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CalculatOR™

The Operating Room, PACU, and Anesthesia Staffing Computer

All Cases

Average Hours Including Turnover Times

Example of OR Staffing Report

04/12/2004 - 12/29/2004 Weeks = 37

Service	Monday	Tuesday	Wednesday	Thursday	Friday
ENT	16.9	32.7	21.3	24.1	11.7
Gen	66.9	38.1	59.8	39.1	28.4
GynAs	21.5	12.9	17.1	6.0	14.0
Hens	0.7	0.3	0.9	0.8	2.7
Nsurg	15.4	17.9	18.8	18.4	15.3
OralS	5.9	1.2	8.3	4.4	7.9
Ortho	29.0	31.9	40.3	26.3	43.0
Pacif	7.2	9.9	5.1	4.5	5.5
Thor	9.7	9.9	7.9	9.1	9.9
Urol	27.6	33.8	3.8	25.3	37.7
Vascu	2.6	7.9	2.6	5.5	3.8
Wolf	9.0	1.0	6.3	1.3	6.2
All Elective	**212**	**198**	**193**	**165**	**186**
All Urgent	**5.0**	**8.7**	**5.8**	**8.3**	**7.8**
All OTHER Services	**3.3**	**2.7**	**3.7**	**2.3**	**6.7**

The table above lists the average number of hours of elective cases done by each service by day of the week for services doing at least 2 hours on at least one weekday. The All Urgent line reflects the average number of hours of urgent cases done by day of the week. The ALL OTHER Services line reflects the average number of hours of elective cases done by all the services combined into the OTHER group as the service assigned. Some facilities refer to OTHER as unblocked, open, first-come first-served, flexible, or overflow time.

CalculatOR™

The Operating Room, PACU, and Anesthesia Staffing Computer

1st Shift Staffing

8 Hour Room Assignments

Example of OR Staffing Report

Relative Cost = 1.75

Regularly Scheduled Hours for Full-Time Hourly or Salaried Staff

Service	Monday	Tuesday	Wednesday	Thursday	Friday
ENT	16 (16-24)	40	24	24	16
Gen	72	40	64	48	32
GynAs	24	16	16 (16-24)	8	16
Nsurg	16	24	24	24	16
OralS	8		8		8
Ortho	32	32	48	32	48
OTHER	0	0	16	16	8
Pacif	8	16			8
Thor	8	16	8	8 (8-16)	16
URGENT	8	8	8	8	8
Urol	32	40		32	48
Vascu		8		8	
Wolf	8		8		8
Total Rooms Needed	29	30	28	26	29

Rooms

Hours	8 Hr	10 Hr	13 Hr
8	1		
16	2		
24	3		
32	4		
40	5		
48	6		
56	7		
64	8		
72	9		
80	10		
88	11		
96	12		
104	13		
112	14		

The table above lists the number of hours to assign daily to each service in order to minimize the inefficiency of use of time. The numbers in parentheses are the range of hours resulting in the inefficiency of use of time up to 105% of the optimum value. If no range is given, then alternative staffing plans would result in inefficiencies of use of time higher than 105% of the optimum value. Total Rooms Needed is the minimum. Details are in McIntosh et al., Anesthesia & Analgesia, 2006.

Match the hours displayed with the corresponding values in the # Rooms table to the right. Services without assigned time on a given day of the week are combined, and its cases scheduled into the OTHER time. For application to trainee scheduling, see Dexter et al., Anesthesia & Analgesia, 2010.

The runs test did not detect a statistically significant trend or autocorrelation in forecasted staffing costs among consecutive four-week periods.

If you were to change from 8 hour rooms to 8 and 10 hour rooms, you could expect yearly savings of $94,900 ($54,900 to $134,900) (p<0.01). If you were to change from 8 hour rooms to 8, 10, and 13 hour rooms, you could expect yearly savings of $80,500 ($50,200 to $110,700) (p<0.01). Values listed are the mean (95% confidence interval).

CalculatOR™

The Operating Room, PACU, and Anesthesia Staffing Computer

1st Shift Staffing

8 and 10 Hour Room Assignments

Example of OR Staffing Report

Relative Cost = 1.75

Regularly Scheduled Hours for Full-Time Hourly or Salaried Staff

Service	Monday	Tuesday	Wednesday	Thursday	Friday
ENT	20	38	24 (24-26)	28	16
Gen	76 (76-78)	44	68 (68-70)	46 (46-50)	34 (34-38)
GynAs	24 (24-26)	16 (16-18)	20	8	16
Nsurg	18 (18-20)	20	20 (20-24)	24	18 (18-20)
OralS	8		10		10
Ortho	34 (34-36)	34 (34-36)	44 (44-46)	28 (28-30)	48 (48-50)
OTHER	0	0	16 (16-18)	10 (10-16)	8
Pacif	10	10			8
Thor	10	10	10	10	10
URGENT	8	10	8	10	8 (8-10)
Urol	30 (30-32)	38 (38-40)		28 (28-30)	46 (46-48)
Vascu		8 (8-10)		8	
Wolf	10		8		8
Total Rooms Needed	27	25	25	22	26

The table above lists the number of hours to assign daily to each service in order to minimize the inefficiency of use of time. The numbers in parentheses are the range of hours resulting in the inefficiency of use of time up to 105% of the optimum value. If no range is given, then alternative staffing plans would result in inefficiencies of use of time higher than 105% of the optimum value. Total Rooms Needed is the minimum. Details are in McIntosh et al., Anesthesia & Analgesia, 2006.

Match the hours displayed with the corresponding values in the # Rooms table to the right. Services without assigned time on a given day of the week are combined, and its cases scheduled into the OTHER time. For application to trainee scheduling, see Dexter et al., Anesthesia & Analgesia, 2010.

The runs test did not detect a statistically significant trend or autocorrelation in forecasted staffing costs among consecutive four-week periods.

The yearly savings that would result from a change from 8 and 10 hour room assignment to 8, 10, and 13 hour assignments is not statistically significant.

Rooms

Hours	8 Hr	10 Hr	13 Hr
8	1		
10		1	
16	2		
18	1	1	
20		2	
24	3		
26	2	1	
28	1	2	
30		3	
32	4		
34	3	1	
36	2	2	
38	1	3	
40		4	
40	5		
42	4	1	
44	3	2	
46	2	3	
48	1	4	
48	6		
50		5	
50	5	1	
52	4	2	
54	3	3	
56	7		
56	2	4	
58	6	1	
58	1	5	
60		6	
60	5	2	
62	4	3	
64	3	4	
64	8		
66	2	5	
66	7	1	
68	6	2	
68	1	6	
70		7	
70	5	3	
72	4	4	
72	9		
74	3	5	
74	8	1	
76	2	6	
76	7	2	
78	6	3	

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The Operating Room, PACU, and Anesthesia Staffing Computer

Cost Analysis

OR Data Apr 2004 - Dec 2004

Relative Cost = 1.75

Daily Changes in Staffing Costs from Applying the 1st Shift Solution

	Regularly-Scheduled OR Staffing		Over-Utilized OR Time		Under-Utilized OR Time		OR Staffing Costs (Regular Hrs)	
	Hours	%	Hours	%	Hours	%	Hours	%
Mean	-69	-23.1	17	6.4	-52	-50.1	**-39**	**-12.8**
Lower 95% prediction bound	-67	-22.6	24	12.8	-45	-46.3	-27	-8.9
Lower 95% confidence bound	-68	-23.0	19	8.3	-50	-49.0	-35	-11.6
Upper 95% confidence bound	-69	-23.3	15	4.5	-54	-51.3	-42	-14.0
Upper 95% prediction bound	-70	-23.6	11	0.1	-59	-53.9	-51	-16.7

To interpret the -39 (-12.8%) financially, multiply these Regular Hours by $40,625 per yearly scheduled hour, where $40,625 = ($325,000 per year) x (250 workdays per year) / (2000 hr per year). Thus, the annual mean (expected) change in cost would be -$1,579,400. The corresponding change in mean productivity expected to occur in applying the 1st shift solution is from 65% to 75%.

This cost analysis systematically underestimates expected cost reductions for two reasons. First, the analysis uses the recommended 1st shift staffing solution while excluding any 2nd shift staffing. Cases performed after 5 PM are considered to be over-utilized hours even if they would be performed by 2nd shift staff. Second, the analysis excludes methods to reduce over-utilized OR time other than matching staffing to workload. Other appropriate methods include the releasing of allocated OR time a few days before the day of surgery and the movement of cases on the day of surgery. Details are in McIntosh et al., Anesthesia & Analgesia, 2006.

Comparative maximum number of simultaneous cases from current Weekday Staffing

Day	7 AM - 3 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM
Mon	29	20	20	7	7	3	3	3	3
Tue	29	20	20	7	7	3	3	3	3
Wed	29	20	20	7	7	3	3	3	3
Thu	29	20	20	7	7	3	3	3	3
Fri	29	20	20	7	7	3	3	3	3

CalculatOR™ Change in Allocations

The Operating Room, PACU, and Anesthesia Staffing Computer

Example of OR Staffing Report

Day	Service	Current Allocation (hr)	Mean Used - Allocated (hr)	Allocation (hr)	Change in Allocation (hr)	Full Name
Mon	ENT	16	1	20	4	Otolaryngology
Mon	Gen	56	11	76	20	General Surgery
Mon	GynAs	16	6	24	8	Gyn Associates
Mon	Nsurg	16	-1	18	2	University Neurosurgeons
Mon	OralS	9	-3	8	-1	Oral Surgery
Mon	Ortho	24	5	34	10	Orthopedics
Mon	Pacif	8	-1	10	2	Pacific Vascular
Mon	Thor	14	-4	10	-4	Thoracic Surgery
Mon	Urol	24	4	30	6	Urology
Mon	Wolf	8	1	10	2	Elizabeth Wolf, MD
Mon	OTHER	12		0	-12	
Mon	URGENT			8	8	
Tue	ENT	32	1	38	6	Otolaryngology
Tue	Gen	32	6	44	12	General Surgery
Tue	GynAs	8	5	16	8	Gyn Associates
Tue	Nsurg	16	2	20	4	University Neurosurgeons
Tue	Ortho	32	0	34	2	Orthopedics
Tue	Pacif	8	2	10	2	Pacific Vascular
Tue	Thor	8	2	10	2	Thoracic Surgery
Tue	Urol	24	10	38	14	Urology
Tue	Vascu	8	0	8	0	Vascular
Tue	URGENT	10		10	1	
Wed	ENT	16	5	24	8	Otolaryngology
Wed	Gen	48	12	68	20	General Surgery
Wed	GynAs	16	1	20	4	Gyn Associates
Wed	Nsurg	16	3	20	4	University Neurosurgeons
Wed	OralS	8	0	10	2	Oral Surgery
Wed	Ortho	32	8	44	12	Orthopedics
Wed	Pacif	8	-3	0	-8	Pacific Vascular
Wed	Thor	8	0	10	2	Thoracic Surgery
Wed	Wolf	8	-2	8	0	Elizabeth Wolf, MD
Wed	OTHER	14		16	2	
Wed	URGENT	19		8	-11	
Thu	ENT	24	0	28	4	Otolaryngology
Thu	Gen	32	7	46	14	General Surgery
Thu	GynAs	8	-2	8	0	Gyn Associates
Thu	Nsurg	16	2	24	8	University Neurosurgeons
Thu	OralS		4	0	0	Oral Surgery
Thu	Ortho	24	2	28	4	Orthopedics
Thu	Pacif	8	-3	0	-8	Pacific Vascular

CalculatOR™ Change in Allocations

The Operating Room, PACU, and Anesthesia Staffing Computer

Day	Service	Current Allocation (hr)	Mean Used - Allocated (hr)	Allocation (hr)	Change in Allocation (hr)	Full Name
Thu	Thor	8	1	10	2	Thoracic Surgery
Thu	Urol	24	1	28	4	Urology
Thu	Vascu	8	-2	8	0	Vascular
Thu	OTHER	9		10	1	
Thu	URGENT	8		10	2	
Fri	ENT	8	4	16	8	Otolaryngology
Fri	Gen	24	4	34	10	General Surgery
Fri	GynAs	8	6	16	8	Gyn Associates
Fri	Nsurg	16	-1	18	2	University Neurosurgeons
Fri	OralS	8	0	10	2	Oral Surgery
Fri	Ortho	40	3	48	8	Orthopedics
Fri	Pacif	8	-2	8	0	Pacific Vascular
Fri	Thor	8	2	10	2	Thoracic Surgery
Fri	Urol	32	6	46	14	Urology
Fri	Wolf	8	-2	8	0	Elizabeth Wolf, MD
Fri	OTHER	20		8	-12	
Fri	URGENT	12		8	-4	

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The Operating Room, PACU, and Anesthesia Staffing Computer

Fixed Rooms

8 and 10 Hour Room Assignments

Example of OR Staffing Report

Regularly Scheduled Hours for Full-Time Hourly or Salaried Staff

Service	Monday	Tuesday	Wednesday	Thursday	Friday
ENT	20	38	28	30	18
Gen	76	44	72	50	40
GynAs	26	18	24	10	18
Nsurg	20	20	26	26	20
OralS	8		10		10
Ortho	34	36	48	34	52
OTHER	8	8	10	16	10
Pacif	10	16	10		8
Thor	10	16	16	16	16
URGENT	8	10	8	16	10
Urol	32	42		32	50
Vascu		10		10	
Wolf	10		10		10
Total Rooms Needed	29	29	29	27	28

Relative Cost	2.25	2.50	4.00	4.00	4.00

Rooms

Hours	8 Hr	10 Hr	13 Hr
8	1		
10		1	
16	2		
18	1	1	
20		2	
24	3		
26	2	1	
28	1	2	
30		3	
32	4		
34	3	1	
36	2	2	
38	1	3	
40		4	
40	5		
42	4	1	
44	3	2	
46	2	3	
48	1	4	
48	6		
50		5	
50	5	1	
52	4	2	
54	3	3	
56	7		
56	2	4	
58	6	1	
58	1	5	
60		6	
60	5	2	
62	4	3	
64	3	4	
64	8		
66	2	5	
66	7	1	
68	6	2	
68	1	6	
70		7	
70	5	3	
72	4	4	
72	9		
74	3	5	
74	8	1	
76	2	6	
76	7	2	
78	6	3	

Match the hours displayed with the corresponding values in the # Rooms table to the right and on the next page. There may be more than one choice of # Rooms. The Relative Cost of an hour of over-utilized time to an hour of under-utilized time was increased incrementally. The results reveal the staffing that provides allocations as close as possible to those that would maximize the efficiency of use of time while maintaining first case of the day starts. The results also assess the sensitivity of the 1st Shift Staffing results for each day of the week to the value of the Relative Cost parameter. Details are in Dexter and Macario, Anesthesia & Analgesia, 2002.

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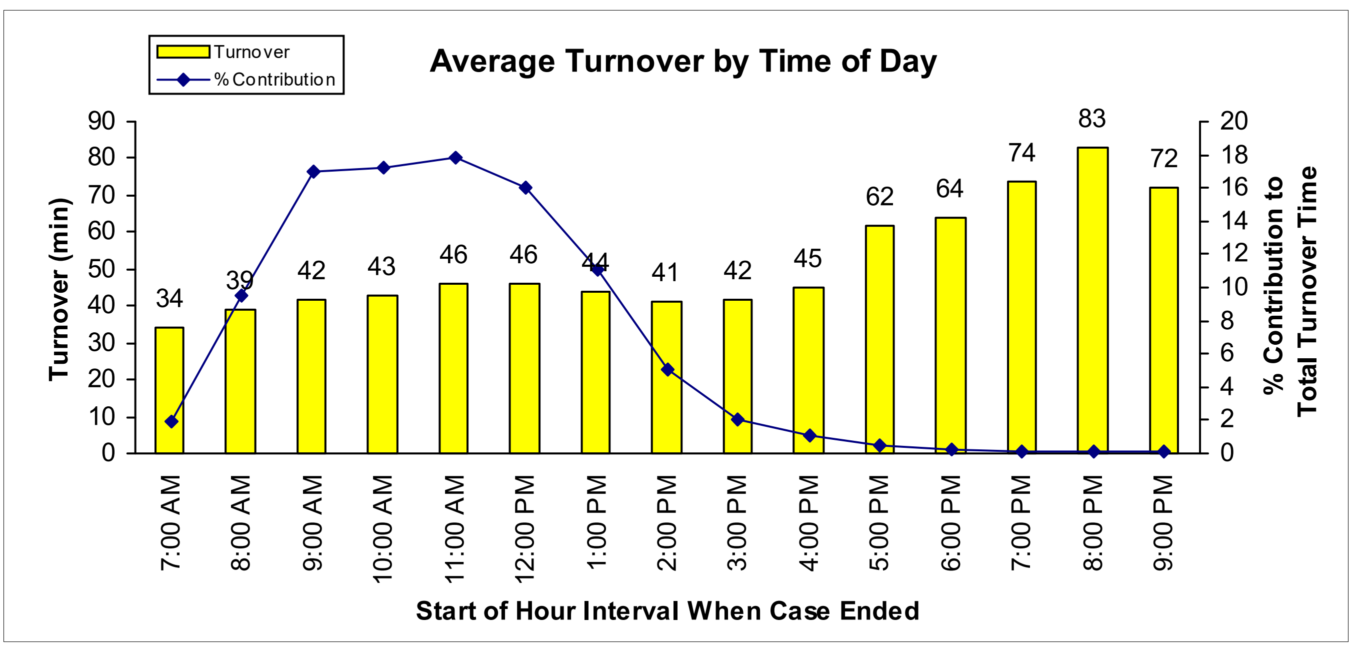
The Operating Room, PACU, and Anesthesia Staffing Computer

Turnovers & Delays

Example of OR Staffing Report

Max Turnover (minutes)	Avg Turnover (minutes)	Allocated (hours)	Underutilized (hours)	Overutilized (hours)	Cost (hours)
90	43.1	226.2	48.1	20.7	262.4
80	42.3	0.0	0.3	-0.2	-0.1%
70	41.2	-1.2	-0.3	-0.3	-0.7%
60	39.8	-2.0	-0.4	-0.4	-1.0%
50	37.8	-3.2	-0.5	-0.6	-1.6%
45	36.3	-4.8	-1.3	-0.7	-2.3%
40	34.4	-5.2	-0.9	-1.1	-2.8%
35	31.8	-6.0	-0.6	-1.5	-3.4%

The values in the top table are the daily average baseline values with the maximum turnover time between cases limited to 90 min. Savings listed in the second table are the change from the daily baseline hours and cost (expressed in units of regular time hours) with the maximum turnover time set at 90 min. This table represents the possible savings that could accrue from a reduction in the turnover time and/or delays between cases. Details are in Dexter et al. Anesthesia & Analgesia, 2003. All turnovers are included in the analysis, even those turnovers lasting longer than needed for setup and cleanup, because staff are present during the prolonged turnovers.



Each bar represents the average turnover during each hourly period of the day (e.g., 3:00 PM to 3:59 PM). The line indicates the % contribution to the total turnover time for the facility.

Cost Ratio = 1.75 **Start Date: 04/12/2004** **End Date: 12/29/2004**

CalculatOR™

The Operating Room, PACU, and Anesthesia Staffing Computer

Service-Specific Turnovers

Baseline Max Turnover = 75 min

Reduced Max Turnover = 40 min

Example of OR Staffing Report

Reduction in OR Minutes per 8 Hr of Staffed OR Time

Service	Mon	Tue	Wed	Thu	Fri
All Services	9	7	8	6	7
ENT	21	5	12	9	6
Gen	6	10	5	4	9
GynAs	10	5	20	2	9
Nsurg	9	7	6	10	12
OralS	5		23		15
Ortho	9	11	5	8	6
OTHER			11	8	9
Pacif	23	0			10
Thor	8	1	2	3	0

Largest Potential Reductions

Day	Service	Reduction
Mon	Pacif	23
Wed	OralS	23
Mon	Wolf	22
Mon	ENT	21
Wed	GynAs	20
Fri	OralS	15
Fri	Wolf	14
Wed	Wolf	13
Fri	Nsurg	12
Wed	ENT	12
Tue	Ortho	11
Wed	OTHER	11
Fri	Pacif	10
Mon	GynAs	10
Thu	Nsurg	10
Tue	Gen	10
Fri	Gen	9
Fri	GynAs	9
Fri	OTHER	9
Mon	Nsurg	9
Mon	Ortho	9
Thu	ENT	9
Tue	Vascu	9
Mon	Thor	8
Thu	Ortho	8
Thu	OTHER	8
Tue	Nsurg	7
Fri	ENT	6
Fri	Ortho	6
Mon	Gen	6
Mon	Urol	6
Wed	Nsurg	6
Mon	OralS	5

Results tend to be only weakly sensitive to the average turnover time for each service, because of four important factors. First, reductions in OR minutes exceed total reductions in turnover time, because 1 min of over-utilized OR time is more expensive than 1 min of staffed OR time. Second, baseline under-utilized and over-utilized OR times vary among services (e.g., reducing turnover time cannot reduce staffing costs for services with workloads less than 8 hr per OR per day). Third, services' average turnover times vary among days of the week, because different procedures are performed. Fourth, numbers of turnovers per OR per day vary among services (e.g., reducing turnover time has a small effect when there is just 1 turnover per OR per day). Details are in McIntosh et al. Anesthesia & Analgesia, 2006.

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The Operating Room, PACU, and Anesthesia Staffing Computer

Benchmark Turnovers

Type	Practice	# ORs	Cases per year	25th percentile	75th percentile	Mean
Ambulatory	Academic	6	6118	12	25	21
Ambulatory						24
Ambulatory						27
Ambulatory						27
Ambulatory						29
Ambulatory	Private		4210	17	36	30
Hospital	Academic		8209	7	30	20
Hospital						21
Hospital						23
Hospital						23
Hospital						24
Hospital						25
Hospital						25
Hospital						25
Hospital						25
Hospital						26
Hospital						26
Hospital						28
Hospital						28
Hospital						29
Hospital						29
Hospital						29
Hospital						30
Hospital						31
Hospital						31
Hospital						31
Hospital						31
Hospital						31
Hospital						31
Hospital	Private	19	17174	18	42	32

Table is filled in for a real consult

"Turnover time" was from when one patient left an OR until another patient entered the same OR on the same day, provided both cases were elective and the time was 90 min or less. The N > 1000 turnovers for all facilities. Details are in Dexter et al., Anesthesiology, 2005.

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The Operating Room, PACU, and Anesthesia Staffing Computer

Benchmark Turnovers

Type	Practice	# ORs	Cases per year	25th percentile	75th percentile	Mean	
Hospital						32	
Hospital						32	
Hospital						32	
Hospital						32	
Hospital						33	
Hospital						33	
Hospital						33	
Hospital						33	
Hospital						34	
Hospital						34	
Hospital						35	
Hospital						35	
Hospital						35	
Hospital						36	
Hospital						36	
Hospital						37	
Hospital						37	
Hospital						37	
Hospital						38	
Hospital	Academic	31	16315	29	48	38	Your Facility
Hospital						40	
Hospital						41	
Hospital						42	
Hospital						45	
Hospital						47	
Hospital						49	
Hospital						49	
Hospital						55	
Hospital	Private	12	20117	36	68	58	

Table is filled in for a real consult

"Turnover time" was from when one patient left an OR until another patient entered the same OR on the same day, provided both cases were elective and the time was 90 min or less. The N > 1000 turnovers for all facilities. Details are in Dexter et al., Anesthesiology, 2005.

Printed: 02/24/2009

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The Operating Room, PACU, and Anesthesia Staffing Computer

Prolonged Turnovers

Example of OR Staffing Report

Percentages of Turnovers that are Both Prolonged and Occurred at the Specified Hour of the Day

Hour of the day	Prolonged turnovers	95% confidence interval
8:00 - 8:59	1.6%	1.3% to 1.9%
9:00 - 9:59	3.3%	2.4% to 4.2%
10:00 - 10:59	3.8%	3.2% to 4.5%
11:00 - 11:59	4.5%	3.8% to 5.2%
12:00 - 12:59	3.8%	3.1% to 4.5%
13:00 - 13:59	2.6%	2.0% to 3.2%
14:00 - 14:59	0.9%	0.6% to 1.2%
15:00 - 15:59	0.4%	0.2% to 0.5%
16:00 - 16:59	0.2%	0.0% to 0.3%
Overall	21.4%	20.3% to 22.5%

Prolonged Turnovers were defined as those > 15 min longer than the mean. Turnovers < 90 min had a mean of 38.8 min. During the most recent 13 four-week periods, there were 9,348 turnovers. Among these, 2,003 were prolonged, lasting 53.8 min or longer. Confidence intervals were calculated with Bonferroni correction for the multiple comparisons of the hours of the day chosen automatically for analysis. Details are in Dexter et al., Anesthesiology, 2005. Interventions to reduce prolonged turnovers include reducing scheduled delays between cases ('holes') and adjusting staff schedules to focus on those times of the day with the most prolonged turnovers.

Turnover Teams

Example of OR Staffing Report

	8 to 9	9 to 10	10 to 11	11 to 12
Minimum expected reduction in minutes per day of simultaneous turnovers exceeding number of turnover teams	85	20	0	0
Maximum potential reduction in minutes of turnover time per day by increasing number of turnover teams	196	61	17	6

The number and total minutes of simultaneous turnovers was calculated for each 1 minute over the past 1 year. The first row of numbers gives the lower 95% confidence bound for the mean reduction, in minutes, of simultaneous turnovers achieved by increasing the number of turnover teams by 1. For example, if there were 9 turnover teams and 1 more were added, then the minimum expected reduction in daily minutes of turnover times would be 20 minutes. Details and explanation are in Dexter et al., Anesthesia & Analgesia, 2009. The second row gives the maximum potential reduction in total turnover time. All cases were included, with or without a member of the anesthesia care team.

CalculatOR™

The Operating Room, PACU, and Anesthesia Staffing Computer

Cancellations

Example of OR Staffing Report

Service	Cancellation Rate	95% Confidence Interval	Full Name of Service
Gyn	12.9%	7.5% to 19.4%	Gynecology Group
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
Ortho	15.2%	11.3% to 19.6%	Orthopedics
ENT	16.1%	13.3% to 19.1%	Otolaryngology
Gen	16.5%	11.8% to 21.9%	General Surgery
Thor	22.0%	18.3% to 26.0%	Thoracic Surgery
Wolf	24.0%	14.5% to 35.0%	Elizabeth Wolf, MD
Vascu	20.4%		Vascular
Waters	35.4%		Rachel Waters, MD
Grand Total	16.7%	15.5% to 17.9%	

Cancellations were quantified for elective cases from Jul 16 2004 to Dec 31 2004. A cancellation was included if the case was cancelled within one day of surgery. Services without a listed confidence interval had < 1 cancellation per four-week period. Although estimates of the cancellation rates were provided for such services, those values are suspect. For each of 6 four-week periods, the Freeman-Tukey double arcsine transformation was applied to the observed cancellation rate. The confidence interval was calculated using Student's t distribution. Bisection was used to find the inverse of the transformation. Details are in Dexter F et al., Anesthesia & Analgesia, 2005 and 2012. This report by case quantifies cancellation from a patient perspective, not surgeon. See Ehrenfeld J et al. Anesthesia & Analgesia 2013.

Example of OR Staffing Report

Lower 95% Confidence Bounds for Underestimation of Case Duration (Minutes) Reported Per 8 Hours of Used OR Time

Urol	-1	Urology
ENT	-1	Otolaryngology
Nsurg	-1	University Neurosurgeons
Gen	-1	General Surgery
Vascu	-1	Vascular
Ortho	-2	Orthopedics
GynPC	-2	Gyn Associates
OralS	-2	Oral Surgery
Pacif	-2	Pacific Vascular
Waters	-3	Rachel Waters, MD
Thor	-3	Thoracic Surgery
Wolf	-3	Elizabeth Wolf, MD

Since the overall bias is -0.1 min, case duration estimation is unlikely to be contributing substantively to overall excess staffing costs. For each four-week period, a ratio was computed for each service. The numerator in minutes equaled the sum of the differences between actual case duration and scheduled case duration for each of the service's cases during the four-week period. The denominator in hours equaled the sum of the durations of all cases performed by the service during the four-week period. The ratio was multiplied by 8 hr. The result was the four-week period's bias in the service's scheduled case durations reported per 8 hr of used OR time. The services listed had at least 5 four-week periods with at least 10 cases and at least 8 hr of used OR time. Details are in Dexter et al., Canadian Journal of Anesthesia, 2005 and Dexter & Epstein, Anesthesia & Analgesia, 2024.

Example of OR Staffing Report

2.4619 α, Bayesian (inverse gamma) parameter
0.1762 β

n_k	Geometric Mean	SEM (%)	Surgeon	Procedure
112	0.28	5.6%	Surgeon 1	Esophagogastro Duodenoscopy
108	0.86	5.1%	Surgeon 1	ERCP With Anesthesia
107	0.86	4.8%	Surgeon 2	Enteroscopy
105	8.01	3.0%	Surgeon 3	Whipple Procedure
104	2.93	2.8%	Surgeon 4	Left Total Hip Revision
103	0.54	2.0%	Surgeon 5	EGD & Colonoscopy
102	1.16	3.3%	Surgeon 6	Right Inguinal Hernia Repair
101	0.67	3.5%	Surgeon 1	EGD & Colonoscopy
100	0.30	3.8%	Surgeon 5	EGD
99	3.16	3.4%	Surgeon 7	Neck Exploration, Parathyroidectomy
98	0.67	2.8%	Surgeon 8	EGD & Colonoscopy
84	2.72	1.9%	Surgeon 4	Bilateral Total Knee Replacement
67	1.95	2.2%	Surgeon 9	Laparoscopic Cholecystectomy, Possible Open
47	3.81	3.5%	Surgeon 7	Total Thyroidectomy
38	3.56	5.9%	Surgeon 10	Robotic Myomectomy, Hysteroscopy

(email Franklin-Dexter@Uiowa.edu for Excel worksheet with the other 5140 combinations)
Effective number of common combinations is 488.2 [standard error 4.9]

The 3rd parameter τ is not listed because it can be set to any reasonable value (e.g., τ = 5 cases). See Dexter et al., Anesthesia & Analgesia, 2013. The Bayesian methods for analyzing case duration data are useful for predicting the longest amount of time cases may take (i.e., create a hole, fill a hole, or prevent a hole in the OR schedule); for avoiding conflicts over resources (e.g., microscope to be used in each of two ORs); and for calculating the times remaining in late running cases. These methods can be used accurately even when there are 0, 1, 2, etc., previous cases of the same combination of procedure(s), surgeon, and anesthesia. See Dexter et al., Anesthesia & Analgesia, 2010. Applying the listed parameters involves lookup table and arithmetic. Store the Student-t statistics in a lookup table as described in Appendix 2 of Dexter et al., Anesthesia & Analgesia, 2009. Substitute ln(geometric mean) and $(\ln(1 + \mathrm{SEM}))^2(n_k-1)(n_k)$ into equations (2-4) of Dexter & Ledolter, Anesthesiology, 2005. The diversity measure is from Dexter et al. Anesthesia & Analgesia, 2016.

Tardiness of Starts

Example of OR Staffing Report

Time from start of day	Service	Average (minutes)	95% Confidence Interval (minutes)			Full Name
First case	Gen	26	22	to	30	General Surgery
	Gyn	22	18	to	26	Gynecology
	Nsurg	34	29	to	39	Neurosurgeons
	Ortho	43	35	to	50	Orthopedics
	Urol	28	25	to	31	Urology
	Overall	32	29	to	35	
0:05 to 2:00 hr	Gen	36	30	to	42	General Surgery
	<Other services printed here>					
	Overall	49	46	to	52	
2:05 to 4:00 hr	Gen	72	63	to	80	General Surgery
	<Other services printed here>					
	Overall	84	80	to	87	
4:05 to 6:00 hr	ENT	88	76	to	99	Otolaryngology
	Gen	65	56	to	75	General Surgery
	Ortho	63	54	to	71	Orthopedics
	Urol	83	71	to	95	Urology
	Overall	72	67	to	76	
6:05 or more hr	Gen	23	8	to	38	General Surgery
	Ortho	23	6	to	39	Orthopedics
	Overall	29	23	to	35	

Tardiness is the difference between the actual time of patient entry into his or her OR and the scheduled time. If the difference is negative, tardiness is set equal to zero. In addition, the 7.5% of observations during the studied period (Jul 16 2004 to Dec 31 2004) that exceeded 180 minutes were set equal to that value. "Overall" includes non-Urgent cases of all Services. The confidence interval for mean tardiness was calculated by pooling the data into six successive four-week periods. An average was calculated for each four-week period. The confidence interval was calculated using Student's t distribution applied to the mean and standard deviation of the 6 averages. Results are reported for Services with at least 10 tardiness values for each of the 6 four-week perios. The starts of the workday used were: Mon 7:10, Tue 7:10, Wed 7:10, Thu 8:10, and Fri 7:10. Details are in Wachtel and Dexter, Anesthesia & Analgesia, 2009.

Example of OR Staffing Report

Weekday	Service	10% Prediction Bound	5% Prediction Bound	Example of 5% Bound Applied to Scheduled Start of 12 noon
Mon	ENT	0.838	0.698	10:45
Mon	Gen	0.742	0.442	9:40
Mon	GynAs	1.032	0.985	11:55
Mon	Nsurg	0.571	0.481	9:50
Mon	OralS	0.648	0.546	10:05
Mon	Ortho	0.701	0.551	10:05
Mon	Pacif	0.869	0.778	11:05
Mon	Thor	0.764	0.682	10:50
Mon	Urol	1.041	0.700	10:45
Mon	Vascu	0.356	0.316	9:10
Mon	Wolf	1.045	0.869	11:25
Tue	ENT	0.982	0.823	11:15
Tue	Gen	0.911	0.738	10:55
Tue	GynAs	0.996	0.956	11:50
Tue	Nsurg	0.872	0.796	11:10
Tue	OralS	0.684	0.547	10:05
Tue	Ortho	0.847	0.765	11:10
Tue	Pacif	0.925	0.827	11:20
Tue	Thor	0.796	0.690	10:40
Tue	Urol	1.004	0.770	11:00
Tue	Vascu	0.963	0.865	11:25
Tue	Wolf	0.705	0.574	10:15
Wed	ENT	0.796	0.719	10:50
Wed	Gen	0.785	0.693	10:45
Wed	GynAs	0.956	0.861	11:25
Wed	Nsurg	0.464	0.331	9:10
Wed	OralS	0.796	0.729	11:00
Wed	Ortho	0.832	0.569	10:10
Wed	Pacif	0.834	0.824	11:15
Wed	Thor	0.391	0.335	9:15
Wed	Urol	0.809	0.759	11:00
Wed	Vascu	0.610	0.345	9:15
Wed	Wolf	0.968	0.876	11:30
Thu	ENT	0.962	0.891	11:40
Thu	Gen	0.722	0.497	10:25
Thu	GynAs	1.150	1.001	12:00
Thu	Nsurg	0.562	0.400	10:05
Thu	OralS	1.034	0.534	10:30
Thu	Ortho	0.891	0.798	11:20
Thu	Pacif	0.869	0.778	11:05
Thu	Thor	0.959	0.950	11:50
Thu	Urol	0.933	0.774	11:15
Thu	Vascu	0.646	0.508	10:25
Thu	Wolf	0.874	0.870	11:35

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The Operating Room, PACU, and Anesthesia Staffing Computer

Earliness of Starts

Weekday	Service	10% Prediction Bound	5% Prediction Bound	Example of 5% Bound Applied to Scheduled Start of 12 noon
Fri	ENT	0.897	0.768	11:00
Fri	Gen	0.986	0.904	11:35
Fri	GynAs	1.170	1.041	12:00
Fri	Hens	0.783	0.577	10:15
Fri	Nsurg	1.076	0.954	11:50
Fri	OralS	0.927	0.828	11:15
Fri	Ortho	0.819	0.678	10:40
Fri	Pacif	0.956	0.908	11:40
Fri	Thor	0.865	0.733	10:55
Fri	Urol	1.006	0.950	11:45
Fri	Vascu	0.703	0.443	9:40
Fri	Wolf	0.669	0.582	10:20

Use Acrobat Select Text and Export Selection as Excel Workbook. Using your OR information system's report writer or a spreadsheet program, calculate daily the earliest time at which each of your patients should be ready to enter the OR using the third column and equation 2 of Wachtel and Dexter, Anesthesia & Analgesia, 2007, with the turnover time set at 40 minutes. Prediction bounds were calculated as described on page 135 of that paper. Bounds take into account the incidence of cases being moved, preceding cases in the patient's room being cancelled, and predictive variability in case durations. The 10% prediction bounds are included as a sensitivity analysis. When substantially different from 5% bounds to be used, critique qualitatively why this would be so. Determine fasting times for each patient by subtracting a medically appropriate interval based on the patient's age and service (e.g., 3 hr for clear liquids). Determine the time of patient arrival by subtracting the 90% upper prediction bound for the time to prepare patients, of the same age and service, who are not having surgery at the start of the workday (see Dexter et al. Anesthesia & Analgesia, 2007).

Example of OR Staffing Report

Maximum Eight-Hour Blocks Per 2 Weeks

Service	Surgeon	
ENT	Surgeon 1	3
	Surgeon 2	2
	Surgeon 3	1
	Surgeon 4	4
	Surgeon 5	2
	Surgeon 6	5
	Surgeon 7	2
Gen	Surgeon 8	2
	Surgeon 9	1
	Surgeon 10	3
	Surgeon 11	4
	Surgeon 12	6
	Surgeon 13	6
	Surgeon 14	6
	Surgeon 15	7
	Surgeon 16	4
	Surgeon 17	5
	Surgeon 18	6

<Continued for other services, but not printed>

CalculatOR reports are based on surgeons being provided open access to OR time on any future workday for elective cases. Surgeon blocks can be used to enhance the likelihood that available scheduled start times are convenient, but at the expense of a reduction in flexibility. Only once a surgeon has filled or released his or her block time over a four week cycle can he or she can schedule an elective case outside of block time. The table shows the maximum number of eight-hour blocks for each surgeon. Each surgeon makes his or her own decision as to how many blocks to be allocated. There is no target utilization to be maintained. Allocations are calculated to be small enough to be filled consistently by its surgeons' cases. Details are in Dexter et al., Anesthesia & Analgesia, 1999. The blocks were calculated with 12 four-week periods of data. Turnovers were attributed to the preceding case of a pair of elective cases..

Example of OR Staffing Report

Threshold For Staffing Another Operating Room

Last Day of 4-Week Period	Overall Hours of Elective Cases and Turnovers per 20 Workdays and per Each of 29 ORs
02/27/2004	6.4
03/26/2004	6.3
04/23/2004	6.6
05/21/2004	6.9
06/18/2004	6.5
07/16/2004	6.0
08/13/2004	6.6
09/10/2004	5.9
10/08/2004	6.8
11/05/2004	6.9
12/03/2004	6.3
12/31/2004	5.5

6.8 80% Upper Prediction Bound

Does Not Exceed Threshold of 8 Hr per Workday per OR

Statistical methods can guide when a facility opens another OR. The mean and standard deviation of the total hours of OR time and turnovers during 12 consecutive four week periods were used to calculate a suitable (80%) prediction bound for future workload using Student's t-distribution. Another OR can be staffed if the chosen prediction bound for future workload exceeds some threshold, such as 8 hr per workday per OR. Details are in Dexter et al., Anesthesiology, 1999, Masursky et al., Anesthesia & Analgesia, 2008, Dexter and Marco, Anesthesia & Analgesia, 2011, and Dexter et al., Journal of Clinical Anesthesia, 2018.

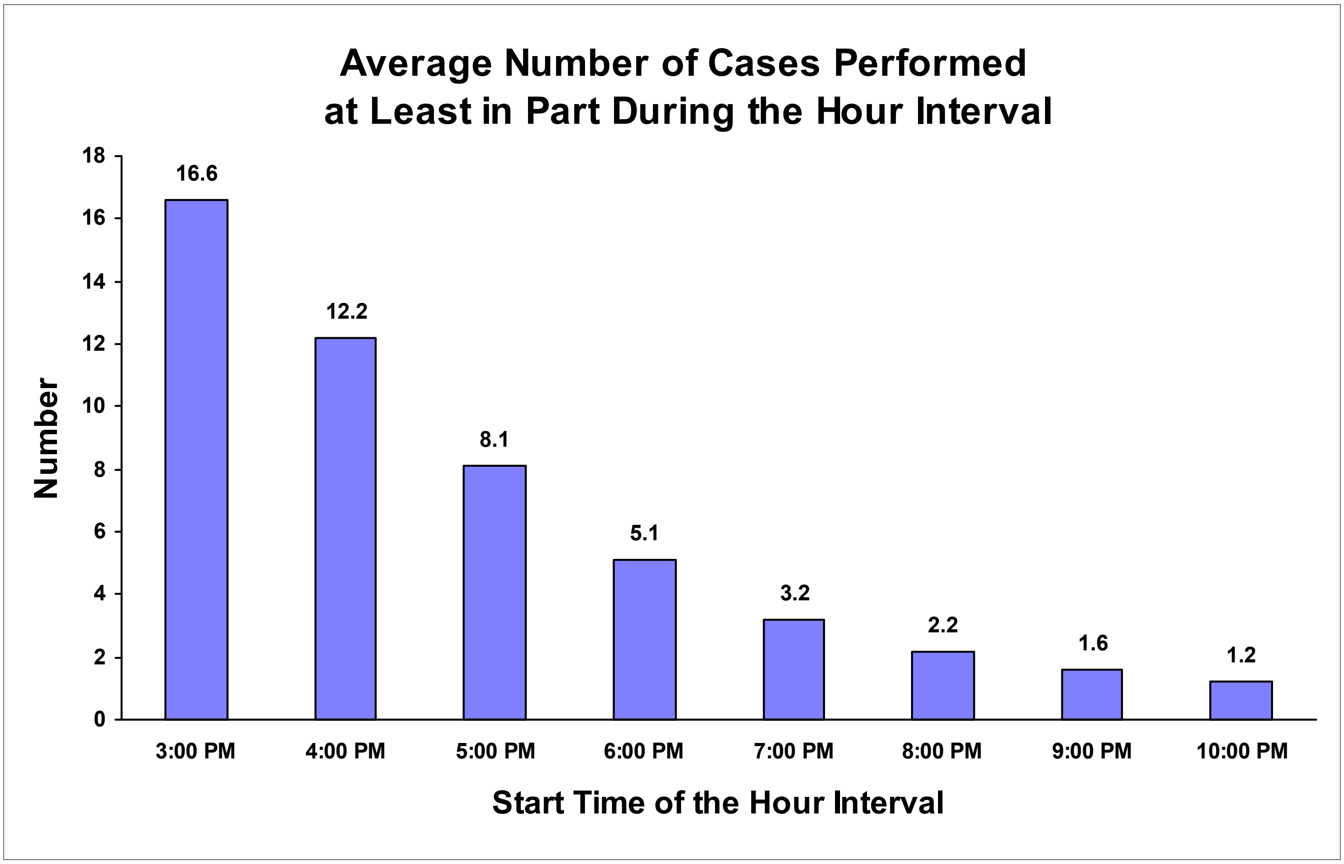
CalculatOR™

The Operating Room, PACU, and Anesthesia Staffing Computer

2nd Shift Case Count

5 PM to 7 PM

Example of OR Staffing Report



Start Date **07/01/2002**

End Date **12/29/2004**

Average number of cases running during each hour interval from 3 PM to 11 PM. Each interval starts on the hour and ends at 59 minutes past the hour. For example, the 3 PM interval includes all cases that were in progress at any time between 3 PM and 3:59 PM, inclusive.

CalculatOR™

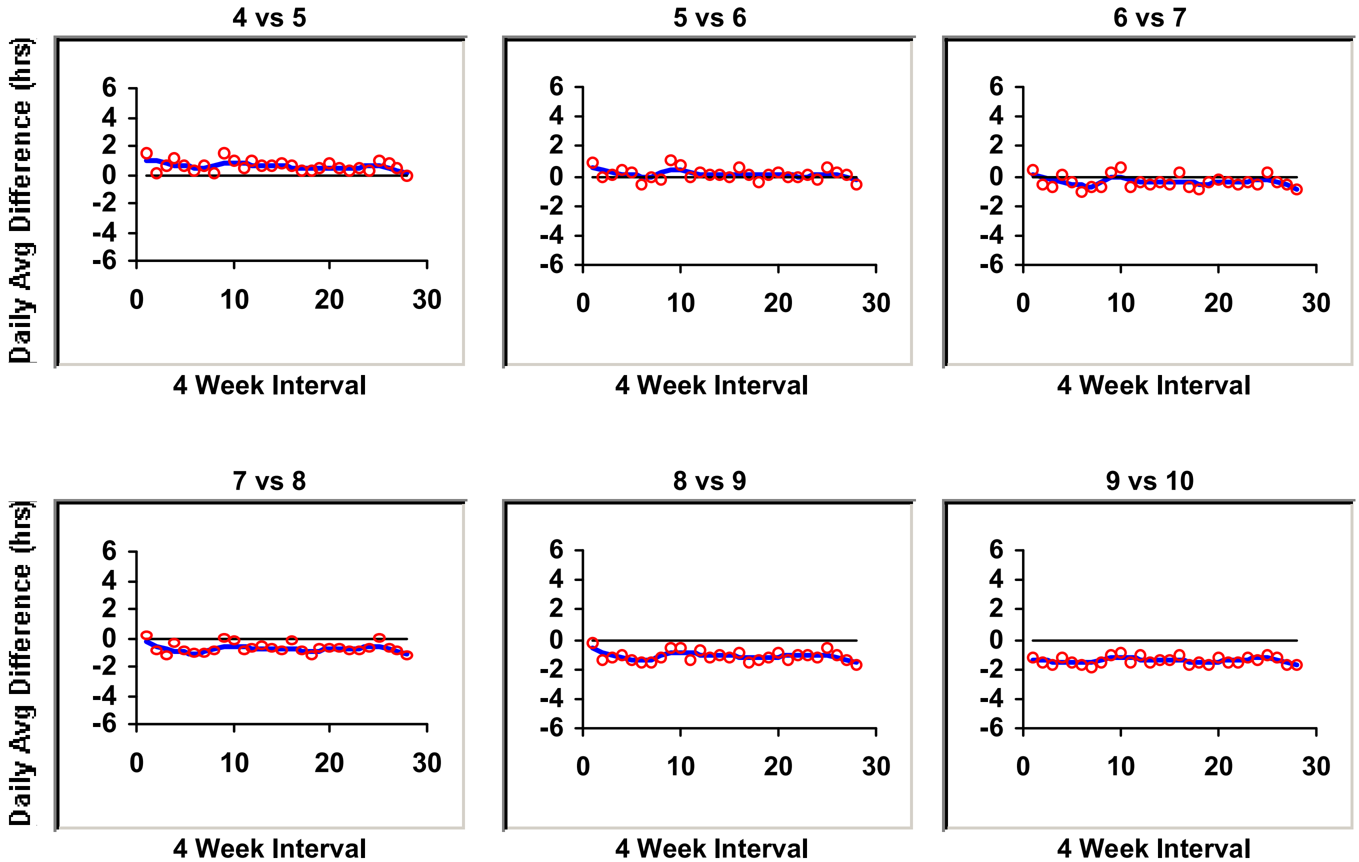
The Operating Room, PACU, and Anesthesia Staffing Computer

2nd Shift Staffing

5 PM to 7 PM

Example of OR Staffing Report

Relative Cost = 1.75



Based on an annual salary per OR of $325,000, a difference of one hour per day translates into a yearly cost of $40,625, where $40,625 = ($325,000 per year) x (250 workdays per year) / (2000 hr per year). Results show that you should provide 2nd shift staffing from 5 PM to 7 PM for either 5 or 6 cases. Details are in Dexter and Epstein, AORN Journal, 2003.

2nd Shift Staffing

Example of OR Staffing Report

Afternoon teams scheduled to work after 3 PM (compare to 2nd Shift Case Count)

Time	Recommended	Current
3 PM - 5 PM	9	20
5 PM - 7 PM	5	7
7 PM - 11 PM	1	3

Afternoon teams available to work late, if necessary ("on call")

Time	Recommended	Current
3 PM - 5 PM	1	9
5 PM - 7 PM	4	9
7 PM - 11 PM	2	9

The 2nd Shift Staffing analysis is not based on the efficiency of use of OR time. Rather, it is based on the existing cases being done on precisely the same date and time as before. For valid implementation, change should have no noticeable effect on either surgeons or patients. Consequently, both Anesthesia and Nursing can implement immediately, based on the analysis. Details are in Dexter and Epstein, AORN Journal, 2003.

Start Date **07/01/2002**

End Date **12/29/2004**

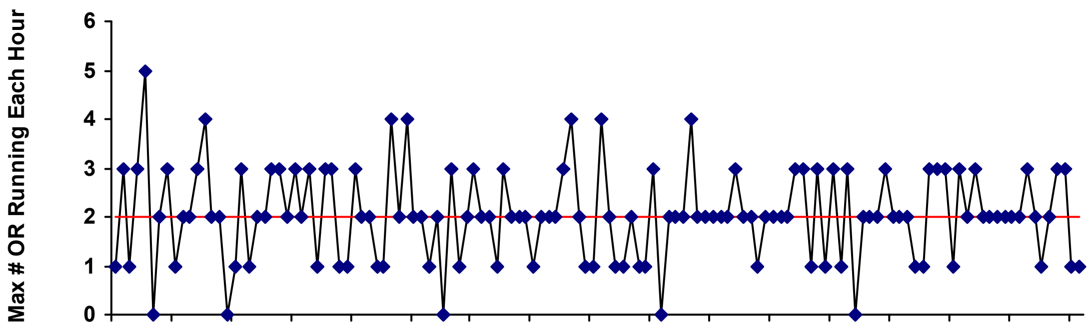
Example of OR Staffing Report

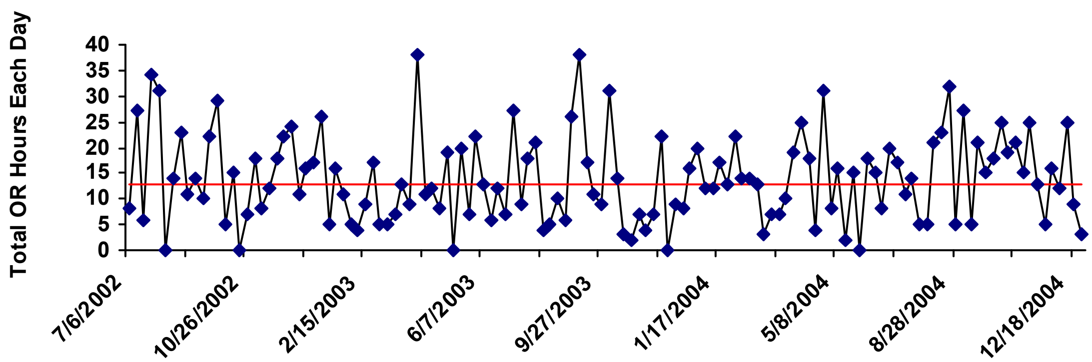
Criterion	Day of Week	Median	80th percentile
≥ 6 ORs			
	Monday	4 PM	6 PM
	Tuesday	5 PM	7 PM
	Wednesday	5 PM	7 PM
	Thursday	6 PM	7 PM
	Friday	6 PM	7 PM
≥ 5 ORs			
	Monday	6 PM	8 PM
	Tuesday	7 PM	8 PM
	Wednesday	7 PM	8 PM
	Thursday	7 PM	8 PM
	Friday	7 PM	8 PM
≥ 4 ORs			
	Monday	7 PM	9 PM
	Tuesday	7 PM	8 PM
	Wednesday	7 PM	9 PM
	Thursday	8 PM	9 PM
	Friday	8 PM	9 PM
≥ 3 ORs			
	Monday	8 PM	9 PM
	Tuesday	8 PM	10 PM
	Wednesday	8 PM	10 PM
	Thursday	8 PM	> 11 PM
	Friday	9 PM	> 11 PM
≥ 2 ORs			
	Monday	9 PM	10 PM
	Tuesday	10 PM	> 11 PM
	Wednesday	9 PM	10 PM
	Thursday	10 PM	> 11 PM
	Friday	10 PM	> 11 PM
≥ 1 ORs			
	Monday	10 PM	> 11 PM
	Tuesday	10 PM	> 11 PM
	Wednesday	> 11 PM	> 11 PM
	Thursday	> 11 PM	> 11 PM
	Friday	> 11 PM	> 11 PM

The data analyzed statistically are the number of cases performed at least in part each hour. The '80th percentile' is the 95% upper confidence bound on the 80th percentile. For example, there is a > 95% chance that there will be 2 or fewer cases running at 9 PM on 4 out of 5 Mondays. The 80th percentile provides realistic expectations for the earliest time at which staff can reliably plan to be finished when they are scheduled to work late. The median can be used when individuals are deciding months in advance whether to sign up to work late if necessary. Details are in Dexter et al., Anesthesia & Analgesia, 2009.

Example of OR Staffing Report

The graphs below show your weekend activity for the period of time included in the dataset analyzed. The horizontal red line on each graph represents the median value. The Staff Shift Assignments to cover this workload are on the other page of this weekend OR Staffing report.





There were no statistically significant trends in either Maximum # OR Running Each Hour or Total OR Hours Each Day.

CalculatOR™

The Operating Room, PACU, and Anesthesia Staffing Computer

Saturday OR Staffing

Understaffed Risk = 5%

Example of OR Staffing Report

Saturday Shifts

Shift #	Start Time	End Time	Duration (hr)
1	07:00 AM	07:00 AM	24
2	07:00 AM	03:00 PM	8
3	07:00 AM	05:00 PM	10
4	07:00 AM	07:00 PM	12
5	07:00 AM	09:00 PM	14
6	07:00 AM	11:00 PM	16
7	11:00 AM	07:00 PM	8
8	11:00 AM	11:00 PM	12
9	11:00 PM	07:00 AM	8
10	03:00 PM	11:00 PM	8
11	03:00 PM	07:00 AM	16
12	05:00 PM	07:00 AM	14
13	07:00 PM	07:00 AM	12
14	09:00 PM	07:00 AM	10
15	11:00 PM	07:00 AM	8

The table to the right lists possible solutions to the weekend staffing problem, ordered by increasing number of total hours. Total hours represents the sum of the staffed hours for all of the specified shift assignments. Solutions from 100% to 105% of the minimum number of hours have been tabulated (with a minimum of 25 solutions). All solutions provide coverage such that you can be confident, with 95% certainty, that at least 95% of all days will have no understaffed hours. Match the shift numbers in the Staff Shift Assignments table to the Shifts table listed above.

Some solutions require fewer numbers of shifts than other solutions. Within each group of total hours, solutions with the fewest number of shifts are presented first. A given shift might be staffed by one or more persons. For example, a 24 hour shift could be staffed by 1 person working 24 hours, 2 people working 12 hours, or 3 people working 8 hours. Details are in Dexter & O'Neil, AORN Journal, 2001.

Staff Shift Assignments

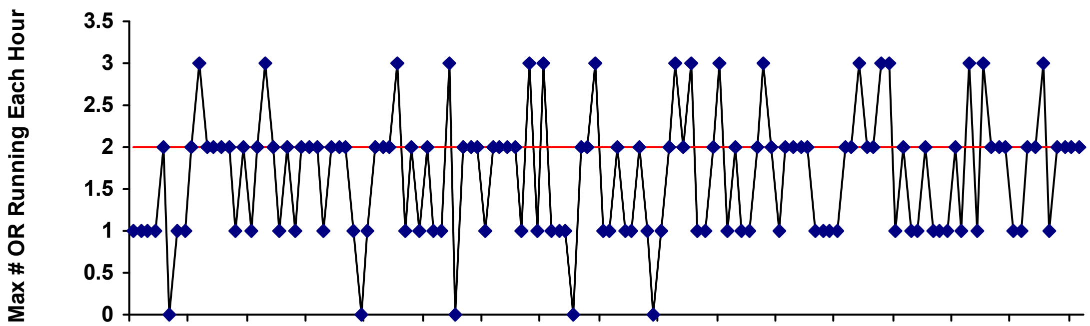
Total Shifts	Total Hours	Shift A	Shift B	Shift C	Shift D	Shift E	Shift F
4	84	1	1	1	4		
5	82	1	1	2	5	8	
5	84	1	1	2	4	11	
5	84	1	1	2	5	12	
5	84	1	1	2	6	8	
5	84	1	1	3	4	12	
5	84	1	1	3	5	8	
5	84	1	1	4	4	13	
5	84	1	1	4	5	14	
5	84	1	1	4	6	15	
5	84	1	1	4	6	9	
5	84	1	1	5	5	15	
5	84	1	1	5	5	9	
6	82	1	2	2	5	8	11
6	82	1	2	3	5	8	12
6	82	1	2	4	5	8	13
6	82	1	2	5	5	8	14
6	82	1	2	5	6	7	13
6	82	1	2	5	6	8	15
6	82	1	2	5	6	8	9
6	84	1	1	2	2	8	10
6	84	1	1	2	4	10	15
6	84	1	1	2	4	9	10
6	84	1	2	2	4	11	11
6	84	1	2	2	5	11	12

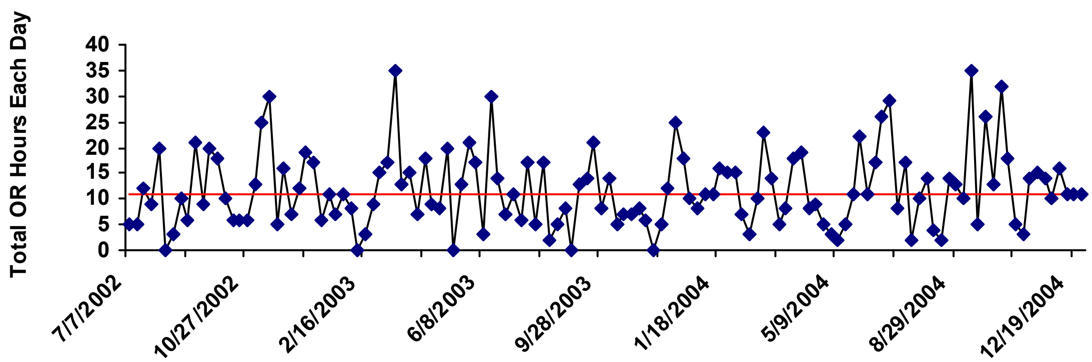
Sunday OR Staffing

Understaffed Risk = 5%

Example of OR Staffing Report

The graphs below show your weekend activity for the period of time included in the dataset analyzed. The horizontal red line on each graph represents the median value. The Staff Shift Assignments to cover this workload are on the other page of this weekend OR Staffing report.





There were no statistically significant trends in either Maximum # OR Running Each Hour or Total OR Hours Each Day.

CalculatOR™

The Operating Room, PACU, and Anesthesia Staffing Computer

Sunday OR Staffing

Understaffed Risk = 5%

Example of OR Staffing Report

Sunday Shifts

Shift #	Start Time	End Time	Duration (hr)
1	07:00 AM	07:00 AM	24
2	07:00 AM	03:00 PM	8
3	07:00 AM	05:00 PM	10
4	07:00 AM	07:00 PM	12
5	07:00 AM	09:00 PM	14
6	07:00 AM	11:00 PM	16
7	11:00 AM	07:00 PM	8
8	11:00 AM	11:00 PM	12
9	11:00 PM	07:00 AM	8
10	03:00 PM	11:00 PM	8
11	03:00 PM	07:00 AM	16
12	05:00 PM	07:00 AM	14
13	07:00 PM	07:00 AM	12
14	09:00 PM	07:00 AM	10
15	11:00 PM	07:00 AM	8

The table to the right lists possible solutions to the weekend staffing problem, ordered by increasing number of total hours. Total hours represents the sum of the staffed hours for all of the specified shift assignments. Solutions from 100% to 105% of the minimum number of hours have been tabulated (with a minimum of 25 solutions). All solutions provide coverage such that you can be confident, with 95% certainty, that at least 95% of all days will have no understaffed hours. Match the shift numbers in the Staff Shift Assignments table to the Shifts table listed above.

Some solutions require fewer numbers of shifts than other solutions. Within each group of total hours, solutions with the fewest number of shifts are presented first. A given shift might be staffed by one or more persons. For example, a 24 hour shift could be staffed by 1 person working 24 hours, 2 people working 12 hours, or 3 people working 8 hours. Details are in Dexter & O'Neil, AORN Journal, 2001.

Staff Shift Assignments

Total Shifts	Total Hours	Shift A	Shift B	Shift C	Shift D	Shift E	Shift F
3	62	1	1	5			
4	62	1	2	5	11		
4	62	1	3	5	12		
4	62	1	4	5	13		
4	62	1	4	6	14		
4	62	1	5	5	14		
4	62	1	5	6	15		
4	62	1	5	6	9		
5	62	1	2	4	10	14	
5	62	1	2	5	10	15	
5	62	1	2	5	9	10	
5	62	2	2	5	11	11	
5	62	2	3	5	11	12	
5	62	2	4	5	11	13	
6	62	2	2	4	10	11	14
6	62	2	2	5	10	11	15
6	62	2	2	5	9	10	11
6	62	2	3	4	10	12	14
6	62	2	3	5	10	12	15
6	62	2	3	5	9	10	12
6	62	2	4	4	10	13	14
6	62	2	4	5	10	13	15
6	62	2	4	5	10	14	14
6	62	2	4	5	9	10	13
6	62	2	4	6	10	14	15

Example of OR Staffing Report

Saturday result

```
7 AM to  7 AM , 1 OR team , scheduled in-house
7 AM to  7 PM , 1 OR team , on-call from home
7 AM to  7 AM , 2 OR teams, on-call from home
```

Sunday result

```
7 AM to  7 AM , 1 OR team , scheduled in-house
7 AM to  9 PM , 1 OR team , on-call from home
7 AM to  7 AM , 1 OR team , on-call from home
```

Data used

7/1/2002 to 12/31/2004
$163 per hour when scheduled in-house
$16.67 per hour when on-call from home
$325 per hour when called in from home
4 hour minimum when called in from home

Methodology

CalculatOR finds the staffing solution that runs as few OR hours each day as needed to keep a wanted service level. This service level is the percentage of days that a facility is willing to accept in not having sufficient staff to deliver urgent care to a patient. For example, if a facility accepts a 5% future risk of being understaffed, then an acceptable new staffing solution would allow at most one future day in twenty when not enough OR teams are available to care for every urgent case that previously was performed.

Potential staffing solutions are combinations of shifts (e.g., one team on Saturday from 7 AM to 7 PM and one team from 7 AM Saturday to 7 AM Sunday). The number of OR teams that would be available for every hour of the 24 hr period of interest is calculated for each potential staffing solution. One team is needed for each OR with an urgent case. The calculated number of OR teams at each hour is compared to the number of teams that were actually needed at that hour for urgent cases during each 24 hr period of historical data. If during any hour of a 24 hr period a potential staffing solution would not have provided adequate staffing, then the potential staffing solution is counted as providing inadequate staffing for that 24 hr period. If the number of understaffed 24 hr periods exceeds a statistically determined cut-off value, then that potential staffing solution is discarded as unacceptable. For example, if 248 weekdays (one year) of data were being analyzed, then the cutoff value for a 5% risk would be 6 understaffed days for each proposed staffing solution.

For each acceptable staffing solution, the total numbers of staffed hours and shifts needed for the 24 hr period are calculated. There are multiple solutions that achieve the desired service level and provide the least number of staff hours and/or total number of staff required per 24-hour period. These are shown in the CalculatOR reports.

Next, the shifts from CalculatOR are used to generate every possible combination of staff being on-call from home (e.g., with pager) or being scheduled to work in-house. Using the actual workload data, the cost of each combination is calculated. The lowest cost staffing solution is the recommendation above.

References

Dexter F, Macario A, Traub RD. Statistical method using operating room information system data to determine anesthetist weekend call requirements. AANA J 68:21-26, 2000

Dexter F, O'Neill L. Weekend operating room on-call staffing requirements. AORN J 74:666-671, 2001

Dexter F, Epstein RH, HM Marsh. Costs and risks of weekend anesthesia staffing at six independently managed surgical suites. AANA J 70: 377-381, 2002

CalculatOR™
The Operating Room, PACU, and Anesthesia Staffing Computer

Holiday Analysis

Holidays vs Weekends

Cases Started per 12 Hr Interval

Days	Interval	# Studied	Mean	SE
Holidays: Tue, Wed, Thu	7 AM - 7 PM	13	12.8	3.1
Holidays: Mon, Fri	7 AM - 7 PM	17	10.9	2.3
Sunday	7 PM - 7 AM	130	5.7	0.2
Saturday	7 AM - 7 PM	126	3.6	0.2
Sunday	7 AM - 7 PM	130	2.4	0.1
Holidays: Mon, Fri	7 PM - 7 AM	17	2.0	0.3
Holidays: Tue, Wed, Thu	7 PM - 7 AM	13	1.5	0.4
Saturday	7 PM - 7 AM	126	1.0	0.1

The mean number of cases started during each 12 hr period is a valid and useful statistic to assess relative OR workload among weekends and holidays. This report is used with the Saturday and Sunday staffing reports to infer the appropriate staffing for Holidays. "SE" refers to the standard error of the mean. Weekdays without cases were excluded from the Holiday calculations. Holidays with similar caseloads were combined to simplify the staffing recommendations. Details are in Dexter and Epstein, Anesthesia & Analgesia, 2006.

Postoperative Infections

Example of OR Staffing Report

Infections per Week	Case Pairs per Week	Service and Room Combination
2.06 (0.11)	4.81 (0.12)	Orthopedics - MAIN OR 03
1.92 (0.15)	5.52 (0.25)	University Neurosurgeons - MAIN OR 06
1.46 (0.25)	4.54 (0.12)	Gyn Associates - MAIN OR 18
1.21 (0.07)	4.58 (0.10)	Orthopedics - MAIN OR 07
0.96 (0.17)	2.77 (0.09)	Pacific Vascular - MAIN OR 08
0.77 (0.13)	4.00 (0.14)	Thoracic Surgery - MAIN OR 19
0.69 (0.06)	4.60 (0.12)	Urology - MAIN OR 04
0.54 (0.15)	1.48 (0.23)	General Surgery - MAIN OR 10
0.31 (0.04)	3.10 (0.24)	Orthopedics - MAIN OR 09

The columns are reported as the weekly mean (SE) among the 6 eight-week periods from Sunday Apr 12 2018 to Saturday Jul 13 2019. The overall incidence of postoperative infections was 22.72 (1.19) per week. The service and operating room combinations are listed in descending sequence of the mean of the observed numbers of postoperative infections per week. The mean absolute difference among all pairwise combinations (i.e., Gini index) equaled 0.859. See Dexter et al. American Journal of Infection Control May 2020, Journal of Medical Systems 2020, and Canadian Journal of Anesthesia 2021 for explanation why the methodology is appropriate. Also see Dexter et al. Perioperative Care and Operating Room Management 2020 Table 5 for why it is necessary. The adjacent column shows the mean per week of successive non-urgent cases in the same room on the same day. The more such pairs, the quicker an operating room nurse, surgical technologist, or anesthesia technician can complete sampling for study of Staphylococcus aureus transmission within and between successive cases. See Dexter et al. American Journal of Infection Control June 2020. Adding more service x operating room combinations will reduce the sampling time, but with less potential benefit to reducing postoperative infections. The entries listed had at least one infection per period.

Example of OR Staffing Report

Infections per Week	Case Pairs per Week	Operating Room (Location)
2.06 (0.11)	4.81 (0.12)	MAIN OR 03
1.92 (0.15)	5.54 (0.25)	MAIN OR 06
1.48 (0.25)	4.71 (0.11)	MAIN OR 08
1.44 (0.13)	2.94 (0.37)	MAIN OR 15
1.23 (0.06)	4.67 (0.11)	MAIN OR 17
1.19 (0.17)	3.50 (0.11)	MAIN OR 18
0.92 (0.16)	1.71 (0.20)	MAIN OR 20
0.90 (0.08)	5.65 (0.22)	MAIN OR 02
0.85 (0.14)	0.92 (0.16)	Surgery Center 02
0.81 (0.15)	4.44 (0.12)	MAIN OR 09
0.75 (0.10)	3.83 (0.16)	MAIN OR 14
0.73 (0.08)	4.60 (0.13)	MAIN OR 04
0.71 (0.19)	4.48 (0.22)	MAIN OR 05
0.71 (0.16)	2.52 (0.12)	MAIN OR 07
0.69 (0.12)	3.40 (0.21)	MAIN OR 01
0.67 (0.14)	3.77 (0.09)	MAIN OR 12
0.67 (0.11)	2.50 (0.15)	MAIN OR 10
0.58 (0.10)	0.35 (0.06)	Surgery Center 06
0.56 (0.08)	4.33 (0.19)	MAIN OR 19
0.54 (0.10)	3.56 (0.12)	Surgery Center 05
0.42 (0.09)	3.92 (0.23)	Surgery Center 01

The columns are reported as the weekly mean (SE) among the 6 eight-week periods from Sunday Apr 12 2018 to Saturday Jul 13 2019. The overall incidence of postoperative infections was 22.72 (1.19) per week. The operating rooms (anesthetizing locations) are listed in descending sequence of the mean of the observed numbers of postoperative infections per week. The mean absolute difference among all pairwise combinations (i.e., Gini index) equaled 0.410. See Dexter et al. American Journal of Infection Control May 2020, Journal of Medical Systems 2020, and Canadian Journal of Anesthesia 2021 for explanation why the methodology is appropriate. Also see Dexter et al. Perioperative Care and Operating Room Management 2020 Table 5 for why it is necessary. The adjacent column shows the mean per week of successive non-urgent cases in the same room on the same day. The more such pairs, the quicker an operating room nurse, surgical technologist, or anesthesia technician can complete sampling for study of Staphylococcus aureus transmission within and between successive cases. See Dexter et al. American Journal of Infection Control June 2020. Adding more operating rooms sampled will reduce the sampling time, but with less potential benefit to reducing postoperative infections. The entries listed had at least one infection per period.