

# Economics of Reducing Turnover Times

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# Economics of Reducing Turnover Times (US Surgical Suites)

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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

# Why Focus on Turnover Times (Cleanup Time + Setup Time)?

- Lean manufacturing principles
  - Value added time when labor is “touching” product, changing its form or function
  - Non-value added activity is the opposite
- Times when patients are in or out of an OR
  - No reliable and valid instrument and process to record times of the start and stop of value-added activity for most procedures
  - Turnover times can be measured reliably



# Economics of Reducing Turnover Times

- Potential benefits of reducing turnover times
  - Increase OR efficiency on the day of surgery by reducing over-utilized OR time
  - Increase OR efficiency, even if under-utilized OR time, by reducing staffing
  - Increase number of cases
- Focus not just on setup and cleanup times, but also the frustrating prolonged turnovers



# Economics of Reducing Turnover Times

- Potential benefits of reducing turnover times
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    - Increase number of cases
- Focus not just on setup and cleanup times, but also the frustrating prolonged turnovers



# Example of *Under-Utilized OR Time*

- OR staffing is planned from 7 AM to 3 PM
- Yesterday, the last case of the day in OR 1 ended at 1 PM
- There were 2 hours of under-utilized OR time
  - Under-utilized time was from 1 PM to 3 PM

Strum DP et al. Anesthesiology 1999



# Example of *Over-Utilized OR Time*

- OR staffing is planned from 7 AM to 3 PM
- Two days ago, the last case of the day in OR 1 ended at 5 PM
- There were 2 hr of *over-utilized OR time*
  - Over-utilized OR time was from 3 PM to 5 PM



# Precise Meaning of "Maximize Efficiency of Use of OR Time"

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



# Reducing Turnover Times on Day of Surgery

- OR nurses and nurse anesthetists are full-time, hourly employees
- Staffing is planned from 7 AM to 3 PM
- There is estimated to be 9 hr of cases including turnover times
- Because of quick setup and cleanup times, OR finishes at 3 PM, instead of at 4 PM
- Has ↓ turnover times ↑ OR efficiency?



# Reducing Turnover Times on Day of Surgery

- OR nurses and nurse anesthetists are full-time, hourly 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

McIntosh C et al. Anesth Analg 2006



# 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)



# 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



# Reducing Turnover Times on Day of Surgery

- Scenario
  - Staffing is planned from 7 AM to 3 PM
  - By reducing turnover times, cases finished in 8 hr instead of in the expected 9 hr
    - Finished at 3 PM instead of at 4 PM



# Reducing Turnover Times on Day of Surgery

- Scenario
  - Staffing is planned from 7 AM to 3 PM
  - By reducing turnover times, cases finished in 8 hr instead of in the expected 9 hr
    - Finished at 3 PM instead of at 4 PM
  - Reducing turnover times *increased* OR efficiency by preventing 1 hr of over-utilized OR time



# Reducing Turnover Times on Day of Surgery

- OR nurses and nurse anesthetists are full-time, hourly employees
- Staffing is planned from 7 AM to ~~3~~ 5 PM
- There is estimated to be 9 hr of cases including turnover times
- Because of quick setup and cleanup times, OR finishes at 3 PM, instead of at 4 PM
- Has ↓ turnover times ↑ OR efficiency?



# Reducing Turnover Times on Day of Surgery

- Scenario
  - Staffing is planned from 7 AM to ~~3~~ 5 PM
  - By reducing turnover times, cases finished in 8 hr instead of in the expected 9 hr
    - Finished at 3 PM instead of at 4 PM



# Reducing Turnover Times on Day of Surgery

- Scenario
  - Staffing is planned from ~~7 AM to 3~~ **5 PM**
  - By reducing turnover times, cases finished in 8 hr instead of in the expected 9 hr
    - Finished at 3 PM instead of at 4 PM
  - Reducing turnover times **did not** increase OR efficiency by preventing ~~1~~ **0** hr of over-utilized OR time



# Reducing Turnover Times on Day of Surgery

- Impact of reductions in turnover times and delays on OR efficiency is highly sensitive to the staffing for each OR
- Efforts to reduce turnover times should be targeted based on OR staffing

Dexter F et al. Anesth Analg 2003

McIntosh C et al. Anesth Analg 2006



# Principles Apply to First Case of Day Starts

- If OR has 3 cases and first case of the day start enters the OR 8 min late, that is same as increasing mean turnover time by 4 min

McIntosh C et al. Anesth Analg 2006

Dexter F, Epstein RH. Anesth Analg 2009



# Principles Apply to First Case of Day Starts

- If OR has 3 cases and first case of the day start enters the OR 8 min late, that is same as increasing mean turnover time by 4 min
- For scenarios involving more than 1 OR, such as anesthesiologist medically directing CRNAs, many decisions that increase % cases with on-time first case start reduce OR efficiency

Dexter F et al. Anesth Analg 2007



# Impact of Staffing on Benefit of Turnover Time Reduction

- Outpatient Surgery Center with 6 ORs, all staffed from 7 AM to 5 PM
- Mean ORs in use before intervention
  - 2 PM – 5 ORs
  - 3 PM – 2 ORs
  - 4 PM – 1.4 ORs
  - 5 PM – 0.3 ORs
- Mean ORs in use after intervention
  - 2 PM – 4 ORs
  - 3 PM – 1.2 ORs
  - 4 PM – 0.8 ORs
  - 5 PM – 0.1 ORs
- Increased OR efficiency?



# Impact of Staffing on Benefit of Turnover Time Reduction

- 1) Evaluate the OR allocation (staffing)



# Impact of Staffing on Benefit of Turnover Time Reduction

- Outpatient Surgery Center with 6 ORs, all staffed from 7 AM to 5 PM
- Mean ORs in use before intervention
  - 2 PM – 5 ORs
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- Mean ORs in use after intervention
  - 2 PM – 4 ORs
  - 3 PM – 1.2 ORs
  - 4 PM – 0.8 ORs
  - 5 PM – 0.1 ORs
- Increased OR efficiency?



# Impact of Staffing on Benefit of Turnover Time Reduction

- Outpatient Surgery Center with 6 ORs, all staffed from 7 AM to 5 PM **Unchanged**
- Mean ORs in use before intervention
  - 2 PM – 5 ORs
  - 3 PM – 2 ORs
  - 4 PM – 1.4 ORs
  - 5 PM – 0.3 ORs
- Mean ORs in use after intervention
  - 2 PM – 4 ORs
  - 3 PM – 1.2 ORs
  - 4 PM – 0.8 ORs
  - 5 PM – 0.1 ORs
- Increased OR efficiency?



# Impact of Staffing on Benefit of Turnover Time Reduction

2) Evaluate the over-utilized OR time



# Impact of Staffing on Benefit of Turnover Time Reduction

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



# Impact of Staffing on Benefit of Turnover Time Reduction

- Outpatient Surgery Center with 6 ORs, all staffed from 7 AM to 5 PM

- Mean ORs in use before intervention

2 PM – 5 ORs                      4 PM – 1.4 ORs

3 PM – 2 ORs                      5 PM – 0.3 ORs

- Mean ORs in use after intervention

2 PM – 4 ORs                      4 PM – 0.8 ORs

3 PM – 1.2 ORs                      5 PM – 0.1 ORs

**Small & same**

- Increased OR efficiency?



# Impact of Staffing on Benefit of Turnover Time Reduction

- 1) Evaluate the OR allocation (staffing)
  - 2) Evaluate the over-utilized OR time
- No impact on OR efficiency, because staffing and over-utilized OR time are effectively the same



# Impact of Staffing on Benefit of Turnover Time Reduction

- 1) Evaluate the OR allocation (staffing)
- 2) Evaluate the over-utilized OR time
  - No impact on OR efficiency, because staffing and over-utilized OR time are effectively the same
  - Impact of intervention was mostly an increase in hours of under-utilized OR time



# Impact of Staffing on Benefit of Turnover Time Reduction

- Outpatient Surgery Center with 6 ORs, all staffed from **7 AM to ~~5~~ 3 PM**
- Mean ORs in use before intervention
  - 2 PM – 5 ORs
  - 3 PM – 2 ORs
  - 4 PM – 1.4 ORs
  - 5 PM – 0.3 ORs
- Mean ORs in use after intervention
  - 2 PM – 4 ORs
  - 3 PM – 1.2 ORs
  - 4 PM – 0.8 ORs
  - 5 PM – 0.1 ORs
- Increased OR efficiency?



# Impact of Staffing on Benefit of Turnover Time Reduction

- ***Increase*** in OR efficiency by reducing hours of over-utilized OR time
  - From 3.7 hr a day down to 2.1 hr a day



# Impact of Staffing on Benefit of Turnover Time Reduction

- Which is right?



# Impact of Staffing on Benefit of Turnover Time Reduction

- Which is right? Plan staffing from 7 AM to 3 PM or to 5 PM to maximize OR efficiency?

McIntosh C et al. Anesth Analg 2006



# Precise Meaning of "Maximize Efficiency of Use of OR Time"

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Strum DP et al. J Med Syst 1997



# Impact of Staffing on Benefit of Turnover Time Reduction

- Which is right? Plan staffing from 7 AM to 3 PM or to 5 PM to maximize OR efficiency?
  - Suppose that from long-term perspective the relative cost of an hour of over-utilized OR time to hour of under-utilized OR time is 2.0



# Impact of Staffing on Benefit of Turnover Time Reduction

- Which is right? Plan staffing from 7 AM to 3 PM or to 5 PM to maximize OR efficiency?
  - Suppose that from long-term perspective the relative cost of an hour of over-utilized OR time to hour of under-utilized OR time is 2.0
    - Reasonable, as equals time and a half plus increment for intangible cost of working late



# Impact of Staffing on Benefit of Turnover Time Reduction

- Which is right? Plan staffing from 7 AM to 3 PM or to 5 PM to maximize OR efficiency?
  - Suppose that from long-term perspective the relative cost of an hour of over-utilized OR time to hour of under-utilized OR time is 2.0
    - Reasonable, as equals time and a half plus increment for intangible cost of working late
- Staff so 2/3<sup>rd</sup> ORs finish early, 1/3<sup>rd</sup> finish late



# Impact of Staffing on Benefit of Turnover Time Reduction

- Which is right? Plan staffing from 7 AM to 3 PM or to 5 PM to maximize OR efficiency?
  - Suppose that from long-term perspective the relative cost of an hour of over-utilized OR time to hour of under-utilized OR time is 2.0
    - Reasonable, as equals time and a half plus increment for intangible cost of working late
  - Staff so 2/3<sup>rd</sup> ORs finish early, 1/3<sup>rd</sup> finish late
  - Staffing based on maximizing efficiency of use of OR time should be 7 AM to 3 PM



# Impact of Staffing on Benefit of Turnover Time Reduction

- If:
  - Staffing planned and cases scheduled based on maximizing the efficiency of use of OR time
- And:
  - There are more than 8 hr of cases and turnover times in ORs
- Then:
  - Reducing turnover times can increase OR efficiency



# Impact of Staffing on Benefit of Turnover Time Reduction

- If:
  - Staffing planned and cases scheduled based on maximizing the efficiency of use of OR time
- And:
  - There are more than 8 hr of cases and turnover times in ORs
- Then:
  - Reducing turnover times *can increase* OR efficiency



# Impact of Staffing on Benefit of Turnover Time Reduction

- If:

*Straightforward, with mathematics*

- ~~Staffing planned and cases scheduled based on maximizing the efficiency of use of OR time~~

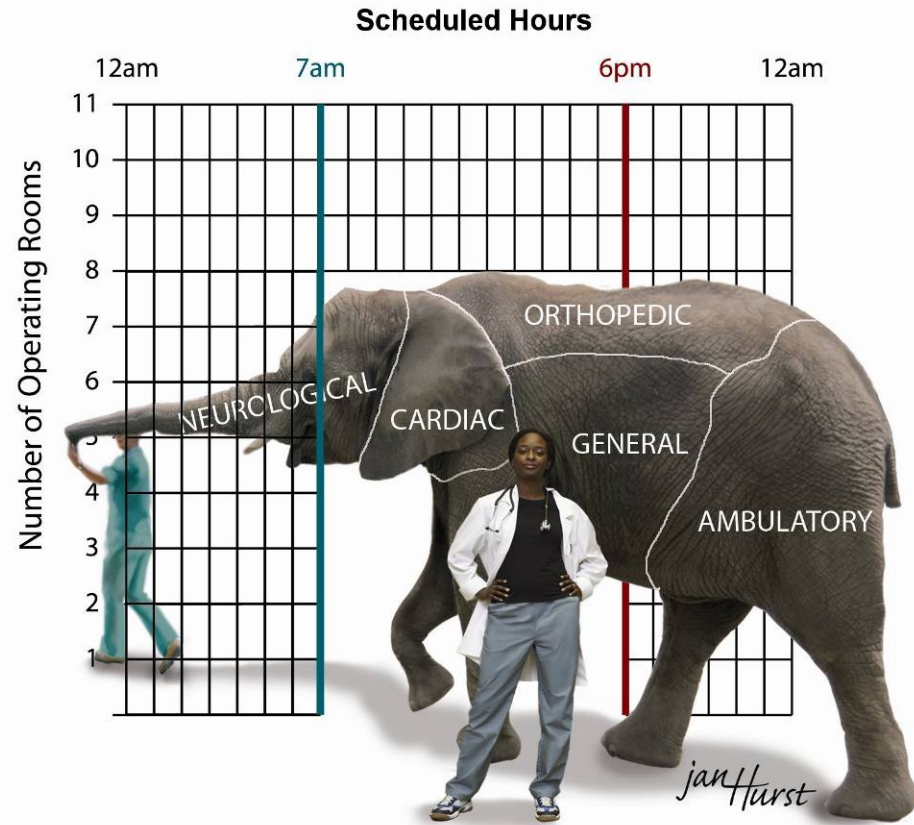
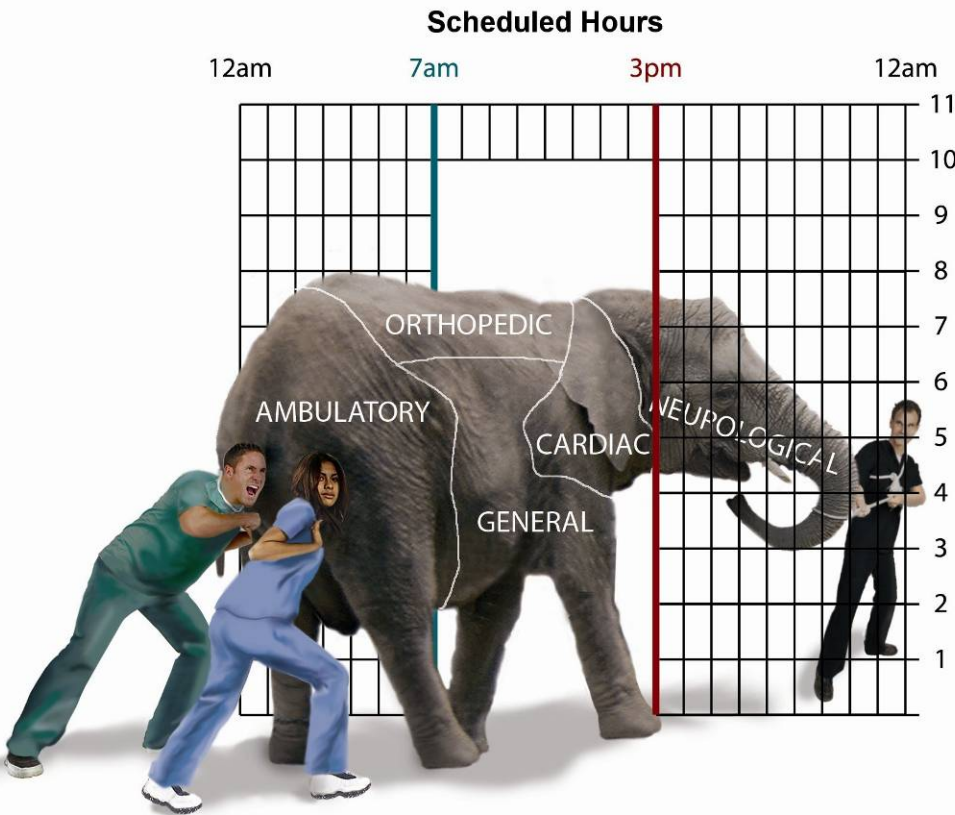
- And:

- There are more than 8 hr of cases and turnover times in ORs

- Then:

- Reducing turnover times can increase OR efficiency





“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

# Consideration of Appropriate OR Staffing is Useful

- For 11 of 13 suites, staffing plan to maximize OR efficiency had 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 1.2 instead of 2.0
  - 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 1.2 instead of 2.0
  - 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



# Impact of Staffing on Benefit of Turnover Time Reduction

- If:
  - Staffing planned and cases scheduled based on maximizing the efficiency of use of OR time
- And: ***Easy Screening Question***
  - There are more than 8 hr of cases and turnover times in ORs
- Then:
  - Reducing turnover times can increase OR efficiency



# Screening Question Useful Since Often Fewer Than 8 Hr of Cases

- Average 5.5 hr of OR time per OR per day at 8 US community hospitals' ORs with knee and hip replacement surgery
- Average 6.0 hr of anesthesia time per OR per day at 11 US community anesthesia groups
- Average 55% utilization of staffed OR time at UK day surgery ORs

Commission for Healthcare Audit and Inspection, July 2005

Dexter F et al. Health Care Manag Sci 2006

Abouleish AE et al. Anesthesiology 2002



# Impact of Staffing on Benefit of Turnover Time Reduction

- Two screening questions to determine if <option below> can increase OR efficiency by reducing turnover (or even OR) times
    - Reduced delays on day of surgery
    - Product to reduce setup and cleanup times
    - Changes in anesthetic care, drugs, monitors
1. How many ORs have at least 8 hr of cases?
  2. What is the achievable average reduction in total time per OR per day?



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***Conclusion***



# Economics of Reducing Turnover Times

- Potential benefits of reducing turnover times
  - Increase OR efficiency on the day of surgery by reducing over-utilized OR time
  - Increase OR efficiency, even if under-utilized OR time, by reducing staffing
  - Increase number of cases
- Focus not just on setup and cleanup times, but also the frustrating prolonged turnovers



# Increasing OR Efficiency Even If Under-Utilized OR Time

- Facility with 6 ORs, all staffed for the same period, calculated based on OR efficiency
- Mean ORs in use before intervention
  - 2 PM – 5 ORs                      4 PM – 2.0 ORs
  - 3 PM – 4 ORs                      5 PM – 0.6 ORs
- Mean ORs in use after intervention
  - 2 PM – 4 ORs                      4 PM – 1.3 ORs
  - 3 PM – 2.0 ORs                    5 PM – 0.1 ORs
- Increased OR efficiency?



# Increasing OR Efficiency Even If Under-Utilized OR Time

- Mean ORs in use *before* intervention
  - 2 PM – 5 ORs
  - 3 PM – 4 ORs
  - 4 PM – 2.0 ORs
  - 5 PM – 0.6 ORs
- If staffing options are 7 AM to 3 PM or 7 AM to 5 PM, staff 7 AM to **5** PM to maximize efficiency of use of OR time
  - Excess over-utilized OR time if 7 AM to 3 PM



# Increasing OR Efficiency Even If Under-Utilized OR Time

- Mean ORs in use *after* intervention
  - 2 PM – 4 ORs      4 PM – 1.3 ORs
  - 3 PM – 2.0 ORs      5 PM – 0.1 ORs
- If staffing options are 7 AM to 3 PM or 7 AM to 5 PM, staff 7 AM to **3** PM to maximize efficiency of use of OR time
  - Excess under-utilized OR time if 7 AM to 5 PM



# Increasing OR Efficiency Even If Under-Utilized OR Time

- Facility with 6 ORs, all staffed for the same period, calculated based on OR efficiency

- Mean ORs in use before intervention **7 AM – 5 PM**

2 PM – 5 ORs                      4 PM – 2.0 ORs

3 PM – 4 ORs                      5 PM – 0.6 ORs

- Mean ORs in use after intervention **7 AM – 3 PM**

2 PM – 4 ORs                      4 PM – 1.3 ORs

3 PM – 2.0 ORs                      5 PM – 0.1 ORs

- Increased OR efficiency?



# Increasing OR Efficiency Even If Under-Utilized OR Time

- On day of surgery, no impact of intervention on OR efficiency, because staff scheduled to 5 PM have no less over-utilized OR time
- On long-term basis, if staffing were changed from 7 AM – 5 PM to 7 AM – 3 PM, then intervention would increase OR efficiency



# Caution: Do Not ↑ OR Efficiency at the Expense of ↓ Productivity

- Reduced productivity from 3 versus 2 anesthesia providers assigned to 2 ORs
- Increased productivity from 4 versus 3 anesthesia teams assigned to 3 ORs
- Increased productivity from 5 versus 4 anesthesia & nursing teams assigned to 4 ORs

Williams et al. Am J Anesthesiol 1998

Hanns et al. Anesthesiology 2005

Torkki et al. Anesthesiology 2005



# Service, Day of Week, and Procedure Specific Analysis

- Orthopedics' staffing is 3 OR each day for 8 hr
- Mean 6.8 hr (SD 0.8 hr) cases per OR per day
- Even if reduce turnover times, would still have 3 ORs for 8 hr
  - No increase in OR efficiency
    - No resulting reduction in staffing cost



# Service, Day of Week, and Procedure Specific Analysis

- ENT's staffing is 3 OR each day for 10 hr
- Mean 11 hr (SD 0.8 hr) cases per OR per day
- If reduce turnover time, would reduce over-utilized OR time, and perhaps also reduce some OR's staffing to 8 hr
  - Increase in OR efficiency
    - Resulting reduction in staffing cost



# Monitor Impact of Reducing Turnover Times by Service

1. Calculate current service-specific staffing
2. Reduce all turnovers that are longer than a collective maximum value to the maximum
3. Recalculate service-specific staffing
4. Report reduction in staffing costs, if any, in units of minutes per 8 hr of staffed OR time

Dexter F et al. Anesth Analg 2003

Abouleish AE et al. Anesthesiology 2004

McIntosh C et al. Anesth Analg 2006



# Monitor Impact of Reducing Turnover Times by Service

Service	Mon	Tue	Wed	Thu	Fri
BURN		7			
ENT	<b>44</b>	<b>14</b>	7	6	<b>11</b>
GEN	4				8
GU	6		8		9
NEURO			<b>11</b>	<b>11</b>	
OPTH		2			
ORTH	6	7	7	8	6
URGENT	<b>24</b>	9	<b>13</b>	<b>55</b>	<b>24</b>
<b>TOTAL</b>	14	8	10	14	13

# Monitor Impact of Reducing Turnover Times by Service

Service	Mon	Tue	Wed	Thu	Fri
BURN		7			
ENT	<b>44</b>	<b>14</b>	7	<b>6</b>	<b>11</b>
GEN	4				8
GU	6		8		9
NEURO			<b>11</b>	<b>11</b>	
OPTH		2			
ORTH	6	7	7	8	6
URGENT	<b>24</b>	9	<b>13</b>	<b>55</b>	<b>24</b>
<b>TOTAL</b>	14	8	10	14	13

# Service, Day of Week, and Procedure Specific Analysis

- Factors to consider about each service:
  - Mean turnover time
    - Opportunity if mean is long
  - Turnover times per OR each day
    - Opportunity if many turnovers per OR
  - Hours of cases including turnovers each day
    - Hours of under- and over-utilized OR time
  - Variability in workload among weeks
    - Benefit if less variability



# Service, Day of Week, and Procedure Specific Analysis

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  - Variability in workload among weeks
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- Potential benefits of reducing turnover times
  - Increase OR efficiency on the day of surgery by reducing over-utilized OR time
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- Focus not just on setup and cleanup times, but also the frustrating prolonged turnovers



# Irrational: Reduce Turnover Times to Reduce Cancellations

- Reducing turnover times can prevent a case from being canceled out of concern that the case may finish in over-utilized OR time and thus increase OR costs
- One fallacy to the argument is that cancelling a case to perform it another day increases overall costs whether analyzed from societal, hospital, physician, or patient perspective

Tessler MJ et al. Can J Anaesth 1997

Spenaniak PS et al. Anesth Analg 2009



# Irrational: Reduce Turnover Times to Reduce Cancellations

- Another fallacy of argument is that, except for very short cases, mean turnover times are less than mean absolute difference between scheduled and actual case durations
  - Achievable turnover time reductions practically only permit another case to be scheduled if willing to often ( $> 20\%$ ) cancel and keep patient on ward another day waiting for OR

Dexter F et al. Anesth Analg 1995, 2003



# Monitor Cancellations

Service	Cancellation Rate	95% Confidence Interval	Full Name of Service
Thor	12.9%	7.5% to 19.4%	Thoracic Surgery
Urol	13.2%	11.2% to 15.3%	Urology
OralS	14.1%	7.9% to 21.7%	Oral Surgery
Nsurg	14.6%	9.5% to 20.6%	University Neurosurgeons
Gen	15.2%	11.3% to 19.6%	General Surgery
ENT	16.1%	13.3% to 19.1%	Otolaryngology
Ortho	16.5%	11.8% to 21.9%	Orthopedics
Gyn	22.0%	18.3% to 26.0%	Gynecology Group
Wolf	24.0%	14.5% to 35.0%	Elizabeth Wolf, MD
Vascu	20.4%		Vascular
Waters	35.4%		Rachel Waters, MD

Dexter F et al. Anesth Analg 2005

# Irrational: Reduce Turnover Times to Permit Another Case

- Staffing is planned from 7 AM to 5 PM
- Laparoscopic surgeon does 4 cases per day, finishing between 4 PM and 4:30 PM
- Turnover times 40 min, because of ...
  - Cleaning up OR in haphazard manner
  - Setting up poorly organized instruments
  - Wheeling and setting up incompatible video
- “If reduce turnover times, we would not reduce staffing to 8 hr, but do 5<sup>th</sup> case a day to increase revenue.”



# Irrational: Reduce Turnover Times to Permit Another Case

- Argument
  - “If reduce turnover times, we would ~~not reduce staffing to 8 hr,~~ but do 5<sup>th</sup> case a day to increase revenue.”



# Irrational: Reduce Turnover Times to Permit Another Case

- Argument
  - “If reduce turnover times, we would ~~not reduce staffing to 8 hr, but~~ do 5<sup>th</sup> case a day to increase revenue.”
- Question
  - If objective were to increase revenue, would the rational decision be to do the 5<sup>th</sup> case even if turnover times were not reduced?



# Irrational: Reduce Turnover Times to Permit Another Case

- Variable costs
  - Change relative to volume of activity
  - Examples of variable costs
    - Patient-care employees' time
      - Maybe: discussed later
    - Implants
    - Disposable supplies
    - Medications



# Irrational: Reduce Turnover Times to Permit Another Case

- Fixed costs
  - Do not change relative to volume of activity
  - Examples of fixed costs
    - Maintenance of building and grounds
    - Billing office and information systems
    - OR equipment and instruments
  - Since fixed costs are fixed, irrelevant to decisions regarding reducing turnover times



# Irrational: Reduce Turnover Times to Permit Another Case

- Profit =  
revenue – variable costs – fixed costs
- Contribution margin =  
revenue – variable costs
- If contribution margin is positive, case contributes to covering a facility's fixed costs
- Financial goal of tactical decision-making is not to increase revenue, but to increase contribution margin



# Irrational: Reduce Turnover Times to Permit Another Case

- 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

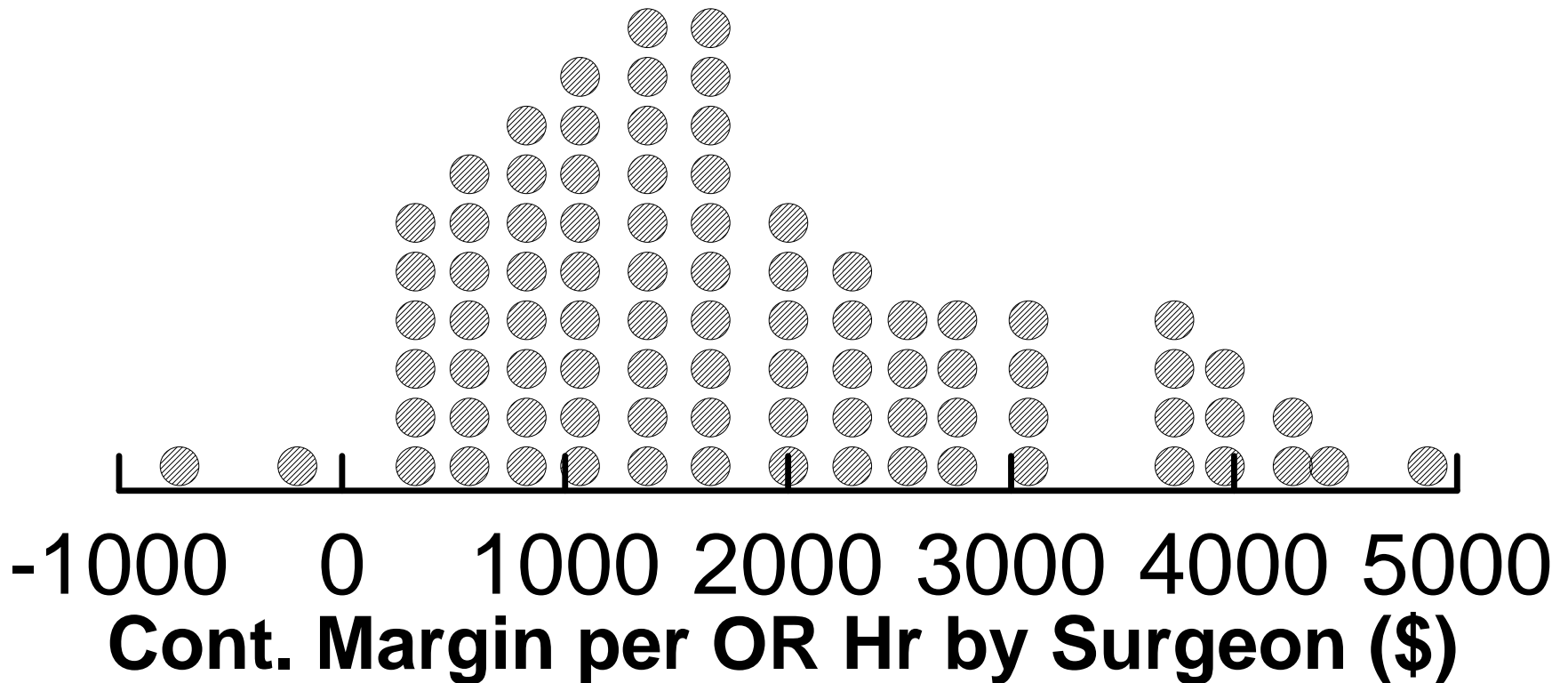


# Irrational: Reduce Turnover Times to Permit Another Case

- 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

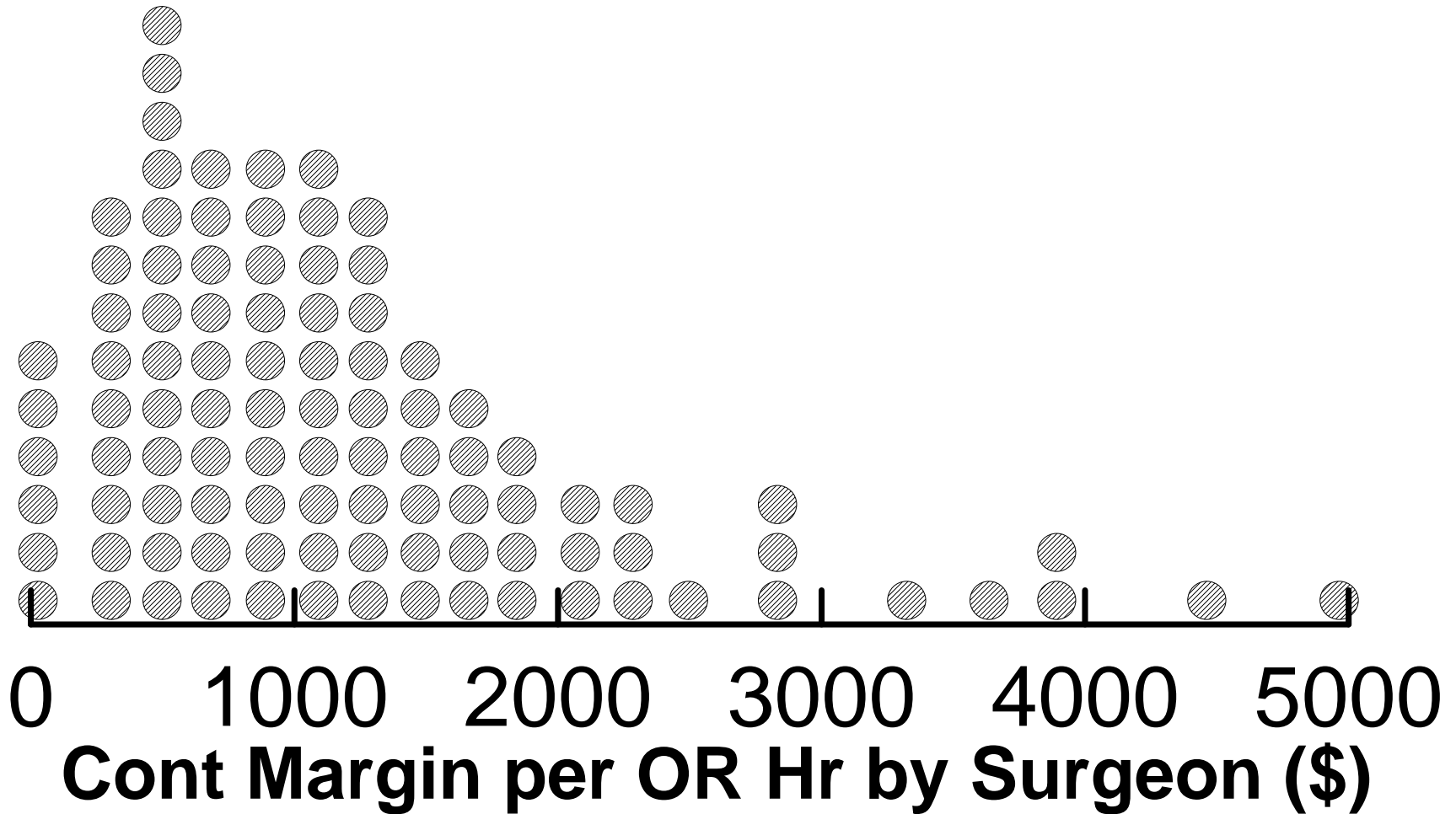


# Hospital Losing Money Has + Cont. Margin For 97% Surgeons



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

# Other Hospital Positive Contribution Margin all Surgeons



# Irrational: Reduce Turnover Times to Permit Another Case

- Summary of contribution margins (FY04 US\$)
  - \$1,864 per OR hour, 97% surgeons > \$0
    - Macario A et al. Anesth Analg 2001
  - \$1,773 per OR hour, 99% surgeons > \$0
    - Dexter F et al. Anesth Analg 2005
  - \$1,530 per OR hour, 100% surgeons > \$0
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- Irrational financially not to encourage nurses and anesthesia providers to get cases done regardless of whether reduce turnover time



# Irrational: Reduce Turnover Times to Permit Another Case

- Staffing is planned from 7 AM to 5 PM
- **Laparoscopic surgeon** does 4 cases per day, finishing between 4 PM and 4:30 PM
- Turnover times 40 min, because of ...
  - Cleaning up OR in haphazard manner
  - Setting up poorly organized instruments
  - Wheeling and setting up incompatible video
- "If reduce turnover times, we won't reduce staffing to 8 hr, but **do 5<sup>th</sup> case a day!**"



# Irrational: Reduce Turnover Times to Permit Another Case

- Laparoscopic surgery (e.g., cholecystectomy) consistently achieves a contribution margin around \$1,800 per OR hour
- Even if paid nurses \$300 per hour, revenue far exceeds costs for the case



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- Rational manager has case done regardless of whether turnover time is reduced
  - Conclusion even stronger if goal were to increase revenue, as then costs are ignored



# Irrational: Reduce Turnover Times to Permit Another Case

- Variable costs
  - Change relative to volume of activity
  - Examples of variable costs
    - Patient-care employees' time
      - Maybe: *discussed later*
      - Conclusion even stronger if were to consider employees' time to be a fixed cost, because then contribution margin is even larger



# Reducing Turnover Times *Can* Increase Number of Cases

- When turnover times are reduced, some surgeons schedule additional cases that could otherwise have been scheduled, but which *the surgeon* otherwise chose not to schedule

Sandberg WS et al. Anesthesiology 2005

Dexter F. Anesthesiology 2005

Cendán JC, Good M. Arch Surg 2006

Smith MP et al. Anesthesiology 2008



# Reducing Turnover Times *Can* Increase Number of Cases

- When turnover times are reduced, some surgeons schedule additional cases that could otherwise have been scheduled, but which *the surgeon* otherwise chose not to schedule
- Reducing turnover times can rationally increase cases and revenue



# Reducing Turnover Times *Can* Increase Number of Cases

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- Reducing turnover times can rationally increase cases and revenue *indirectly*



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- Reducing turnover times can rationally increase cases and revenue *indirectly*
  - Small reductions in turnover time are sufficient to increase surgeons' feelings of personal competence and achievement

Stahl JE et al. Surgery 2005



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***Conclusion***



# Economics of Reducing Turnover Times

- Potential benefits of reducing turnover times
  - Increase OR efficiency on the day of surgery by reducing over-utilized OR time
  - Increase OR efficiency, even if under-utilized OR time, by reducing staffing
  - Increase number of cases
- Focus not just on setup and cleanup times, but also the frustrating prolonged turnovers



# Facilities' Average Turnover Times Can be Reduced

- Benchmarking report of typical turnovers
  - Turnovers longer than 90 min are excluded
    - “Average” assesses setup and cleanup times
- Typically reported (achievable) reductions
  - For avg. turnovers < 40 min, reductions  $\cong$  7 min
  - For avg. 57 to 65 min, reductions  $\cong$  15 min

Adams R et al. JONA 2004

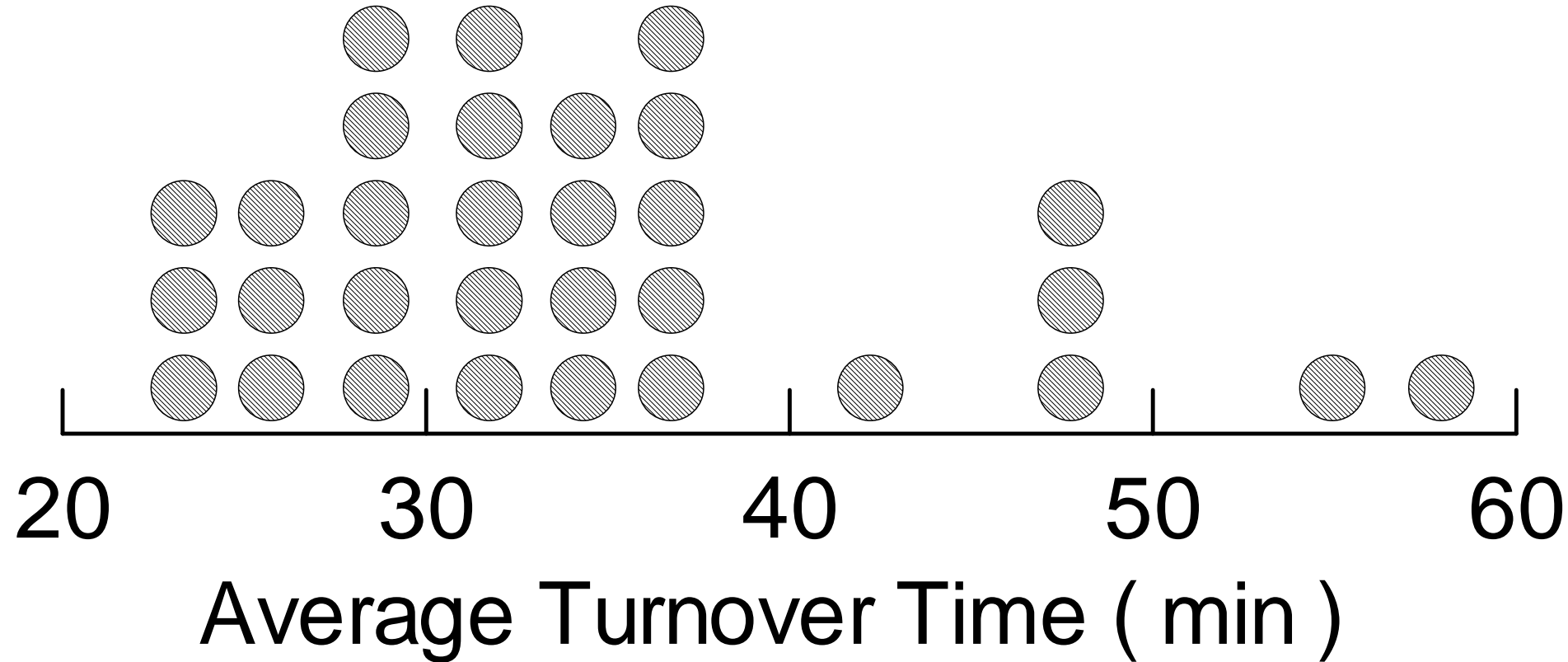
Cendán JC, Good M. Arch Surg 2006

Overdyk FJ et al. Anesth Analg 1998

Sokolovic E et al. Eur J Anaesth 2002



# Average Turnover Times at 31 Hospitals in United States



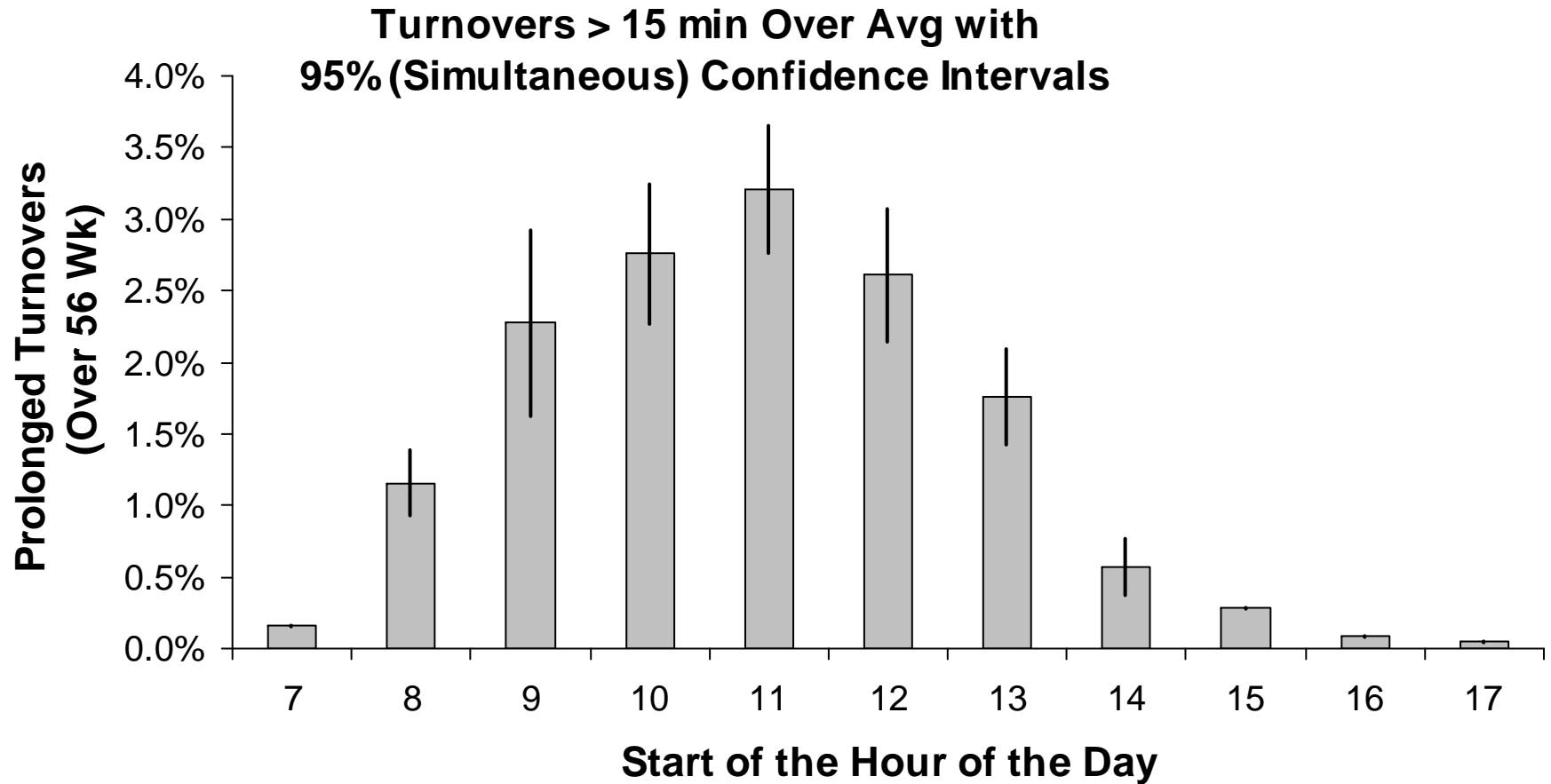
# Prolonged Turnovers Times are Noticeable and Frustrating

- Turnover “prolonged” if time from one elective case ends until another starts in the same OR is  $> 15$  min longer than the average turnover
  - “Average” includes just setup & cleanup times

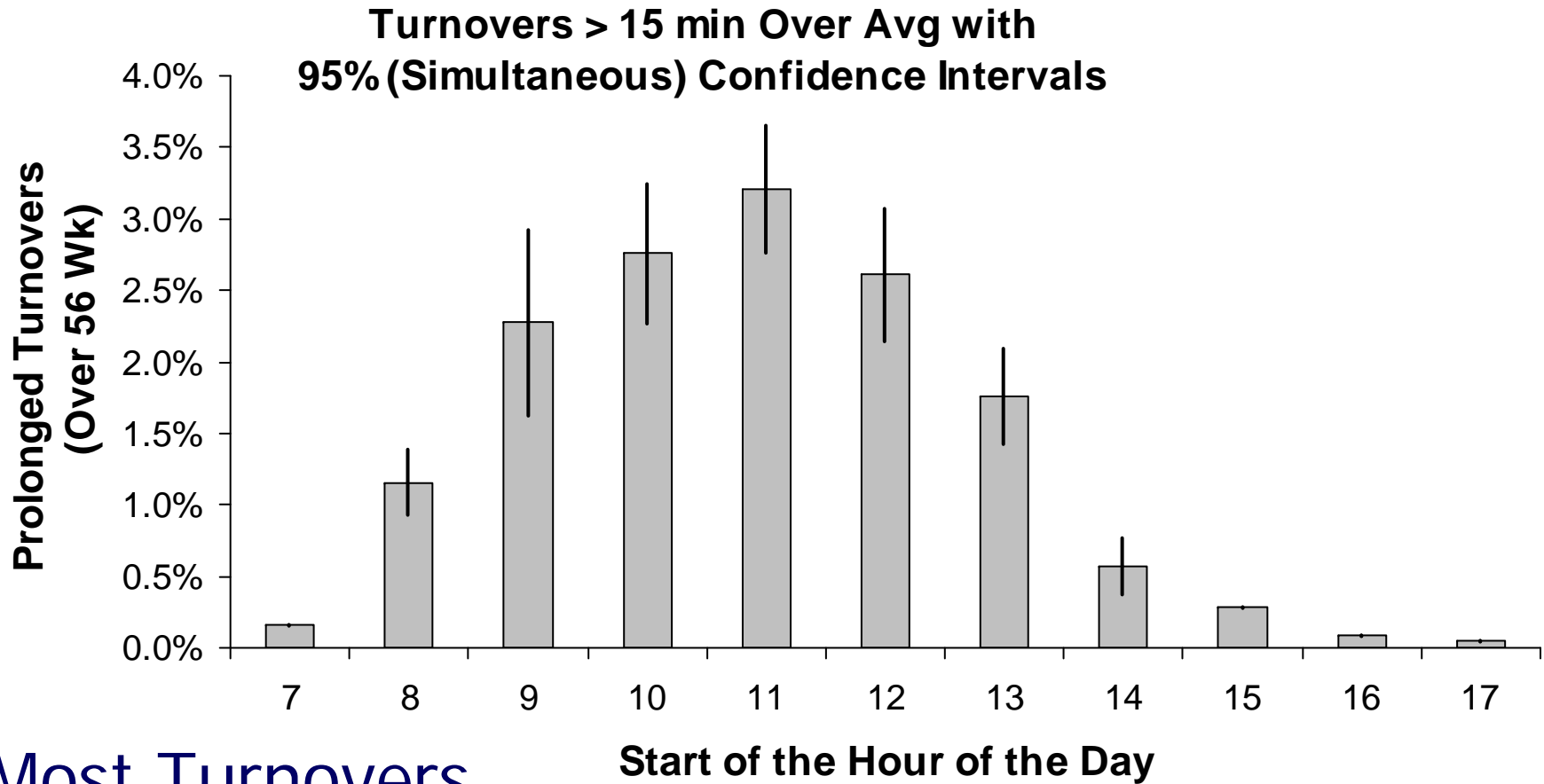
Dexter F et al. Anesthesiology 2005



# Monitor Incidence of Prolonged Turnovers Times by Time of Day

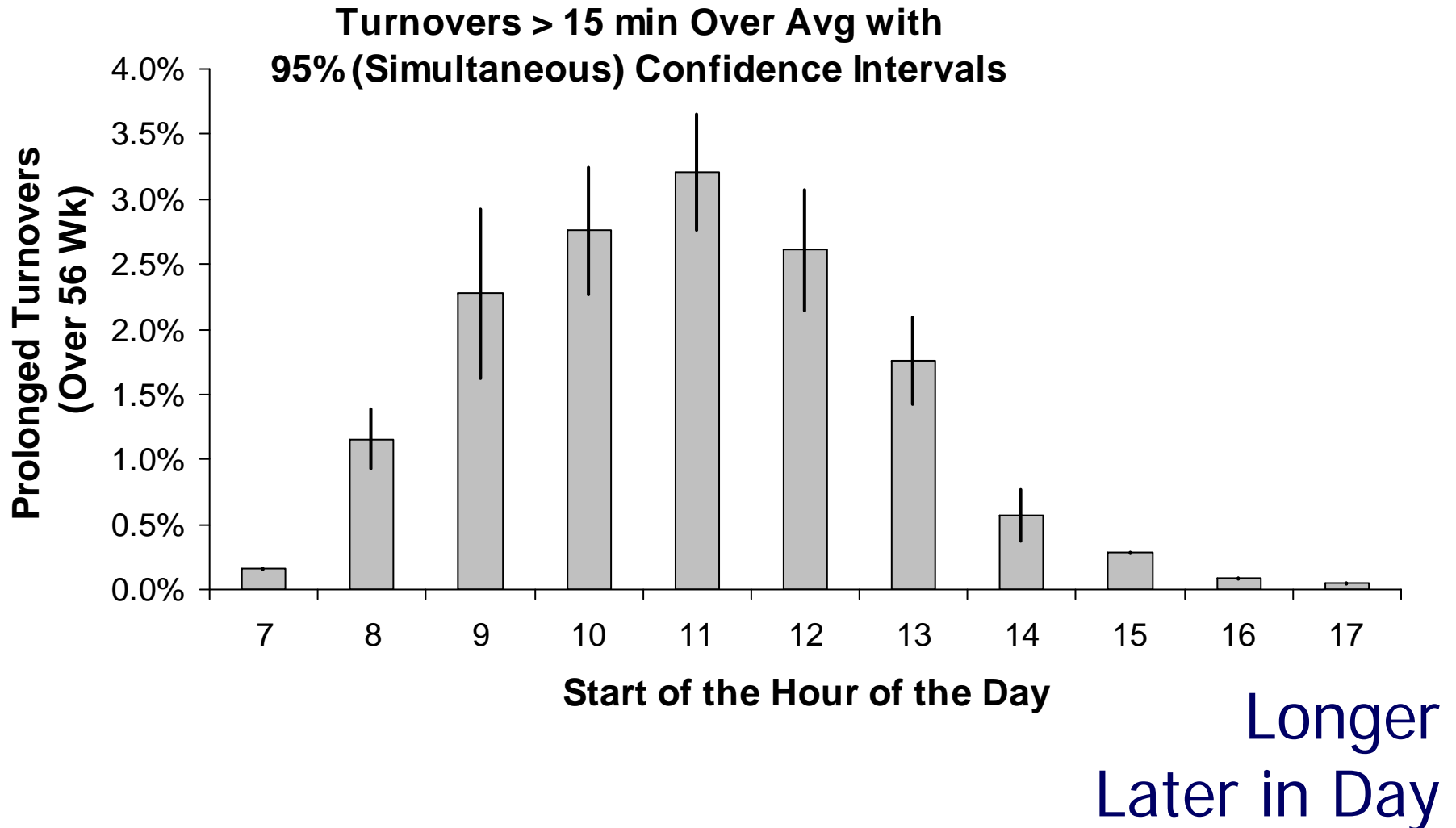


# Monitor Incidence of Prolonged Turnovers Times by Time of Day



Most Turnovers  
Early in Day

# Monitor Incidence of Prolonged Turnovers Times by Time of Day



# Time of Day with the Most Prolonged Turnovers

- Balance of incidence (earlier in day) and magnitude (later in day) is for most prolonged turnovers to occur in the middle of the day



# Reducing Incidence of Prolonged Turnovers Times

- Interventions to reduce prolonged turnovers
  - $\Delta$  schedules of staff (e.g., housekeepers) to focus on those times of day
  - Add 1 or occasionally more turnover teams
  - $\downarrow$  scheduled delays between cases (“holes”)
  - Coordinate using decision-support systems
  - Have sufficient equipment on site to do all cases of the day without reprocessing
  - Enhance equipment standardization



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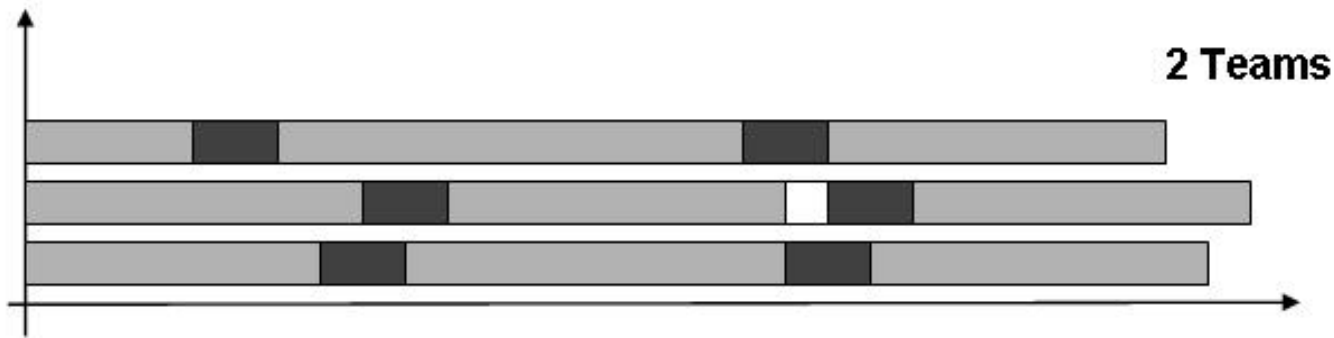


# Simultaneous Turnovers to Decide If Add Turnover Team

Dexter F et al. Anesth Analg 2009

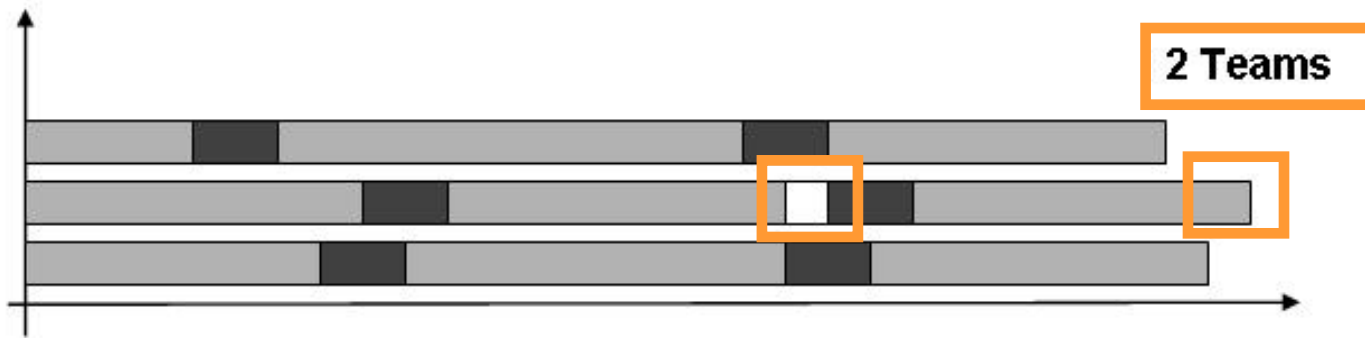


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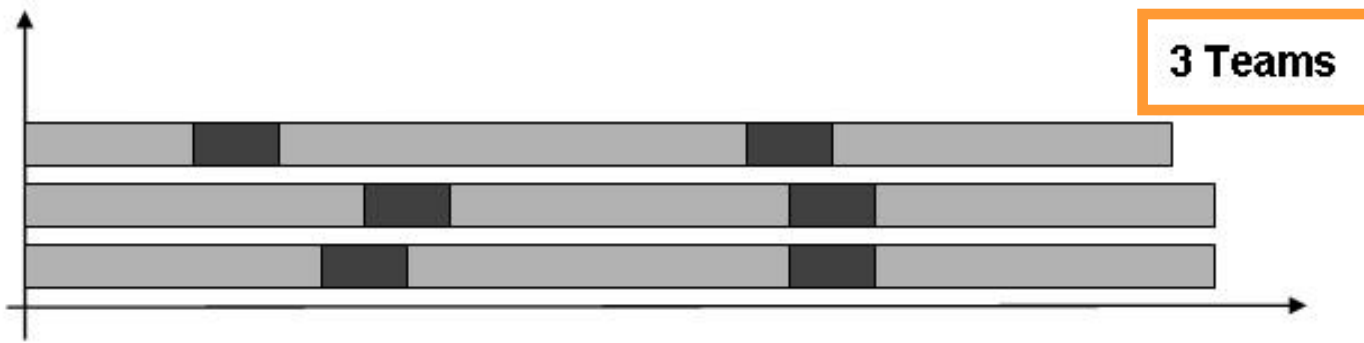
- Time is plotted along the horizontal axis
- Each row represents an OR
- Long light gray bars represent patients in ORs
- Dark gray bars represent cleanup and setup times
- White bar represents 10 min delay in starting cleanup waiting for turnover team from other OR

# Simultaneous Turnovers to Decide If Add Turnover Team



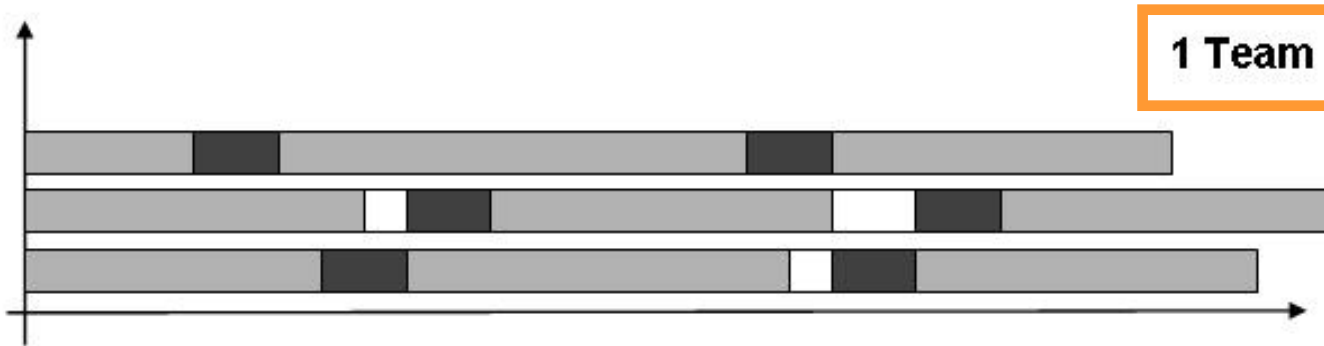
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# Simultaneous Turnovers to Decide If Add Turnover Team



- Adding 1 team reduces the minutes of simultaneous turnovers exceeding the threshold of the number of teams from 10 min to 0 min
- Adding the 1 team also reduces the total surgeon experienced turnover time by 10 min

# Simultaneous Turnovers to Decide If Add Turnover Team



- Removing 1 team increases the minutes of simultaneous turnovers exceeding the threshold of the number of teams from 10 min to 40 min
- Removing 1 team also increases the total surgeon experienced turnover time by 30 min

# Mean ↓ Min of Turnovers per Day From Each 1 Increase in # of Teams

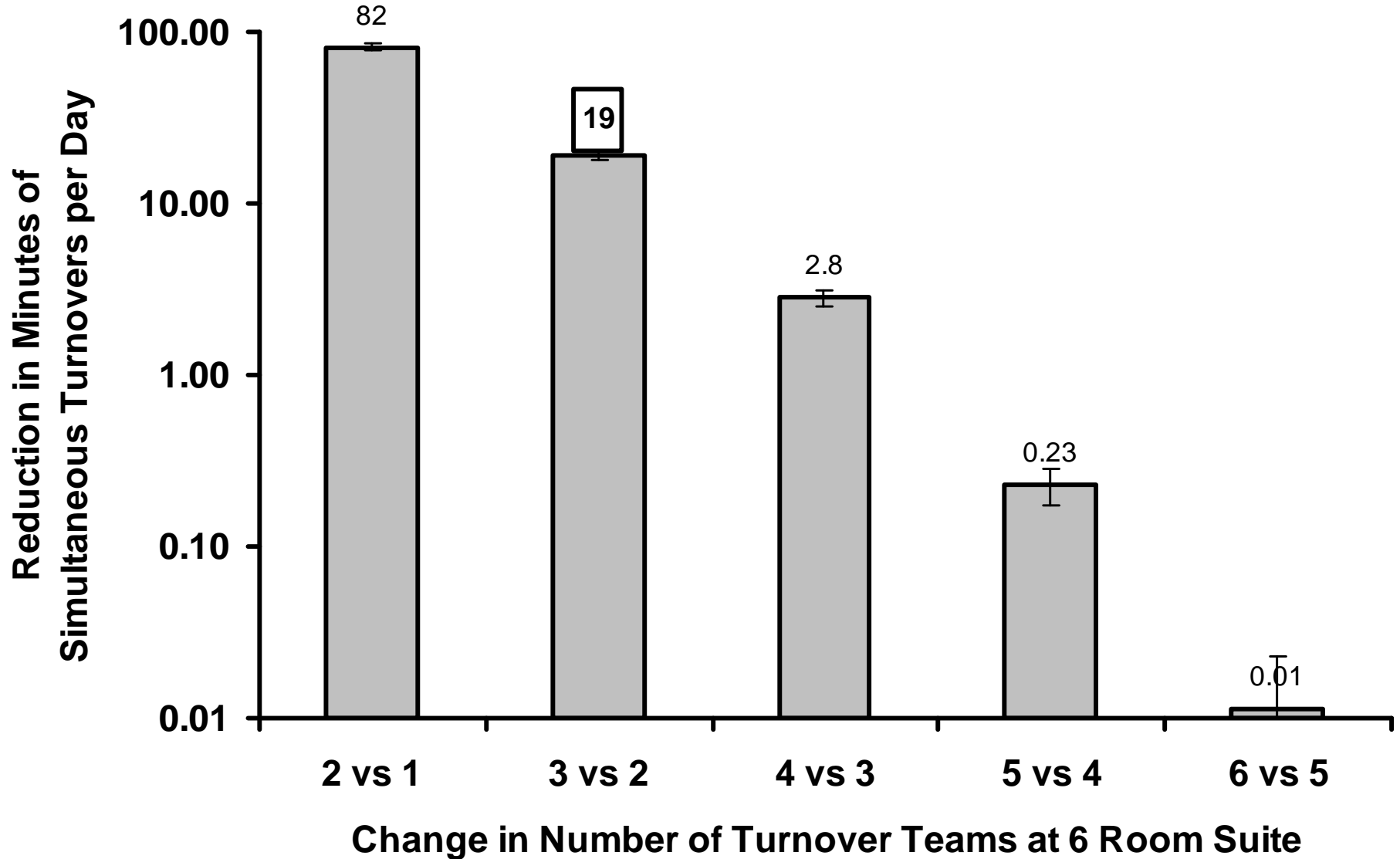
- 24 min = (5% of 8 hr) × (60 min per hr)
  - Threshold of 24 min per day is reasonable threshold if hiring for an 8 hr workday
- 12 min = (5% of 4 hr) × (60 min per hr)
  - Threshold of 12 min per day is reasonable threshold if can hire for an extra 4 hr per day

Dexter F, Traub RD. Anesthesiology 2000

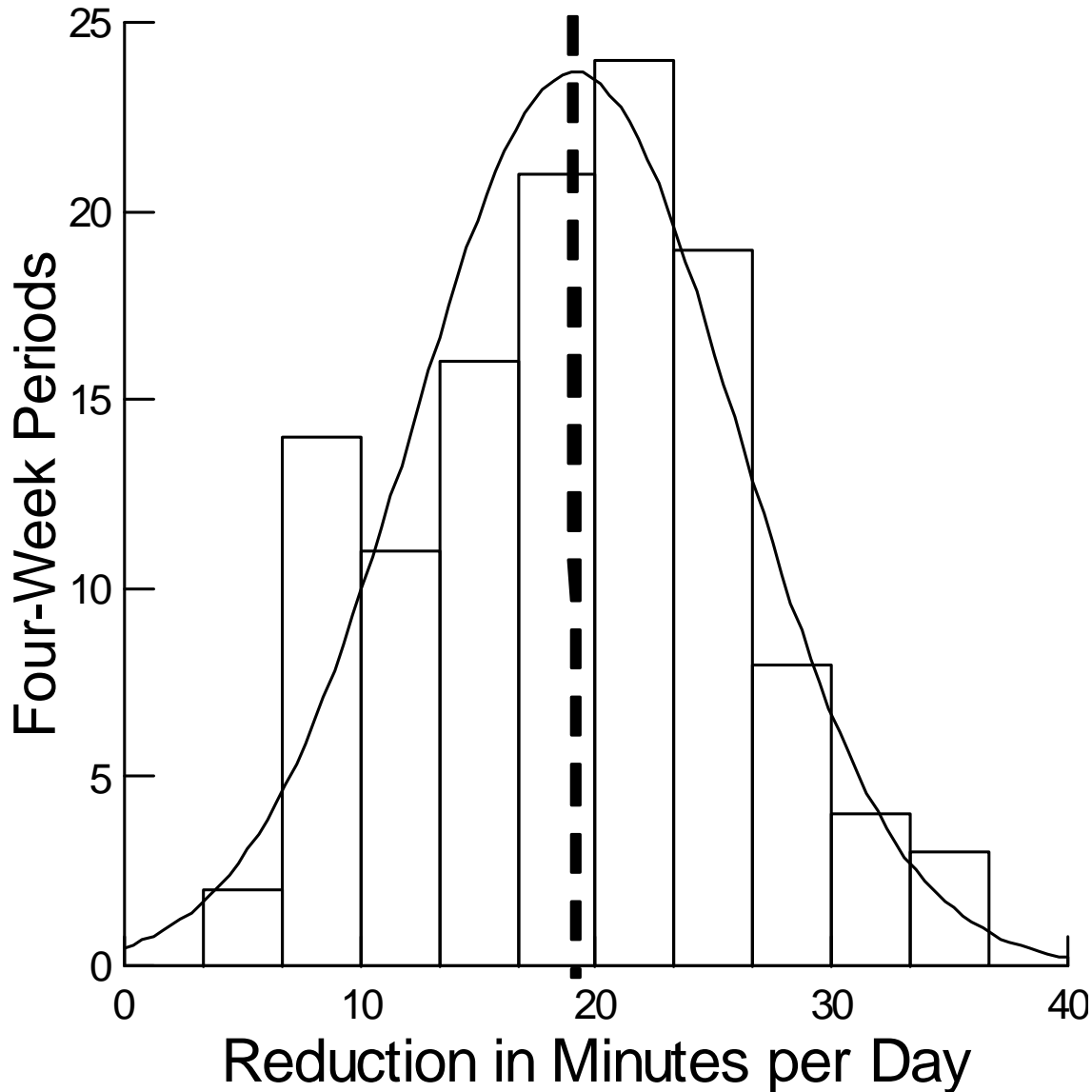
Wachtel RE, Dexter F. Anesth Analg 2007



# Mean ↓ Min of Turnovers per Day From Each 1 Increase in # of Teams



# Confidence Intervals Based on Normal Distribution



- Use 13 four-week periods of results to calculate lower 95% confidence limit for savings with Student's  $t$  distribution

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# 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 service-specific OR staffing, day of surgery decision making, anesthesia staffing, drug and supply costs, comparing surgical services among hospitals, strategic decision making, and PACU staffing
  - Contact information

