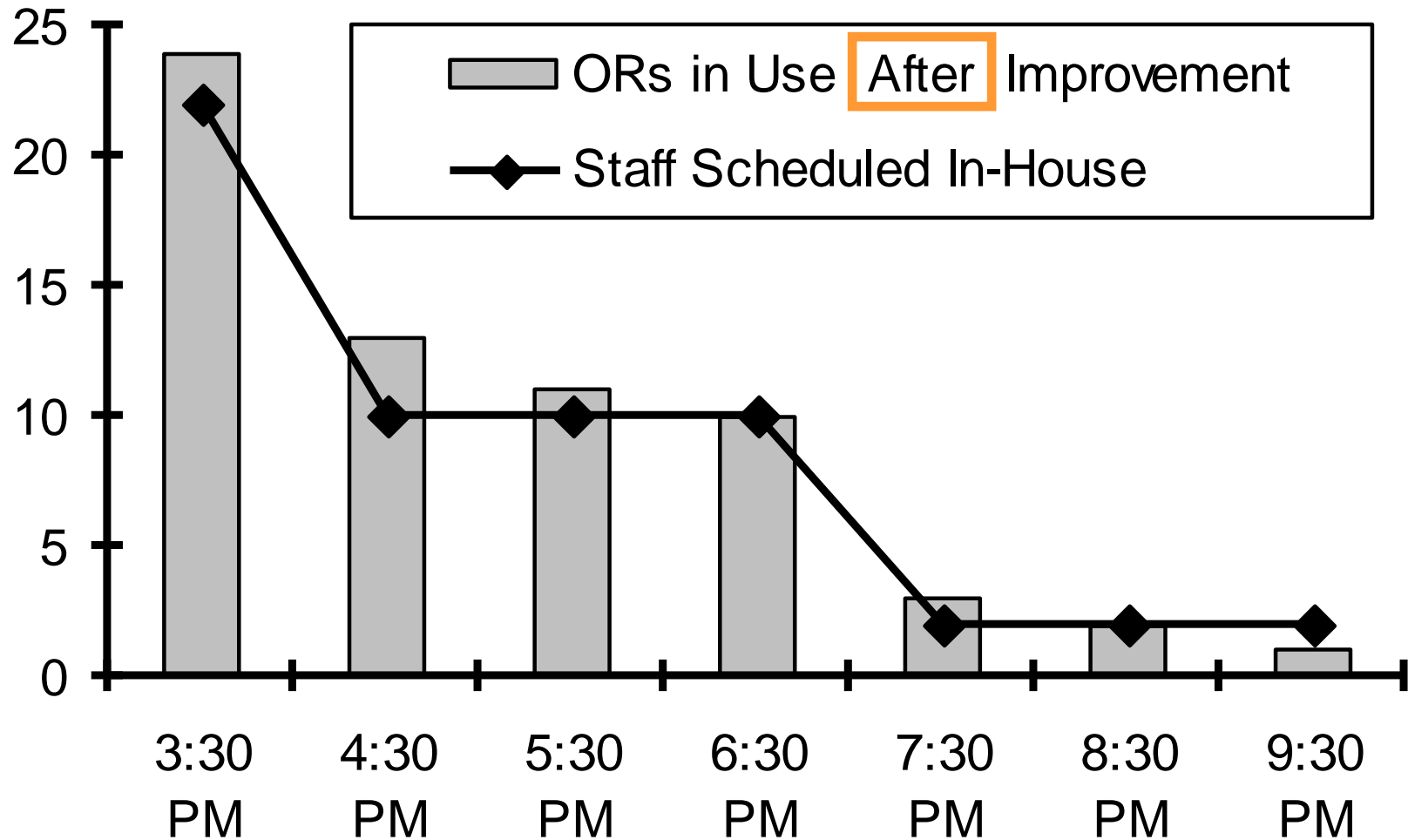
- Smaller (5-10%) reductions in costs when no change to numbers of ORs (first case of the day starts), just planned hours for each OR
  - Example with 8 hr, 10 hr, 13 hr staffing
    - Subsequent slides



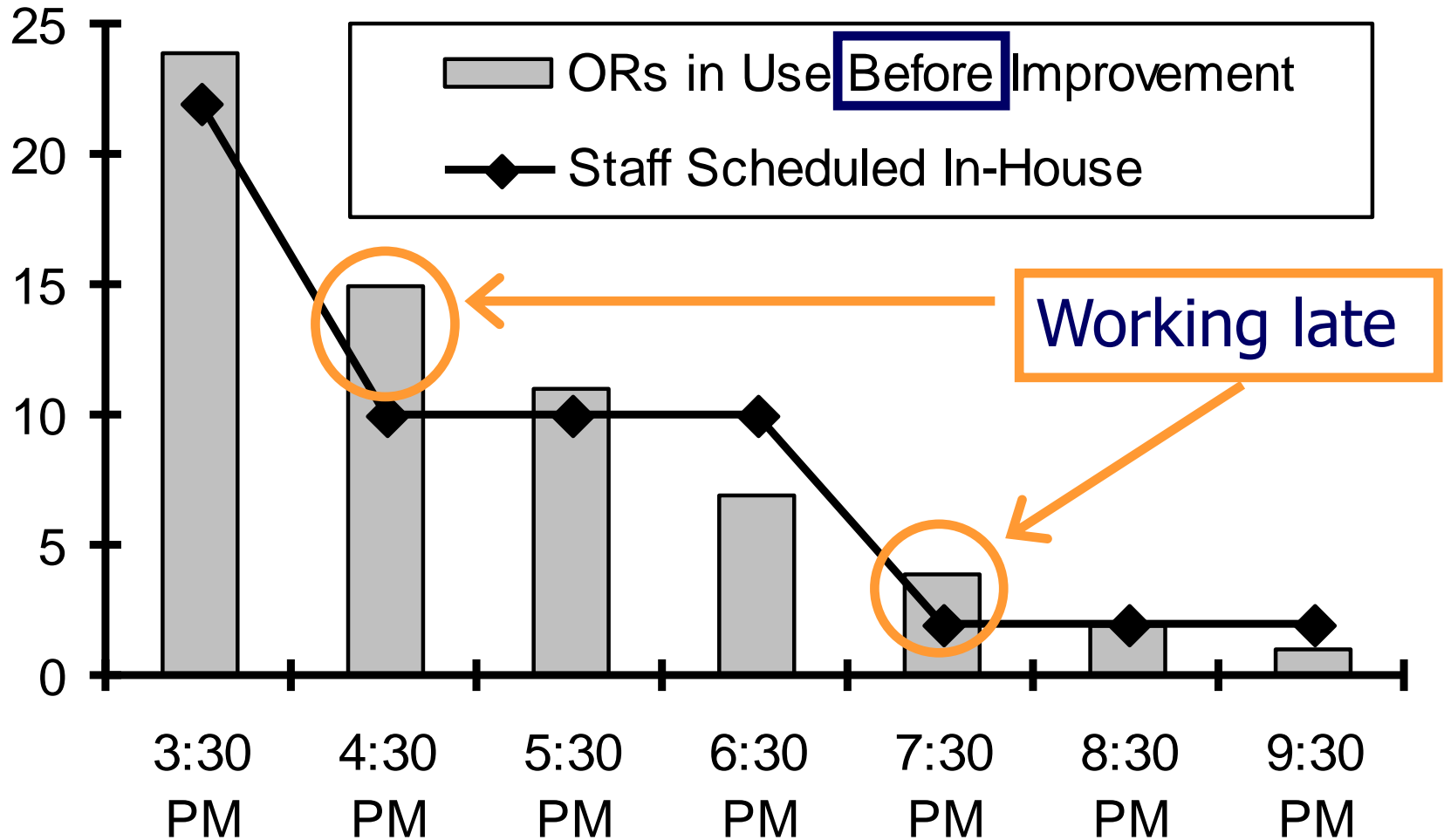
# Example of Small Reduction in Costs from Change Allocations



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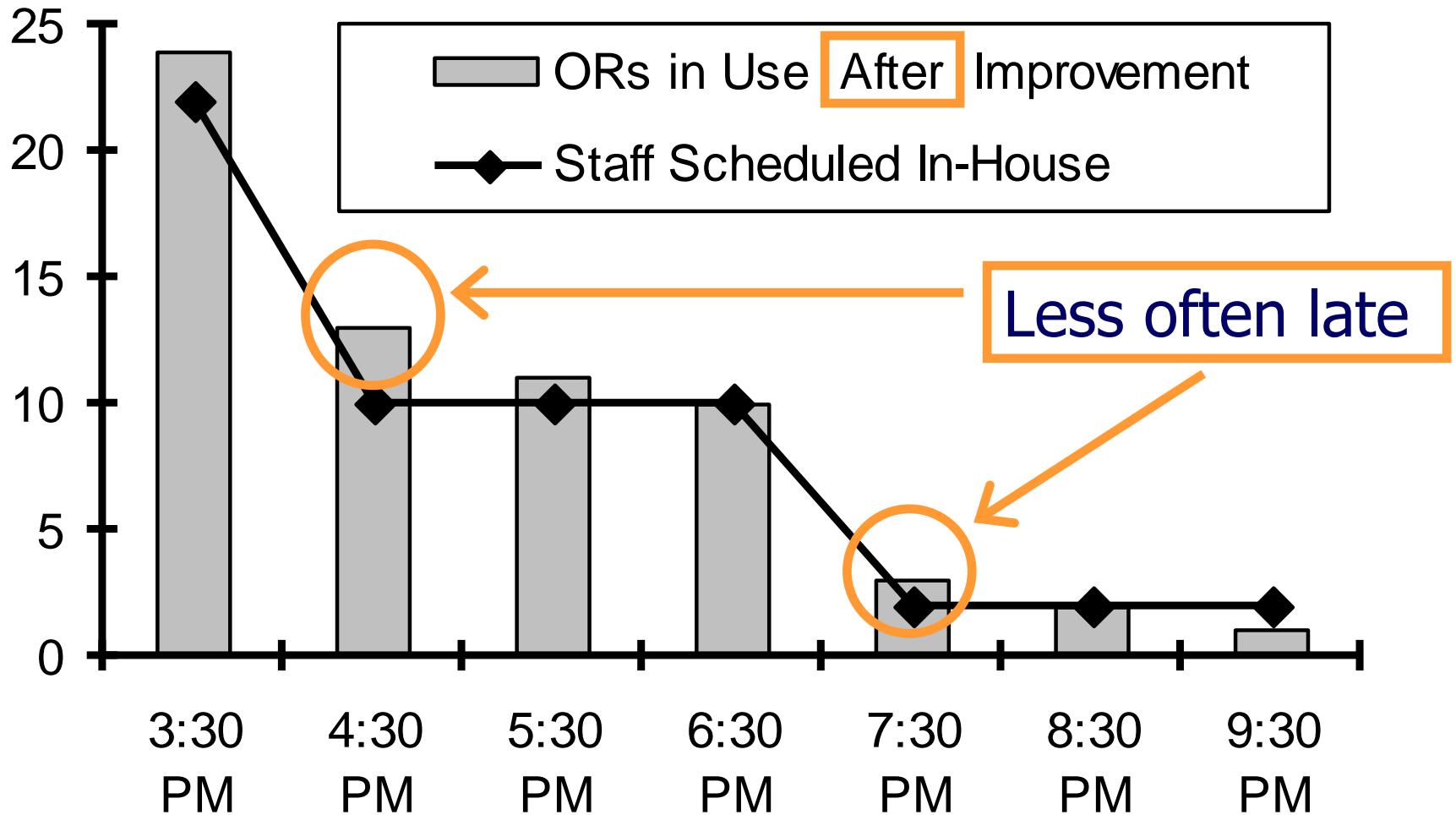


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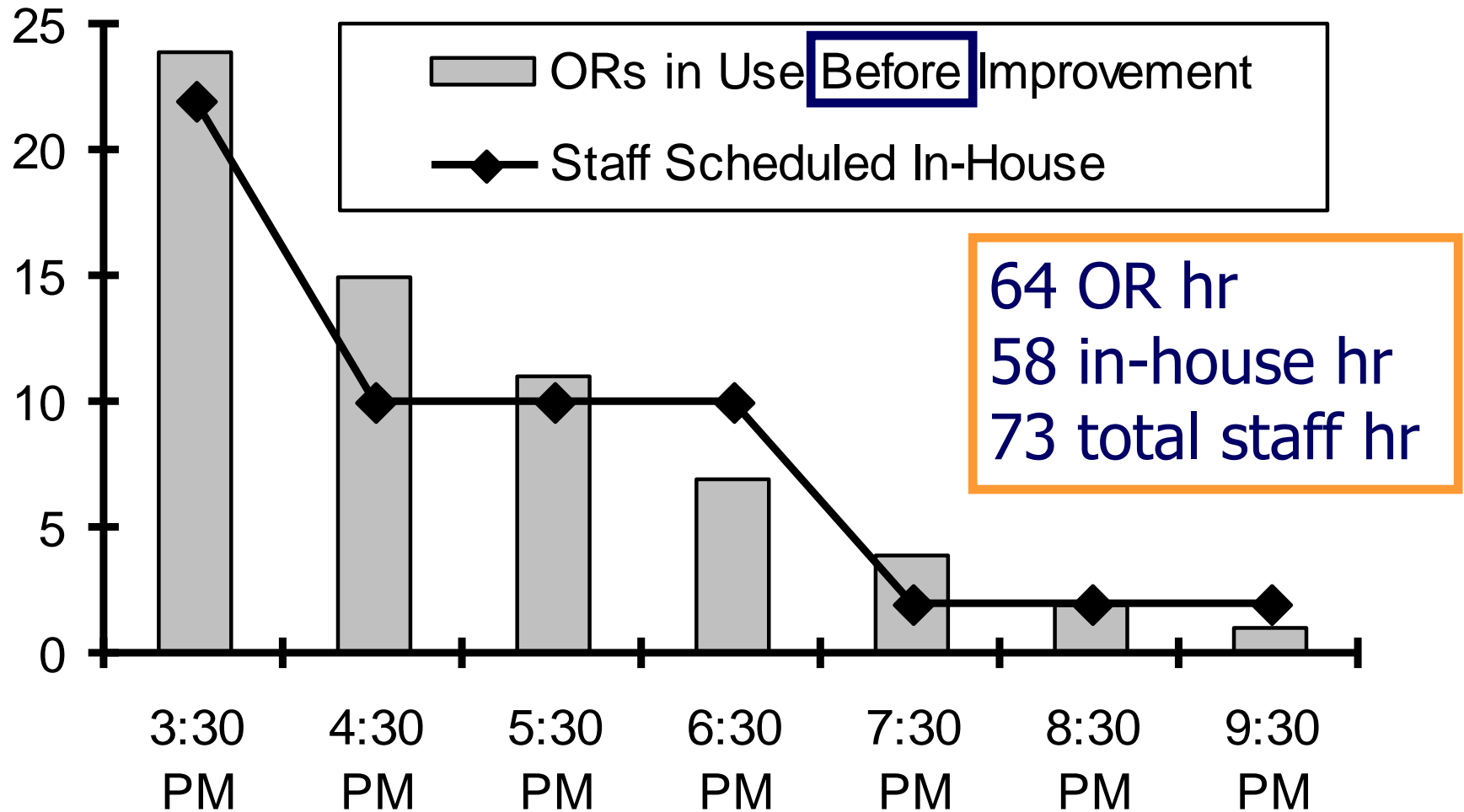




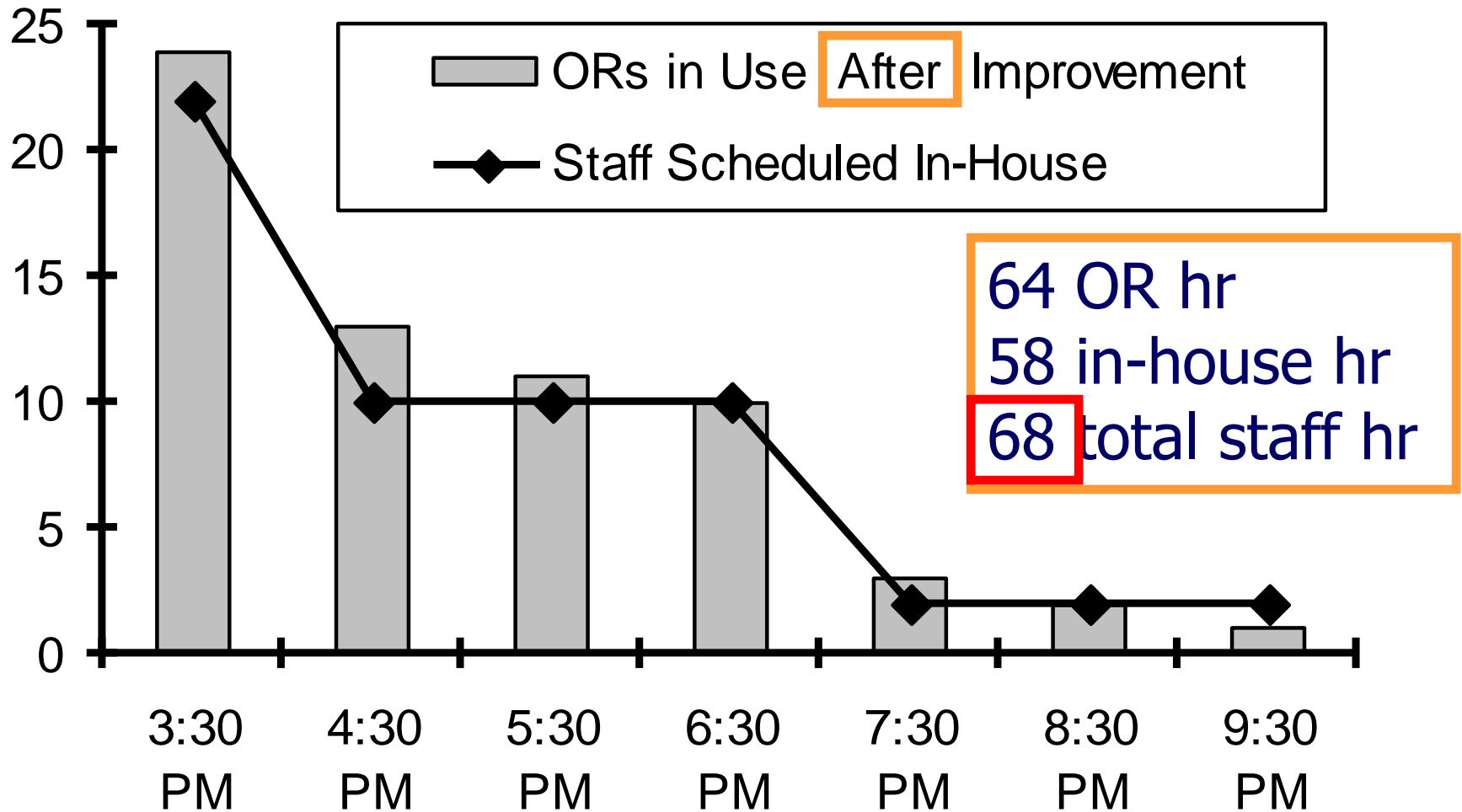
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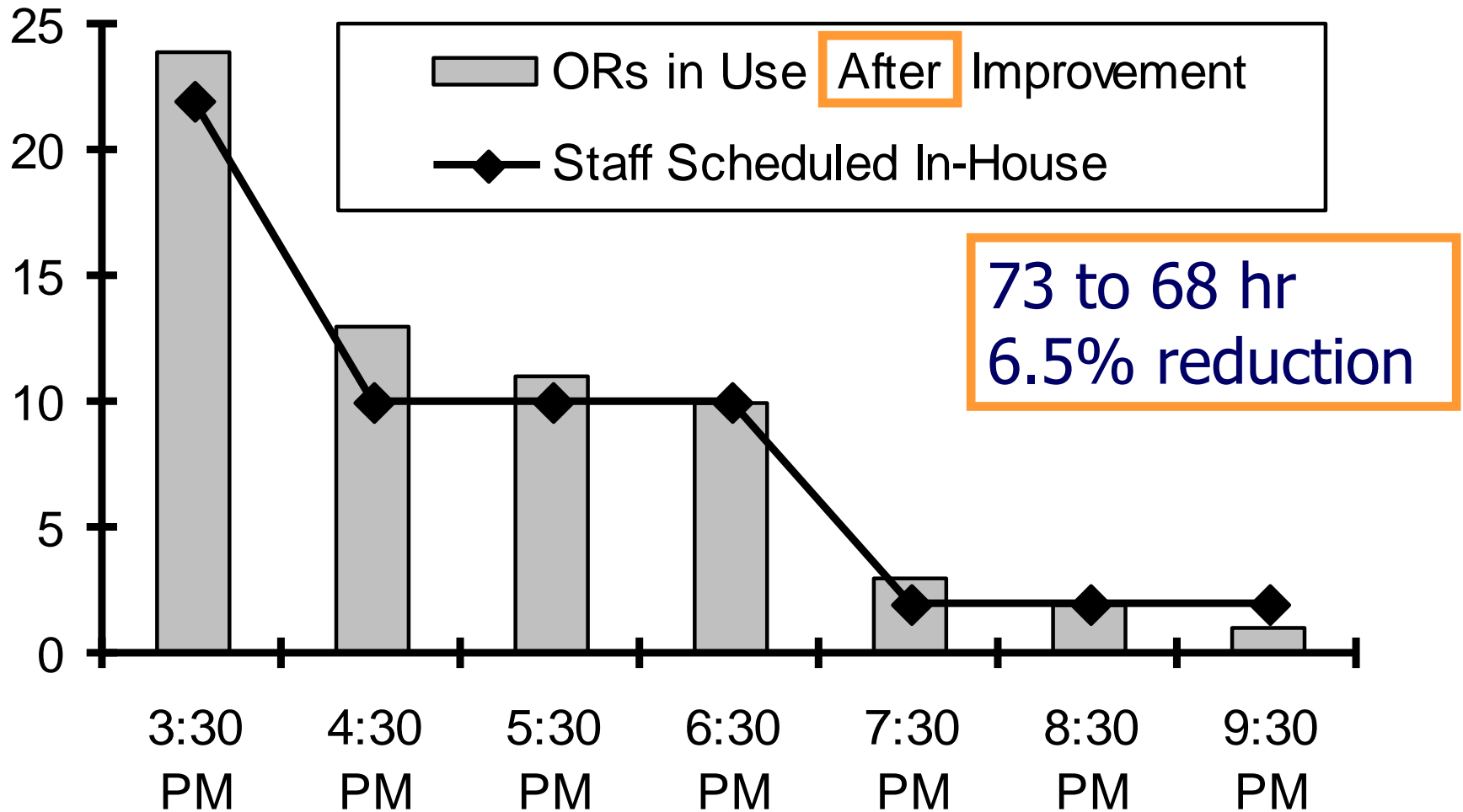
# Example of Small Reduction in Costs from Change Allocations



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# Staffing to Finish On-Time, ↑ Productivity, and ↓ Costs

- Definitions of productivity and staffing costs
- Afternoon staffing to maximize productivity
- Other approaches for improving afternoons
  - Provide information to group members
  - Change day of surgery decision making
  - Change OR allocations and case scheduling
  - Adjust non-operating room responsibilities



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# Typical Scenario of Finishing Early and Low Productivity

- Hospital employs two anesthesiologists and five nurse anesthetists to run 4 ORs
- Most ORs are finished by 1:30 PM
- Benchmarking shows low productivity
  - Based on ASA RVG units per OR per day
  - Based on ASA RVG units per \$ staffing cost
- CEO wants this “anesthesia problem” fixed
  - But, no change to OR nursing or surgeons



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Dexter F, Wachtel RE. Anesth Analg 2014



# Increase Productivity Numerator with Unscheduled Activities

- Since times that ORs finish are unpredictable, increasing productivity by doing more clinical work is doubtful
- Add non-clinical anesthesia activities to the numerator of productivity
  - Salaried anesthesia providers are essentially high-priced professional hospital employees
  - Professionals play many roles in organization

Dexter F, Wachtel RE. Anesth Analg 2014



# Valued Activities That Can Be Done with Unscheduled Time

- Learn anesthesia billing
  - Teach others in the group what they can do each day to increase resulting collections



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Dexter F, Epstein RH. Anesth Analg 2015



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Epstein RH, Dexter F. Anesth Analg 2015

Schulte TE et al. J Clin Anesth 2016



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- Become local expert and champion in applying the science of OR management
  - Start by focusing 0 to 2 workdays ahead
- Lead perioperative quality improvement
  - Clinical pathways and educational materials to improve outcomes and/or reduce costs (e.g., fewer prolonged extubations)

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- Preanesthesia management including appropriate consultations and testing
- Post-anesthesia care unit medical director
- Telecommunication devices for use in ORs
- Advising and teaching surgical leadership on principles in use of block time





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- Post-anesthesia care unit medical director
- Telecommunication devices for use in ORs
- Advising and teaching surgical leadership on principles in use of block time
- Anesthesia information management system informatics including use for coordinating managerial decisions on day of surgery



# Review – Summarize the Facts of the Talk



# For Which Would Hospital Gain in Requesting to be Done?



# For Which Would Hospital Gain in Requesting to be Done?

1. Definitions of productivity and staffing costs
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3. Provide information to group members
4. Change day of surgery decision making
5. Change OR allocations and case scheduling
6. Adjust non-operating room responsibilities



# Additional Information on Operating Room Management

- [www.FranklinDexter.net/education.htm](http://www.FranklinDexter.net/education.htm)
  - Example reports with calculations
  - Lectures on drug and supply costs, PACU staffing, OR allocation and staffing, weekend and holiday staffing, financial and capacity planning, and strategic decision making
- [www.FranklinDexter.net](http://www.FranklinDexter.net)
  - Comprehensive bibliography of peer reviewed articles in operating room and anesthesia group management