Smith Hager Bajo, Inc.
Simulation Modeling Case Study – Freestanding Women and Babies Hospital

The Problem:

A community hospital in Pennsylvania was in the planning stages for a freestanding women and babies hospital. Preliminary planning with an architectural firm had raised concerns about the validity of the number of beds planned (ratio methods had been used to determine LDR and post-partum bed need). Current birth volume was 2850 in 1998 and there was consensus that the volume could increase as much as 20% over the next few years.

Before finalizing the space program and design planning, the leadership team decided to engage Smith Hager Bajo to provide input on the bed needs for obstetrics, NICU and GYN patients, planned design and comment on its operational and staffing efficiency. The analysis requested by the hospital included the following components.

- **Facility Review**: A) review obstetric bed, GYN and NICU bed quantity and mix of rooms taking into account functional relationships and B) provide input on general flow and layout of preliminary drawings

- **Staffing Analysis**: analyze current obstetric, GYN and neonatal staffing and design implications on future staffing

The Analysis:

Smith Hager Bajo worked with the leadership team and caregivers to complete the project. Their computerized simulation models, designed specifically for obstetric, GYN and neonatal services, were chosen as the tools for the obstetric, GYN and neonatal facility and staffing analysis. Nine scenarios

for obstetrics, seven for GYN and three for neonatal were simulated using volume projections for obstetrics and NICU ranging from 2,850 to 3,700 annual births. Volume projections for GYN included 10 & 20 % increases in GYN surgical volume, as well as evaluating the impact of adding breast, plastic and female urology patients to the volume projections.

Computerized simulation modeling was used to complete the analysis for several reasons:

- Ability to include key variables such as the impact of scheduled procedures, seasonal variability and discharge times (could not be evaluated with former bed need prediction model)
- Allows the evaluation of staffing levels for each type of caregiver involved in the care process
- Flexibility to compare/contrast the results of a variety of scenarios

The Results:

- The results confirmed the 37 postpartum rooms planned are more than needed to support 3700 annual births. The recommended number to meet bed needs 95% of the time is 27 and for 99.5%, 31 beds are needed.
- The unit is currently staffing at greater than the 95% confidence level, which means that less than 5% of the time there will be inadequate staffing for the volume at that time. If experience has demonstrated that there is the ability to flex up through overtime, per diem staff, on call staff and other means to fill current gaps, then actual staffing levels may be greater than necessary for the current volume.

The model generated three types of results. They include:

- Bed need by type of bed
- Patient overages and days all beds full
- Staffing requirements by position

Predicted Bed Need Results Summary

BED TYPE	1 2850 Births 3.03 ALOS 28.7% C/S	2 3000 Births 2.7 ALOS 28.7% C/S	3 3200 Births 3.03 ALOS 25% C/S	4 3400 Births 2.7 ALOS 25% C/S	5 3700 Births 3.03 ALOS 28.7% C/S
LDR	8	8	8	8	9
Postpartum	24	24	26	26	27
Triage	5	5	5	6	6
Antepartum	4	4	5	5	6
TOTAL	**34**	**33**	**34**	**32**	**36**

Predicted Bed Need Results by Scenario

Scenario 1 - 2850 Annual Births

Room Type	Max	Mean	Std. Deviation	1 Std. Deviation (87% Confidence)	2 Std. Deviations (95% Confidence)	3 Std. Dev. (99.5% Confidence)
Triage	9	2.11	1.44	3.55	**4.99**	6.43
LDR	11	3.43	1.88	5.31	**7.19**	9.07
Post-partum	32	14.83	4.56	19.39	**23.95**	28.51
Antepartum	5	1.56	1.19	2.75	**3.94**	5.13

Scenario 2 - 3000 Annual Births

Room Type	Max	Mean	Std. Deviation	1 Std. Deviation (87% Confidence)	2 Std. Deviations (95% Confidence)	3 Std. Deviations (99.5% Confidence)
Triage	8	2.07	1.38	3.45	**4.83**	6.21
LDR	13	3.44	1.86	5.3	**7.16**	9.02
Post-partum	31	14.66	3.92	18.58	**22.5**	26.42
Antepartum	5	1.28	0.95	2.23	**3.18**	4.13

Scenario 3 - 3200 Annual Births

Room Type	Max	Mean	Std. Deviation	1 Std. Deviation (87% Confidence)	2 Std. Deviations (95% Confidence)	3 Std. Deviations (99.5% Confidence)
Triage	8	2.15	1.43	3.58	**5.01**	6.44
LDR	12	3.65	1.88	5.53	**7.41**	9.29
Post-partum	31	15.7	4.7	20.4	**25.1**	29.8
Antepartum	7	2.03	1.15	3.18	**4.33**	5.48

Scenario 4 - 3400 Annual Births

Room Type	Max	Mean	Std. Deviation	1 Std. Deviation (87% Confidence)	2 Std. Deviations (95% Confidence)	3 Std. Deviations (99.5% Confidence)
Triage	9	2.33	1.51	3.84	**5.35**	6.86
LDR	13	3.82	1.95	5.77	**7.72**	9.67
Post-partum	29	16.34	4.38	20.72	**25.1**	29.48

Antepartum	4	1.75	1.2	2.95	**4.15**	5.35

Scenario 5 - 3700 Annual Births						
Room Type	Max	Mean	Std. Deviation	1 Std. Deviation (87% Confidence)	**2 Std. Deviations (95% Confidence)**	3 Std. Deviations (99.5% Confidence)
Triage	9	2.52	1.6	4.12	**5.72**	7.32
LDR	14	4.15	2.06	6.21	**8.27**	10.33
Post-partum	33	17.89	4.51	22.4	**26.91**	31.42
Antepartum	7	2.52	1.44	3.96	**5.4**	6.84

Staffing Results By Scenario

Scenario	Mean	Std. Dev.	Mean + 1 Std. Dev.	Mean + 2 Std. Dev.	Mean + 3 Std. Dev.
Scenario #1 - 2850 births	6.42	2.9	9.32	12.22	15.12
Scenario #2 - 3000 births	6.62	2.95	9.57	12.52	15.47
Scenario #3 - 3200 births	6.84	3.01	9.85	12.86	15.87
Scenario #4 - 3400 births	7	2.97	9.97	12.94	15.91
Scenario #5 - 3700 births	7.93	3.13	11.06	14.19	17.32

Mean + 1 Standard Deviation	**Current**	**1**	**2**	**3**	**4**	**5**
Daily Caregiver Hours Required	312	223.68	229.68	236.4	239.28	265.44
Weekly Caregiver Hours	2,184	1,565.76	1,607.76	1,654.8	1,675	1,858.1
Caregiver Hours Annualized	113,568	81,420	83,604	86,050	87,098	96,620
Caregiver FTE's Required	54.6	39.1	40.2	41.4	41.9	46.5
Fixed FTE's	32.5	32.5	32.5	32.5	32.5	32.5
Fixed Management FTE's	4	4	4	4	4	4
TOTAL FTE'S REQUIRED	91.1	75.6	76.7	77.9	78.4	83

Mean + 2 Standard Deviations	**Current**	**1**	**2**	**3**	**4**	**5**
Daily Caregiver Hours Required	312	293.3	300.48	308.64	310.56	340.56
Weekly Caregiver Hours	2,184	2,052.96	2,103.36	2,160.48	2,173.92	2,383.92
Caregiver Hours Annualized	113,568	106,524	109,375	112,345	113,044	123,964
Caregiver FTE's Required	54.6	51.32	52.6	54	54.3	59.6
Fixed FTE's	32.5	32.5	32.5	32.5	32.5	32.5
Fixed Management FTE's	4	4	4	4	4	4
TOTAL FTE'S REQUIRED	91.1	87.8	89.1	90.5	90.8	96.1

The Results:

The new hospital opened its obstetric and neonatal service in late June of 2000 and has seen a 12% increase in birth volume since that time. The GYN service opened in October and has also seen an increase in volume. Outpatient services have been provided via the inpatient GYN unit until the outpatient unit opens in January 2001.

The footprint of the new hospital actually allowed 10 LDR's (rather than the recommended 9), 4 antepartum rooms (instead of the recommended 6) and 34 post-partum rooms (rather than the original 37 planned) to be built. The PACU, originally planned as two contiguous areas to recover Cesarean Birth patients and GYN patients, was downsized during the planning stages and combined to recover both types of patients together.

Six months after opening their doors, the management staff identified the following as comments on their planning:

- The triage process, a new concept for the hospital, was difficult to implement because of the short operational planning time frame (concept to move-in less than a year and no opportunity to practice). In addition, it was decided to use the area for triage of GYN patients (2 more triage rooms are being added to accommodate the additional patients).

- In spite of the increase in birth volumes, they have not experienced a shortage of beds. Even though "we don't tell people when to go home", there has not been a problem with the number of beds. "It's been tight at times, but we've never had to use our overflow plan".

- Response to the neonatal special care nursery has been very positive – we have not experienced any problems with the unit.

- Couplet care was difficult to implement at the time of the move – the staff went back to their old care model and now are slowly being moved back to couplet care.

- The change in the PACU plan has led to tremendous patient dissatisfaction. The staff are resolving the problem by admitting and recovering cesarean birth patients in their post-partum rooms.

- Initially, staffing levels were set high to help adjustment to the move. They are now in the process of lowering those staffing levels to reflect recommendations.

- Patient satisfaction has increased 10-12 points in every category, not just those related to the facility change.