

A DESCRIPTIVE LOOK AT STAFFING AND  
PATIENT LOADS AT STILLWATER  
MEDICAL CENTER

By

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Scope and Method of Study: One of the more difficult jobs confronting the hospital administrator is estimating the level of nurse staffing needed to meet patient requirements. The further in advance these estimates can be made, the easier it is to plan levels of staffing, vacation time, and training programs. These factors are vital inputs into the control of nursing salary costs, which usually represent about 50% of the operating costs incurred by the hospital. The purpose of this study is to provide a descriptive profile of the staffing and patient loads experienced by the Stillwater Medical Center during the years of 1982 and 1983. It is also the hope that this study will serve as a bench mark for further study. Means were determined for patient loads, forecast staffing needs, actual staffing, RN's on duty, and LPN's on duty by years, months, days of the week, units and shifts. Also the same means for each unit were calculated for more in depth analysis. Trends and differences were then noted from these means.

Findings and Conclusions: When the data for 1983 was compared to 1982 a decline in the average patient load was seen, while the average nursing staff level remained unchanged. In general, a low in the average patient load and staffing activity occurred on Sundays for both years while the high was on Wednesdays. Also the forecast of nursing needs was considerably different than the actual staffing.

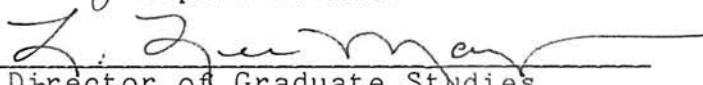
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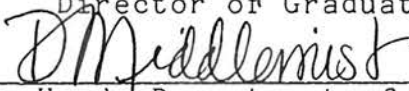
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## CHAPTER I

### INTRODUCTION

The channel through which hospitals work to deliver health care services is very unique. The final consumer, the patient, has in most cases no control over what type of treatment to buy and at what price. It is the decision of his doctor as to what medical tests are to be made and what treatment procedures are to be followed. Also while the delivery of health care services to consumers is direct, the payment system for these services involves intermediaries such as the Federal government, state and local governments, and private, commercial insurance companies. In the past, this third-party payment system along with the unique supply-demand relationship has created a lack of incentive for cost-containment on the part of hospitals in the past.

Total health care expenditures in the last 18 years have increased over 880% from \$41 billion in 1965 to over \$362 billion in 1983 and is expected to be over \$1 trillion by 1993.<sup>1</sup> Inflation along with full reimbursement and third party payments

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<sup>1</sup>Herman B. Safflas, Health Care Analyst, Feb. 1983, p. H13.

are the major reasons behind these soaring health care costs. Although these costs increased at a faster pace than inflation, part of the increase can be attributed to the high inflation of the late 1960's and 1970's. Currently that is no longer true. While inflation has slowed to 4%, health care costs continue to increase at a double digit pace.

The need for fundamental reform in the health care system was recognized by the Federal government. If some changes were not implemented it was determined that the Medicare Hospital Insurance Trust Fund would run out by the year 1990. Hence, a new program was passed by Congress which took effect in October 1983. This program, called the "prospective-payment system" (pps), replaces the previous reimbursement program which was based solely on hospital costs. The pps program is based on putting all prospective medical treatments into one of 468 Diagnostic-Related Groups (DRG's), where a predetermined fee has been set for any treatment falling under that group. Therefore, a flat fee will be paid to hospitals regardless of their costs. In addition, hospitals would have no legal recourse as to the adequacy of the reimbursement amount in any DRG category. However, they can challenge the classification of a particular patient under one DRG rather than another.

The free reign hospitals had with the cost-based system has been replaced with a fixed-payment system. Thus, if a hospital's costs exceed the flat payment the loss will be

absorbed by the hospital; if costs are less than the payment the hospital will make a profit.

The new payment system has turned the hospital industry upside down and forced all hospitals to reevaluate their operations in order to insure survival. The Stillwater Medical Center is currently involved in such reevaluations. They have been monitoring their staffing and patient loads for the past two years and forecasting their nursing needs for a little over a year. These activities are aimed at helping control the costs of the hospital and at giving them a better idea of what their environment is.

## CHAPTER II

### OBJECTIVES

This research project aims to provide a descriptive profile of the staffing and patient loads experienced by the Stillwater Medical Center during 1982 and 1983 by:

1. Determining means for patient loads, forecasted staffing needs, actual staffing, registered nurses (RN's) on duty, and licensed practical nurses (LPN's) on duty by year, month, week, day of the week, unit, and shift.
2. Determining if there are any trends in the data.
3. Determining if there are differences between the units in the hospital.

## CHAPTER III

### METHODOLOGY

#### Background

The Stillwater Medical Center is a 145 bed hospital consisting of ten different units. These units are: Unit 2, Maternity; Unit 3, Cardiovascular/Pediatrics; Unit 4, Outpatient Surgery; Unit 5, Broken Bones; Unit 10, Labor and Delivery; Unit 11, Nursery; Unit 12, Intensive Care; Unit 13, Psychiatric; Unit 14, Emergency Room (E.R.); and Unit 15, Birthing. For each unit the number of nurses that will be needed for each shift each day is estimated or forecast each day.

Once the forecasted nursing needs are determined it becomes the job of the nursing supervisor to use the forecast, to control actual staffing levels. Theoretically the actual and forecasted staffing levels should be the same but since the forecast is not limited to whole numbers this is not true.

#### Research Design

This research project is a descriptive study. In past years Stillwater Medical Center has been collecting data on its patient loads and staffing, but this data has been in a

data base for only the last two years. In this time few studies have been done to really analyze the data and what can be done with it. For this reason a descriptive study was chosen to make an analysis of the data and provide a baseline for future research.

#### Data Collection Method

For this study primary data was collected by the Stillwater Medical Center during the years 1982 and 1983. Samples of the forms used for collecting the data are in the Appendix. Using form A a census was obtained every day for shift one on each unit. From these censuses the patient loads and actual nursing staff levels were obtained.

Determining the forecast of nurses need was not nearly as straightforward. First nurses use form B to determine each patient's acuity level which gives an indication as to how much care a patient needs. The lower the level the less care a patient needs. The nurse rates the patient in each of the categories on form B such as ambulation, bath/hygiene, etc. and records the results on form C. For example if the patient is to have complete bed rest they would receive a score of 6 in the ambulation category. Then the scores from each category are totaled to obtain the Total Relative Patient Value or Total Points on form C.

After totals are obtained each patient is assigned to an acuity level according to the range their total points falls into on form C. Then the number of patients in each

acuity level is totaled under Today's Acuity on form C. Form D is then used to calculate the number of nurses needed. For example if there were three patients that had an acuity level of III then 1.0 nurses would be needed on shift one to care for them. These nursing needs are then totaled and entered on form E under the 7-3 needs column. This is how forecast nursing needs are determined for shift one. Shift two and three needs are then determined by multiplying shift one needs by 88 and 58% respectively. These percentages were determined by a 1981 time study conducted by the hospital during a one week period.

## CHAPTER IV

### LIMITATIONS

As with any study there are certain limitations on this research project. One of them is that the data contains only two years of observations. Therefore making generalizations about events outside these two years should be done with caution.

Another problem is that the forecast of nurses needed does not always come out to a whole number. Thus when the forecast calls for 3.5 nurses the administration must determine whether to use three or four nurses which causes under or over staffing. Therefore, the hospital will not be as efficient as it should be.

Also the data does not give any idea as to how much activity the nurses are actually engaged in. We can only determine how well the forecast is compared to the actual number of nurses used.



## CHAPTER V

### FINDINGS

#### Yearly Averages

When examining any situation it is usually better to look at the broad picture first in order to further define areas that might want to be looked at in more detail. It was with that thought in mind that the yearly averages were computed first. These averages are computed from data with observations every day on every unit for all three shifts. It should be noted that in 1983, the Birthing Room, unit 15 was established. Therefore in order to make accurate comparisons between the averages for 1982 and 1983, discussions will be confined to the averages for 1983 that exclude unit 15. The 1983 averages with unit 15 are shown for comparison. Also the number of RN's and LPN's on duty have been combined into one variable (Actual Nurses); therefore they are shown, but the discussion will be confined to their sum (Actual Nurses).

The average for total patients shown in Table I indicates that the 1983 average is 20% less than that of 1982, whereas the average number of nurses on duty in 1983 was virtually unchanged. Note the nurse forecast only reflects units 2 - 5 and cannot be accurately compared to

TABLE I  
 AVERAGE DAILY UNIT PATIENT LOAD AND NURSING  
 STAFF, STILLWATER MEDICAL CENTER,  
 1982 AND 1983

	1982	1983#	1983
Patients	13.345	11.476	10.641
Nurses Forecast	*	3.555	3.555
Actual Nurses	1.855	1.857	1.730
RN's	1.214	1.258	1.175
LPN's	0.641	0.599	0.555

\*missing data

#data doesn't include unit 15

Note: Forecasting nursing requirements started in 1983 and includes only units 2, 3, 4 and 5.

the actual nurses on duty here because the actual averages are for all units in the hospital.

#### Monthly Averages

The monthly averages were computed in order to look at the data in more detail. These averages for 1982 and 1983 (see Table II) further support the decline in patients from 1982 to 1983 as each month except for August has declined from its 1982 average. Also the average patient load declines steadily from April through July for both years. For 1983 we can see that the average number of nurses actually on duty is quite similar to the monthly averages for 1982.

#### Day of the Week

When the data for the two years is looked at by day of the week (see Table III) several interesting trends are apparent. From the 1982 data we can see that the average number of patients is at its lowest level on Sundays. It then begins a steady climb until it reaches its peak of 13.999 on Wednesdays, after which it declines steadily through Sunday. The average number of nurses actually on duty follows the same path with highs on Wednesdays and lows on Sundays during 1982.

In 1983 the average patient load and the average number of nurses actually on duty show the same trend as 1982 with only slight differences. The average patient load for 1983

TABLE II  
 AVERAGE DAILY UNIT PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, 1982 AND  
 1983, JANUARY-DECEMBER

Year	Month	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	January	13.364	*	1.858	1.214	0.644
	February	15.288	*	1.929	1.219	0.709
	March	14.151	*	1.868	1.278	0.591
	April	14.158	*	1.773	1.192	0.581
	May	13.832	*	1.773	1.150	0.624
	June	13.247	*	1.739	1.107	0.632
	July	12.400	*	1.768	1.177	0.591
	August	11.569	*	1.733	1.150	0.583
	September	12.659	*	1.952	1.242	0.709
	October	13.816	*	1.928	1.251	0.678
	November	13.933	*	2.035	1.306	0.729
	December	12.060	*	1.909	1.284	0.625
#1983	January	12.152	4.323	1.971	1.328	0.643
	February	12.327	4.436	1.984	1.303	0.681
	March	12.576	4.576	1.991	1.295	0.695
	April	11.432	*	1.879	1.242	0.637
	May	11.050	3.553	1.802	1.227	0.575
	June	10.596	3.162	1.790	1.221	0.568
	July	10.909	3.248	1.752	1.212	0.540
	August	11.768	2.795	1.821	1.252	0.568
	September	12.165	2.934	1.852	1.236	0.616
	October	10.931	3.298	1.807	1.235	0.573
	November	12.065	4.214	1.875	1.301	0.574
	December	9.830	2.646	1.773	1.250	0.523
1983	January	12.152	4.323	1.971	1.328	0.643
	February	12.327	4.436	1.984	1.303	0.681
	March	12.572	4.576	1.991	1.295	0.695
	April	10.763	*	1.776	1.177	0.599
	May	9.998	3.553	1.648	1.129	0.519
	June	9.540	3.162	1.614	1.103	0.512
	July	9.827	3.248	1.585	1.099	0.486
	August	10.610	2.795	1.657	1.145	0.511
	September	10.962	2.934	1.680	1.125	0.555
	October	9.858	3.298	1.647	1.132	0.515
	November	10.867	4.214	1.696	1.179	0.517
	December	8.857	2.646	1.606	1.135	0.471

\*missing data

#data doesn't include unit 15

Note: Forecasting nursing requirements started in 1983 and includes only units 2, 3, 4 and 5.

TABLE III  
 AVERAGE DAILY UNIT PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, 1982 AND  
 1983, SUNDAY-SATURDAY

Year	Day	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	Sunday	12.324	*	1.596	1.046	0.550
	Monday	12.926	*	1.911	1.232	0.678
	Tuesday	13.878	*	1.997	1.309	0.688
	Wednesday	13.999	*	2.132	1.375	0.756
	Thursday	13.911	*	1.959	1.309	0.650
	Friday	13.578	*	1.832	1.204	0.628
	Saturday	12.788	*	1.559	1.023	0.535
1983#	Sunday	10.291	2.945	1.573	1.063	0.510
	Monday	11.145	3.431	1.885	1.292	0.593
	Tuesday	12.091	3.608	2.030	1.375	0.655
	Wednesday	12.313	4.040	2.127	1.430	0.696
	Thursday	12.184	3.890	1.988	1.319	0.669
	Friday	11.630	3.595	1.831	1.283	0.548
	Saturday	10.697	3.380	1.573	1.049	0.524
1983	Sunday	9.547	2.945	1.469	0.996	0.473
	Monday	10.327	3.431	1.753	1.204	0.549
	Tuesday	11.215	3.608	1.891	1.284	0.607
	Wednesday	11.423	4.040	1.983	1.338	0.645
	Thursday	11.283	3.890	1.847	1.228	0.619
	Friday	10.787	3.595	1.706	1.198	0.508
	Saturday	9.917	3.380	1.467	0.981	0.485

\*missing data

#data doesn't include unit 15

Note: Forecasting nursing requirements started in  
 1983 and includes only units 2, 3, 4 and 5.

by day of the week was always about 2.9 patients less than in 1983 and the average actual nurse count was always about the same as the 1982 average. Also the 1983 average actual nurse count shows a low on Saturdays and Sundays of 1.573.

The forecast of nurses needed in 1983 also exhibits the low Sundays, high Wednesday trend. Notice these averages are for units two, three, four, and five, and are twice the number of actual nurses on duty on average for the entire hospital.

#### Unit Averages

The best way to eliminate the distortion in the averages and still keep a broad perspective is to look at the unit averages. In Table IV the unit averages have been calculated and give us a different view of the data.

As the average patient load for both years changes on units two through five so does the average actual number of nurses on duty for those units. But for the other units of the hospital this does not hold, an increase or decrease in patient load does not mean a corresponding increase or decrease in actual nurses on duty. For example when the average patient load is from 15.629 on unit two to 31.57 on unit three the average number of nurses actually on duty rises correspondingly from 1.980 to 4.475. But when the average patient load rises on unit 10, on unit 11 the average number of nurses actually on duty falls. This is reasonable given unit 10 is Labor and Delivery.

TABLE IV  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNITS 2-15,  
 1982 AND 1983

Year	Unit	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	2	17.668	*	2.147	1.211	0.937
	3	33.084	*	4.506	2.527	1.979
	4	3.441	*	0.289	0.137	0.151
	5	28.211	*	3.642	1.922	1.720
	10	1.333	*	1.379	1.361	0.018
	11	8.767	*	1.072	0.545	0.527
	12	2.571	*	1.293	1.293	0.000
	13	8.052	*	1.202	0.778	0.424
	14	12.502	*	1.156	1.148	0.008
	15	*	*	*	*	*
1983	2	15.629	3.462	1.980	1.269	0.711
	3	31.576	3.226	4.475	2.672	1.802
	4	0.190	2.787	0.034	0.015	0.020
	5	25.967	4.747	3.656	1.896	1.761
	10	1.164	*	1.448	1.444	0.004
	11	7.664	*	1.051	0.482	0.570
	12	2.275	*	1.518	1.380	0.138
	13	6.781	*	1.182	0.799	0.383
	14	12.048	*	1.369	1.367	0.002
	15	0.130	*	0.130	0.130	0.000

\*missing data

Note: Unit 15 wasn't established until April 1983.

An important point brought out by these averages is that on units two through five in 1983 the average forecast of nurses needed and the actual number on duty are quite different. The forecast for units two, four and five is considerably higher than the actual and the forecast on unit three is lower than the actual.

#### Shift Averages

Averages for each shift are presented in Table V and reveal yet another way of analyzing patient and staffing loads. In 1982 the average patient load was its greatest on shift one (7 a.m. - 3 p.m.) then declined only slightly during shift two (3 p.m. - 11 p.m.) and finally reached its low during the third shift (11 p.m. - 7 a.m.). The actual nurses on duty followed the same trend with a larger decline on second shift from the first.

For 1983 the average patient load, nurses forecast, and actual nurses on duty had the same pattern as in 1982. Shift one had the highest averages with shifts two and three following respectively. The average patient load for 1983 however was about 1.8 patients below 1982 averages on every shift. The actual number of nurses on duty for 1983 was also below 1982 on the average except for shift one which remained the same at 2.202 nurses.

#### Unit Analysis

In order to gain a better understanding of the patient



TABLE V  
 AVERAGE DAILY UNIT PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, SHIFTS 1-3,  
 1982 AND 1983

Year	Shift	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	1	13.696	*	2.202	1.487	0.716
	2	13.640	*	1.825	1.141	0.683
	3	12.698	*	1.537	1.015	0.523
1983#	1	11.822	3.877	2.168	1.472	0.696
	2	11.724	3.662	1.901	1.238	0.664
	3	10.883	3.130	1.502	1.064	0.438
1983	1	10.965	3.877	2.202	1.377	0.644
	2	10.871	3.662	1.772	1.157	0.615
	3	10.086	3.130	1.395	0.990	0.405

\* missing data

# data doesn't include unit 15

Note: Forecasting nursing requirements started in 1983 and includes only units 2, 3, 4 and 5.

and staffing loads an indepth analysis was done on each of the different units in the hospital. This should be helpful in further describing any trends or differences in the data. From this specific problems or strengths may be abstracted.

### Unit 2

On Unit 2 (Maternity) during 1982 the average patient load was highest for the first five months of the year (see Table VI). Then the patient load dropped off during the summer months of June, July, and August only to rise to a fairly steady average of about 17.5 patients through November. December however saw a sharp decline in the average patient load. The average number of nurses on duty in 1982 for unit two followed a slightly different trend than the average patient load. It experienced its lowest levels in the first part of the year and the highest during last few months.

In 1983 the average patient load on unit two varied much more over the months without many clear trends. The averages were highest during the first three months however, as in 1982. Also every months average was down from 1982 except for August which increased. The average number of nurses on duty also is down for every month except January, February, and March. From the average forecast of nurses needed it is apparent that there is not a linear relationship between it and the average patient load. Hence as the patient load goes up or down the forecast for nurses does

TABLE VI  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF  
 STILLWATER MEDICAL CENTER, UNIT 2  
 JANUARY-DECEMBER, 1982 AND 1983

Year	Month	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	January	18.570	*	1.978	1.065	0.914
	February	21.095	*	2.055	1.039	1.015
	March	19.720	*	1.942	1.133	0.809
	April	18.011	*	2.112	1.136	0.977
	May	19.204	*	2.134	1.091	1.043
	June	16.622	*	2.151	1.008	1.143
	July	16.516	*	2.001	1.247	0.754
	August	15.247	*	2.023	1.312	0.711
	September	17.467	*	3.313	1.369	0.944
	October	17.378	*	2.374	1.381	0.994
	November	17.540	*	2.416	1.356	1.060
	December	14.844	*	2.270	1.373	0.897
1983	January	16.767	2.985	2.177	1.433	0.743
	February	16.607	3.340	2.269	1.412	0.857
	March	18.505	3.547	2.231	1.366	0.866
	April	14.733	*	2.020	1.309	0.711
	May	15.548	3.237	1.972	1.295	0.677
	June	13.800	3.338	1.732	1.111	0.621
	July	13.645	3.089	1.745	1.158	0.587
	August	16.495	3.604	1.834	1.229	0.605
	September	16.489	3.826	1.980	1.266	0.714
	October	13.935	3.324	1.857	1.204	0.653
	November	16.460	4.312	2.059	1.260	0.799
	December	14.656	3.505	1.911	1.196	0.716

\* missing data

not necessarily do the same.. An interesting fact about the forecast averages is that they are always above the actual number of nurses who worked:

When unit two is analyzed by day of the week definite trends and differences appear (see Table VII). For both years the same trend is seen in the average patient load, nurses forecast, and actual nurses on duty. Activity is at a low on Sundays and then begins a steady climb until a peak is reached on Wednesdays. The activity declines through Sundays. The only exception is that in 1982 the low for the average number of nurses actually on duty occurred on Saturday instead of Sunday. Average patient and actual staffing loads are also lower in 1983 for every day of the week. The average forecast by day of the week also exceeds the average actual nurses by day of the week everyday. For example, on Fridays the average forecast is 3.632 and the average actual nurses is only 1.863.

Averages for each shift for unit two are shown in Table VIII. Average patient loads for both years show a high on shift one and a low on shift two. The average number of nurses actually on duty declined from shift one through shift three for both years and the average forecast of nurses did the same for 1983. Here again 1983 activity is consistently down from 1982 and the forecast for nurses exceeds the actual.

TABLE VII  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 2,  
 SUNDAY-SATURDAY, 1982 AND 1983

Year	Day	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	Sunday	14.462	*	1.778	1.060	0.718
	Monday	16.516	*	2.242	1.255	0.987
	Tuesday	19.433	*	2.392	1.330	1.062
	Wednesday	20.090	*	2.617	1.422	1.195
	Thursday	19.216	*	2.275	1.347	0.928
	Friday	18.465	*	2.003	1.106	0.896
	Saturday	15.551	*	1.729	0.956	0.772
1983	Sunday	12.365	2.267	1.615	1.055	0.560
	Monday	14.353	3.341	1.901	1.252	0.649
	Tuesday	17.641	3.977	2.258	1.441	0.817
	Wednesday	18.449	4.467	2.433	1.508	0.926
	Thursday	17.536	4.140	2.171	1.344	0.827
	Friday	15.814	3.632	1.863	1.240	0.622
	Saturday	13.277	2.422	1.624	1.047	0.577

\*missing data

TABLE VIII  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 2,  
 SHIFTS 1-3, 1982 AND 1983

Year	Shift	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	1	18.576	*	2.445	1.367	1.078
	2	16.637	*	2.288	1.263	1.025
	3	17.789	*	1.708	1.002	0.707
1983	1	16.401	4.205	2.380	1.505	0.874
	2	14.683	3.727	2.163	1.197	0.197
	3	15.806	2.453	1.394	1.197	0.197

\*missing data

Unit 3

For unit three (Cardiovascular and Pediatrics) during 1982 and 1983 the average patient load was highest during the first three or four months and then leveled off with slight variations the rest of the year (see Table IX). However 1983 levels were down on the average about one to two patients. The average actual number of nurses on duty on unit three during 1982 were considerably higher for the last half of the year whereas for 1983 the first half of the year was higher. Another fact brought out by these monthly averages is that the average actual nurses on duty was higher than the average forecast of nursing needs for every month except November in 1983.

The averages by day of the week are listed in Table X and reveal interesting trends. For both years the average patient load and the average number of nurses actually on duty have the same trend. Activity is at a low on Saturdays and then rises steadily to a high on Wednesdays (note that 1982 patient load is an exception with the high on Tuesdays). Activity then declined steadily through Saturdays. Another exception is that in 1982 the average number of nurses actually on duty on Tuesdays was down and caused a break in the rising trend. Overall the average patient load for 1982 was higher than 1983 for every day of the week. The actual nurses average however was about the same for both years. The nurse forecast in 1983 also

TABLE IX  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 3,  
 JANUARY-DECEMBER, 1982 AND 1983

Year	Month	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	January	34.376	*	4.320	2.477	1.843
	February	34.940	*	4.273	2.492	1.781
	March	31.968	*	4.132	2.449	1.683
	April	34.115	*	4.298	2.328	1.970
	May	32.914	*	4.183	2.355	1.828
	June	32.644	*	4.092	2.422	1.850
	July	33.237	*	4.370	2.398	1.972
	August	33.602	*	4.786	2.592	2.257
	September	32.800	*	4.816	2.609	2.207
	October	31.396	*	4.777	2.723	2.053
	November	33.701	*	5.162	3.000	2.162
	December	31.489	*	4.842	2.713	2.129
1983	January	34.067	4.241	4.991	2.847	2.144
	February	34.988	3.826	4.857	2.726	2.131
	March	33.086	4.575	4.963	2.668	2.296
	April	32.789	*	4.618	2.468	2.150
	May	29.387	3.009	4.378	2.610	1.769
	June	30.089	3.240	4.332	2.522	1.810
	July	30.978	4.432	4.438	2.741	1.697
	August	30.882	2.249	4.201	2.505	1.696
	September	32.311	1.682	4.027	2.502	1.524
	October	29.258	2.658	4.211	2.668	1.543
	November	33.345	5.147	4.415	2.949	1.466
	December	28.167	0.495	4.293	2.880	1.413

\*missing data



TABLE X  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 3,  
 SUNDAY-SATURDAY, 1982 AND 1983

Year	Day	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	Sunday	31.712	*	4.178	2.324	1.854
	Monday	33.529	*	4.706	2.616	2.090
	Tuesday	34.427	*	4.671	2.614	2.056
	Wednesday	34.242	*	4.939	2.732	2.207
	Thursday	34.111	*	4.638	2.504	2.135
	Friday	32.654	*	4.482	2.645	1.837
	Saturday	30.994	*	3.930	2.253	1.677
1983	Sunday	29.603	2.746	4.015	2.343	1.672
	Monday	31.940	3.114	4.615	2.988	1.627
	Tuesday	33.462	2.939	4.715	2.735	1.980
	Wednesday	33.500	3.540	5.006	2.837	2.169
	Thursday	33.405	3.353	4.661	2.679	1.982
	Friday	30.436	3.201	4.381	2.838	1.543
	Saturday	28.792	3.687	3.948	2.305	1.643

\*missing data

followed a similar pattern except the low was on Sundays and the high on Wednesdays. Also the average forecast was below the actual on every day of the week.

Looking at unit three by shift in Table XI we can see that the average patient load for both years shows a high on shift one and a low on shift two. The average number of nurses actually on duty declined from shift one through shift three for both years and were approximately the same for each shift. The average nurse forecast for 1983 is lower than the average number of nurses that actually worked for shifts one and two but higher on shift three. Also patient loads are consistently down.

#### Unit 4

Unit four is used for outpatient surgery at Stillwater Medical Center and appears to have undergone some changes in the past couple of years (see Table XII). From the monthly averages we can see that in the first half of 1982 the patient load was up but since then this unit has been used infrequently and in some months it has not been used at all. The forecast of nursing needs on this unit have been extremely high.

Looking at this unit by day of the week a trend is apparent in 1982 (see Table XIII). For average patient load and actual nurses a low activity level is experienced on Sundays after which activity rises every day until it reaches a high on Wednesdays. Then activity decreases

TABLE XI  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 3,  
 SHIFTS 1-3, 1982 AND 1983

Year	Shift	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	1	33.501	*	5.357	3.220	2.137
	2	32.521	*	4.547	2.432	2.115
	3	33.229	*	3.616	1.931	1.685
1983	1	32.155	2.809	5.310	2.872	2.438
	2	30.856	2.819	4.596	2.927	1.669
	3	31.718	4.049	3.518	2.218	1.300

\*missing data

TABLE XII

AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 4,  
 JANUARY-DECEMBER, 1982 AND 1983

Year	Month	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	January	1.753	*	0.303	0.163	0.140
	February	8.606	*	1.001	0.448	0.554
	March	8.523	*	1.019	0.577	0.442
	April	4.690	*	0.272	0.071	0.201
	May	7.043	*	0.269	0.151	0.118
	June	*	*	0.000	0.000	0.000
	July	0.506	*	0.118	0.054	0.065
	August	0.000	*	0.000	0.000	0.000
	September	1.072	*	0.205	0.055	0.150
	October	1.444	*	0.032	0.032	0.000
	November	7.000	*	0.322	0.127	0.196
	December	0.000	*	0.000	0.000	0.000
1983	January	0.189	4.947	0.067	0.033	0.033
	February	0.000	4.740	0.000	0.000	0.000
	March	0.097	3.973	0.043	0.022	0.022
	April	0.400	*	0.067	0.022	0.044
	May	0.129	3.874	0.032	0.011	0.022
	June	0.000	2.753	0.000	0.000	0.000
	July	0.000	1.257	0.000	0.000	0.000
	August	1.387	1.840	0.187	0.075	0.122
	September	0.000	2.497	0.000	0.000	0.000
	October	0.032	1.245	0.011	0.011	0.000
	November	0.000	2.438	0.000	0.000	0.000
	December	0.000	1.272	0.000	0.000	0.000

\*missing data

TABLE XIII  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 4,  
 SUNDAY-SATURDAY, 1982 AND 1983

Year	Day	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	Sunday	1.372	*	0.083	0.026	0.058
	Monday	1.827	*	0.128	0.059	0.069
	Tuesday	4.500	*	0.449	0.212	0.237
	Wednesday	5.725	*	0.592	0.282	0.310
	Thursday	4.561	*	0.439	0.183	0.256
	Friday	3.094	*	0.236	0.148	0.087
	Saturday	1.724	*	0.096	0.051	0.045
1983	Sunday	0.000	2.318	0.000	0.000	0.000
	Monday	0.000	2.659	0.000	0.000	0.000
	Tuesday	0.481	2.738	0.084	0.036	0.048
	Wednesday	0.551	3.064	0.083	0.038	0.045
	Thursday	0.235	3.153	0.059	0.017	0.045
	Friday	0.057	2.782	0.015	0.015	0.000
	Saturday	0.000	2.792	0.000	0.000	0.000

\*missing data

steadily through Sundays. In 1983 this trend is still apparent for average patient loads and average actual nurses but there is no activity at all on Saturdays, Sundays or Mondays. Here again the average forecast of nurses needed is extremely high for every day.

As far as shifts are concerned (see Table XIV) for both 1982 and 1983 the average patient loads show a high on shift one and a low on shift two. The average number of nurses actually on duty declined from shift one through shift three in 1982 but essentially stayed the same for all three shifts in 1983. Also we again notice a radical drop in activity during 1983 and a large forecast for nursing needs in 1983 on all shifts.

#### Unit 5

On unit five (broken bones) during 1982 the average patient load was highest for the first five months of the year (see Table XV). Then the patient load dropped off during June, July and August. December then saw the average patient load drop to its lowest point. The average number of nurses on duty in 1982 for unit five also experienced a drop during the summer months but its highest point was reached at the end of the year.

In 1983 the average patient load on unit five varied much more over the different months without many clear trends. However in December the average patient load dropped considerably and every months average except August

TABLE XIV  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 4,  
 SHIFTS 1-3, 1982 AND 1983

Year	Shift	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	1	3.714	*	0.345	0.162	0.184
	2	3.174	*	0.296	0.128	0.167
	3	3.428	*	0.224	0.121	0.103
1983	1	0.229	3.279	0.038	0.015	0.023
	2	0.149	2.831	0.032	0.014	0.018
	3	0.190	2.261	0.033	0.015	0.018

\*missing data

TABLE XV  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 5,  
 JANUARY-DECEMBER, 1982 AND 1983

Year	Month	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	January	31.011	*	3.835	2.020	1.815
	February	33.083	*	3.818	1.812	2.006
	March	33.011	*	3.581	2.065	1.516
	April	30.149	*	3.368	2.023	1.345
	May	28.183	*	3.585	1.860	1.725
	June	25.556	*	3.468	1.844	1.623
	July	25.247	*	3.476	1.903	1.573
	August	23.441	*	3.178	1.722	1.457
	September	30.311	*	3.934	2.067	1.868
	October	27.622	*	3.771	1.904	1.867
	November	28.034	*	4.120	2.000	2.120
	December	23.267	*	3.585	1.839	1.746
1983	January	27.278	5.118	3.830	1.978	1.852
	February	27.619	5.836	3.936	2.054	1.882
	March	28.849	6.209	3.952	2.075	1.876
	April	26.433	*	3.597	2.027	1.570
	May	23.194	4.094	3.414	1.817	1.597
	June	23.944	3.314	3.414	1.786	1.629
	July	25.204	4.212	3.216	1.614	1.602
	August	28.355	3.487	3.663	1.947	1.716
	September	28.511	3.730	4.150	1.924	2.226
	October	26.204	5.986	3.822	1.876	1.945
	November	26.207	4.958	3.739	1.921	1.818
	December	19.856	5.312	3.172	1.744	1.428

\*missing data



was down from 1982. On the other hand the average number of nurses actually on duty is higher for 1983 on many months and does not appear to have changed much. The average forecast of nurses needed is higher than the actual nurses for all months except June, August, and September.

Analyzing unit five by day of the week shows definite trends and differences (see Table XVI). For both years the average patient load shows the same trend. Sundays on the average experience the lowest number of patients. Then the average rises every day of the week until Thursdays when on the average the highest patient load is experienced. After which the average decreases every day through Sundays. The average number of nurses actually on duty also exhibits a similar trend, except that the highs are reached on Wednesdays and the lows are on Saturdays. The average forecast of nurses needed shows the same trend with a high on Wednesday and a low on Sunday. It should be noted that the average forecast of nurses needed is higher than the actual for every day of the week.

Averages for each shift for unit five are shown in Table XVII. Average patient loads for both years show a high on shift one and a low on shift two. The average number of nurses actually on duty declined from shift one through shift three for both years. The average forecast of nurses needed however had a high on shift two and a low on shift three. Here again 1983 activity is consistently down from 1982 and the forecast for nurses exceeds the actual.

TABLE XVI  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 5,  
 SUNDAY-SATURDAY, 1982 AND 1983

Year	Day	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	Sunday	23.987	*	2.942	1.553	1.389
	Monday	27.007	*	3.851	2.007	1.844
	Tuesday	30.333	*	4.051	2.100	1.951
	Wednesday	30.615	*	4.224	2.201	2.023
	Thursday	30.797	*	3.820	2.123	1.697
	Friday	29.138	*	3.678	1.922	1.756
	Saturday	25.686	*	2.929	1.546	1.383
1983	Sunday	20.808	4.454	2.974	1.635	1.338
	Monday	24.373	4.611	3.873	2.034	1.839
	Tuesday	28.038	4.779	3.978	2.088	1.890
	Wednesday	28.808	5.089	4.175	2.099	2.076
	Thursday	29.320	4.911	3.974	1.912	2.062
	Friday	27.564	4.771	3.704	2.004	1.699
	Saturday	22.918	4.617	2.945	1.509	1.435

\*missing data

TABLE XVII  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 5,  
 SHIFTS 1-3, 1982 AND 1983

Year	Shift	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	1	28.809	*	4.376	2.066	2.311
	2	27.332	*	3.702	2.142	1.561
	3	28.490	*	2.846	1.557	1.289
1983	1	26.569	5.212	4.354	2.064	2.290
	2	25.066	5.271	3.670	1.881	1.789
	3	26.265	3.759	2.945	1.742	1.203

\* missing data

Units 10 - 15

Units 10 - 15 are the Labor and Delivery, Nursery, Intensive Care, Psychiatric, E.R., and Birthing units respectively. Tables analyzing these units in the same way that units two to five were analyzed are shown in Tables XVIII to XXXV for comparison.

## Regression Analysis

As a part of the new scheduling method used by Stillwater Medical Center it has been determined that an audit can be made to determine nursing requirements for the first shift (7 a.m. to 3 p.m.) each day and from these requirements the nursing staff needed for the second and third shift (3 to 11 p.m. and 11 p.m. to 7 a.m. respectively) can be approximated. The general rule is that the second shift will require 88% of the nursing staff the first shift required and the third shift only 58%. This study has analyzed the data in order to determine if the actual nursing staff requirements have been consistent with this rule.

In order to study this situation models were built using regression techniques. Only data from 1983 was used because the new forecasting program did not originate until that year. Tables XXXVI to XXXVII show the actual models and reveal several interesting things. Table XXXVI shows two equations that model the actual nursing staff levels experienced. They model shift two and three as a function

TABLE XVIII  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 10,  
 JANUARY-DECEMBER, 1982 AND 1983

Year	Month	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	January	1.290	*	1.312	1.312	0.000
	February	1.750	*	1.381	1.381	0.000
	March	1.602	*	1.330	1.330	0.000
	April	1.471	*	1.394	1.337	0.057
	May	1.108	*	1.230	1.230	0.000
	June	1.400	*	1.296	1.296	0.000
	July	1.237	*	1.278	1.278	0.000
	August	1.172	*	1.151	1.151	0.000
	September	1.089	*	1.556	1.511	0.044
	October	1.367	*	1.508	1.465	0.043
	November	1.471	*	1.562	1.529	0.033
	December	1.089	*	1.559	1.516	0.043
1983	January	1.278	*	1.597	1.597	0.000
	February	0.964	*	1.586	1.550	0.036
	March	1.538	*	1.452	1.441	0.011
	April	0.933	*	1.457	1.457	0.000
	May	1.183	*	1.435	1.435	0.000
	June	1.244	*	1.494	1.494	0.000
	July	0.968	*	1.460	1.460	0.000
	August	0.892	*	1.396	1.396	0.000
	September	1.133	*	1.403	1.403	0.000
	October	1.022	*	1.329	1.329	0.000
	November	1.529	*	1.398	1.398	0.000
	December	1.289	*	1.383	1.383	0.000

\*missing data

TABLE XIX  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 10,  
 SUNDAY-SATURDAY, 1982 AND 1983

Year	Day	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	Sunday	1.013	*	1.117	1.092	0.026
	Monday	1.476	*	1.444	1.412	0.033
	Tuesday	1.233	*	1.619	1.606	0.013
	Wednesday	1.377	*	1.534	1.502	0.032
	Thursday	1.765	*	1.578	1.571	0.006
	Friday	1.346	*	1.270	1.270	0.000
	Saturday	1.135	*	1.092	1.073	0.019
1983	Sunday	0.929	*	1.147	1.147	0.000
	Monday	1.307	*	1.388	1.381	0.007
	Tuesday	1.205	*	1.724	1.704	0.019
	Wednesday	1.295	*	1.700	1.700	0.000
	Thursday	1.222	*	1.614	1.614	0.000
	Friday	1.167	*	1.376	1.376	0.000
	Saturday	1.031	*	1.194	1.194	0.000

\*missing data

TABLE XX  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 10,  
 SHIFTS 1-3, 1982 AND 1983

Year	Shift	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	1	1.499	*	1.765	1.740	0.025
	2	1.503	*	1.221	1.216	0.005
	3	0.997	*	1.150	1.125	0.025
1983	1	1.124	*	1.910	1.910	0.006
	2	1.423	*	1.269	1.269	0.000
	3	0.945	*	1.166	1.160	0.006

\*missing data

TABLE XXI

AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
STILLWATER MEDICAL CENTER, UNIT 11,  
JANUARY-DECEMBER, 1982 AND 1983

Year	Month	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	January	8.430	*	1.055	0.539	0.516
	February	10.548	*	1.071	0.646	0.425
	March	9.344	*	1.065	0.720	0.344
	April	8.179	*	1.069	0.793	0.276
	May	9.376	*	1.097	0.613	0.484
	June	8.144	*	1.111	0.422	0.689
	July	6.925	*	1.103	0.510	0.594
	August	8.892	*	1.017	0.505	0.512
	September	9.322	*	1.171	0.493	0.678
	October	8.811	*	1.023	0.419	0.603
	November	8.253	*	1.082	0.444	0.638
	December	9.067	*	1.004	0.455	0.549
1983	January	8.111	*	1.122	0.511	0.611
	February	6.667	*	1.045	0.438	0.607
	March	7.753	*	1.011	0.441	0.570
	April	6.667	*	1.062	0.407	0.656
	May	9.097	*	1.065	0.473	0.591
	June	5.856	*	1.056	0.389	0.667
	July	7.548	*	1.038	0.403	0.634
	August	6.785	*	1.000	0.559	0.441
	September	8.689	*	1.054	0.533	0.521
	October	7.862	*	1.011	0.505	0.505
	November	8.885	*	1.092	0.563	0.529
	December	7.989	*	1.066	0.556	0.510

\*missing data



TABLE XXII  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 11,  
 SUNDAY-SATURDAY, 1982 AND 1983

Year	Day	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	Sunday	8.372	*	1.026	0.528	0.499
	Monday	8.320	*	1.093	0.535	0.558
	Tuesday	8.605	*	0.994	0.560	0.433
	Wednesday	8.705	*	1.203	0.551	0.651
	Thursday	9.039	*	1.079	0.656	0.423
	Friday	9.553	*	1.060	0.475	0.586
	Saturday	8.744	*	1.049	0.513	0.537
1983	Sunday	6.949	*	1.006	0.478	0.529
	Monday	7.473	*	1.041	0.454	0.587
	Tuesday	7.859	*	1.057	0.493	0.564
	Wednesday	7.737	*	1.126	0.579	0.547
	Thursday	8.059	*	1.065	0.516	0.549
	Friday	8.089	*	1.045	0.434	0.611
	Saturday	7.484	*	1.019	0.418	0.601

\*missing data

TABLE XXIII  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 11,  
 SHIFTS 1-3, 1982 AND 1983

Year	Shift	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	1	9.392	*	1.106	0.622	0.484
	2	8.200	*	1.015	0.561	0.454
	3	8.708	*	1.095	0.453	0.642
1983	1	8.227	*	1.062	0.656	0.406
	2	7.179	*	1.025	0.545	0.480
	3	7.588	*	1.067	0.243	0.823

\*missing data

TABLE XXIV  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 12,  
 JANUARY-DECEMBER, 1982 AND 1983

Year	Month	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	January	2.742	*	1.463	1.463	0.000
	February	3.136	*	1.351	1.351	0.000
	March	2.860	*	1.396	1.396	0.000
	April	2.869	*	1.218	1.218	0.000
	May	2.301	*	1.196	1.196	0.000
	June	2.311	*	1.156	1.156	0.000
	July	2.108	*	1.152	1.152	0.000
	August	2.839	*	1.071	1.071	0.000
	September	1.656	*	1.139	1.139	0.000
	October	2.222	*	1.383	1.383	0.000
	November	3.000	*	1.405	1.405	0.000
	December	2.900	*	1.582	1.582	0.000
1983	January	2.389	*	1.611	1.533	0.078
	February	2.024	*	1.710	1.473	0.237
	March	2.817	*	1.799	1.584	0.215
	April	2.800	*	1.633	1.486	0.148
	May	1.720	*	1.513	1.374	0.139
	June	1.878	*	1.477	1.388	0.089
	July	2.118	*	1.409	1.366	0.043
	August	3.258	*	1.474	1.340	0.134
	September	1.822	*	1.341	1.191	0.150
	October	2.272	*	1.524	1.441	0.083
	November	2.310	*	1.424	1.261	0.163
	December	1.844	*	1.311	1.122	0.189

\*missing data

TABLE XXV  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 12,  
 SUNDAY-SATURDAY, 1982 AND 1983

Year	Day	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	Sunday	2.256	*	1.138	1.138	0.000
	Monday	2.427	*	1.376	1.376	0.000
	Tuesday	2.789	*	1.380	1.380	0.000
	Wednesday	2.827	*	1.477	1.477	0.000
	Thursday	2.662	*	1.327	1.327	0.000
	Friday	2.585	*	1.274	1.274	0.000
	Saturday	2.462	*	1.081	1.081	0.000
1983	Sunday	2.263	*	1.218	1.088	0.129
	Monday	2.180	*	1.661	1.481	0.180
	Tuesday	2.301	*	1.684	1.501	0.183
	Wednesday	2.442	*	1.723	1.595	0.128
	Thursday	2.137	*	1.612	1.459	0.153
	Friday	2.329	*	1.563	1.441	0.122
	Saturday	2.264	*	1.182	1.107	0.075

\*missing data

TABLE XXVI  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 12,  
 SHIFTS 1-3, 1982 AND 1983

Year	Shift	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	1	2.691	*	1.529	1.529	0.000
	2	2.462	*	1.205	1.205	0.000
	3	2.561	*	1.145	1.145	0.000
1983	1	2.403	*	1.629	1.575	0.053
	2	2.141	*	1.619	1.516	0.102
	3	2.279	*	1.308	1.049	0.259

\*missing data

TABLE XXVII

AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 13,  
 JANUARY-DECEMBER, 1982 AND 1983

Year	Month	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	January	9.269	*	1.249	0.706	0.543
	February	11.952	*	1.151	1.151	0.000
	March	7.161	*	1.196	0.680	0.516
	April	7.405	*	1.154	0.752	0.402
	May	6.984	*	1.115	0.744	0.371
	June	6.478	*	1.186	0.806	0.380
	July	11.312	*	1.186	0.825	0.361
	August	6.312	*	1.166	0.854	0.312
	September	6.167	*	1.222	0.767	0.456
	October	10.744	*	1.298	0.785	0.513
	November	8.894	*	1.159	0.795	0.364
	December	5.022	*	1.238	0.958	0.280
1983	January	8.411	*	1.111	0.789	0.322
	February	10.190	*	1.190	0.810	0.381
	March	9.742	*	1.277	0.874	0.403
	April	6.056	*	1.169	0.736	0.433
	May	7.570	*	1.054	0.677	0.376
	June	5.978	*	1.064	0.764	0.300
	July	3.763	*	1.083	0.788	0.295
	August	5.516	*	1.290	0.882	0.409
	September	7.811	*	1.300	0.889	0.411
	October	4.731	*	1.204	0.785	0.419
	November	7.471	*	1.278	0.883	0.395
	December	4.467	*	1.170	0.714	0.456

\*missing data

TABLE XXVIII  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 13,  
 SUNDAY-SATURDAY, 1982 AND 1983

Year	Day	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	Sunday	8.269	*	1.059	0.655	0.404
	Monday	8.112	*	1.156	0.669	0.487
	Tuesday	8.054	*	1.258	0.828	0.429
	Wednesday	8.006	*	1.333	0.949	0.385
	Thursday	8.003	*	1.277	0.884	0.394
	Friday	7.981	*	1.288	0.805	0.483
	Saturday	7.935	*	1.040	0.654	0.386
1983	Sunday	6.878	*	1.004	0.643	0.362
	Monday	6.740	*	1.170	0.723	0.447
	Tuesday	6.846	*	1.267	0.876	0.391
	Wednesday	6.885	*	1.332	0.957	0.375
	Thursday	6.882	*	1.259	0.864	0.395
	Friday	6.603	*	1.181	0.848	0.333
	Saturday	6.635	*	1.066	0.682	0.384

\*missing data

TABLE XXIX  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 13,  
 SHIFTS 1-3, 1982 AND 1983

Year	Shift	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	1	8.132	*	1.544	1.326	0.218
	2	7.911	*	1.046	0.235	0.812
	3	8.112	*	1.014	0.773	0.241
1983	1	6.878	*	1.395	1.231	0.164
	2	6.663	*	1.096	0.243	0.853
	3	6.801	*	1.056	0.923	0.133

\*missing data



TABLE XXX  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 14,  
 JANUARY-DECEMBER, 1982 AND 1983

Year	Month	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	January	12.333	*	1.203	1.182	0.022
	February	11.952	*	1.151	1.151	0.000
	March	12.742	*	1.126	1.126	0.000
	April	13.369	*	1.071	1.071	0.000
	May	12.269	*	1.151	1.108	0.043
	June	12.822	*	1.193	1.193	0.000
	July	14.000	*	1.226	1.226	0.000
	August	12.613	*	1.205	1.205	0.000
	September	13.144	*	1.170	1.148	0.022
	October	12.033	*	1.160	1.149	0.011
	November	11.989	*	1.084	1.084	0.000
	December	10.774	*	1.127	1.127	0.000
1983	January	10.878	*	1.233	1.233	0.000
	February	11.881	*	1.262	1.262	0.000
	March	10.763	*	1.187	1.187	0.000
	April	12.067	*	1.288	1.288	0.000
	May	11.264	*	1.355	1.355	0.000
	June	12.578	*	1.539	1.539	0.000
	July	13.957	*	1.376	1.376	0.000
	August	12.344	*	1.339	1.339	0.000
	September	12.722	*	1.412	1.142	0.000
	October	13.141	*	1.315	1.315	0.000
	November	12.379	*	1.470	1.470	0.000
	December	10.200	*	1.654	1.654	0.000

\*missing data

TABLE XXXI  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 14,  
 SUNDAY-SATURDAY, 1982 AND 1983

Year	Day	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	Sunday	14.000	*	1.038	1.038	0.000
	Monday	11.240	*	1.199	1.160	0.039
	Tuesday	11.531	*	1.161	1.154	0.006
	Wednesday	11.302	*	1.235	1.235	0.000
	Thursday	11.719	*	1.196	1.183	0.013
	Friday	12.503	*	1.179	1.179	0.000
	Saturday	15.154	*	1.083	1.083	0.000
1983	Sunday	12.821	*	1.180	1.180	0.000
	Monday	11.940	*	1.319	1.319	0.000
	Tuesday	10.987	*	1.506	1.501	0.005
	Wednesday	11.147	*	1.562	1.562	0.000
	Thursday	10.863	*	1.474	1.467	0.007
	Friday	12.652	*	1.365	1.365	0.000
	Saturday	13.868	*	1.181	1.181	0.000

\*missing data

TABLE XXXII  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 14,  
 SHIFTS 1-3, 1982 AND 1983

Year	Shift	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	1	12.562	*	1.351	1.343	0.008
	2	18.252	*	1.093	1.084	0.008
	3	6.707	*	1.025	1.016	0.008
1983	1	12.414	*	1.433	1.428	0.005
	2	17.329	*	1.641	1.641	0.000
	3	6.385	*	1.031	1.031	0.000

\*missing data

TABLE XXXIII  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 15,  
 JANUARY-DECEMBER, 1982 AND 1983

Year	Month	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	January	*	*	*	*	*
	February	*	*	*	*	*
	March	*	*	*	*	*
	April	*	*	*	*	*
	May	*	*	*	*	*
	June	*	*	*	*	*
	July	*	*	*	*	*
	August	*	*	*	*	*
	September	*	*	*	*	*
	October	*	*	*	*	*
	November	*	*	*	*	*
	December	*	*	*	*	*
1983	January	*	*	*	*	*
	February	*	*	*	*	*
	March	*	*	*	*	*
	April	0.137	*	0.137	0.137	0.000
	May	0.211	*	0.211	0.211	0.000
	June	0.033	*	0.033	0.033	0.000
	July	0.086	*	0.086	0.086	0.000
	August	0.183	*	0.183	0.183	0.000
	September	0.133	*	0.133	0.133	0.000
	October	0.204	*	0.204	0.204	0.000
	November	0.080	*	0.080	0.080	0.000
	December	0.100	*	0.100	0.100	0.000

\*missing data

TABLE XXXIV  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 15,  
 SUNDAY-SATURDAY, 1982 AND 1983

Year	Day	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	Sunday	*	*	*	*	*
	Monday	*	*	*	*	*
	Tuesday	*	*	*	*	*
	Wednesday	*	*	*	*	*
	Thursday	*	*	*	*	*
	Friday	*	*	*	*	*
	Saturday	*	*	*	*	*
1983	Sunday	0.144	*	0.144	0.144	0.000
	Monday	0.102	*	1.102	1.102	0.000
	Tuesday	0.135	*	1.135	0.135	0.000
	Wednesday	0.171	*	0.171	0.171	0.000
	Thursday	0.099	*	0.099	0.099	0.000
	Friday	0.126	*	0.126	0.126	0.000
	Saturday	0.132	*	0.132	0.132	0.000

\*missing data

TABLE XXXV  
 AVERAGE DAILY PATIENT LOAD AND NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNIT 15,  
 SHIFTS 1-3, 1982 AND 1983

Year	Shift	Patients	Nurses Forecast	Actual Nurses	RN's	LPN's
1982	1	*	*	*	*	*
	2	*	*	*	*	*
	3	*	*	*	*	*
1983	1	0.185	*	0.185	0.185	0.000
	2	0.147	*	0.174	0.147	0.000
	3	0.058	*	0.058	0.058	0.000

\*missing data

TABLE XXXVI  
 REGRESSION MODELS OF NURSING STAFF,  
 STILLWATER MEDICAL CENTER, SHIFT 1  
 VS. SHIFTS 2 AND 3, 1983

Shift	m	Constant	R <sup>2</sup>
2	0.774 <sup>@</sup>	0.207 <sup>@</sup>	0.826
3	0.583 <sup>@</sup>	0.218 <sup>@</sup>	0.767

Note: Number of  
 Nurses Needed = m x Number of  
 Nurses on Shift 1 + Constant

<sup>@</sup>Significant at the 0.0001 level.

TABLE XXXVII  
 REGRESSION MODELS OF NURSING STAFF,  
 STILLWATER MEDICAL CENTER, 1983,  
 SHIFT 1 VS. SHIFTS 2 AND 3,  
 SUNDAY-SATURDAY

Day	Shift	m	Constant	R <sup>2</sup>
Sunday	2	0.819 <sup>@</sup>	0.210 <sup>@</sup>	0.837
	3	0.697 <sup>@</sup>	0.184 <sup>@</sup>	0.804
Monday	2	0.742 <sup>@</sup>	0.227 <sup>@</sup>	0.807
	3	0.621 <sup>@</sup>	0.210 <sup>@</sup>	0.762
Tuesday	2	0.818 <sup>@</sup>	0.186 <sup>@</sup>	0.827
	3	0.620 <sup>@</sup>	0.175 <sup>@</sup>	0.783
Wednesday	2	0.741 <sup>@</sup>	0.149	0.831
	3	0.535 <sup>@</sup>	0.172 <sup>@</sup>	0.757
Thursday	2	0.802 <sup>@</sup>	0.134	0.826
	3	0.588 <sup>@</sup>	0.156 <sup>@</sup>	0.784
Friday	2	0.781 <sup>@</sup>	0.190 <sup>@</sup>	0.826
	3	0.513 <sup>@</sup>	0.224 <sup>@</sup>	0.802
Saturday	2	0.777 <sup>@</sup>	0.251 <sup>@</sup>	0.837
	3	0.637 <sup>@</sup>	0.221 <sup>@</sup>	0.801

Note: Number of  
 Nurses = m x Number of  
 Needed Shift 1 + Constant

<sup>@</sup>Significant at the 0.0001 level.



of shift one. It is interesting to note that had the forecast rule been exactly right the constants for both shifts would have been zero and  $m$  would have been 0.880 and 0.58 for shifts two and three respectively. From the models we see that this is not what happened. Shift two requirements were actually 77.4% of shift one requirements plus 0.207 nurses and shift three was 58.4% plus 0.218. Table XXXVII shows similar models except that instead of modeling the whole year each day of the week was modeled. These models gave similar results to the overall model developed using the entire years data.

The models developed for each unit however gave radically different results (see Table XXXVIII). The values for  $m$  were much lower in all cases. Units two to five had the largest values for  $m$  and they were low (0.203 - 0.491). Units 10 - 15 show very little relationship between actual shift one nursing staff and shifts two and three nursing staffs, as seen by the small values of  $m$ .

Beyond just determining the monthly averages for patient loads and actual nurses on duty the study analyzed the relationship between the number of nurses on duty and the patient load, taking into account seasonal differences. To do this regression models were developed from both years data and are shown in Table XXXIX. All of the models have the same general form:

$$\begin{aligned} \text{Number of} & \hspace{18em} \text{Number of} \\ \text{Nurses Needed} & = \text{Constant} + A \times \text{Patients} + B \times Q1 \\ \text{(Actual or} & \hspace{10em} + C \times Q2 + D \times Q3. \\ \text{Forecast)} \end{aligned}$$

TABLE XXXVIII  
 REGRESSION MODELS OF NURSING STAFF,  
 STILLWATER MEDICAL CENTER, UNITS  
 2-15; SHIFT 1 VS. SHIFTS  
 2 AND 3, 1983

Unit	Shift	m	Constant	R <sup>2</sup>
2	2	0.363 <sup>@</sup>	1.299 <sup>@</sup>	0.174
	3	0.285 <sup>@</sup>	0.716 <sup>@</sup>	0.122
3	2	0.356 <sup>@</sup>	2.703 <sup>@</sup>	0.146
	3	0.329 <sup>@</sup>	1.770 <sup>@</sup>	0.136
4	2	0.491 <sup>@</sup>	0.014	0.284
	3	0.472 <sup>@</sup>	0.015	0.282
5	2	0.437 <sup>@</sup>	1.767 <sup>@</sup>	0.353
	3	0.203 <sup>@</sup>	2.062 <sup>@</sup>	0.091
10	2	0.198 <sup>@</sup>	0.890 <sup>@</sup>	0.100
	3	0.033	1.102 <sup>@</sup>	0.004
11	2	0.036	0.987 <sup>@</sup>	0.002
	3	-0.024	1.092 <sup>@</sup>	0.001
12	2	0.261 <sup>@</sup>	1.194 <sup>@</sup>	0.080
	3	0.129	1.098 <sup>@</sup>	0.023
13	2	0.025	1.061 <sup>@</sup>	0.002
	3	0.112	0.900 <sup>@</sup>	0.019
14	2	0.251 <sup>@</sup>	1.282 <sup>@</sup>	0.049
	3	0.026	0.994 <sup>@</sup>	0.006
15	2	0.280 <sup>@</sup>	0.095 <sup>@</sup>	0.095
	3	0.006	0.057	0.000

Note: Number of  
 Nurses = m x Number of + Constant  
 Needed Shift 1

<sup>@</sup>Significant at the 0.0001 level.

TABLE XXXIX  
 REGRESSION MODELS OF NURSING STAFF  
 VS. PATIENT LOADS ACCOUNTING  
 FOR SEASONALITY, STILLWATER  
 MEDICAL CENTER, UNITS 2-15  
 1982 AND 1983

Unit	Constant	A	B	C	D	R <sup>2</sup>
2-15	0.685 <sup>@</sup>	0.105 <sup>@</sup>	-1.142 <sup>@</sup>	-0.121 <sup>@</sup>	-0.146 <sup>@</sup>	0.700
2	1.149 <sup>@</sup>	0.063 <sup>@</sup>	-0.216 <sup>@</sup>	-0.161 <sup>@</sup>	-0.178 <sup>@</sup>	0.157
3	2.214 <sup>@</sup>	0.078 <sup>@</sup>	-0.262 <sup>@</sup>	-0.385 <sup>@</sup>	-0.288 <sup>@</sup>	0.093
4	0.039	0.126 <sup>@</sup>	0.001	0.004	-0.015	0.760
5	1.859 <sup>@</sup>	0.074 <sup>@</sup>	-0.254 <sup>@</sup>	-0.312 <sup>@</sup>	-0.233 <sup>@</sup>	0.161
10	1.409 <sup>@</sup>	0.036	-0.019	-0.069	-0.075	0.009
11	0.949 <sup>@</sup>	0.012 <sup>@</sup>	0.008	0.036	0.015	0.019
12	1.309 <sup>@</sup>	0.053 <sup>@</sup>	0.107	-0.057	-0.166 <sup>@</sup>	0.051
13	1.134 <sup>@</sup>	0.013	-0.044	-0.095	-0.017	0.013
14	1.181 <sup>@</sup>	0.010 <sup>@</sup>	-0.109	-0.035	0.028	0.026
15	0.000	1.000	0.000	0.000	0.000	1.000

Note: Number of  
 Nurses = Constant + A x Patients + B x Q1  
 Needed + C x Q2 + D x Q3

<sup>@</sup>Significant at the 0.0001 level.

Each of the Q variables is a dummy variable designed to take into account the seasonal differences. For example Q1 is always zero except for the first quarter of the year (January to March), during which it is one. Q2 and Q3 act the same and are only taken into account during the second and third quarters of the year respectively. The fourth quarter is taken into account as part of the constant as only three quarters in the model can have variables at any one time.

An applied example of the model may help to clarify its use. If we wanted to determine the number of nurses needed on unit 10 during September for any day on any shift the model would look like this:

$$\begin{array}{l} \text{Number of} \\ \text{Nurses} \\ \text{Needed} \end{array} = 1.409 + 0.036 \times \begin{array}{l} \text{Number of} \\ \text{Patients} \end{array} + (-0.075) \times 1$$

Note that the constant term equals 1.409, A equals 0.036, Q1 and Q2 equal zero, D equals -0.075, and Q3 equals 1.0. Q1 and Q2 are zero because September is in the third quarter of the year (hence Q3 equals 1). All that would be needed now is the number of patients on unit 10 at the time in September and the number of nurses needed could be determined.

Going back to Table XXXIX now the results can be examined. Overall for both years we can see that for all units (2 - 15) the first three quarters have a negative effect on the actual number of nurses needed. The same is true of units two, three, five, 10 and 13. Although these

findings may show a slight negative trend the magnitude of each seasonal correction is only slight, with -0.385 being the largest. Therefore the seasonal differences are almost negligible.

The same type of analysis was then done to find the relationship between the forecast of nurses needed and the patient load. Table XXXX contains the results of this analysis (note that only units two through five forecast nursing needs). Combining the units that forecast nursing needs we see that in the first quarter of the year the forecast calls for 0.937 more nurses to be used on the average while in the third quarter 0.472 less nurses will be forecast.

Looking at each unit by itself revealed several differences. For units two and three the first quarter showed seasonal differences but in the opposite direction. Unit two shows a decrease of almost one in the forecast of nurses in the first quarter while unit three shows an increase of over one for the first quarter. Unit four showed a large increase in the forecast during the first and second quarters as indicated by the values of B and C. The fifth unit showed decreases in the second and third quarters of about 1.7 in the forecasts.

TABLE XXXX  
 REGRESSION MODELS OF FORECAST NURSING STAFF VS.  
 PATIENT LOADS ACCOUNTING FOR SEASONALITY,  
 STILLWATER MEDICAL CENTER,  
 UNITS 2-5, 1982 AND 1983

Unit	Constant	A	B	C	D	R <sup>2</sup>
2-5	2.779 <sup>@</sup>	0.037 <sup>@</sup>	0.937 <sup>@</sup>	-0.041	-0.472 <sup>@</sup>	0.071
2	0.518	0.216 <sup>@</sup>	-0.960 <sup>@</sup>	-0.397	-0.370	0.231
3	1.942	0.027	1.325 <sup>@</sup>	0.378	0.011	0.036
4	1.646 <sup>@</sup>	0.008	2.907 <sup>@</sup>	1.677 <sup>@</sup>	0.208	0.305
5	4.915 <sup>@</sup>	0.024	0.145	-1.782 <sup>@</sup>	-1.774 <sup>@</sup>	0.102

Note: Forecast Number  
 of Nurses Needed = Constant + A x Patients + B x Q1  
 + C x Q2 + D x Q3

<sup>@</sup>Significant at the 0.0001 level.

## CHAPTER VI

### CONCLUSIONS AND RECOMMENDATIONS

It is apparent that the Stillwater Medical Center has experienced a decline in its patient load during 1983 when compared to 1982. While it seems that this drop in patient load would also cause some decline in nursing staff needs on the average, this did not occur. Instead nursing staff activity remained virtually unchanged.

In general, a low in the average patient load and nursing staff activity occurred on Sundays for both years while the high was on Wednesdays. Also the method in which the forecast of nursing needs is obtained or the way in which the results are applied needs to be reevaluated. As there was considerable differences between the forecast of nursing needs and the actual staffing level.

The recommendation of this study is that data should continue to be collected by the Stillwater Medical Center so that trends and differences can be more thoroughly examined. This study will serve as a bench mark for continued research from which the hospital can gain valuable information about its operations and the changing environment it finds itself in.

## BIBLIOGRAPHY

- (1) Ellis, Randy and Jim Killackey, "Cost Epidemic Forces Hospitals to Swallow Business Remedies", The Sunday Oklahoman, March 4, 1984, pp. 1 & 14.
- (2) Saftlas, Herman B., Health Care Analyst, Feb., 1983, p. H13.



## APPENDIX

DATE: 12-22-83

MIDNIGHT CENSUS:

67+8

		Total Man. Hours	Total Patients	Man Hours per Patient		Total Man Hours	Total Patients	Man Hours per Patient		Total Man Hours	Total Patients	Man Hours per Patient	Grand Total Man Hours	Average Censur	Man Hours per Patient
SECOND FLOOR	7-3				3-11				11-7						
RN	1				1				1						
LPN	1				1										
UNIT SEC	1				1										
AIDE/ORDERLY	2				2				1				96	12.2	7.2
TOTAL	5	40	16	2.5	5	40	13	3.	2	16	11	1.5			
THIRD FLOOR	7-3				3-11				11-7						
RN	4				3				3						
LPN	1				2										
UNIT SEC	1				1				1						
AIDE/ORDERLY	4				3				2				2008	28.3	7.1
TOTAL	10	80	29	2.8	9	72	28	2.6	6	48	28	1.7			
FOURTH FLOOR	7-3				3-11				11-7						
RN															
LPN															
UNIT SEC															
AIDE/ORDERLY															
TOTAL															
FIFTH FLOOR	7-3				3-11				11-7						
RN	3				1				2						
LPN	1				2				1						
UNIT SEC	1				1										
AIDE/ORDERLY	3				3				1				152	19.3	9.3
TOTAL	8	64	20	3.2	7	56	18	3.1	4	32	17	1.9			
PERINATAL UNIT															
L AND O	7-3				3-11				11-7						
RN	2				1				1						
LPN															
TECH	1				1				1				56		14
TOTAL	3	24	1	24	2	16	1	16	2	16	2	8			
BIRTHING ROOM	7-3				3-11				11-7						
RN															
LPN															
TECH															
TOTAL			0												
NURSERY	7-3				3-11				11-7						
RN	1				1				1						
LPN	1				1				1						
TECH	1				1				1				48	7.7	6.2
TOTAL	2	16	9	1.8	2	16	7	2.3	2	16	7	2.3			
I C U	7-3				3-11				11-7						
RN	2				1				1						
LPN					1										
AIDE/TECH	1				1				1				56	3	19.7
TOTAL	3	24	2	12	2	16	3	5.3	2	16	4	4.			
MENTAL HEALTH	7-3				3-11				11-7						
RN	1				1				1						
LPN															
AIDE	1				1				1				48	4	12
TOTAL	2	16	4	4.	2	16	4	4.	2	16	4	4.			
EMERGENCY ROOM	7-3				3-11				11-7						
RN	2				2				1						
LPN															
ORDERLY	3				4				2						
UNIT SEC	1				1				2				132	34	3.9
TOTAL	6	5	11	4.7	7	56	13	4.3	3	24	10	2.4			

2/1/84

B

ADDRESSOGRAPH

DESCRIPTION	RESPIRATORY	TREATMENTS
ad lib/no assist bulate with help ic training/complete assist complete bed rest soluce bed rest	2) Blow gloves, C & DB 1) O <sub>2</sub> PRN 5) O <sub>2</sub> continuous, Croup Tent, 1-7 IPPB 7) Trache tube 10) Ventilator, usable ABG's	2) Simple treatments 4) Simple treatments more than 4 times/day 6) Complex treatments 8) Complex treatments more than 4 x/day 7) Multiple simple treatments 10) Multiple complex treatments
assisted trial, assisted, or tub mple multiple baths ENCE	MEDICATIONS 1) Oral meds 2) Meds with V.S., Suppos., Topical 4) IM and PRN meds 6) Crush meds/spoon feed; meds via NG tube, eye dropper, q 2 hr po meds 7) IV meds/Traced IM and po meds 9) IV meds requiring titration. UAC meds	TRACTION/EQUIPMENT 1) Overhead trapeze; footboard 4) Air mattress/24 hour siderails 3) Special bed positions, K-pad 6) Simple traction 5) Electrical equipment 10) Complex traction and other complex orthopedic equipment
d pan/urinal dside Commode/Assist to casional Incontinence mplete incontinence G	G.U. 1) ISO, checking non-voids 3) Strain urine; urine collection; occasional catheter irrigation; straight cath. 5) Texas and Indwelling catheter, 6 Bottle Voidings, Specific Gravity, Dip Stick UA 6) S-P Cath., hourly urine out- puts, leg bag 8) CSI; presence of filiform catheter	I.V.'s 3) Heparin Lock 2) KOR 4) Assigned rate and volume 7) Subclavian IV/Cutdown 9) Multiple IV sites; Blood and Blood compo- nent administration 12) Oxytocin and Yucopal administration or IV meds for 3/P mainte- nance and cardiac arrhythmia treatment
O/Self-feed sist with tray, ice chips/ c. or restrict fluids, lt. feedings ical Feed/Gavage Feed mplex Feed/Teach mechanics feeding	ORIENTATION/COMMUNICATION 1) Orientated and cooperative 3) Toddler, lethargic, partial hearing or vision loss 5) Infant; confused; septic, orientated by non-compliant 7) Mentally handicapped; blind; aphasic, unresponsive; foreign language only; delusional 10) Disoriented, belligerent; needs frequent calming measures; in- manageable hallucinations; close observation 15) Potentially dangerous to self or others needs constant calm- ing measures; 25) Mentally disturbed non-compli- ant behavior; or antisocial behavior 40) 1:1 observation (ordered)	TOTAL RELATIVE PATIENT VALUE
ANCES/BINDERS D hose, ace bandages, ings mple cast/splint; surgi- ield, peri-wads mplex cast, crutches lkers scrains AND WOUNDS ntrolled osomy; Penrose ain tube; T-tube; Hemovac aining wound lineal sump; wound cking; gnest tubes w osomy; profusely aining wound, continuous irrigation	MONITOR 4) Holter Monitor 5) Telemetry 3) Fetal monitor 10) Cardiac/SpO <sub>2</sub> monitor	
ION ucine Clean Technique od Handwashing spiratory .. cetic und and Skin ocective/Reverse rict	SURGERY/POST-PARTUM 2) Simple Pre-op 3) Second and subsequent days post-op/post partum 5) Complex pre-op, day of surgery/delivery, first day post-op 7) Post-op/post-partum with minor complications 10) Post-op with major complications	
T/FAMILY TEACHING mple health maintenance mple pre and post-op mplex pre- and post-op; l post-partum mplex health maintenance mplex teaching; suicidal eaction		
SIGNS/NEURO CHECKS 3 hours or less 3-4 hours 2 hours 1 hour re frequent than 2 hour		

To ~~Nurse~~ Service

ACUITY RATING SCALE

Total 2.34/2  
2.0

DATE ~~7-17-57~~ 1

UNIT 2nd

Unit/Transfer	Discharge	AMA	Death	Surgery Today	Ambulation	Bath/Hygiene	Continence	Feeding	Appliances/Binders	Drains/Wounds	Isolation	Pt./Family Teaching	V. S./Neuro Check	Respiratory	Medications	Genito/Urinary	Orientation/Communication	Monitor	Surgery/Postpartum	Treatments	Traction and Equipment	IV's/Heparin Lock	Total Points	Assigned Acuity
D				1	3	0	1	3	0	0	4	1	0	4	1	1	0	3	2	5	0	2	2	2
				1	1	0	1	3	0	0	6	2	0	4	1	1	0	0	2	0	0	2	2	2
				1	1	0	1	3	0	0	4	1	2	4	0	1	0	3	2	0	0	2	3	2
				3	3	0	1	3	0	0	4	2	5	4	1	1	0	3	2	0	0	3	2	2
				5	3	3	1	3	0	0	4	2	0	5	1	7	0	5	2	0	0	4	1	3
				5	3	3	1	3	0	0	4	2	0	5	1	1	0	5	2	0	0	3	2	3
				1	3	0	1	3	0	0	4	1	0	1	0	1	0	2	2	0	0	1	9	1
				1	3	0	1	3	0	0	4	2	0	1	1	1	0	3	2	0	0	2	2	2
				1	3	0	1	3	3	1	4	2	0	1	1	1	0	3	2	0	0	2	6	2

RELATIVE RANGE

I	0-1
II	20-3
III	33-4
IV	46-N

TODAY'S A

I	_____
II	_____
III	_____
IV	_____

D

Stella's Copy  
Please don't  
take away  
from Desk  
Thank U

Table for Calculating Number of Staff Personnel  
Needed Based Upon Patient Classification  
(Excluding Ward Clerk)

Number of Patients	Number of Staff Members Needed for Category			
	I	II	III	IV
1	.1	.3	.3	1.0
2	.2	.5	.7	2.0
3	.3	.8	1.0	3.0
4	.4	1.0	1.3	4.0
5	.5	1.3	1.7	5.0
6	.6	1.5	2.0	6.0
7	.7	1.8	2.3	7.0
8	.8	2.0	2.7	8.0
9	1.0	2.3	3.0	9.0
10	1.1	2.5	3.3	10.0
11	1.2	2.8	3.7	11.0
12	1.3	3.0	4.0	12.0
13	1.4	3.3	4.3	13.0
14	1.6	3.5	4.7	14.0
15	1.7	3.8	5.0	15.0
16	1.8	4.0	5.3	
17	1.9	4.3	5.7	
18	2.0	4.5	6.0	
19	2.1	4.8	6.3	
20	2.2	5.0	6.7	
21	2.3	5.3	7.0	
22	2.4	5.5	7.3	
23	2.6	5.8	7.7	
24	2.7	6.0	8.0	

NEW RANGES

I	0-19	1
II	20-32	2
III	33-45	3
IV	46-60 +	4

CALCULATIONS

TOTALS	for 7-3 shift
.88%	for 3-11 "
.58%	for 11-7 "

MEMBER  
1983  
NOV 20

CENSUS	I	II	III	IV	7-3	3-11	11-7	RN	LPN	NA	TOTAL	RN	LPN	NA	TOTAL	RN	LPN	NA	TOTAL
1	3	10	6	1	5.8	5.1	4.1												
2	7	11	5	1	6.7	5.2	3.8												
3	1	18	2	1	4.3	5.2	2.8												
4	0	11	4	2	6.1	5.4	3.5												
5	3	12	4	1	3.8	4.8	2.8												
6	3	10	3	0	6.1	5.4	3.5												
7	1	12	3	2	6.1	5.4	3.5												
8	1	6	3	1	3.6	3.2	2.1												
9	0	13	4	1	1.3	3.3	2.5												
10	0	13	4	1	5.2	2.7	2.1												
11	0	13	4	1	6.6	3.8	2.7												
12	0	11	6	1	3.5	4.8	3.0												
13	0	11	7	0	5.1	4.5	3.0												
14	0	11	7	0	6.1	6.1	4.0												
15	0	11	7	0	4.1	6.1	4.0												
16	3	11	3	1	3.2	3.5	1.1												
17	3	11	4	1	5.1	4.7	2.7												
18	4	1	4	0	4.7	1.1	2.7												
19	4	1	4	0	3.7	3.5	2.8												
20	1	13	3	1	1.9	1.8	3.8												
21	1	13	3	1	7.6	6.0	4.6												
22	2	9	7	0	4.8	4.2	3.3												
23	3	12	4	1	5.0	5.3	3.1												
24	3	13	4	2	6.6	5.8	2.0												
25	0	9	3	1	4.1	3.1	2.3												
26	0	4	3	1	2.0	1.7	1.7												
27	0	4	3	1	3.5	3.1	2.6												
28	0	5	2	1	3.7	3.3	2.2												
29	0	10	2	1	4.7	4.2	2.8												
30	0	10	1	1	1.6	2.1	2.2												
31	0	10	1	1	1.6	2.1	2.2												
32	0	10	1	1	1.6	2.1	2.2												
33	0	10	1	1	1.6	2.1	2.2												
34	0	10	1	1	1.6	2.1	2.2												
35	0	10	1	1	1.6	2.1	2.2												
36	0	10	1	1	1.6	2.1	2.2												
37	0	10	1	1	1.6	2.1	2.2												
38	0	10	1	1	1.6	2.1	2.2												
39	0	10	1	1	1.6	2.1	2.2												
40	0	10	1	1	1.6	2.1	2.2												
41	0	10	1	1	1.6	2.1	2.2												
42	0	10	1	1	1.6	2.1	2.2												
43	0	10	1	1	1.6	2.1	2.2												
44	0	10	1	1	1.6	2.1	2.2												
45	0	10	1	1	1.6	2.1	2.2												
46	0	10	1	1	1.6	2.1	2.2												
47	0	10	1	1	1.6	2.1	2.2												
48	0	10	1	1	1.6	2.1	2.2												
49	0	10	1	1	1.6	2.1	2.2												
50	0	10	1	1	1.6	2.1	2.2												

VITA

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