Using an Extra OR to Reduce Turnover Times and Do More Cases

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Using an Extra OR to Reduce Turnover Times and Do More Cases

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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)

Extra OR to Reduce Turnover Times

- Decision-making on the day before and on the day of surgery to reduce over-utilized time
- Decision-making on the day before and on the day of surgery to increase OR productivity
- Have a sufficient number of turnover teams to benefit from the extra OR

Extra OR to Reduce Turnover Times

- Topic of talk not whether to have and staff 1 or more extra ORs to reduce turnover times
  - Not considering the extensive science about whether to invest in such OR(s)
- Topic of the talk is how to use such ORs

Williams BA et al. Am J Anesthesiol 1998

Hanss R et al. Anesthesiology 2005

Torkki PM et al. Anesthesiology 2005

Dexter F, Marco AP. Anesth Analg 2011

Extra OR to Reduce Turnover Times

- Decision-making on the day before and on the day of surgery to reduce over-utilized time
- Decision-making on the day before and on the day of surgery to increase OR productivity
- Have a sufficient number of turnover teams to benefit from the extra OR

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 & anesthesiologists full-time employees scheduled months ahead
- Staffing is planned from 7 AM to 3 PM
- There is estimated to be 9 hr of cases including turnover times
- By using the extra OR, the 7-3 OR's cases finish at 3 PM, instead of at 4 PM
- Has ↓ turnover times ↑ OR efficiency?

Reducing Turnover Times on Day of Surgery

- OR nurses & anesthesiologists full-time employees scheduled months ahead
  - ➢ 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 ($) ≅

~~(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

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

Meaning of Maximizing OR Efficiency on Day of Surgery

Inefficiency of use of OR time ($) ≅

(Cost per hour of over-utilized OR time)
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Meaning of Maximizing OR Efficiency on Day of Surgery

Inefficiency of use of OR time ($) ≅

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

× (hours of over-utilized OR time)

Constant

Meaning of Maximizing OR Efficiency on Day of Surgery

Inefficiency of use of OR time ($) ≅

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

× (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 ($) ≅

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

× (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 using the extra OR, the 7-3 OR's 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 using the extra OR, the 7-3 OR's 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 & anesthesiologists full-time employees scheduled months ahead
- Staffing is planned from 7 AM to ~~3~~ ***5*** PM
- There is estimated to be 9 hr of cases including turnover times
- By using the extra OR, the 7-3 OR's cases finish 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 using the extra OR, the 7-3 OR's cases finished in 8 hr instead of in the expected 9 hr
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Same

Reducing Turnover Times on Day of Surgery

- Scenario
  - Staffing is planned from 7 AM to ~~3~~ ***5*** PM
  - By using the extra OR, the 7-3 OR's cases finished in 8 hr instead of in the expected 9 hr
    - Finished at 3 PM instead of at 4 PM

Same

➢ 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

- Implications of the two scenarios
  - 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 the staffing for each OR

Dexter F et al. Anesth Analg 2003

McIntosh C et al. Anesth Analg 2006

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

Reducing Turnover Times on Day of Surgery

- Implications of the two scenarios
  - 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 the staffing for each OR
    - ➢ Staffing for each OR that minimizes the inefficiency of use of OR time generally are the most important values to be calculated using local OR management data

Impact of Staffing on Benefit of Turnover Time Reduction

- Outpatient Surgery Center with 6 ORs, all staffed from 7 AM to 5 PM
- Mean of the 6 ORs in use before add a 7th OR

  2 PM – 5 ORs 4 PM – 1.4 ORs

  3 PM – 2 ORs 5 PM – 0.3 ORs
- Mean of the 6 ORs in use after add 7th OR

  2 PM – 4 ORs 4 PM – 0.8 ORs

  3 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 of the 6 ORs in use before add a 7th OR

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  3 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 of the 6 ORs in use before add a 7th OR

  2 PM – 5 ORs 4 PM – 1.4 ORs

  3 PM – 2 ORs 5 PM – 0.3 ORs

- Mean of the 6 ORs in use after add 7th OR

  2 PM – 4 ORs 4 PM – 0.8 ORs

  3 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

assuming (and might be incorrect) that 7 AM to 5 PM allocation minimizes the inefficiency of use of 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
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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 would be mostly an increase in hours of under-utilized OR time

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 would be mostly an increase in hours of under-utilized OR time
    - "would" since "over-utilized" and "under-utilized" are relative to OR allocation that minimizes inefficiency of use of 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 of the 6 ORs in use before add a 7th OR

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- Mean of the 6 ORs in use after add 7th OR

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- Increased OR efficiency?

Impact of Staffing on Benefit of Turnover Time Reduction

- ***Increase*** in OR efficiency by reducing hours of over-utilized OR time
  - Reduction from 3.7 hr a day 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

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

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

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Strum DP et al. J Med Syst 1997

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

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?
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  - ➢ Staff so 2/3rd ORs finish early, 1/3rd finish late

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  - Staff so 2/3rd ORs finish early, 1/3rd finish late
  - ➢ Staffing that minimizes the inefficiency of use of OR time is from 7 AM to 3 PM

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 2/3rd ORs finish early, 1/3rd finish late
  - Staffing that minimizes the inefficiency of use of OR time is from 7 AM to 3 PM

➢ "Over-utilized OR time" is relative to 8 hours

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

Benefit provided do the math

- 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
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Impact of Staffing on Benefit of Turnover Time Reduction

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Targeted use of the extra OR

Impact of Staffing on Benefit of Turnover Time Reduction

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  - 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

Summary of this section

Extra OR to Reduce Turnover Times

- Decision-making on the day before and on the day of surgery to reduce over-utilized time
  - Decision-making on the day before and on the day of surgery to increase OR productivity
- Have a sufficient number of turnover teams to benefit from the extra OR

Increasing OR Productivity Even if Under-Utilized OR Time

- General surgery's 6 ORs all staffed for the same period, calculated based on OR efficiency
- Mean of the 6 ORs in use before add a 7th OR

  2 PM – 5 ORs 4 PM – 2.0 ORs

  3 PM – 4 ORs 5 PM – 0.6 ORs
- Mean of the 6 ORs in use after add 7th OR

  2 PM – 4 ORs 4 PM – 1.3 ORs

  3 PM – 2.0 ORs 5 PM – 0.1 ORs
- Increased OR productivity?

Increasing OR Productivity Even if Under-Utilized OR Time

- Mean ORs in use ***before*** add the 7th OR

  2 PM – 5 ORs 4 PM – 2.0 ORs

  3 PM – 4 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 Productivity Even if Under-Utilized OR Time

- Mean ORs in use ***after*** add the 7th OR

  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 Productivity Even if Under-Utilized OR Time

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

(Not counting the 7th OR)

Target Specific Service and Day of the Week Combinations

- 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 provide orthopedics with a 4th OR, those 3 ORs would still be staffed for 8 hr
  - No increase in OR productivity
    - No resulting reduction in staffing cost

Target Specific Service and Day of the Week Combinations

- ENT's staffing is 3 OR each day for 10 hr
- Mean 11 hr (SD 0.8 hr) cases per OR per day
- If provide them with a 4th OR, would reduce over-utilized OR time, and perhaps also reduce some OR's staffing to 8 hr
  - Increase in OR productivity
    - 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

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

Monitor Impact of Reducing Turnover Times by Service

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

Monitor Impact of Reducing Turnover Times by Service

Service	Mon	Tue	Wed	Thu	Fri
BURN		7			
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ORTH	6	7	7	8	6
URGENT	**24**	9	**13**	**55**	**24**
TOTAL	14	8	10	14	13

Target Specific Service and Day of the Week Combinations

- 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

Target Specific Service and Day of the Week Combinations

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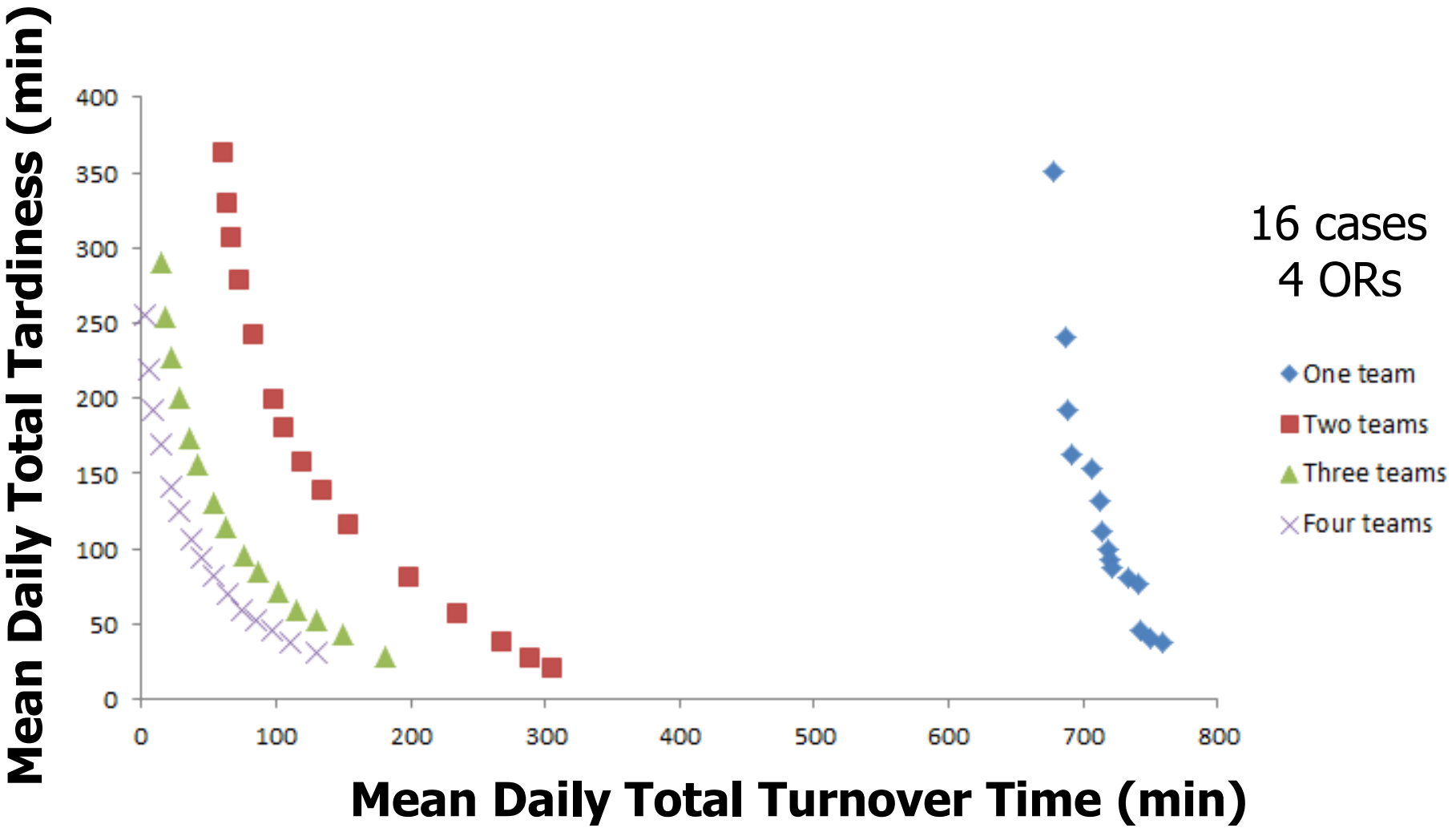
Summary of this section

Extra OR to Reduce Turnover Times

- Decision-making on the day before and on the day of surgery to reduce over-utilized time
- Decision-making on the day before and on the day of surgery to increase OR productivity
  - Have a sufficient number of turnover teams to benefit from the extra OR

Number of Teams Affects Turnover Times and Tardiness



Gül S. Serv Sci 2018

Simultaneous Turnovers to Decide If Add Turnover Team

- 5 OR surgical suite had 2 turnover teams
- Turnover times were longer when >2 cases were finishing close to simultaneously
  - 50th percentile 40 minutes
  - 90th percentile 55 minutes
  - Among turnover times 60 minutes or longer, 66% were when there were >2 turnovers

Wang J et al. Anesth Analg 2013

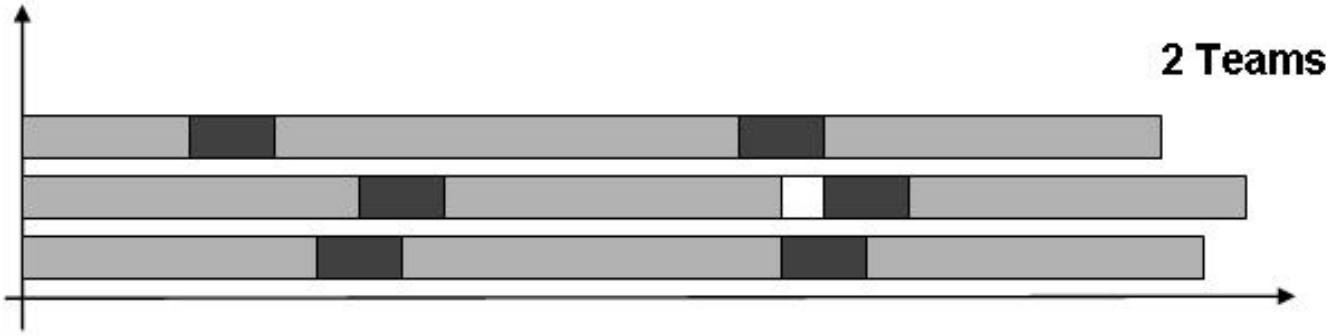
Simultaneous Turnovers to Decide If Add Turnover Team

- Analyze number of simultaneous turnovers exceeding a threshold number of teams

Dexter F et al. Anesth Analg 2009

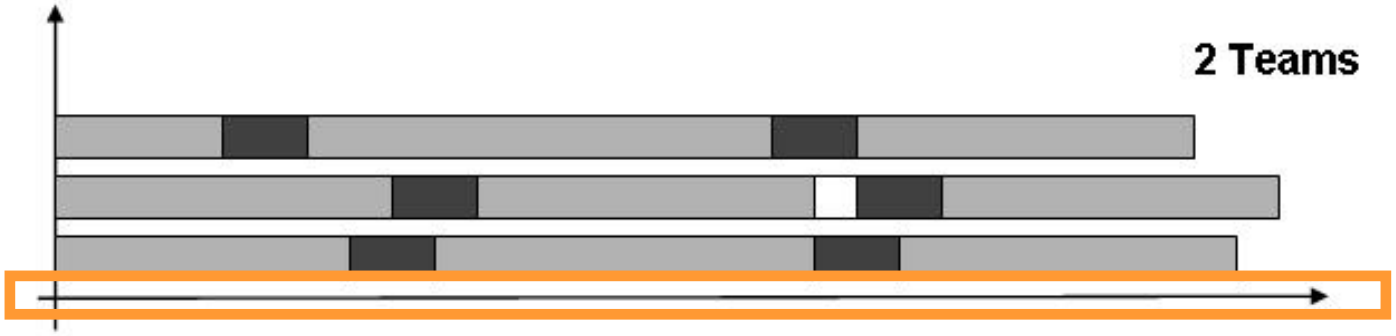
Wang J et al. Anesth Analg 2013

Simultaneous Turnovers to Decide If Add Turnover Team



- 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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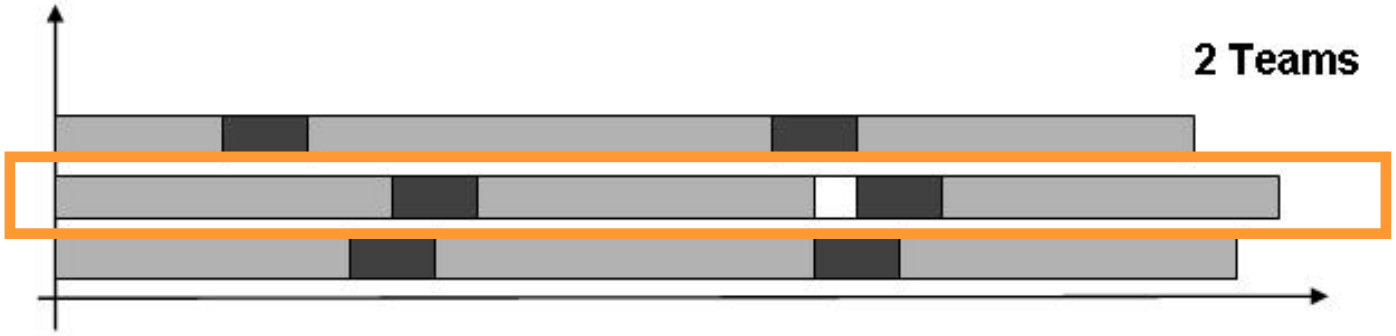

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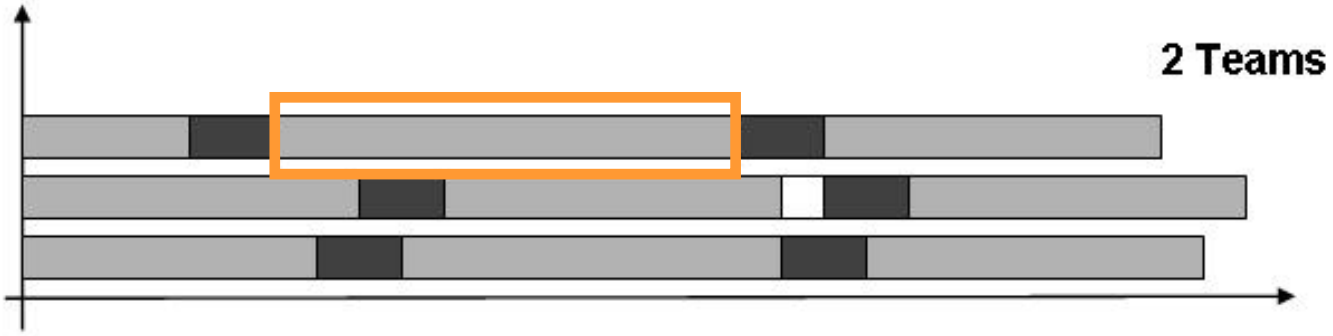

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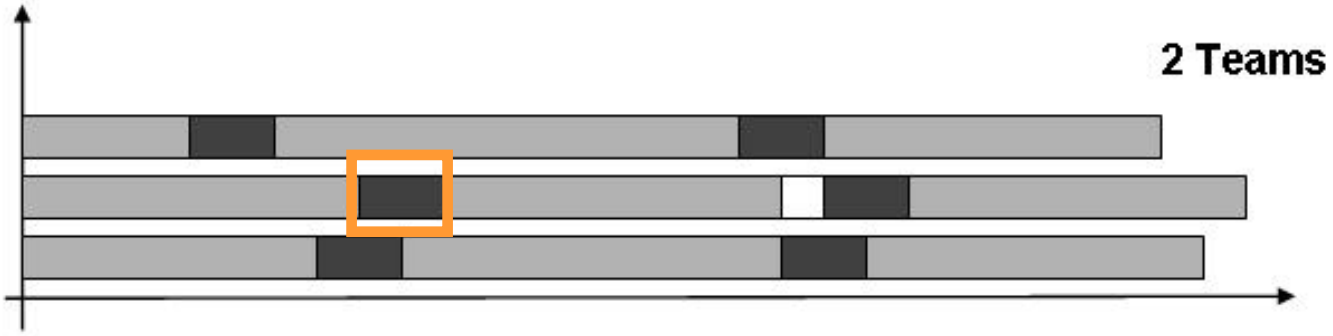

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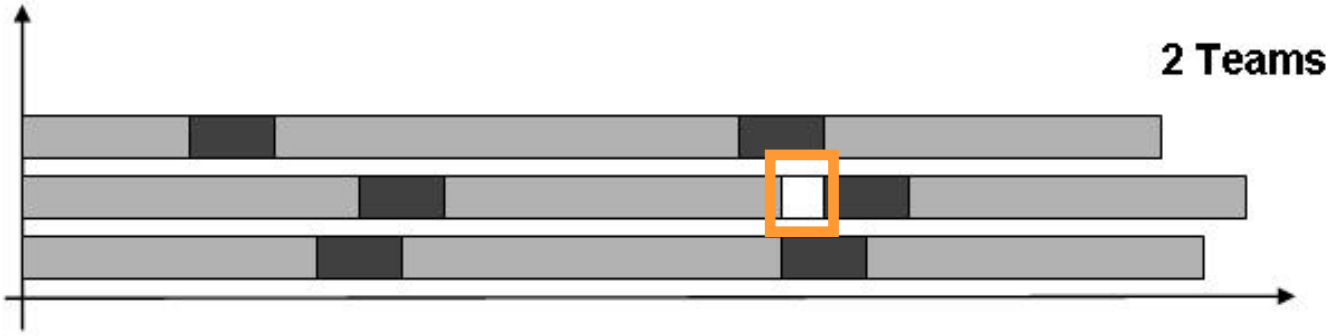

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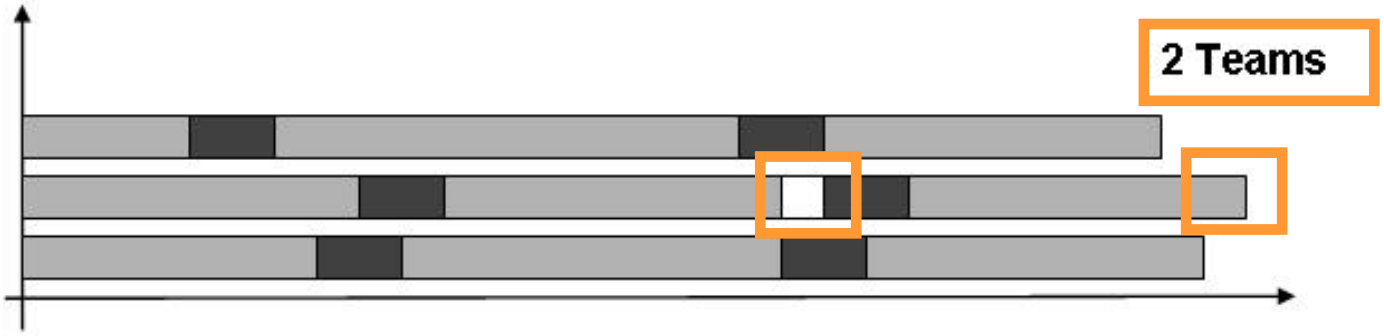

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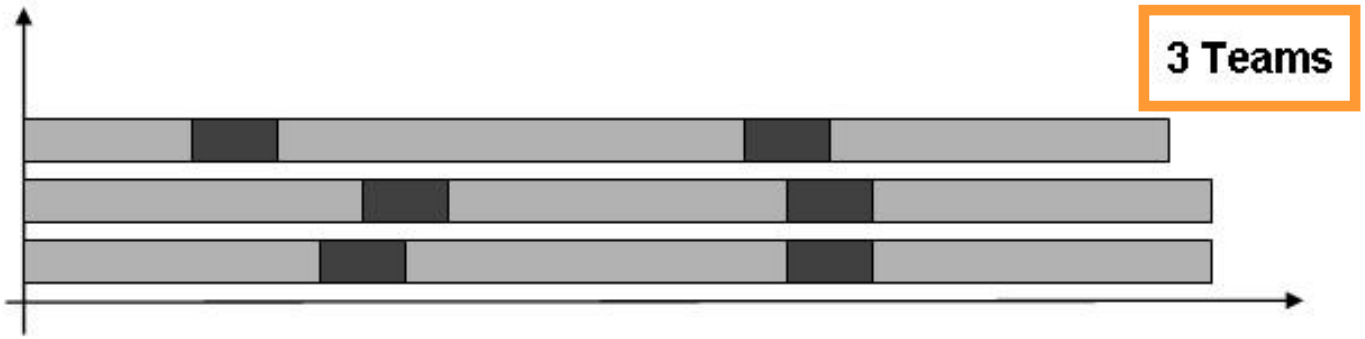
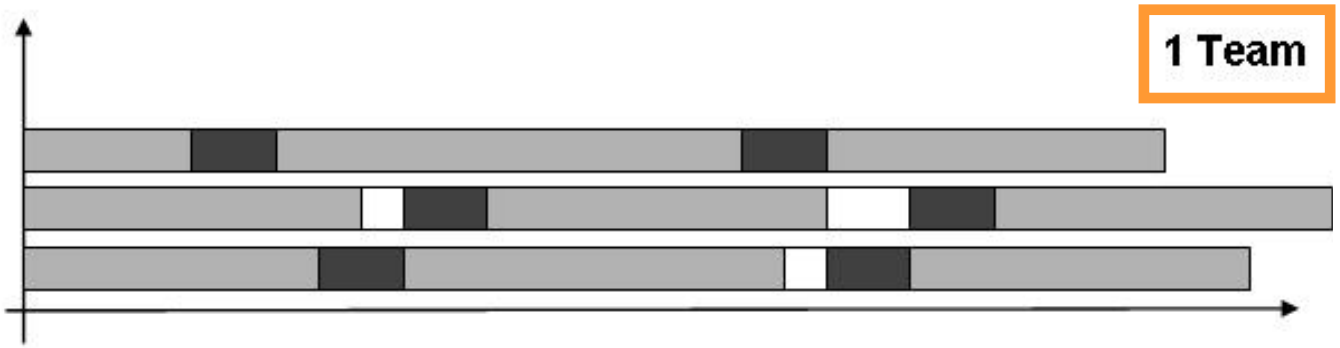


- Adding 1 team reduces the minutes of simultaneous turnovers exceeding the threshold of the number of teams from 10 min to 0 min
- Adding the 1 team also reduces the total surgeon experienced turnover time by 10 min

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

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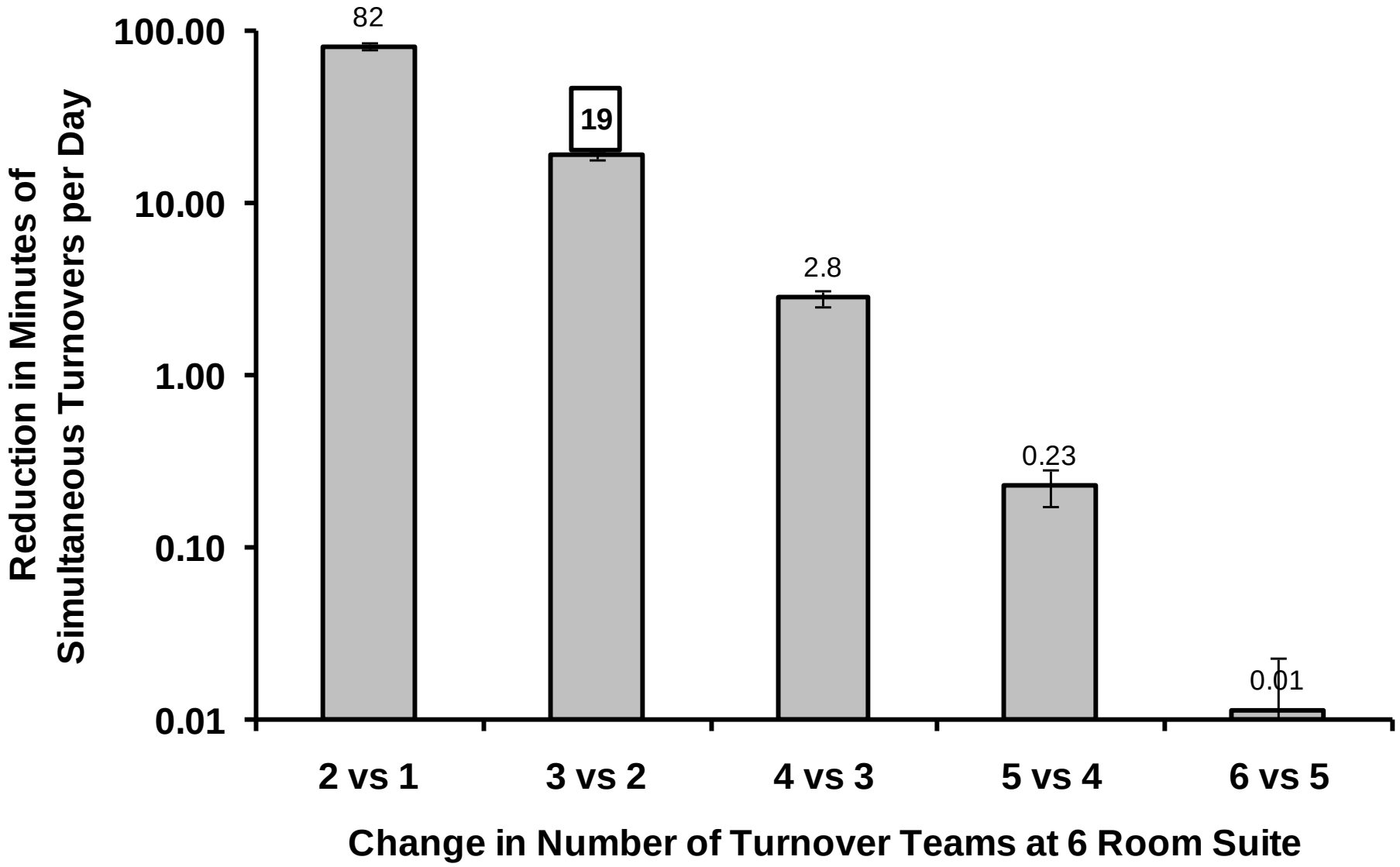
Mean ↓ Min of Turnovers per Day From Each 1 Increase in # of Teams

- $P < 0.05$ is common balance in medicine
- 5% is median annual compensation in US of housekeeper divided by that for (one patient + anesthesiologist + general surgeon + two nurses + FTE housekeeper)
- 5% is measured actual % of occurrences ORs waiting for patients at hospital without policy

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



Extra OR to Reduce Turnover Times

- Decision-making on the day before and on the day of surgery to reduce over-utilized time
- Decision-making on the day before and on the day of surgery to increase OR productivity
  - ➢ Have a sufficient number of turnover teams to benefit from the extra OR

Summary of this section

Additional Information on Operating Room Management

- www.FranklinDexter.net/education.htm
  - Full course (e.g., medical directors and analysts)
  - Lectures on day of surgery decision making, case duration prediction, allocating OR time, anesthesia staffing, financial analysis, and strategic decision-making
- www.FranklinDexter.net
  - Comprehensive bibliography of peer reviewed articles in operating room and anesthesia group management
    - Sign-up for notifications of new articles

Pretest Question #1

- Staff assignments are made the day before surgery for the extra OR used to reduce turnover times
- 4 surgeons each have lists of cases in single ORs that are suitable for being done in the extra OR, but each option for staff assignment would limit the OR to be used by 2 surgeons
- Epidemiologically, what is the simplest and most important screening criterion to choose which surgeons access the OR?

Pretest Question #2

- A facility currently has 2 housekeepers to assist in reducing turnover times
- There currently is a mean of 60 minutes daily of 3 or more simultaneous turnovers
- There currently is a mean of 30 minutes daily of 4 or more simultaneous turnovers
- Hire a housekeeper to work 7.5 hours daily to achieve this 30 minute time reduction?

Pretest Question #3

- Facility has OR time allocated for 8 hours and 10 hours periods
- On Mondays, Urology typically performs 4 cases, with 9.0 ± 1.0 hours (mean ± standard deviation) of cases and turnovers
- The turnover OR is suitable for Urology cases
- Long-term, using the turnover OR at least in part for Urology cases will likely:
  - Increase or decrease OR productivity?

Pretest Question #4

- Facility has OR time allocated for 8 hours and 10 hours periods
- On Mondays, Urology typically performs 4 cases, with 9.0 ± 1.0 hours (mean ± standard deviation) of cases and turnovers
- The turnover OR is suitable for Urology cases
- Long-term, using the turnover OR at least in part for Urology cases will likely:
  - Increase or decrease OR productivity?
  - ➢ Increase or decrease over-utilized OR time?

Answers to Pretest Questions

1. Which surgeons have scheduled more than 8 hours of cases (and turnovers)?
2. Yes, clearly so
3. Increase productivity by reducing the OR allocation from 10 hours to 8 hours
4. Increase over-utilized OR time when reduce the OR allocation to 8 hours from 10 hours