Anesthesiologist and Nurse Anesthetist Afternoon Staffing

- This talk includes many similar slides
  - Paging through produces animation
  - View with Adobe Reader for **mobile**: iPad, iPhone, Android
- Slides were tested using Adobe Acrobat
  - You can select View and then Full Screen
    - First optimize your settings
    - Select Edit, then Preferences, then Full Screen, and then No Transition
- Other PDF readers suitable if scrolling can be disabled
  - Google Chrome PDF Viewer has Select Fit to Page, and then use the right/left arrow keys

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Anesthesiologist and Nurse Anesthetist Afternoon Staffing

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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

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

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)

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Understand Staffing versus Staff Scheduling & Assignment

- Staffing
- Staff scheduling
- Assignment

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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

Understand Staffing versus Staff Scheduling & Assignment

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- Staffing
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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

Understand Staffing versus Staff Scheduling & Assignment

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Understand Staffing versus Staff Scheduling & Assignment

- Staffing
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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

- **Staffing** → Anesthesia Group Productivity
- Staff scheduling
- Assignment ⇢ 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)

(Costs to provide the anesthesia care)

Three different types of costs

Definition of Anesthesia Group Productivity

$$\frac{\text{(ASA RVG units of anesthesia care)}}{\text{(Direct + Indirect + Opportunity)}}$$

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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 ≅ $2,100,000 per year

  $2,100,000 = 12 × $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. ≅ $35,000 per hire
- Indirect costs ≅ $240,000 per year

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

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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 ≅ $6,000,000 per year

  $6,000,000 = 20 × $300,000

Equation Applies Broadly Since Both Direct & Opportunity Costs

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Value of the Numerator for Afternoon and Evening

$$\frac{\text{(ASA RVG units of anesthesia care)}}{\text{(Direct + Indirect + Opportunity)}} \equiv \text{Constant}$$

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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    - ➢ Costs are in the denominator, not in the numerator

Value of the Denominator for Afternoon and Evening

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  - Scheduled hours
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  - $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

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To Maximize Afternoon and Evening Staffing Productivity

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= Constant

To Maximize Afternoon and Evening Staffing Productivity

Maximize the following ratio:

$$\frac{\text{(ASA RVG units of anesthesia care)}}{\text{(Scheduled hours + \{relative cost of 1 hour worked late to 1 scheduled hour\} } \times \text{ Hours worked late)}}$$

= Constant

To Maximize Afternoon and Evening Staffing Productivity

Minimize costs in denominator:

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:

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{relative cost of 1 hour worked late to 1 scheduled hour} $\times$

Hours worked late

Dexter F, Traub RD. AANA J 2000

Dexter F et al. Anesth Analg 2001

Dexter F, Epstein RH. AORN J 2003

} Some references for this material

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Steps Performed Independently for Each Sub-specialty Call

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

Steps Performed Independently for Each Sub-specialty Call

- Example from academic hospital
  - For CRNA 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

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- ➢ Calculate the number of simultaneous anesthetics for each hour of each day

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➢ Repeat process for other times of the day

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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 +

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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 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
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    - 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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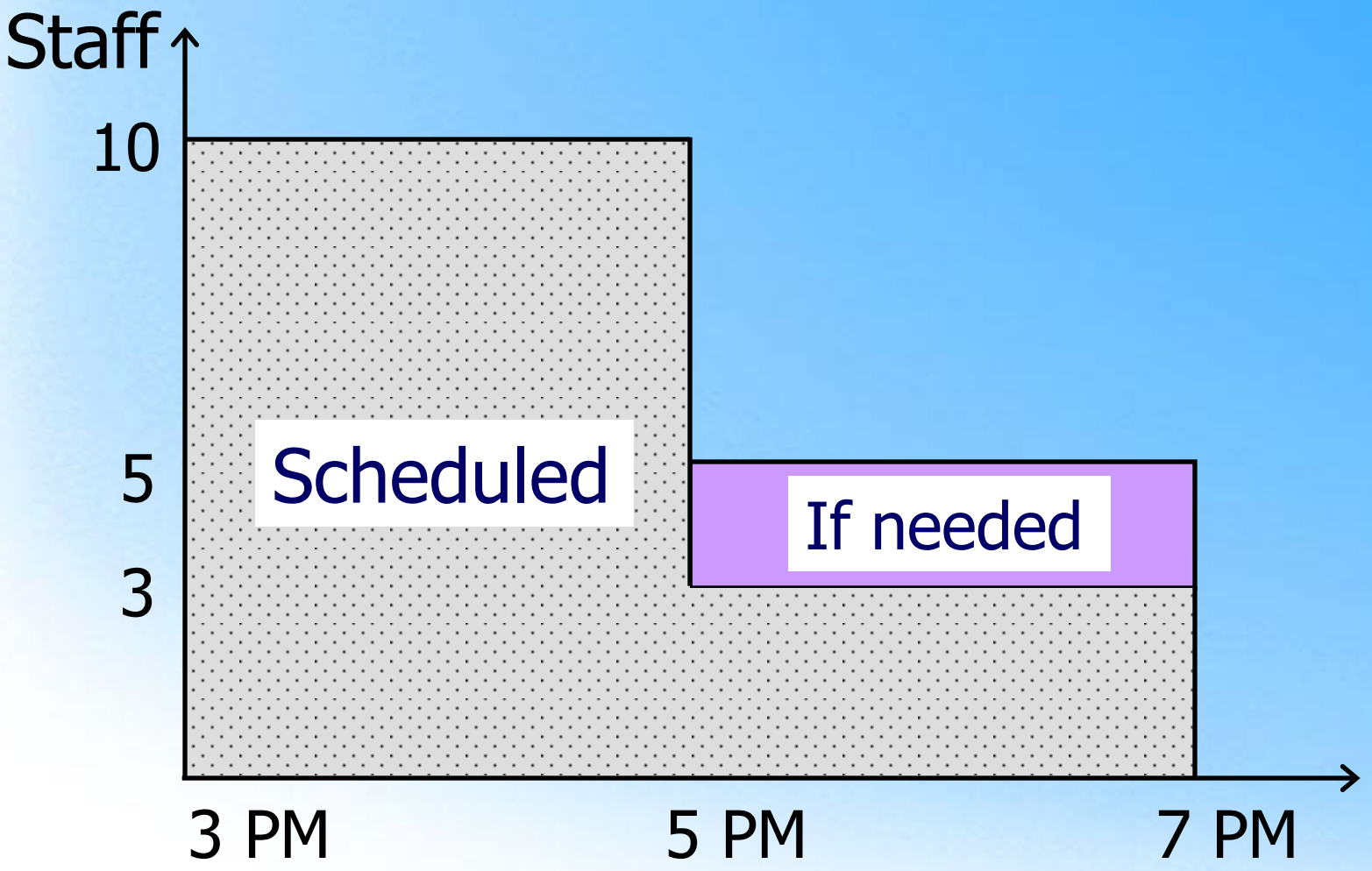

Example of Applying Different Relative Costs to 5 PM – 7 PM

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- 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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➢ 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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- How to convert this into a staffing plan
  - 7 AM to 3 PM, 12 providers, 12 = 22 – (6 + 4)
  - 7 AM to 5 PM, 6 providers, 6 = 12 – (4 + 2)
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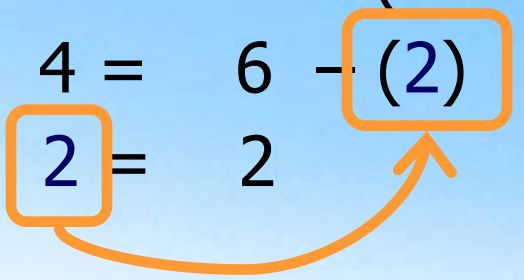

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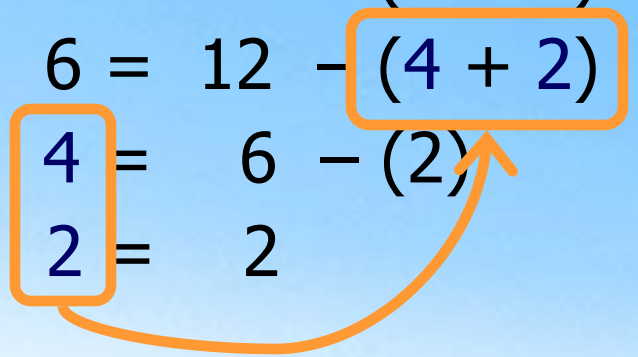

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Staffing Plan Indicates When Group Should Consider Hiring

- 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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    - 3 PM to 11 PM, 2 anesthesiologists

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Extra beyond current staffing

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    - 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

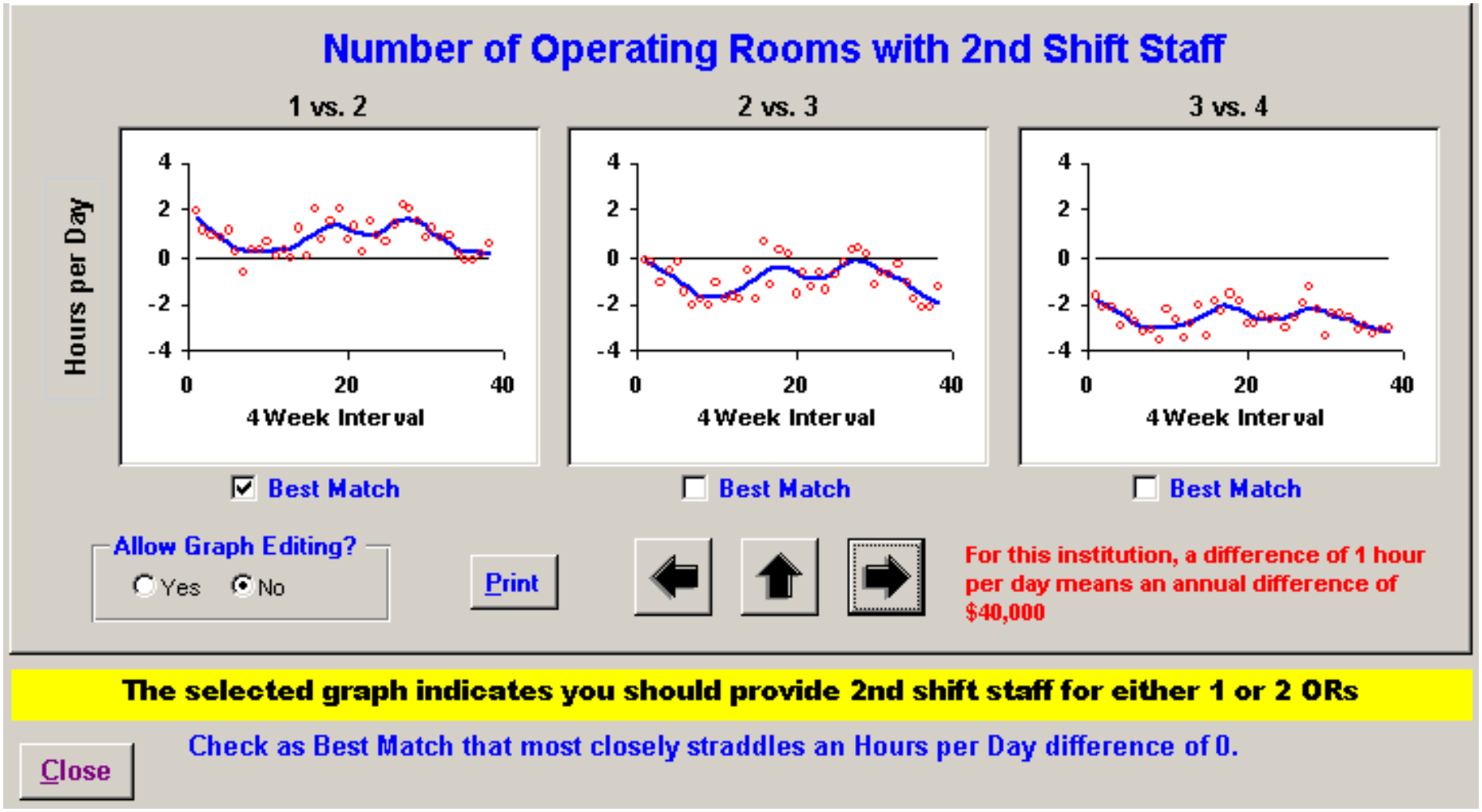
- If use data from anesthesia billing system or electronic anesthesia record
  - Anesthesia start and end date/time
- If use data from OR information system
  - Time of entrance and exit of patient from his or her OR

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



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
  - You do not need to use the product
- Financial disclosure
  - U Iowa provided consultation to the company (MDA Ltd.) as they wrote the software shown
  - MDA Ltd. refers customers to U Iowa

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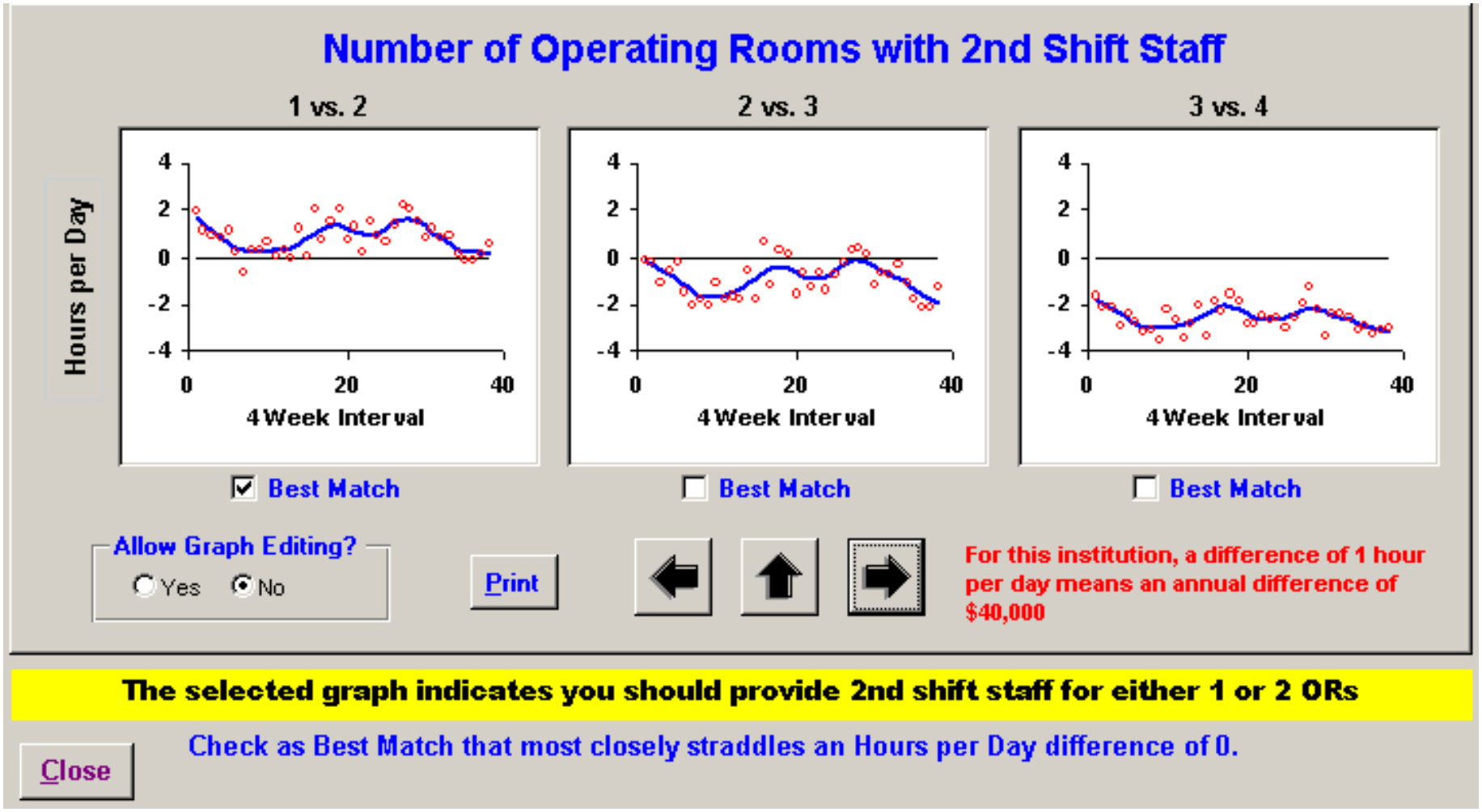
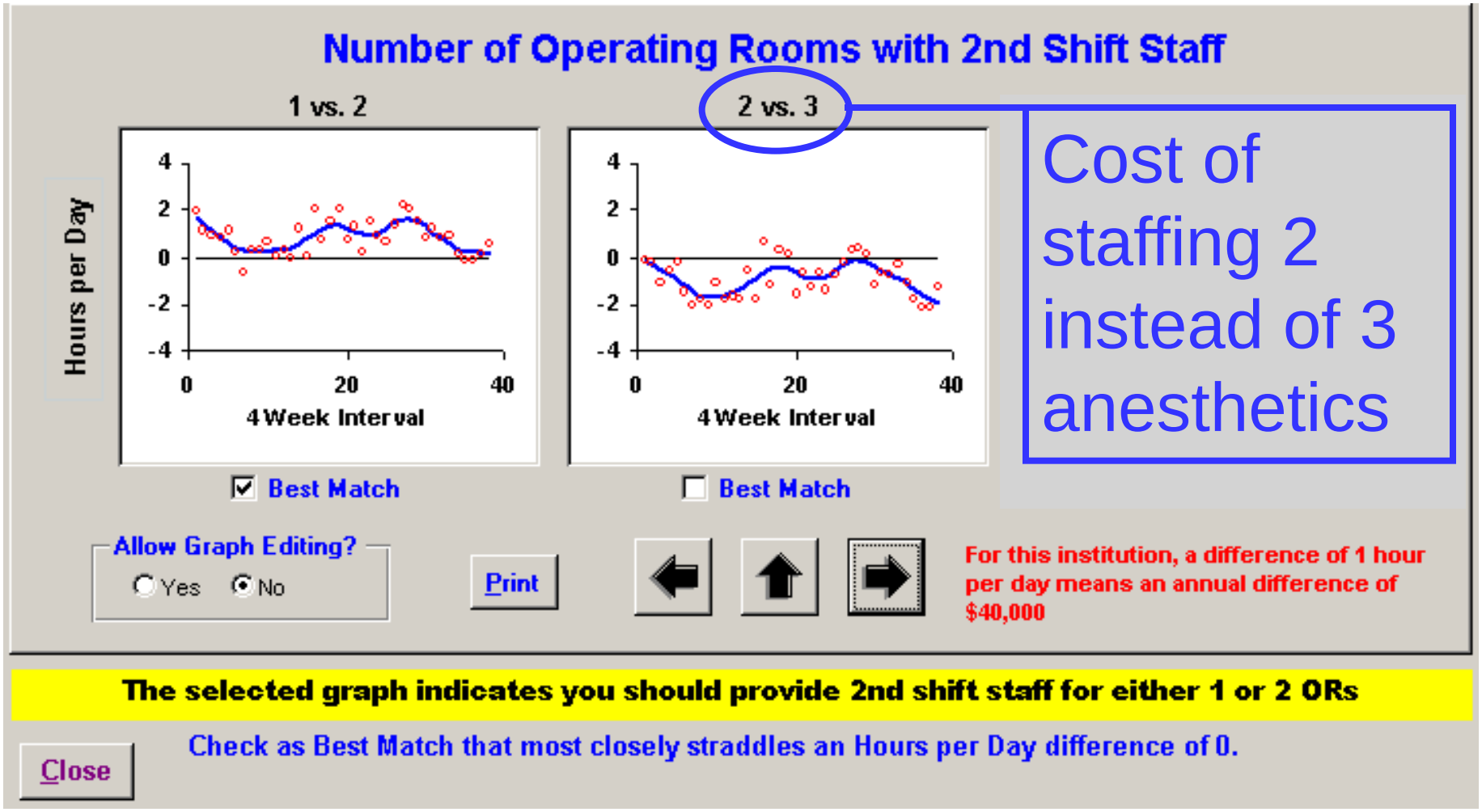
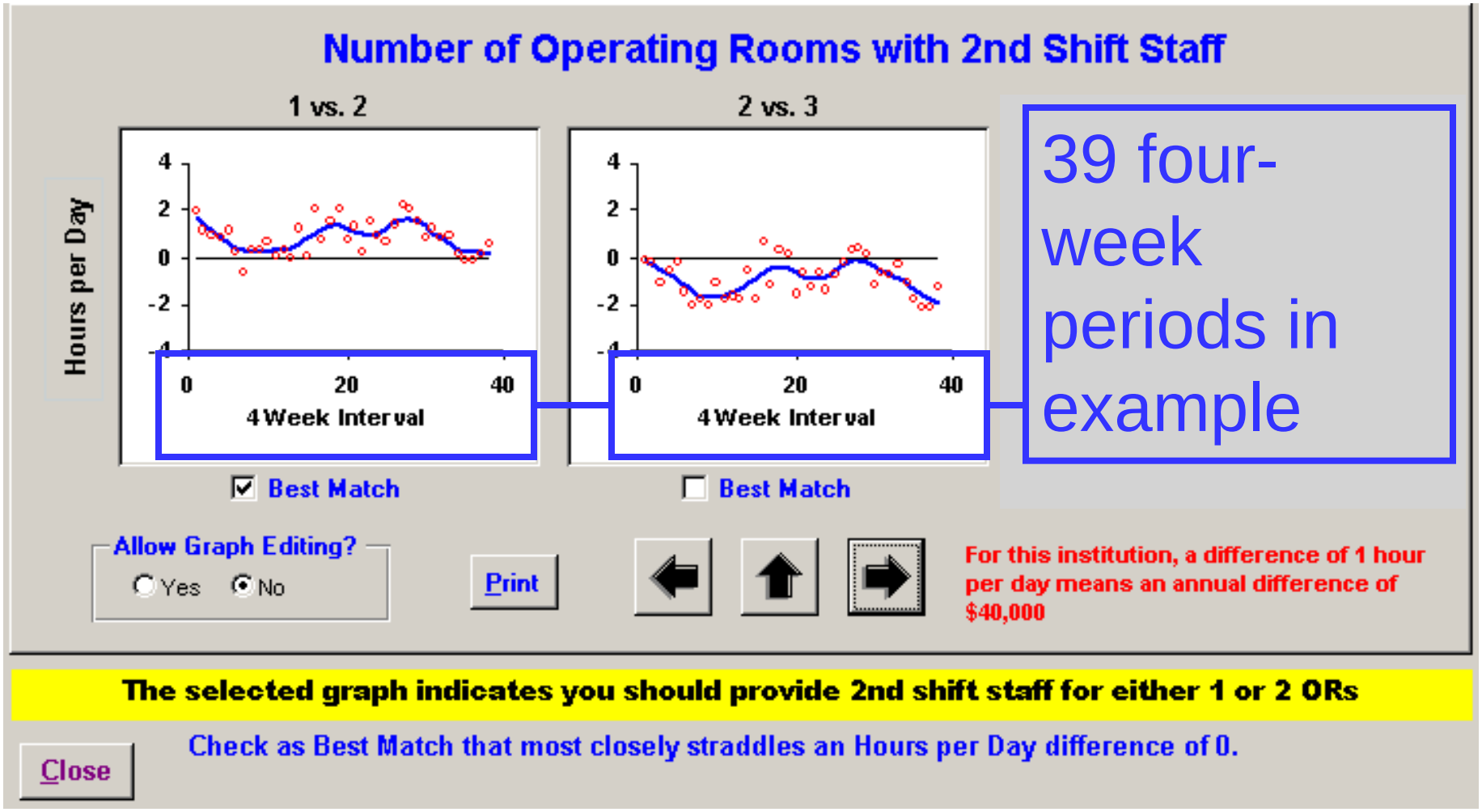


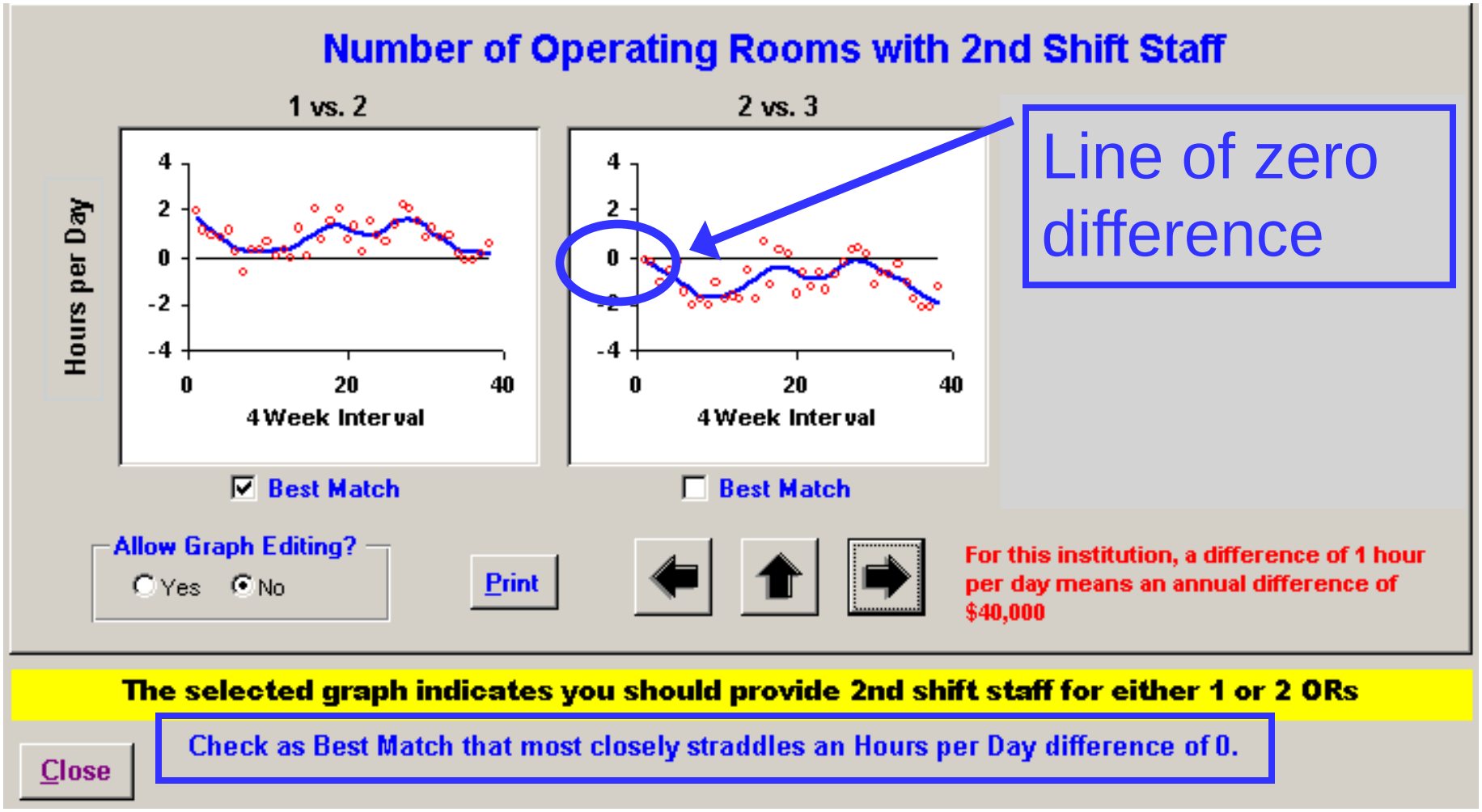
Calculate Each Day's Pair Wise Difference in Staffing Cost



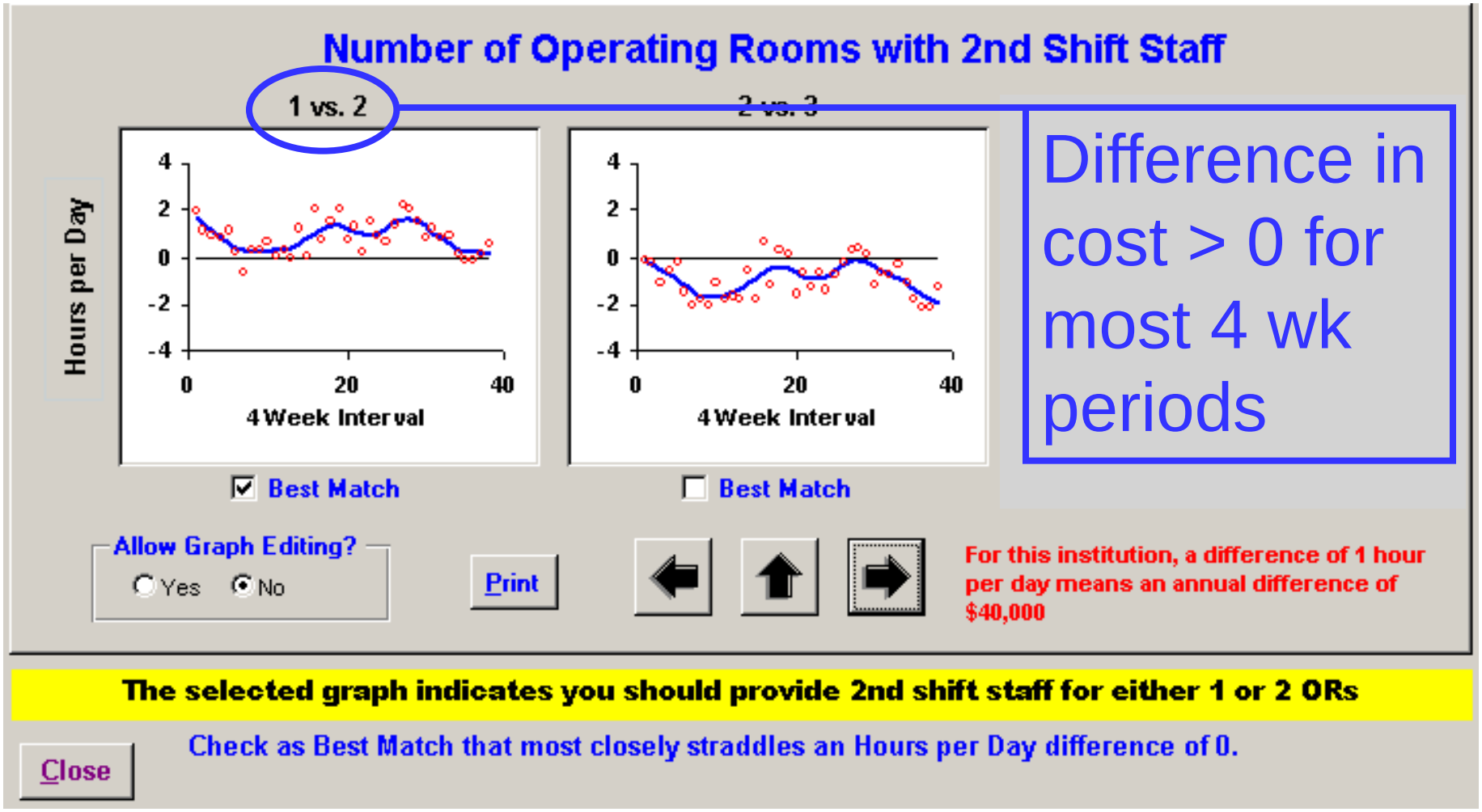
Average Daily Differences Over Successive Four-Week Periods



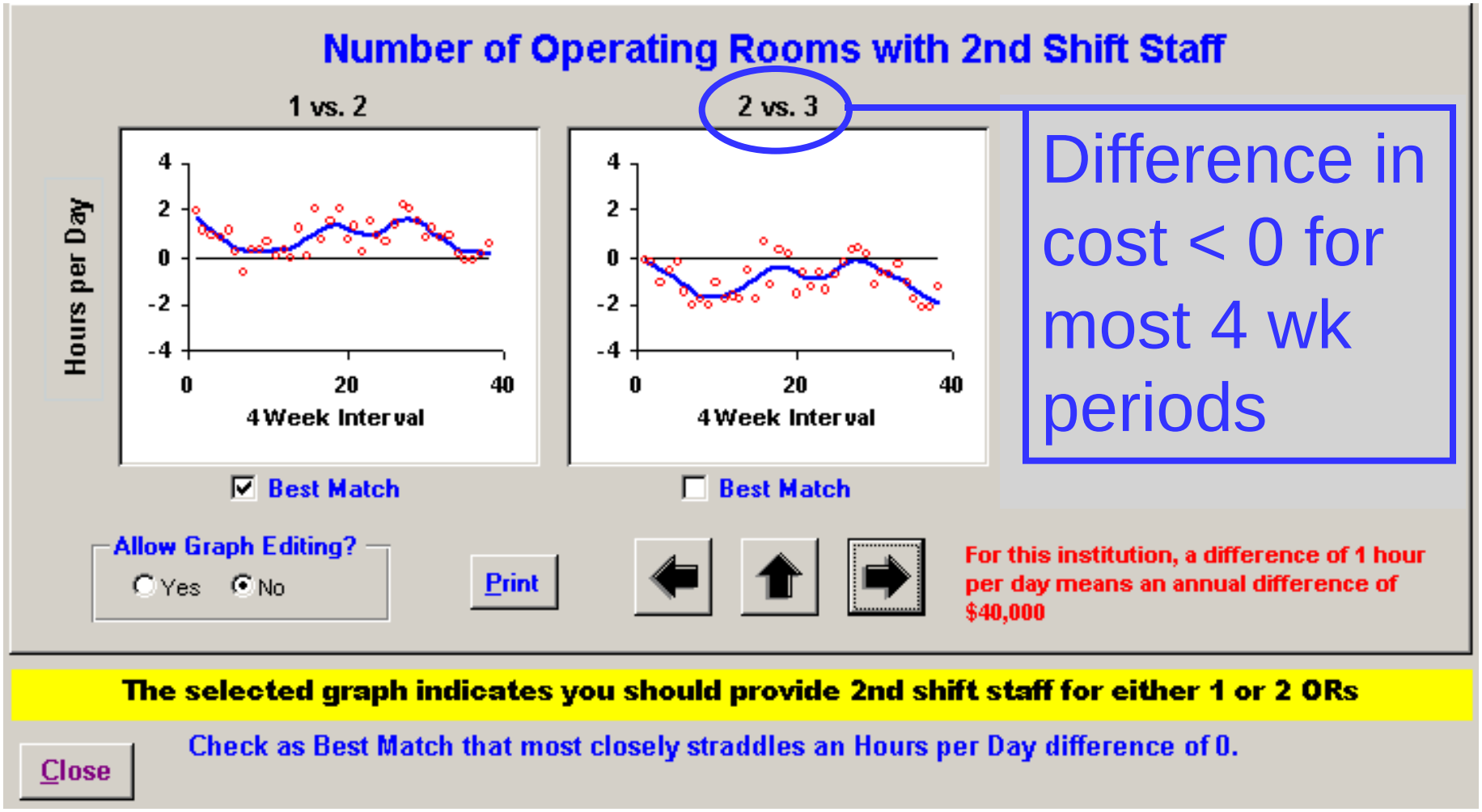
Best Staffing Pair Straddles Line of Zero Difference



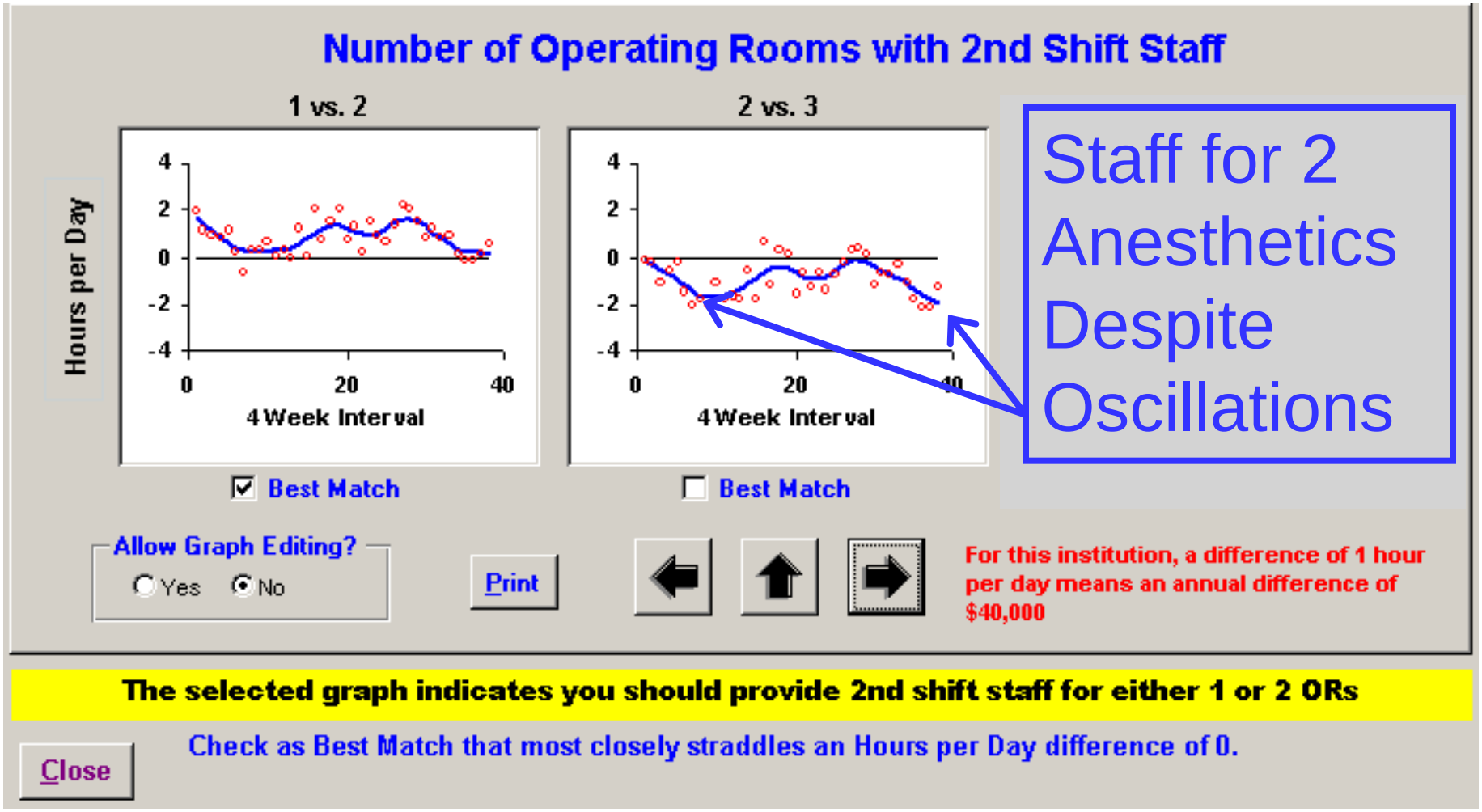
Greater Cost If Staff for One Anesthetic Instead of Two



Greater Cost If Staff For Three Anesthetics Instead of Two



Result of Graphical Analysis For Trends and Seasonality



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?

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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 1st out, 2nd out, 3rd out, …, 9th out, 10th out, and then an 11th 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 ± SD):

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

Scenario – Group Has Shifts By a Different Name

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

Dexter F et al. Anesth Analg 2009

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

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

Provide Information on Work Hours for Different Shifts

- 80^{th} percentiles of earliest times when always running $\leq$ 6 ORs, $\leq$ 4 ORs, and $\leq$ 2 ORs
- Anesthesiologists who had taken these 4^{th}, 3^{rd}, and 2^{nd} 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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Anesthesia and Nursing Change Day of Surgery Decision Making

- Assignment to minimize staffing costs
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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
- When ≥ 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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  - 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

Dexter F et al. Anesthesiology 2004

Summary from the Referenced Review Article

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  - Moving cases from one OR to another
  - Assigning and relieving staff
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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

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- 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

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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

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

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- ➢ 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 × cost of it finishing 1 hour early, then 2/3rd 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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Same Maximum Number of ORs for Each Specialty

- OR nursing has *three* cardiac surgery teams scheduled for the next Monday
- *Two* anesthesiologists with cardiac sub-specialty 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 sub-specialty 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

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➢ No decision overlaps with one to obtain desired numbers of ORs in use at some future time

Dexter F et al. Anesth Analg 2016

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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

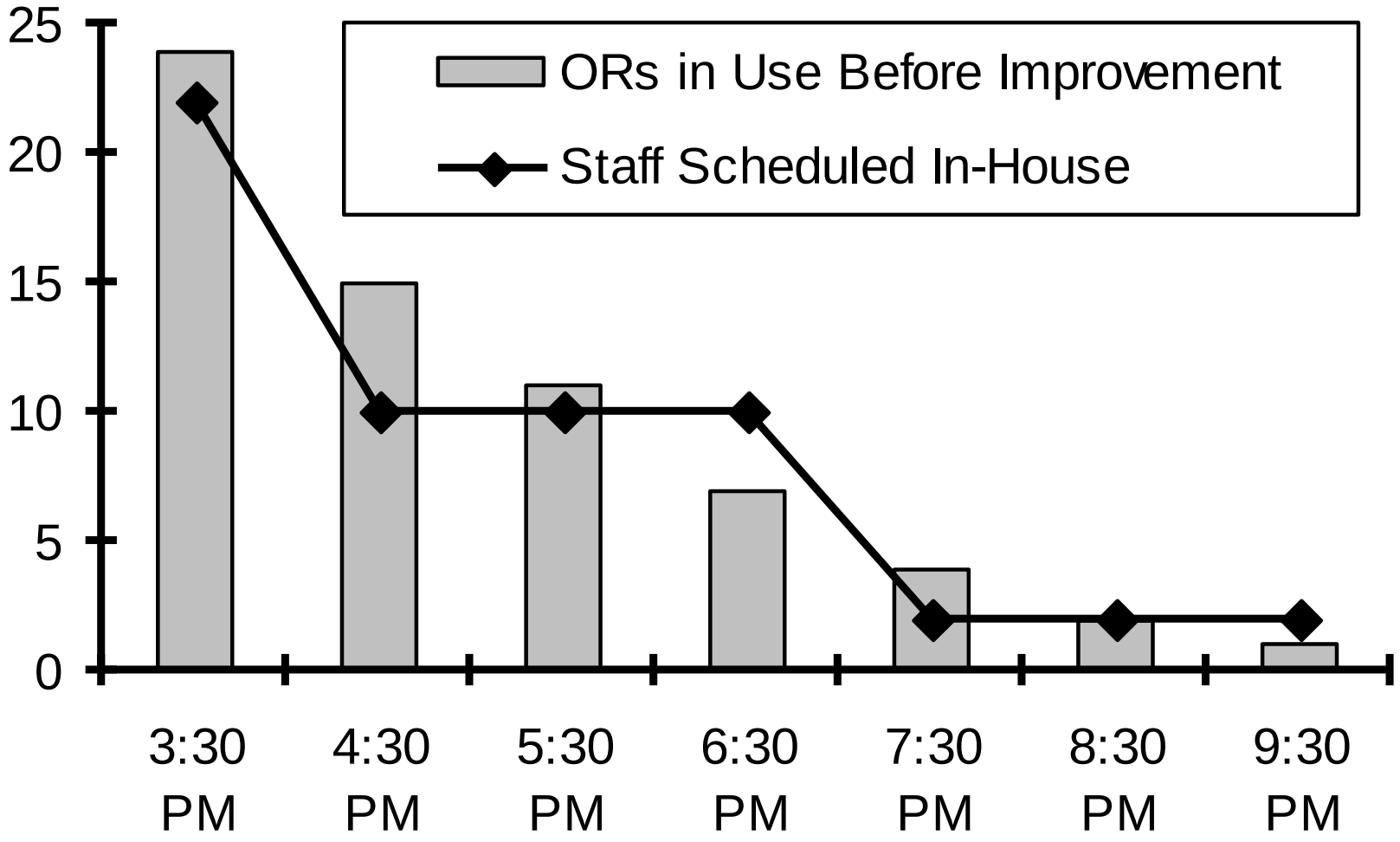
Improving OR Allocations Reduces Anesthesia Costs

- 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

Improving OR Allocations Reduces Anesthesia Costs

- 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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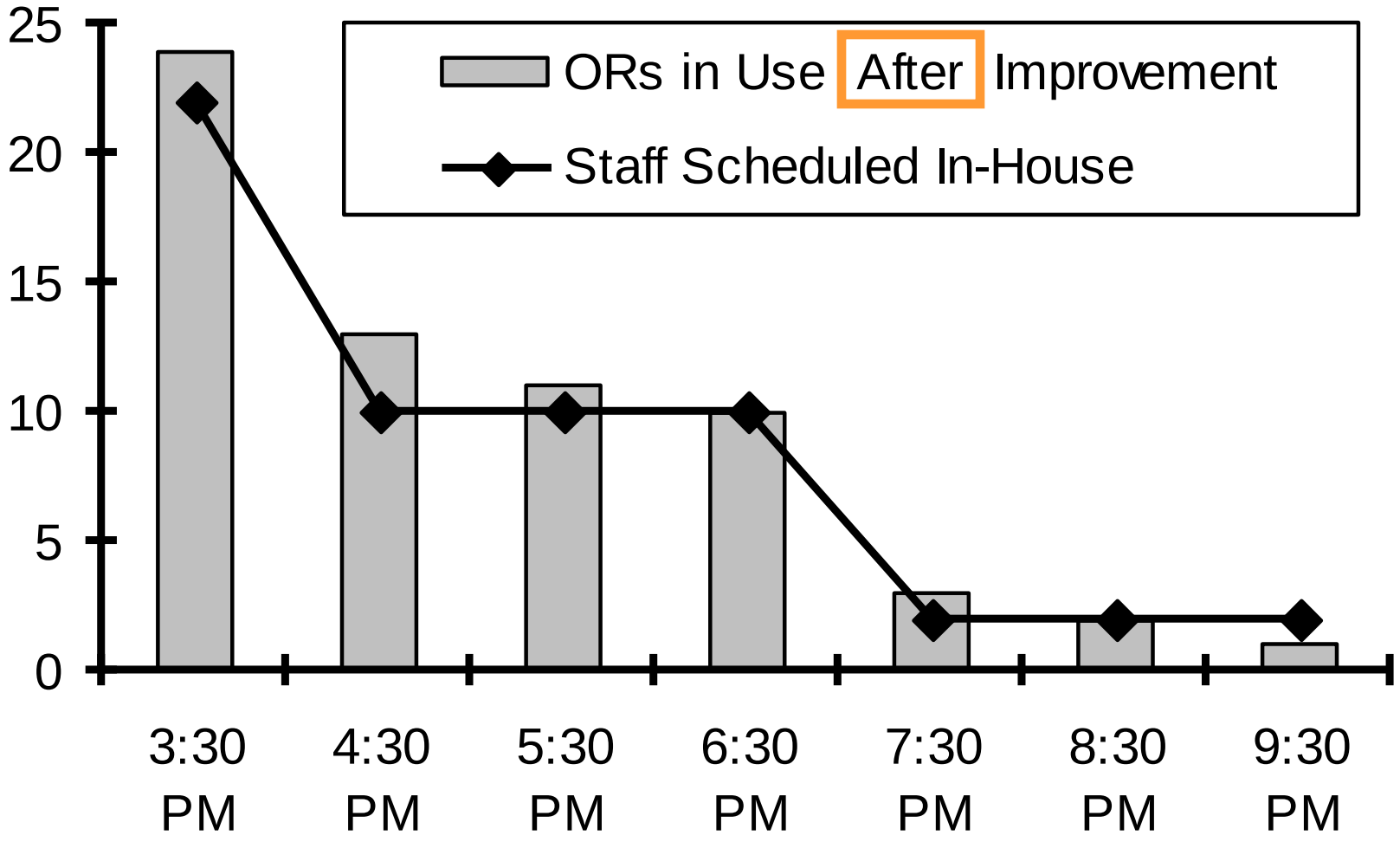

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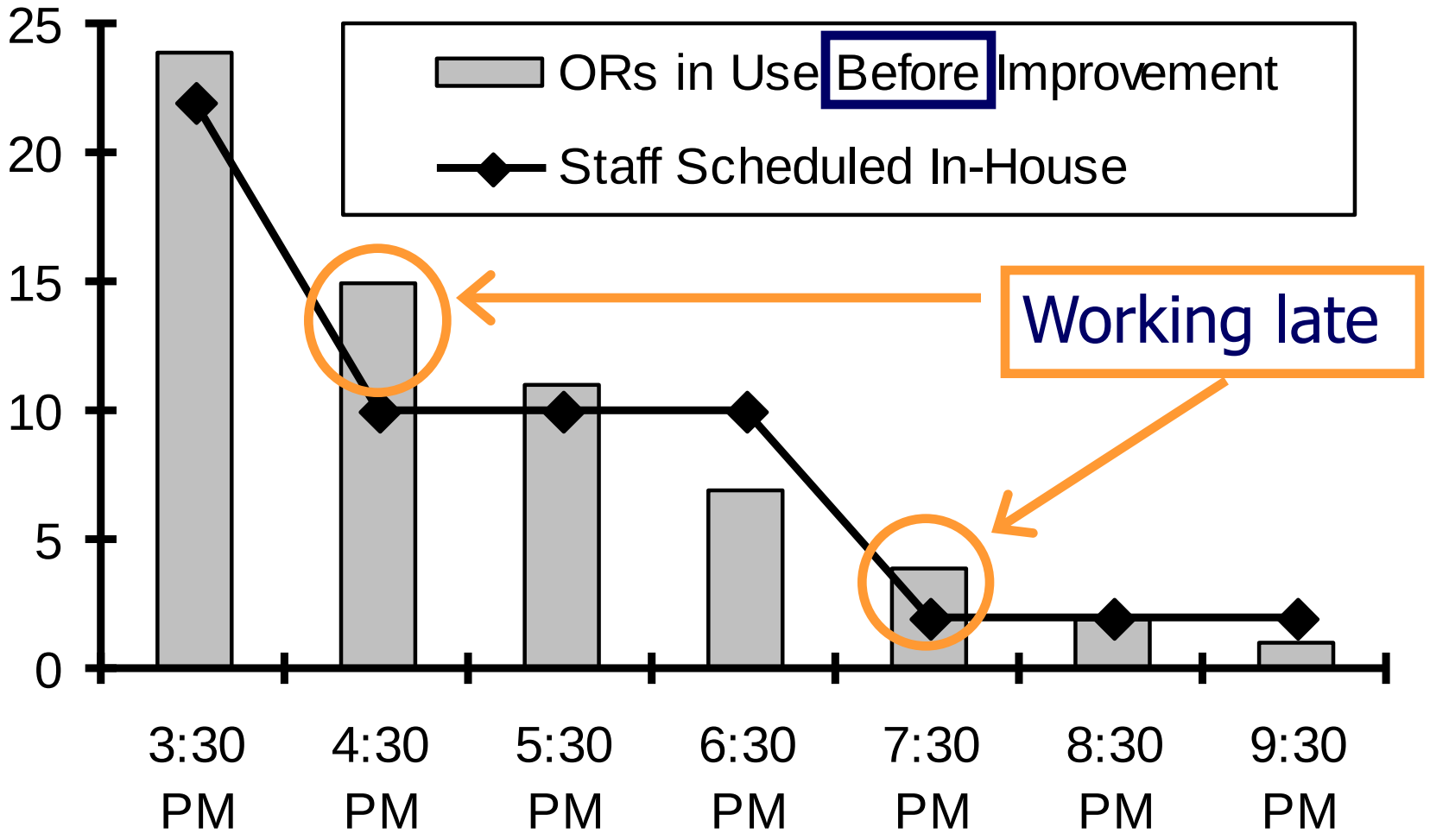

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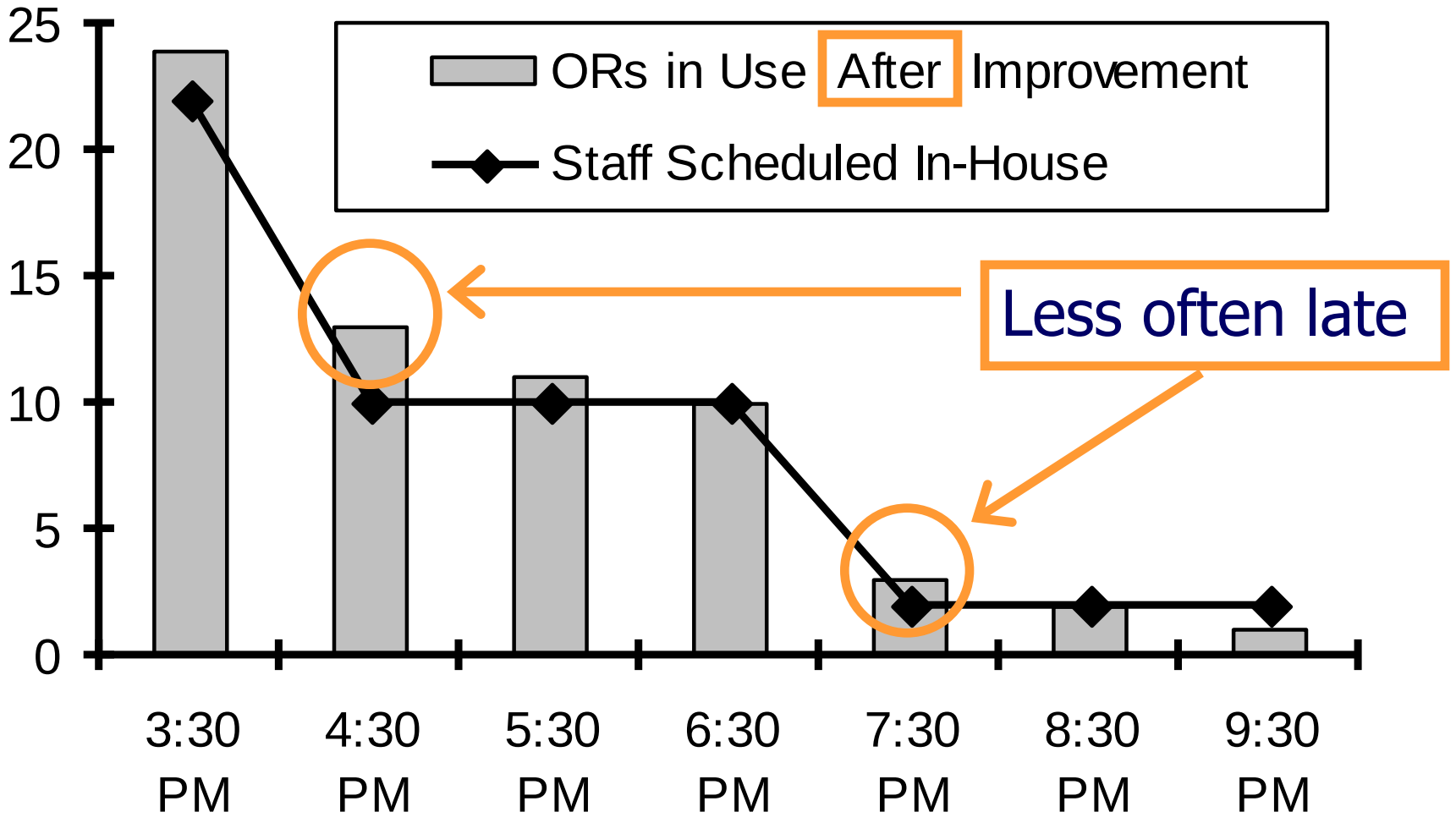

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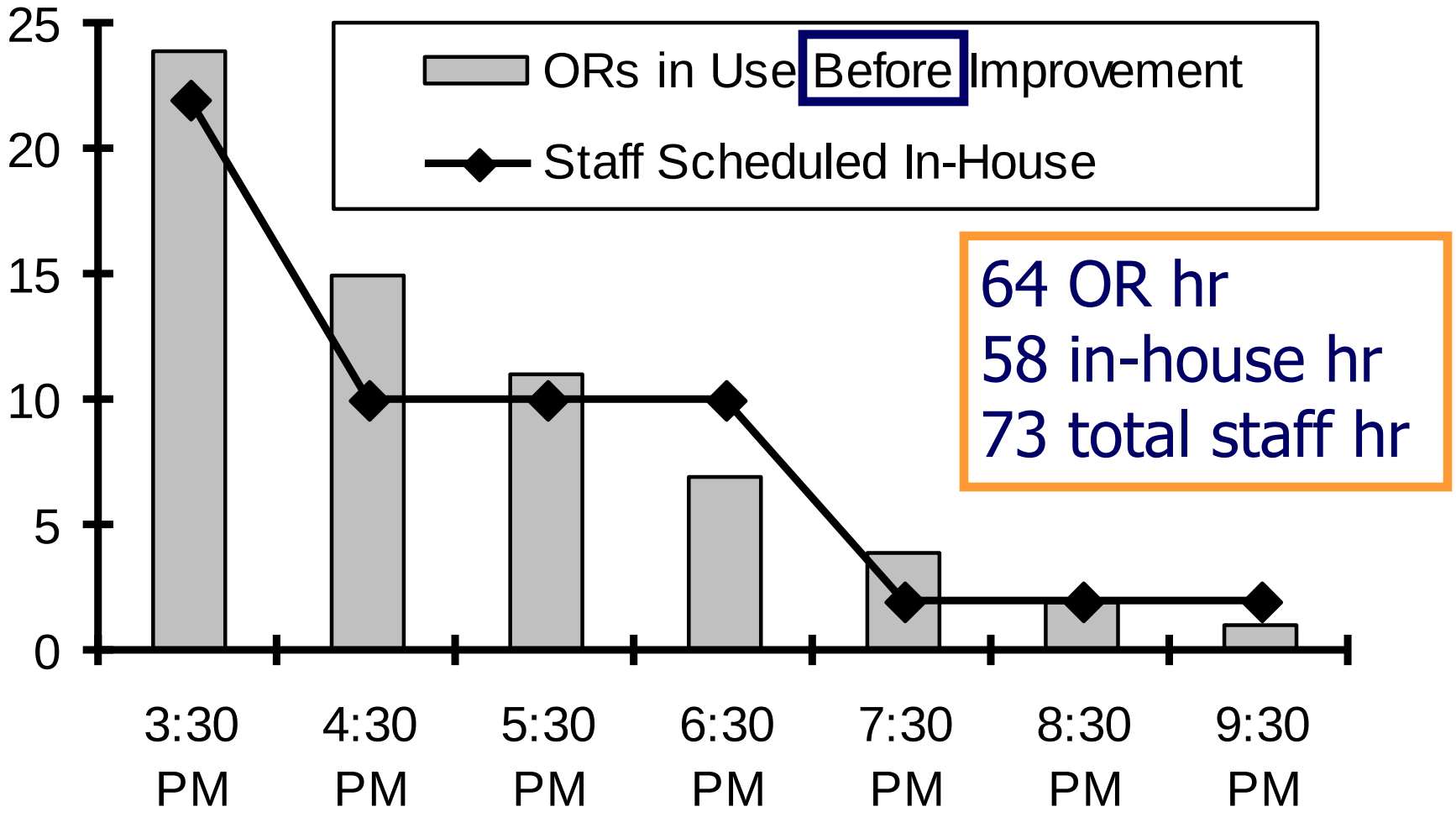

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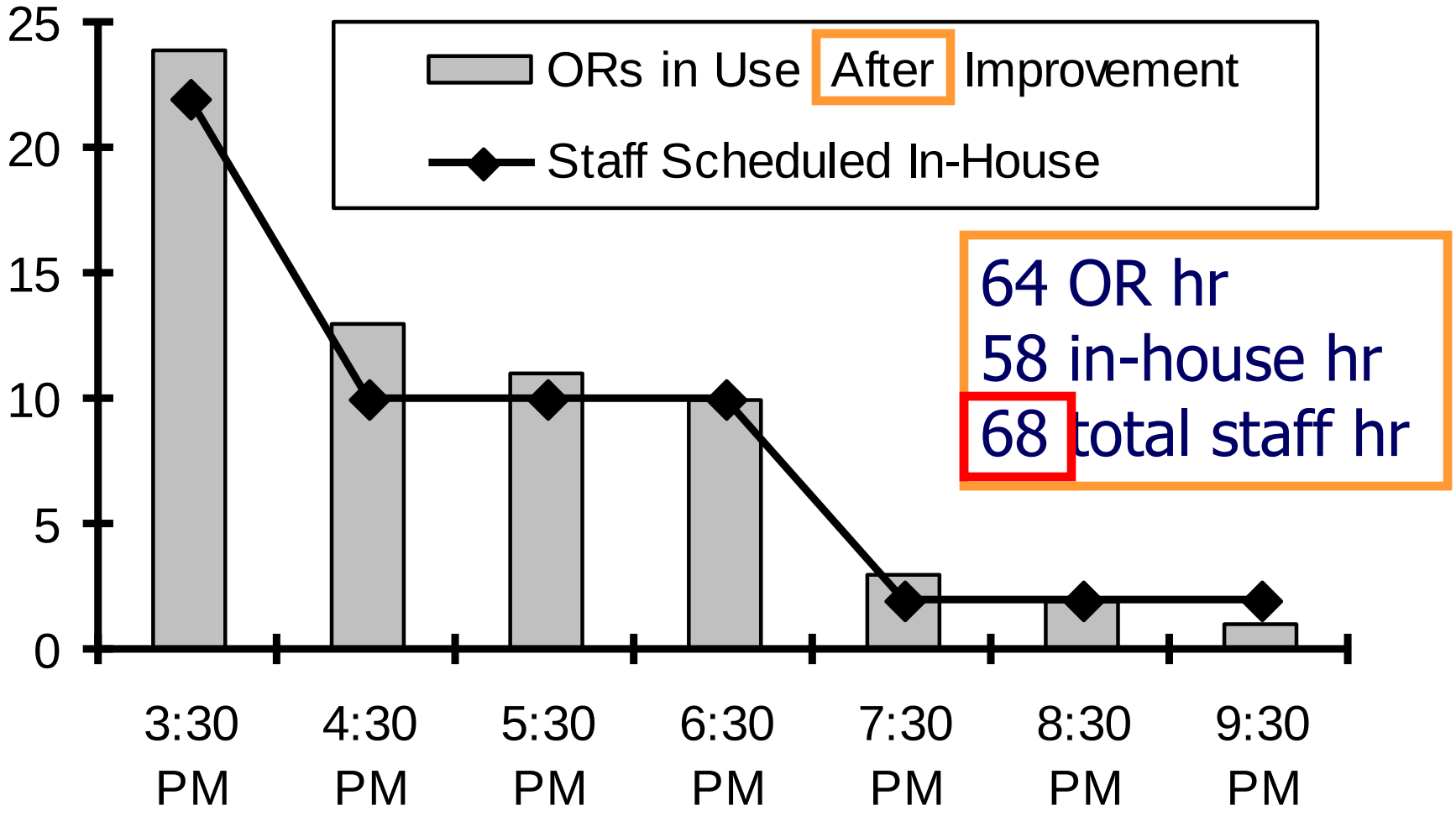

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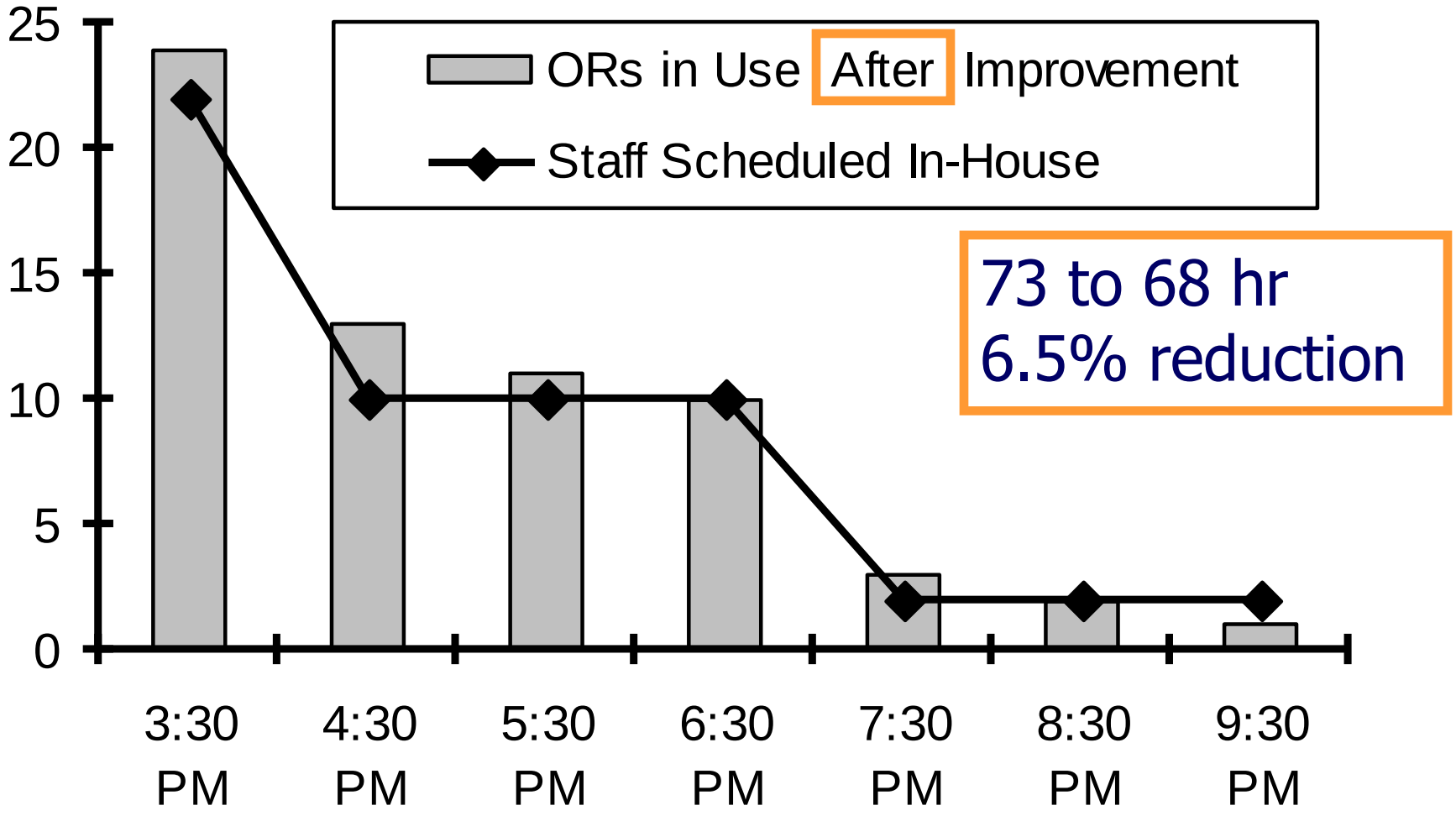

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Typical Scenario of Finishing Early and Low Productivity

- 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

Increase Productivity Numerator with Unscheduled Activities

- Since times that ORs finish are unpredictable, increasing productivity by doing more clinical work is doubtful

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- 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

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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  - ➢Start by focusing 0 to 2 workdays ahead

Epstein RH, Dexter F. Anesth Analg 2015

Schulte TE et al. J Clin Anesth 2016

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  - 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)

Valued Activities That Can Be Done with Unscheduled Time

- 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

Valued Activities That Can Be Done with Unscheduled Time

- 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
- ➢ 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?

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Additional Information on Operating Room Management

- 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
  - Comprehensive bibliography of peer reviewed articles in operating room and anesthesia group management