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Frank

www.FranklinDexter.net

Sample Report PACU (3430 cases)

(Despite potential to reduce LOS, intervention seems unlikely to reduce staffing or delays)

Inpatient Postoperatively?	Patients	Average LOS (hr)	Total LOS All Patients
No	37%	1.9	35%
Yes	63%	2.1	65%
Grand Total		2.1	

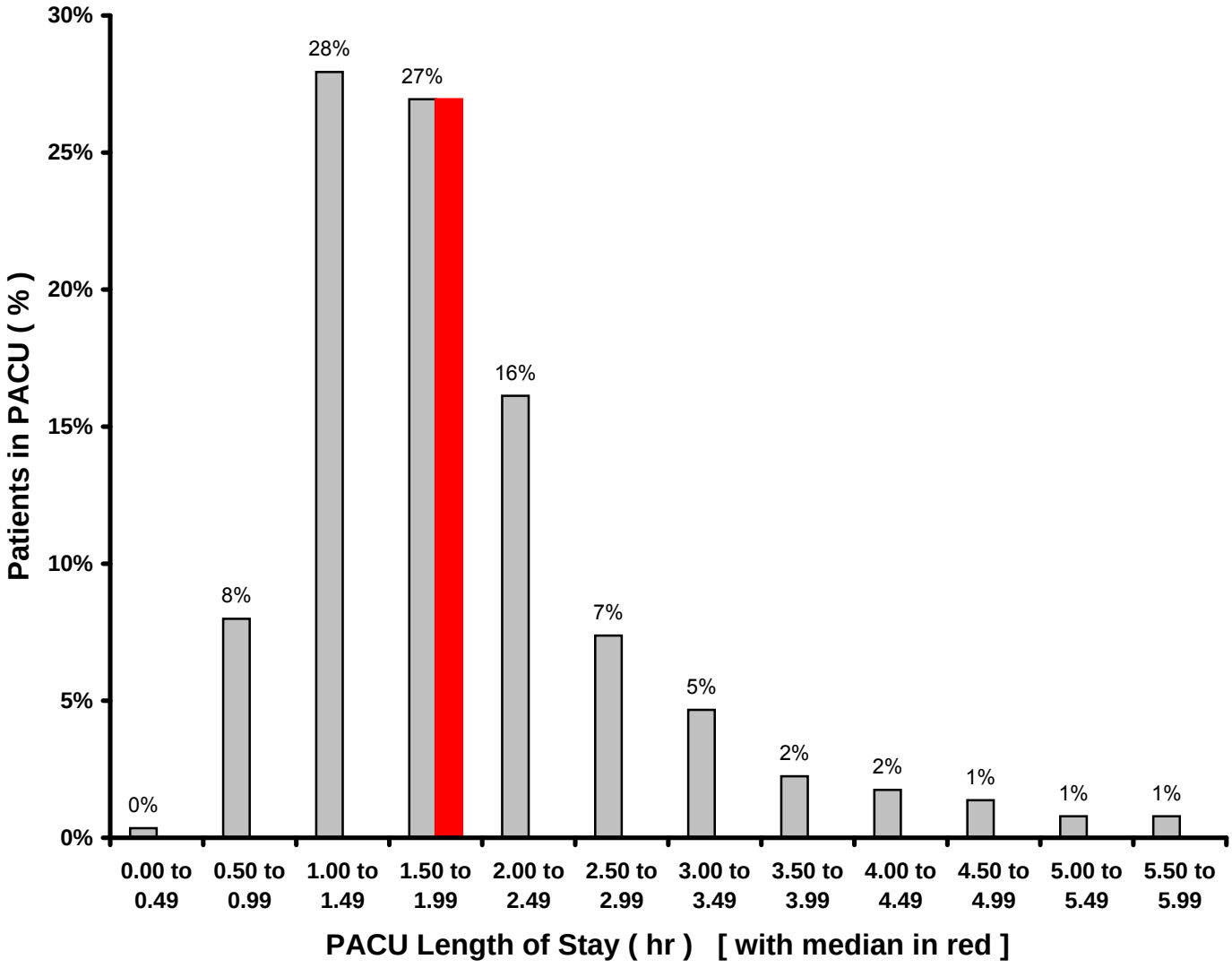
Anesthetic	Patients	Average LOS (hr)	Total LOS All Patients
General	89.6%	2.1	90%
Monitored Anesthesia Care	2.3%	1.3	2%
No Anesthesia Provider	0.2%	-	0%
Peripheral Regional	0.3%	-	0%
Spinal or Epidural	7.6%	2.4	8%

Literature Review

End Point	Type of Anesthetic	Mean LOS (hr)	Facility	Reference
Discharge	General	1.8	Ambulatory	Chung 1995
Discharge	General	2.5	Ambulatory	Dexter et al. 1995
Discharge	Monitored Anesthesia Care	1.4	Ambulatory	Chung 1995
Discharge	Monitored Anesthesia Care	1.5	Ambulatory	Dexter et al. 1995
Discharge	Monitored Anesthesia Care	1.7	Ambulatory	Chung & Mezei 1999
Discharge	Monitored Anesthesia Care	2.0	Ambulatory	Twersky et al. 2008
Discharge	Overall	2.6	Ambulatory	Chung & Mezei 1999
Discharge	Overall	2.7	Community	Duncan et al. 2001
Discharge	Regional	1.7	Ambulatory	Dexter et al. 1995
Phase I LOS	Brachial Plexus Block	1.3	Tertiary	Tessler et al. 1999
Phase I LOS	Epidural	1.5	Obstetric	Cohen et al. 1998
Phase I LOS	Epidural	2.6	Tertiary	Tessler et al. 1999
Phase I LOS	General	1.6	Tertiary	Kiekkas et al. 2005
Phase I LOS	General	1.8	Obstetric	Cohen et al. 1998
Phase I LOS	General	2.0	Tertiary	Tessler et al. 1999
Phase I LOS	General	2.0	Tertiary	Brown et al. 2008
Phase I LOS	Monitored Anesthesia Care	1.5	Tertiary	Tessler et al. 1999
Phase I LOS	Overall	0.7	Tertiary	Liu S et al. 2020
Phase I LOS	Overall	0.7	Community	Bell et al. 1985
Phase I LOS	Overall	1.2	Community	Duncan et al. 2001
Phase I LOS	Overall	1.6	Tertiary	Kiekkas et al. 2005
Phase I LOS	Overall	1.9	Tertiary	Dexter et al. 2001
Phase I LOS	Regional	1.6	Tertiary	Kiekkas et al. 2005
Phase I LOS	Spinal	1.8	Obstetric	Cohen et al. 1998
Phase I LOS	Spinal	2.2	Tertiary	Tessler et al. 1999

Hyperlinks to the above articles, plus those used for the statistical analyses, are available at
https://www.franklindexter.net/bibliography_PACUStaffing.htm

Length of Stay



Sample Report Delays

Patients were considered to be delayed if their wait exceeded 30 min.
16% of the 724 patients with data were reported to have delayed discharge.

The overall average length of stay in the PACU was 2.27 hr.
Delayed patients remained in the PACU an average of 4.78 hr.
Non-delayed patients remained in the PACU an average of 1.80 hr.

By rough analysis, **21% of PACU time** can be reduced by eliminating delays in discharge, where
21% = (16% delayed) x (avg 2.98 hr extra for delay) / (avg 2.27 hr in PACU).
Analysis relies just on mean differences, but shows total time.

By Monte-Carlo simulation, **9% is avg** reduction in each patient's PACU time if eliminate delays.
Simulation incorporates information as to specifically which patients were delayed.
Although the percentage decrease in PACU staffing will be less, staffing can be reduced.
Delays in PACU admission are insensitive to reductions in PACU LOS.

References for the analysis are:

Dexter F, Traub RD, Penning DH. Statistical analysis by Monte-Carlo simulation of the impact of administrative and medical delays in discharge from the post-anesthesia care unit on total patient care hours. Anesthesia & Analgesia 92:1222-1225, 2001

Dexter F, Epstein RH, de Matta R, Marcon E. Strategies to reduce delays in admission into a postanesthesia care unit from operating rooms. Journal of PeriAnesthesia Nursing 20:92-105, 2005

Sample Report Delays

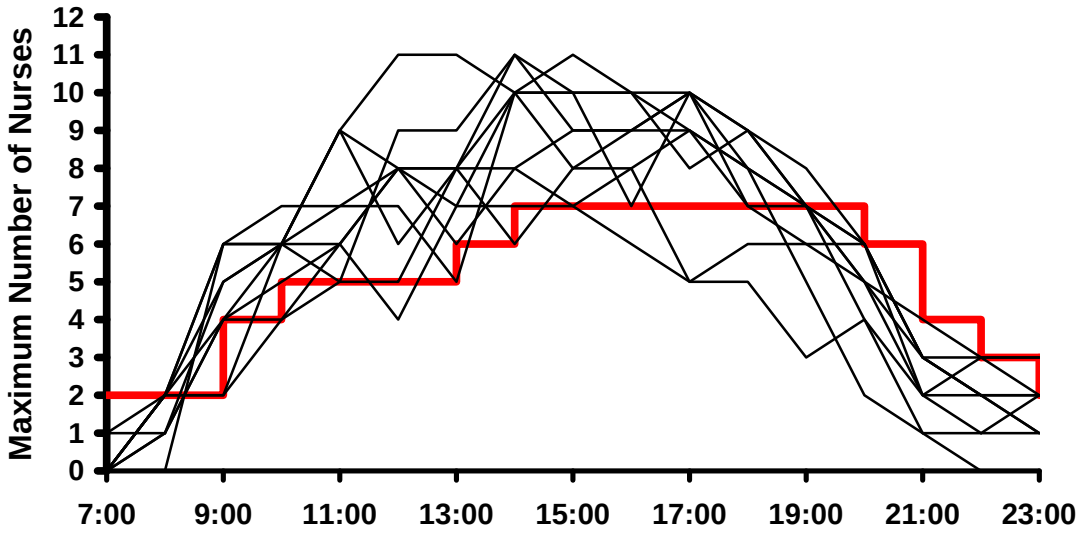
Workdays with delay in PACU admission	87%	***Very*** frequent
95% confidence interval	82% to 91%	
Increase in total PACU patient time if there were no delays in PACU admission	0.4%	Only small adjustment in PACU staffing needed to eliminate the delays
95% confidence interval	0.3% to 0.4%	

There were 464 cases entered into the 'OR Data' worksheet. A delay in PACU admission was considered to have occurred when more than 15 minutes but fewer than 4 hours elapsed between the time when the patient was ready to leave the OR and entered the PACU. The first Mon-Fri with a reported delay was Nov 1, 2006, and the last was Mar 30, 2007. The Clopper-Pearson confidence interval was given for the percentage of those 107 workdays with delay(s). The percentage increase in PACU time from eliminating the delays was calculated for each workday. The confidence interval for the mean percentage increase was the value reported above. Note that the mean duration of delays was deliberately not calculated. The delays were included in the PACU Staffing analyses.

Current Staffing

Number of PACU nurses who are scheduled to be "in-house," Monday-Friday, at all locations for which data are being provided		Number of PACU nurses who are either on-call from home to come in if necessary or who know ahead of time that they may need to work late if needed	
2	7 to 7:59 AM	0	7 to 7:59 AM
2	8 to 8:59 AM	0	8 to 8:59 AM
4	9 to 9:59 AM	0	9 to 9:59 AM
5	10 to 10:59 AM	0	10 to 10:59 AM
5	11 to 11:59 AM	0	11 to 11:59 AM
5	12 noon to 12:59 PM	0	12 noon to 12:59 PM
6	1 to 1:59 PM	0	1 to 1:59 PM
7	2 to 2:59 PM	0	2 to 2:59 PM
7	3 to 3:59 PM	0	3 to 3:59 PM
7	4 to 4:59 PM	0	4 to 4:59 PM
7	5 to 5:59 PM	0	5 to 5:59 PM
7	6 to 6:59 PM	0	6 to 6:59 PM
7	7 to 7:59 PM	0	7 to 7:59 PM
6	8 to 8:59 PM	0	8 to 8:59 PM
4	9 to 9:59 PM	0	9 to 9:59 PM
3	10 to 10:59 PM	0	10 to 10:59 PM
2	11 to 11:59 PM	0	11 to 11:59 PM
2	12 MN to 12:59 AM	0	12 MN to 12:59 AM
2	1 to 1:59 AM	0	1 to 1:59 AM
2	2 to 2:59 AM	0	2 to 2:59 AM
2	3 to 3:59 AM	0	3 to 3:59 AM
2	4 to 4:59 AM	0	4 to 4:59 AM
2	5 to 5:59 AM	0	5 to 5:59 AM
2	6 to 6:59 AM	0	6 to 6:59 AM
100	**Total Hours**		

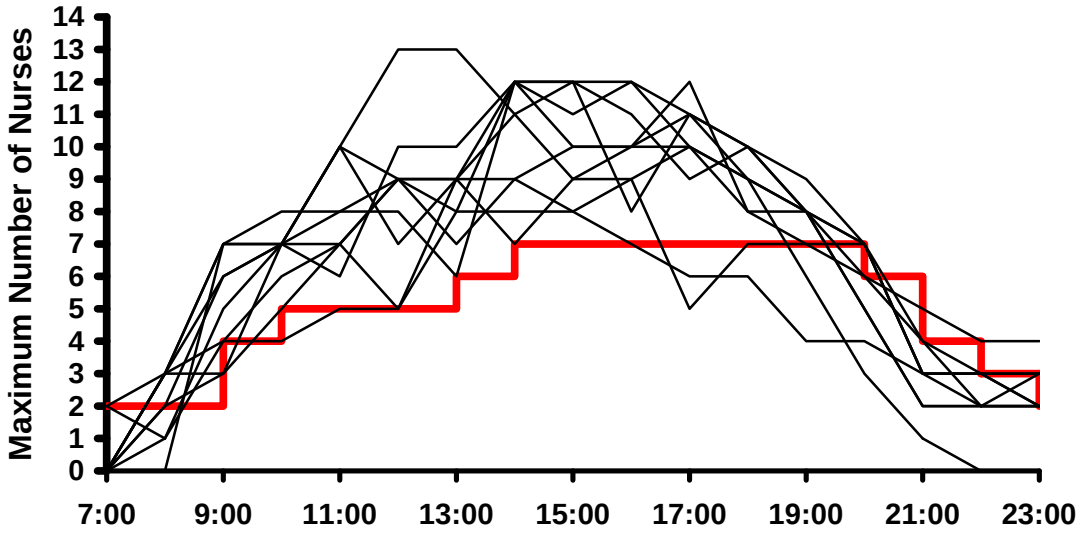
Busiest 10 Days and Current Staff Scheduling



94% 95% upper confidence limit for percentage of future workdays with at least one occurrence of acuity-adjusted demand exceeding staffing. This value is based on current staffing and corresponds to the percentage in the upper right hand corner of the subsequent PACU Staffing reports.

1 : 1.41 Overall Nurse to Patient Ratio from ' PACU Data for Staffing '

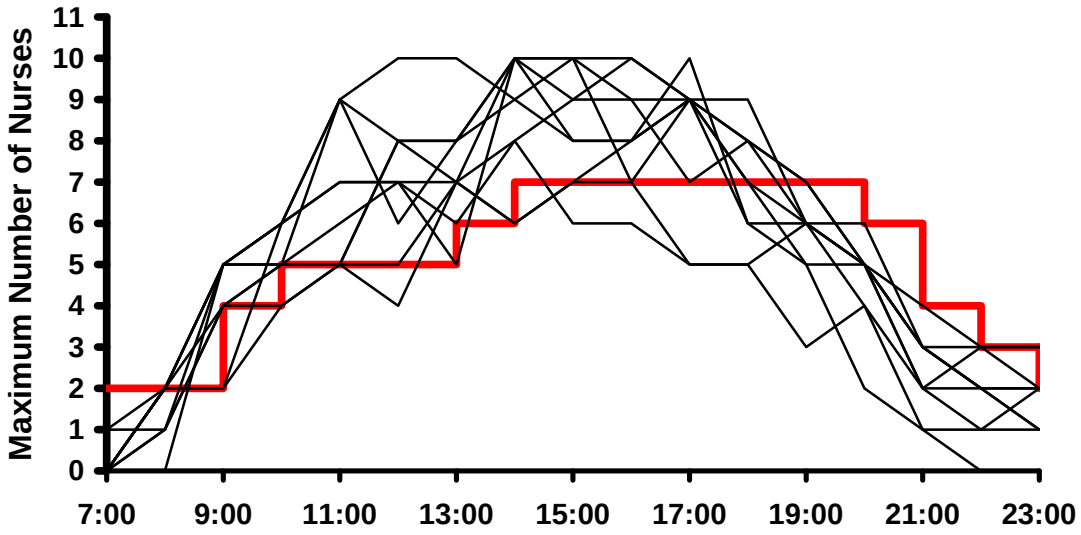
Sensitivity Analysis: Patient to Nurse Ratio 10% Smaller



100% 95% upper confidence limit for percentage of future workdays with at least one occurrence of acuity-adjusted demand exceeding staffing. This value is based on current staffing and corresponds to the percentage in the upper right hand corner of the subsequent PACU Staffing reports.

1 : 1.27 Overall Nurse to Patient Ratio from ' PACU Data for Staffing '

Sensitivity Analysis: Patient to Nurse Ratio 10% Larger



91% 95% upper confidence limit for percentage of future workdays with at least one occurrence of acuity-adjusted demand exceeding staffing. This value is based on current staffing and corresponds to the percentage in the upper right hand corner of the subsequent PACU Staffing reports.

1 : 1.55 Overall Nurse to Patient Ratio from ' PACU Data for Staffing '

CalculatOR™

The Operating Room, PACU, and Anesthesia Staffing Computer

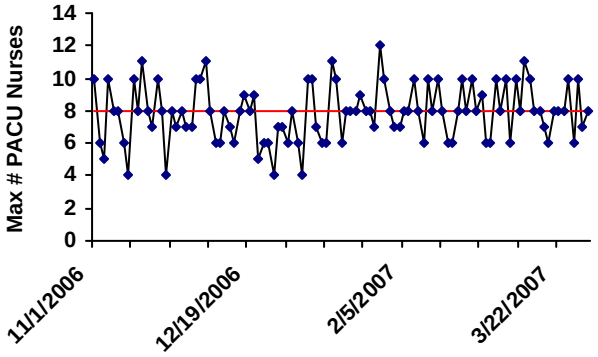
PACU Staffing

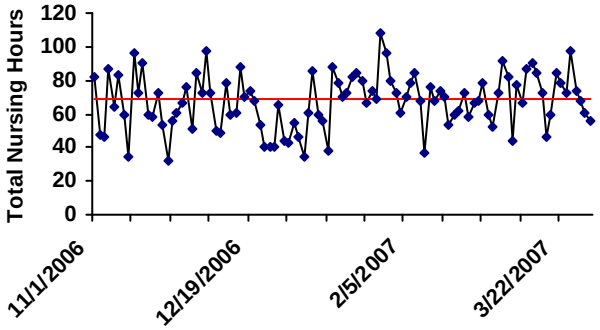
Understaffed Risk = 81%

Sample Report

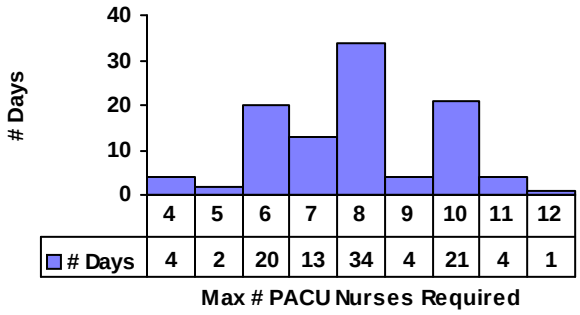
The graphs below show PACU activity from 11/1/2006 to 3/31/2007, as assessed by the number of PACU nurses need based on the patients' acuity. The horizontal red line on each graph represents the median value. The Staff Shift Assignments to cover this workload are on the other page of this PACU Staffing report.

See Warning Below

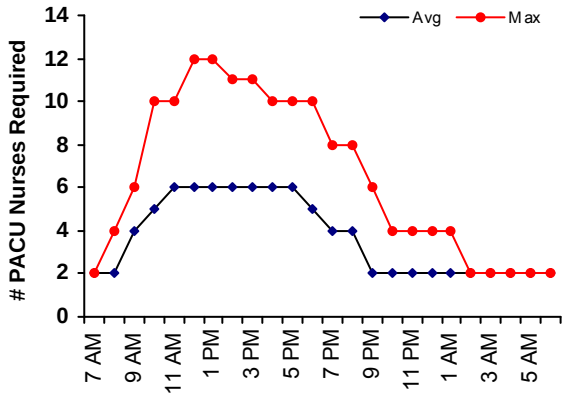




Max # PACU Nurses Required in Any Hour



Avg and Max Nurses by Hour of Day



WARNING!!!

The Runs Test failed for Total PACU Nursing Hours Each Day because there were more runs than expected (p=0.023). The underlying statistical assumption for the staffing solution (i.e., the data are randomly distributed) is not satisfied. If you do not fully understand how data trends and autocorrelation may affect the proposed staffing solutions, it is strongly recommended that you engage a knowledgeable statistical consultant before implementing any changes to your current practice.

CalculatOR™

The Operating Room, PACU, and Anesthesia Staffing Computer

PACU Staffing

Understaffed Risk = 81%

Sample Report (Fixed Hours = 100)

PACU Shifts

Shift #	Start Time	End Time	Duration (hr)
1	07:00 AM	07:00 PM	12
2	08:00 AM	04:00 PM	8
3	08:00 AM	06:00 PM	10
4	09:00 AM	07:00 PM	10
5	09:00 AM	09:00 PM	12
6	10:00 AM	06:00 PM	8
7	10:00 AM	08:00 PM	10
8	11:00 AM	09:00 PM	10
9	11:00 AM	11:00 PM	12
10	02:00 PM	10:00 PM	8
11	02:00 PM	02:00 AM	12
12	04:00 PM	04:00 AM	12
13	07:00 PM	07:00 AM	12
14	11:00 PM	07:00 AM	8

The table to the right lists possible solutions to your PACU staffing problem, ordered by increasing numbers of days with at least one delay in admission. Match the shift numbers in the Staff Shift Assignments table to the PACU Shifts table. For example, a "3" under the column header "A" means that there be one shift staffed using the hours listed to the right of "3" in the PACU Shifts table.

Some solutions require fewer shifts than other solutions (Count. Within each group of delays, solutions with the fewest number of shifts are presented first. A given shift might be staffed by one or more persons. For example, a 16 hour shift could be staffed by 1 person working 16 hours or 2 people working 8 hours. This decision is a "scheduling" problem, and is not addressed by CalculatOR.

You should pick the solution that best matches the preferences of your institution with respect to minimizing the the risk of at least one delay in admission for the day or minimizing the number of scheduled shifts. Details are in Epstein et al. and Dexter et al., Journal of PeriAnestheisa Nursing, 2001, 2005, and 2006, respectively.

Staff Shift Assignments

Delays	Count	A	B	C	D	E	F	G	H	I	J
77	5	3	5	5	6	8					
78	5	2	5	5	6	9					
78	5	3	5	5	7	10					
78	5	3	5	5	6	7					
78	5	3	4	5	7	8					
78	5	3	4	5	7	7					
79	5	3	4	4	5	7					
79	5	2	3	5	5	8					
79	5	3	5	5	7	14					
79	5	3	4	5	6	9					
79	5	3	5	6	7	9					
79	5	2	5	5	5	6					
79	5	3	3	5	7	7					
79	5	3	3	5	7	8					
79	5	2	4	5	5	8					
79	5	2	5	5	6	11					
79	5	3	4	5	8	8					
80	5	2	5	5	7	8					
80	5	4	5	5	6	8					
80	5	1	4	4	7	8					
80	5	3	3	5	8	8					
80	5	5	5	6	6	9					
80	5	3	3	4	5	7					
80	5	4	5	6	7	9					
80	5	5	5	5	6	6					
80	5	3	4	4	7	9					
80	5	2	3	5	7	9					
80	5	2	5	5	5	10					
80	5	1	4	5	6	7					
80	5	2	4	5	5	7					
80	5	2	4	5	7	9					
80	5	3	4	4	5	8					
80	5	2	5	5	6	12					
80	5	3	4	5	5	6					
80	5	3	4	5	6	11					
80	5	3	5	5	8	10					
80	5	3	4	5	9	10					
80	5	3	5	6	7	11					
81	5	3	4	5	6	12					
81	5	4	4	5	7	7					
81	5	2	5	5	5	14					
81	5	1	5	5	6	6					
81	5	3	3	4	7	9					
81	5	2	5	5	8	8					

2 staff will also need to be present for 24 hrs.

CalculatOR™

The Operating Room, PACU, and Anesthesia Staffing Computer

PACU Staffing

Understaffed Risk = 50%

Sample Report

PACU Shifts

Shift #	Start Time	End Time	Duration (hr)
1	07:00 AM	07:00 PM	12
2	08:00 AM	04:00 PM	8
3	08:00 AM	06:00 PM	10
4	09:00 AM	07:00 PM	10
5	09:00 AM	09:00 PM	12
6	10:00 AM	06:00 PM	8
7	10:00 AM	08:00 PM	10
8	11:00 AM	09:00 PM	10
9	11:00 AM	11:00 PM	12
10	02:00 PM	10:00 PM	8
11	02:00 PM	02:00 AM	12
12	04:00 PM	04:00 AM	12
13	07:00 PM	07:00 AM	12
14	11:00 PM	07:00 AM	8

The table to the right lists possible solutions to your PACU 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 the percentage of days when at least one patient cannot be accepted into the PACU with the specified patient:nurse coverage will not exceed the listed Understaffed Risk. Match the shift numbers in the Staff Shift Assignments table to the PACU Shifts table. For example, a "3" under the column header "A" means that there be one shift staffed using the hours listed to the right of "3" in the PACU Shifts table.

Some solutions require fewer shifts than other solutions (Count. 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 16 hour shift could be staffed by 1 person working 16 hours or 2 people working 8 hours. This decision is a "scheduling" problem, and is not addressed by CalculatOR.

You should pick the solution that best matches the preferences of your institution with respect to minimizing the number of required total call hours or minimizing the number of scheduled shifts. Details are in Epstein et al. and Dexter et al., Journal of PeriAnestheisa Nursing, 2001, 2005, and 2006, respectively

Staff Shift Assignments

Tot Hrs	Count	A	B	C	D	E	F	G	H	I	J
74	7	2	4	4	5	7	9	12			
74	7	3	5	5	7	7	9	10			
74	7	2	5	5	6	7	9	11			
74	7	2	5	5	6	7	9	9			
74	7	1	5	5	6	7	9	10			
74	7	2	5	5	5	7	9	10			
74	7	2	4	5	7	7	9	11			
74	7	3	4	5	6	7	9	11			
74	7	2	4	4	5	7	9	9			
74	7	2	4	4	5	7	9	11			
74	7	2	4	5	5	6	9	12			
74	7	2	4	5	5	6	9	9			
74	7	2	3	4	5	7	9	12			
74	7	3	4	5	5	7	9	10			
74	7	2	3	4	5	7	9	9			
74	7	2	4	5	5	6	9	11			
74	7	2	3	4	5	7	9	11			
74	7	2	3	5	7	7	9	11			
74	7	3	4	4	5	7	8	11			
74	7	3	4	4	5	7	8	9			
74	7	1	4	5	5	6	9	10			
74	7	3	4	4	5	5	9	10			
74	7	1	2	5	6	7	9	11			
74	8	2	2	4	6	7	8	9	10		
74	8	2	2	4	5	6	9	10	10		
76	7	1	2	3	5	7	9	12			
76	7	1	2	5	5	7	8	9			
76	7	1	1	5	5	6	9	10			
76	7	1	2	4	5	5	8	9			
76	7	3	3	4	5	5	8	9			
76	7	1	2	5	5	7	8	11			
76	7	1	2	3	5	7	9	9			
76	7	1	2	3	5	7	9	11			
76	7	1	3	4	5	7	8	9			
76	7	1	2	4	5	5	8	11			
76	7	1	2	5	5	5	9	10			
76	7	1	2	5	7	7	9	11			
76	7	1	3	4	5	7	8	11			
76	7	1	3	5	5	6	8	11			
76	7	1	2	4	5	7	9	12			
76	7	1	2	4	5	7	9	11			
76	7	1	2	5	5	6	9	12			
76	7	1	3	5	5	6	8	9			
76	7	3	3	5	5	7	8	11			

2 staff will also need to be present for 24 hrs.

Average Minutes per Workday at Sample Report with OR Case(s) Waiting for PACU Admission For Each Combination of Daily Number of Patients (Rows) and Physical PACU Beds (Columns)

	Beds					
Patients	**10**	**11**	**12**	**13**	**14**	**15**
35	**20**	10	10	0	0	0
40	60	**30**	10	10	0	0
45		60	**30**	**20**	10	0
50			70	40	**20**	10
55				70	40	**20**
60					80	40
65						80

Among the 98 workdays, there was an average of 35 patients per day. The 4 hr period with the most rapid rate of admission (or waiting for admission into the PACU was from 9:00 AM to 12:59 PM. The overall admission rate during that period was 3.08 patients per hour. Those patients' recovery times averaged 2.04 hours. Increases in the patients per day were assumed to increase proportionally to the patients per hour during the peak period. The listed mean expected daily minutes of waiting for a physically open PACU bed was calculated using the analysis of Schoenmeyr et al., Anesthesiology, 2009. Values marked in red are those closest to a threshold of 30 minutes for the total time that patients will wait in ORs because no physical PACU bed is available. This threshold is relatively high since the analysis is studying a costly intervention to build, equip, and staff an additional physical bed, unlike other analyses.