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Part I. Introduction

Preventable medical error is one of the biggest concerns facing hospitals today. This paper will examine the effects of mandated nurse-to-patient ratios on preventable medical error.

Hospitals are focusing on reducing the rate of preventable medical error because these are injuries that result from a physician or nurses' inattention, negligence or neglect instead of injuries that arise from, "the natural progression of the disease that leads to injury or death."¹ Preventable medical error is responsible for over 1 million injuries per year, including bed sores resulting from nurses not turning over a patient, falls getting out of bed without help, physicians leaving instruments inside of the patient, conducting surgery on the wrong side of the body and post-surgery infections that result from a lack of monitoring.² All of these conditions are serious medical issues that harm the patient and could have been prevented had the physicians and nurses paid more attention to the patient during and after surgery. The need to reduce the rate of preventable medical error has largely been overlooked in the past, but recent research has shown

¹ CDC Web site, FastStats: Leading Causes of Death (Jan. 2012); National Vital Statistics Report, Deaths Final Data for 2009, vol. 60, no. 3; and for 98,000 statistic, IOM Report, To Err Is Human (1998).

² Christopher P. Landrigan, M.D., M.P.H. et al, Temporal Trends in Rates of Patient Harm Resulting from Medical Care, The New England Journal of Medicine, Nov. 25, 2010, available at <http://www.nejm.org/doi/full/10.1056/NEJMsa1004404#t=article>. (Last visited April 25, 2013)

that the number of patients killed due to a preventable error has risen from 98,000 patients, almost doubling to 180,000 patients per year.³ This staggering death toll places preventable medical error as the third highest leading cause of death in Americans (between #2 cancer and #4 chronic lower respiratory disease.)⁴

Many state regulatory bodies have tried many ways to reduce the rate of preventable medical error in hospitals. One method that has been gaining popularity is to mandate minimum nurse-to-patient ratios. Mandated minimum nurse-to-patient ratios ensure that nurses are not overworked and that patients are not neglected. This results in lower nurse turnover, better quality care for the patients, a lower rate of preventable medical error, and a better hospital experience for the patient.

There are problems with mandatory nurse-to-patient ratios. There are many different ways to determine minimum nurse-to-patient ratios, debates over which method is the best for patients, and how hospitals can afford to implement these ratios.

The paper will present the following review of the relevant issues in Parts II, III, and IV. Part II will examine how states select adequate minimum nurse-to-patient ratios. Part III will show how mandated nurse-to-patient ratios affect the rate of preventable medical errors. Part IV will discuss how implementing cost control programs can make nurse-to-patient ratios more effective. In Part V, I will argue that the best cost-control programs can be combined with mandated nurse-to-patient ratios.

³ Charles Andel et al, The Economics of Health Care Quality and Medical Errors, Journal of Health Care Finance, Fall 2012, Vol. 39, available at http://www.meditregs.com/economics_of_quality_care. (Last visited April 25, 2013)

⁴ Id.

THESIS: While mandated minimum nurse-to-patient ratios may reduce the rate of preventable medical errors, they are only effective if there are appropriate financial programs put into place.

Part II – Selecting Minimum Nurse-to-patient Ratios

Some states have decided to impose mandatory nurse-to-patient ratios on hospitals in an attempt to improve the quality of care provided and to reduce preventable medical errors. “There is a ‘strong and consistent’ link between nurse staffing levels and patient outcomes.”⁵ However, there was a problem of determining what ratios would be effective and would provide the best outcome for the patients. California, the first state to implement mandatory minimum nurse-to-patient ratios, considered three different ways to approach setting an appropriate minimum nurse-to-patient ratio: staffing by outcome, staffing by diagnosis related groups, and staffing by acuity. These three methods outlined by California have given other states guidance on how they may select an appropriate ratio for their hospitals.

The method of staffing by outcome uses patient outcomes as an indicator of quality and bases staffing ratios as a result of the best outcomes. “Those outcomes which produced the highest quality outcomes in the past would indicate the optimum safe staffing levels to be set in

⁵ Massachusetts Nurses Association, Ten Reasons We Need Safe Staffing Limits, 2002, available at http://www.massnurses.org/files/file/Legislation-and-Politics/Safe_Staffing_Reasons.pdf. (Last visited April 25, 2013)

Citing –The New England Journal of Medicine, May 2002

the future.”⁶ While this sounds like a straight forward method of setting ratios, it is hard to determine what should be counted as a good outcome. It is relatively easy to identify the bad outcomes such as bed sores, falls and infections, but it is difficult to say what would be an indicator of a good outcome. The lack of an adverse event does not reveal whether the patient, “is better off in general or in specific health related areas after they leave a hospital environment compared to the time at which they were initially admitted.”⁷ The difficulty in determining which outcomes are a result of poor staffing and which are caused by the patient’s lifestyle, body, and environment also make using patient outcomes a poor choice for setting ratios. Usually there is no data collected in this area so there is no way to accurately use patient outcomes to establish an accurate nurse-to-patient ratio that benefits the patient outcome.

A second method of establishing nurse-to-patient ratios is through the use of diagnosis related groups (DRGs). DRGs are, “case-mix assignments grouping hospital patients to categories based on diagnostic, therapeutic and demographic characteristics for the purpose of reimbursement.”⁸ DRGs state how many nurses, doctors, and products were used when performing a procedure. This gave the hospital an accurate count of how many nurses there are per patient depending on the procedure. While using the number of nurses derived from the DRGs as the minimum ratio was originally thought of as a feasible idea, it was ultimately rejected because it did not reflect how staffing affected patient care. These numbers only told how many nurses and doctors were involved with each procedure without linking the number of

⁶ Institute for Health and Socio - Economic Policy, AB 394: California and the Demand for Safe and Effective Nurse to Patient Staffing Ratios, March 2001, Available at http://nurses.3cdn.net/a985cdaf1305cc6478_f3m6b0kw8.pdf. (Last visited April 25, 2013)

⁷ Id.

⁸ State of California Office of Statewide Health Planning and Development, Patient Discharge Data File Documentation January-December 2006, July 2007, available at <http://www.oshpd.ca.gov/HID/Products/PatDischargeData/PublicDataSet/Doc/PD06docwapp.pdf>. (Last visited April 25, 2013)

nurses to the patient outcome or the quality of care provided. Since there was no quality measurement in the DRGs, they were disregarded as a sole measure for setting nurse-to-patient ratios.

The third method, the one most states use, is called staffing by acuity. Hospitals use a patient classification system to determine, “the nursing care requirements of individual patients, and indicate to the hospital the amount of nursing staff needed to provide the identified care by patient, by unit and by shift.”⁹ Acuity (severity of illness) is given a rating based on a scale of 1 to 4, ranking the severity of the illness from minor, moderate, major or extreme severity of illness.¹⁰ This method provides the greatest amount of flexibility to the hospitals and offers individualized attention to the patient being treated because the ratio is based on how severe the patient’s illness is.

In order to determine the minimum nurse-to-patient ratios allowable under staffing by acuity, California hospitals started with DRGs. While the DRGs were infeasible as a basis for nursing ratios on their own, they did provide accurate data to establish ratios based on acuity. California used six years of DRG acuity information to determine which hospital unit it was assigned to. Once the DRGs were assigned to a unit, the average acuity was taken to determine the average acuity per unit. The formula to determine the ratios per unit is (Intensive Care Unit [ICU] Average Acuity Indicator Statewide/Individual Unit Acuity Indicator) x ICU Mandated Minimum Staffing Ratio of 2 patients to 1 nurse. The ICU Average Acuity Indicator and its

⁹ American Nursing Association, Nurse Staffing Plans and Ratios, March 3, 2011, available at http://ana.nursingworld.org/MainMenuCategories/ANAPoliticalPower/State/StateLegislativeAgenda/StaffingPlansandRatios_1.aspx. (Last visited April 25, 2013)

¹⁰ Richard F. Averill, MS, et al, Development of the All Patient Refined DRGs (APR-DRGs), 1997, available at http://solutions.3m.com/3MContentRetrievalAPI/BlobServlet?lmd=1225920498000&assetId=1180606514429&assetType=MMM_Image&blobAttribute=ImageFile. (Last visited April 25, 2013)

Mandated Staffing Ratio are used in determining the ratios for other units because California has mandated minimum nursing levels for the ICU 20 years before setting nursing ratios for other hospital units. Since California hospitals have found that a 2:1 ratio in the ICU is acceptable, it is appropriate to use the ICU acuity indicator and ratio as a baseline to determine the ratio for other units. Using this baseline, it is shown that a unit that has a higher acuity indicator than the ICU will have a ratio of less than 2:1 with more nurses per patient and a unit with a lower acuity indicator will result in more patients per nurse in the less severe units.¹¹ This formula has resulted in forming nurse-to-patient ratios in California ranging from 1:1 in the operating room and treating trauma patients in the emergency room to 1:6 for psychiatric and initial medical/surgical units.¹²

Part III – Analysis of Nurse-to-patient Ratios and Preventable Medical Error

One study composed by the Harvard School of Public Health Human Subjects Committee identified fourteen preventable medical errors that occur during a hospital stay that could be affected by changes in nursing staff. The study contained data from eleven different states on hospital discharges and nurse staffing. The study selected 799 hospitals that had average rates of occupancy and staffing per patient to ensure that the results would not be affected by an extreme

¹¹ Institute for Health and Socio - Economic Policy, AB 394: California and the Demand for Safe and Effective Nurse to Patient Staffing Ratios, March 2001, Available at http://nurses.3cdn.net/a985cdaf1305cc6478_f3m6b0kw8.pdf. (Last visited April 25, 2013)

¹² John Kasprak, California RN Staffing Ratio Law, February 10, 2004, available at <http://www.cga.ct.gov/2004/rpt/2004-R-0212.htm>. (Last visited April 25, 2013)

outlier.¹³ The committee then used the information they gathered to compile the average rate of the medical errors and the average number of nursing hours per patient.

The incident rate ratio below was derived as a proportion of total hours of care by licensed nurses and the number of registered nurse hours per patient day. This means that if the incident rate ratio is less than one, then an increase in nurse staffing will cause the rate of an incident occurrence to decline. According to the charts below, an increase in nurse staffing and nurse hours per patient will help reduce the patient's length of stay, urinary tract infection, upper gastrointestinal bleeding, hospital acquired pneumonia, cardiac arrest, and failure to rescue in surgical patients. The fact that an increase in registered nurse hours results in a greater decrease in adverse effects than an increase in registered nurse hours per patient does shows that the need for an increase in nursing staff is not solely for direct care of the patient, but also the other facets of a registered nurse's position. This includes administration work, quality checks and documentation. This tends to suggest that if there are only enough nurses to take care of the patient, but not enough to handle all the other administrative tasks registered nurses handle, preventable medical errors will not decrease.

¹³ Jack Needleman, Ph.D, et al, Nurse-Staffing Levels and the Quality of Care in Hospitals, The New England Journal of Medicine, May 30, 2002, available at <http://www.nejm.org/doi/full/10.1056/NEJMsa012247#t=articleResults>. (Last visited April 25, 2013)

TABLE 3. RELATION BETWEEN ADVERSE OUTCOMES AMONG MEDICAL PATIENTS AND THE LEVELS OF STAFFING BY REGISTERED NURSES (RNs). *

OUTCOME	REGRESSION COEFFICIENT OR INCIDENCE-RATE RATIO (95% CI)†	DECREASE IN RATE OF OUTCOME ASSOCIATED WITH INCREASING STAFFING OF RNs FROM 25TH TO 75TH PERCENTILE	
		% (95% CI)	P value
Length of stay			
Proportion of RN-hours	-1.12 (-2.00 to -0.24)	3.5 (1.4 to 5.7)	0.01
No. of RN-hours per patient-day	-0.09 (-0.13 to -0.05)	5.2 (3.4 to 7.1)	<0.001
Urinary tract infection			
Proportion of RN-hours	0.48 (0.38 to 0.61)	9.0 (6.1 to 11.9)	<0.001
No. of RN-hours per patient-day	0.99 (0.98 to 1.00)	3.6 (1.2 to 6.0)	<0.003
Upper gastrointestinal bleeding			
Proportion of RN-hours	0.66 (0.45 to 0.96)	5.1 (0.5 to 9.7)	0.03
No. of RN-hours per patient-day	0.98 (0.97 to 0.99)	5.2 (1.4 to 8.9)	<0.007
Hospital-acquired pneumonia			
Proportion of RN-hours	0.59 (0.44 to 0.80)	6.4 (2.8 to 10.0)	0.001
No. of RN-hours per patient-day	0.99 (0.98 to 1.00)	2.7 (-0.4 to 5.8)	0.08
Shock or cardiac arrest			
Proportion of RN-hours	0.46 (0.27 to 0.81)	9.4 (2.6 to 16.3)	0.007
No. of RN-hours per patient-day	0.98 (0.96 to 1.01)	4.1 (-2.5 to 10.8)	0.22
Failure to rescue			
Proportion of RN-hours	0.81 (0.66 to 1.00)	2.5 (0.0 to 5.0)	0.05
No. of RN-hours per patient-day	1.00 (0.99 to 1.01)	0.1 (-2.5 to 2.4)	0.96
In-hospital death			
Proportion of RN-hours	0.90 (0.74 to 1.09)	1.4 (-1.1 to 3.8)	0.27
No. of RN-hours per patient-day	1.00 (0.99 to 1.01)	0.3 (-2.1 to 2.7)	0.83

*There were a total of 799 hospitals, but hospitals were excluded from the analysis of any outcome for which their expected count was zero. Two hospitals were excluded from the analysis of length of stay, one was excluded from the analysis of upper gastrointestinal bleeding, and one was excluded from the analysis of shock or cardiac arrest. The proportion of licensed-nurse-hours provided by registered nurses ("proportion of RN-hours") was measured by model 1; the number of RN-hours per patient-day was measured by model 2. Model 1 also included measures of aide-hours per patient-day and licensed-nurse-hours per patient-day, and model 2 also included measures of aide-hours per patient-day and licensed-practical-nurse-hours per patient-day. None of these other variables showed a consistent association with the rates of outcomes. The models are described further in the Methods section. No association was found between the measures of registered-nurse staffing and the following adverse outcomes among medical patients: sepsis, deep venous thrombosis, central nervous system complications, and pressure ulcers. CI denotes confidence interval.

†Data for length of stay are regression coefficients; data for all other outcomes are incidence-rate ratios. A negative regression coefficient or an incidence-rate ratio of less than 1.00 indicates that the frequency of the outcome declines as staffing increases. Confidence intervals have been rounded.

TABLE 4. RELATION BETWEEN ADVERSE OUTCOMES AMONG SURGICAL PATIENTS AND THE LEVELS OF STAFFING BY REGISTERED NURSES (RNs).*

OUTCOME	INCIDENCE-RATE RATIO (95% CI)†	DECREASE IN RATE OF OUTCOME ASSOCIATED WITH INCREASING STAFFING OF RNs FROM 25TH TO 75TH PERCENTILE	
		% (95% CI)	P value
Urinary tract infection			
Proportion of RN-hours	0.67 (0.46 to 0.98)	4.9 (0.3 to 9.5)	0.04
No. of RN-hours per patient-day	1.00 (0.98 to 1.02)	0.0 (-4.2 to 4.2)	1.00
Failure to rescue			
Proportion of RN-hours	0.73 (0.49 to 1.09)	3.9 (-1.1 to 8.8)	0.12
No. of RN-hours per patient-day	0.98 (0.96 to 0.99)	5.9 (1.5 to 10.2)	0.008
In-hospital death			
Proportion of RN-hours	0.99 (0.67 to 1.47)	0.1 (-4.7 to 4.9)	0.97
No. of RN-hours per patient-day	1.00 (0.99 to 1.01)	0.0 (-3.9 to 3.8)	0.98

*There were a total of 799 hospitals, but hospitals were excluded from the analysis of any outcome for which their expected outcome was zero. Two hospitals were excluded from the analysis of urinary tract infection, 14 from the analysis of failure to rescue, and 1 from the analysis of in-hospital death. The proportion of licensed-nurse-hours provided by registered nurses (“proportion of RN-hours”) was measured by model 1; the number of RN-hours per patient-day was measured by model 2. Model 1 also included measures of aide-hours per patient-day and licensed-nurse-hours per patient-day, and model 2 also included measures of aide-hours per patient-day and licensed-practical-nurse-hours per patient-day. None of these other variables showed a consistent association with the rates of outcomes. The models are described further in the Methods section. Only results showing a consistent association with the rates of outcomes are presented. No association was found between the measures of registered-nurse staffing and the following outcomes among surgical patients: length of stay, pneumonia, sepsis, deep venous thrombosis, shock or cardiac arrest, gastrointestinal bleeding, pressure ulcers, metabolic derangement, central nervous system complications, pulmonary failure, and wound infection. CI denotes confidence interval.

†An incidence-rate ratio of less than 1.00 indicates that the frequency of the outcome declines as staffing increases.

Another study determined the incremental increase in patient mortality due to preventable medical error when nurses’ workloads are increased. This study focused on 168 hospitals in Pennsylvania which provided discharge data for the targeted procedures, American Hospital Association (AHA) data, and survey data from staff nurses. Data derived from discharge abstracts from the Pennsylvania Health Care Cost Containment Council was combined with vital statistics to determine patients who died within 30 days of being discharged from the hospital

¹⁴ Id.

and deaths within 30 days of admission among patients who experienced preventable medical error. Once the data was compiled, they adjusted it to compensate for differences in hospital size, demographics of the patients, nature of the hospital admission, whether the hospital was a teaching hospital and the technology available to each hospital. The relevant results from this study are in the table below.

Table 4. Patient-to-Nurse Ratios With High Emotional Exhaustion and Job Dissatisfaction Among Staff Nurses and With Patient Mortality and Failure-to-Rescue*

	Odds Ratio (95% Confidence Interval)					
	Unadjusted	P Value	Adjusted for Nurse or Patient Characteristics	P Value	Adjusted for Nurse or Patient and Hospital Characteristics	P Value
Nurse outcomes						
High emotional exhaustion	1.17 (1.10-1.26)	<.001	1.17 (1.10-1.26)	<.001	1.23 (1.13-1.34)	<.001
Job dissatisfaction	1.11 (1.03-1.19)	.004	1.12 (1.04-1.19)	.001	1.15 (1.07-1.25)	<.001
Patient outcomes						
Mortality	1.14 (1.08-1.19)	<.001	1.09 (1.04-1.13)	<.001	1.07 (1.03-1.12)	<.001
Failure-to-rescue	1.11 (1.06-1.17)	.004	1.09 (1.04-1.13)	.001	1.07 (1.02-1.11)	<.001

*Odds ratios, indicating the risk associated with an increase of 1 patient per nurse, and confidence intervals were derived from robust logistic regression models that accounted for the clustering (and lack of independence) of observations within hospitals. Nurse characteristics were adjusted for sex, experience (years worked as a nurse), type of degree, and type of unit. Patient characteristics were adjusted for the patient's Diagnosis Related Groups, comorbidities, and significant interactions between them. Hospital characteristics were adjusted for high technology, teaching status, and size (number of beds).

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According to the table, the odds ratio for both patient morbidity and errors due to failure to rescue (preventable medical error) is 1.07. This statistic means that for every extra nurse, the rate of patient mortality and the rate of failure to rescue decreases by 7%. In the sample taken for this study, the average nurse-to-patient ratio ranged from 1:4 to 1:8. Therefore, the average nurse-to-patient ratio should be approximately 1:6. In the study, 4535 patients out of 232,342 died within 30 days of being admitted.¹⁶ Using this information, we can predict that if hospitals used the lowest average ratio of nurse-to-patients (1:4) then approximately 635 extra patients

¹⁵ Linda H. Aiken, PhD, RN, et al, Hospital Nurse Staffing and Patient Mortality, Nurse Burnout, and Job Dissatisfaction, *The Journal of the American Medical Association*, Oct. 23/30, 2002, Vol. 288, available at <http://jama.jamanetwork.com/article.aspx?articleid=195438>. (Last visited April 25, 2013)

¹⁶ Id.

would have survived. This was calculated by using the odds ratio of 1.07 and squaring it to represent the percentage of patients saved by increasing the level of nursing staff per patient. This results in 1.14, or a 14% more patients saved. By subtracting (4535 times 1.14) from the total of patients who died 4535, this would result in only 3,900 deaths from preventable medical error. This shows that by increasing nursing staff there would be fewer preventable medical errors.

However, even if the ratio of nurses to patients is 1:1, there is still going to be some patients that will suffer from preventable medical error. In reality, the preventable medical error will never be reduced to 0 due to human error, differences in patients and how patients react to treatment. However, if we use the odds ratio above, hospitals would require a rate of 6-7 nurses per patient. This ratio of 6 nurses per patient is unreasonable due to cost and supply issues. The cost issue can not be resolved unless health care fees are raised enough to pay for so many nurses per patient or nurses take a drastic pay cut. If health care fees raise high enough to pay for all the extra nurses, even if the number of deaths resulting from preventable medical error is reduced to 0, the number of people who die from lack of treatment will rise because many people would not be able to afford paying for the higher health care costs. The supply problem could only be solved if the number of trained nurses increased enough that hospitals could find 6 nurses for every patient. While this is highly improbable, it would also most likely cause problems in the hospital even if it was feasible. For example, if there were six nurses for the one patient that is in the emergency room undergoing surgery, it is highly likely that some type of error would occur due to there being too many people in the operating room. This leads to the supposition that no matter how many nurses per patient a hospital may hire, there will always be

some preventable medical error due to diminishing returns for each extra nurse, and the only thing a hospital can do is try to minimize the rate at which it occurs.

While the above two studies determined that there was an effect in the preventable medical error rate through mandated minimum nursing ratios, and how much the preventable medical error rate drops per nurse, a third study was conducted to compare California’s mandated minimum nurse-to-patient ratios to two other states that do not have mandated nurse-to-patient ratios, New Jersey and Pennsylvania. This study was composed of surveys collected from 80,000 registered nurses in California, New Jersey and Pennsylvania.

Average Workloads Reported by Hospital Nurses, Overall, and by Specialty, in California (CA), New Jersey (NJ), and Pennsylvania (PA)

Specialty	Patient/Nurse Workload Mandated by California Legislation	Mean Patients per Shift (Nurse Sample Size)		
		CA	NJ	PA
All staff nurses		4.1 _{a,b} (9,257)	5.4 (5,818)	5.4 (7,261)
Medical–surgical	5:1	4.8 _{a,b} (1,311)	6.8 _b (802)	6.5 (1,069)

		Mean Patients per Shift (Nurse Sample Size)		
Patient/Nurse Workload Mandated by California				
Specialty	Legislation	CA	NJ	PA
Pediatric	4:1	3.6 _{a,b}	4.6	4.4
		(192)	(129)	(137)
Intensive care units	2:1	2.1 _{a,b}	2.5 _b	2.3
		(2,011)	(1,041)	(1,272)
Telemetry	5:1	4.5 _{a,b}	5.9 _b	5.7
		(515)	(389)	(483)
Oncology	5:1	4.6 _{a,b}	6.3 _b	5.7
		(200)	(121)	(133)
Psychiatric	6:1	5.7 _{a,b}	7.0 _b	7.9
		(122)	(160)	(215)
Labor/delivery	3:1	2.4 _b	2.6	2.8
		(674)	(325)	(290)

Notes. Intensive care units include adult, neonatal, and pediatric intensive care units.

^aSignificantly different from New Jersey at $p < .05$.

^bSignificantly different from Pennsylvania at $p < .05$.¹⁷

The survey revealed that California was complying with their mandated nurse-to-patient ratios, and New Jersey and Pennsylvania had more patients per nurse than California recommended in their mandated ratios except in the area of Labor/Delivery. This establishes that New Jersey and Pennsylvania's ratios differ significantly from California and their data can be used to compare and contrast the difference in hospitals with and without ratios.

Odds Ratios Indicating the Effect of Nurse Staffing on 30-Day Inpatient Mortality and Failure to Rescue, in California, New Jersey, and Pennsylvania

Odds Ratios Estimating the Effect of Nurse Staffing on

Hospital Sample	Model Type	30-Day Inpatient Mortality	Failure-to-Rescue
California	Unadjusted	1.10** (1.03–1.17)	1.15*** (1.08–1.23)
	Adjusted	1.13*** (1.07–1.20)	1.15*** (1.09–1.21)
New Jersey	Unadjusted	1.12**	1.09*

¹⁷ Linda H. Aiken, Implications of the California Nurse Staffing Mandate for Other States, Health Services Research, August 2010, available at <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2908200/>. (Last visited April 25, 2013)

Odds Ratios Estimating the Effect of Nurse Staffing on

Hospital Sample	Model Type	30-Day Inpatient Mortality	Failure-to-Rescue
		(1.03–1.22)	(1.01–1.19)
	Adjusted	1.10*	1.10*
		(1.01–1.22)	(1.01–1.21)
Pennsylvania	Unadjusted	1.06*	1.02
		(1.00–1.12)	(0.97–1.07)
	Adjusted	1.06*	1.06*
		(1.00–1.12)	(1.00–1.12)

Notes. The numbers of patients and hospitals used in the analyses in each state are shown in the appendix.

Unadjusted odds ratios are from bivariate robust logistic regression models. Adjusted odds ratios are from multivariate robust logistic regression models that controlled for 132 patient characteristics, including age, gender, admission type, dummy variables for comorbidities and type of surgery, and interaction terms, and three hospital characteristics—bed size, teaching status, and technology.

*, **, *** Odds ratios which are significant at the .05, .01, and .001 levels, respectively.¹⁸

Since it is established that New Jersey and Pennsylvania have different nurse-to-patient ratios, the adjusted odds ratios represent the difference in patient mortality and failure to prevent serious injury based primarily on the difference in nurse-to-patient ratios. The study has shown

¹⁸ Id.

that California has the highest odds ratios of the three states which indicates that for every extra patient added, the error rate will increase the most in California and the least in Pennsylvania. California's error rate will increase the most because the percent increase in workload for each nurse is greater than in New Jersey or Pennsylvania. The average nurse in California has a workload of 4.1 patients per shift. An increase to 5.1 patients per shift in California is an increase of 25%, whereas an increase in patients per shift in New Jersey and Pennsylvania from 5.1 to 6.1 is an increase of 20%. This shows that even though California has the highest odds ratio, it has the lowest preventable medical error rate

While mandated minimum nurse-to-patient ratios are effective in reducing the rate of preventable medical error in hospitals, most hospitals will not be able to accurately calculate the benefit from mandating ratios until they set up better error reporting systems. Normally, "self-reporting typically identifies only about 5 percent of actual events."¹⁹ However, if a more efficient and easier to use system of reporting medical error was put into place in hospitals, they would be better able to determine the benefits of mandating nurse-to-patient ratios. For example, the Duke University Medical Center Department of Community and Family Medicine created a new voluntary reporting system that results in a higher rate of reporting than other methods. This method does not punish the doctor or nurse for reporting preventable medical errors, but tries to, "identify and address systematic problems to prevent future errors."²⁰ By focusing on prevention and not punishment the Duke system was able to encourage more staff to report the errors so they could reduce the error rate in the future. If more hospitals used a similar method of reporting

¹⁹ Bates DW, Cullen DJ, Laird N, et al. Incidence of adverse drug events and potential adverse drug events—Implications for prevention. *The Journal of the American Medical Association*, 1995;274(1):29–34.

²⁰ Voluntary Error Reporting Program Focusing on System Issues Increases Reporting and Contributes to Reduction in Liability Claims at Outpatient Clinic, AHRQ Health Care Innovations Exchange, Aug. 4, 2008, available at <http://innovations.ahrq.gov/content.aspx?id=2049>. (Last visited March 25, 2013)

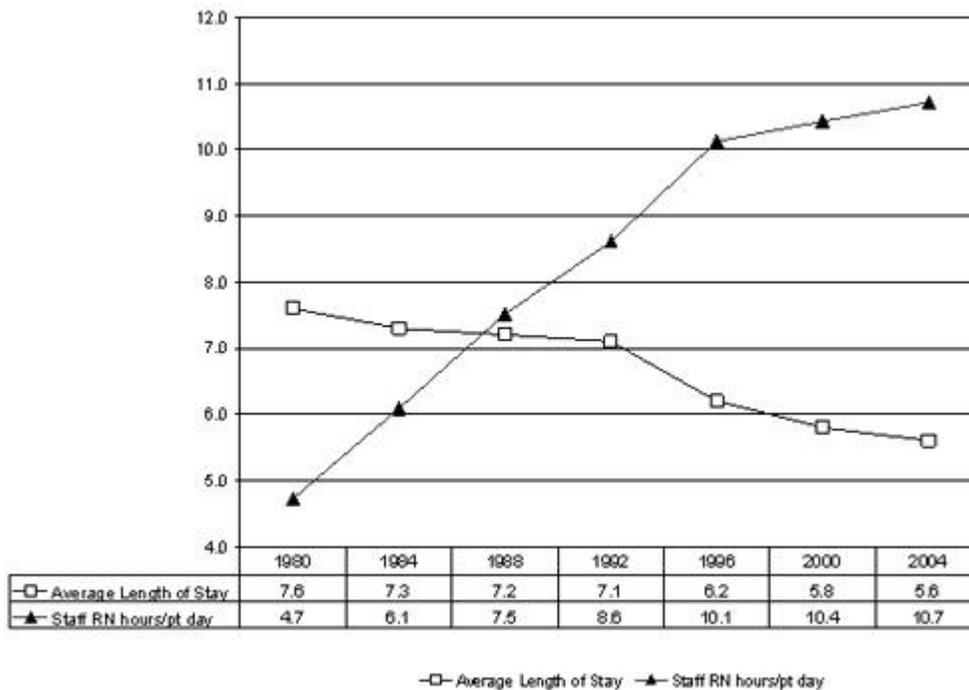
errors, they would be made aware of how much medical error occurs that they are currently unaware of simply because there is no reporting of it. This would encourage hospitals to use mandated ratios and would also allow them to actually see what the improvement in the preventable medical error rate is by looking at the reported rate before and after the ratios were put into effect.

Part IV - Cost Control Programs

Although mandating nurse-to-patient ratios is an effective way to reduce preventable medical error, there are many problems hospitals encounter in trying to implement these ratios. The main problem hospitals face is the cost of hiring the extra nurses to meet mandated nurse-to-patient ratios. This is a large cost because although most states do not have mandated minimum nurse-to-patient ratios, hospitals have been spending more and more on nurses over the years and meeting these ratios will only increase nursing expenses.²¹ The chart below demonstrates the relationship between inpatient length of stay versus the amount of time nurses spend on patients. Over the years the average length of an inpatient stay has dropped by two days. However, this reduction is only possible because nursing hours per patient has increased an extra six hours per patient day. Hospitals have needed to increase their nursing staff over the years to provide quality service to their patients, and the mandatory ratios will increase hospitals costs by forcing hospitals to hire even more nurses. There are three ways to combat this increase in price: incentives and penalties, Federal aid, and changing the way hospitals bill for nursing hours.

²¹ Stephanie Stephens, More Nurses for Hospital Patients: Impact on Quality Questionable, Center for Advancing Health, Sept. 12, 2012, available at <http://www.cfah.org/hbns/2012/more-nurses-for-hospital-patients-impact-on-quality-questionable#.UR0UhB2siSo>. (Last visited April 25, 2013)

Changes in Inpatient Length of Stay and RN Nursing Hours per Patient Day



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Cost is a huge issue for implementing the mandatory nurse-to-patient ratios because hospitals have limited budgets and multiple areas for spending. “The most onerous aspect to the ratios is the requirement that hospitals be in ‘continuous compliance’ – that means in compliance every minute of every shift on every unit every day.”²³ This means that to comply with the mandatory minimum nurse-to-patient ratios, hospitals must have more nurses than are required by the ratio. For example, there is a ratio of 1:4 nurses per patient required for the emergency

²² Welton, J., Mandatory Hospital Nurse to Patient Staffing Ratios: Time to Take a Different Approach, The Online Journal of Issues in Nursing, September 30, 2007, Vol. 12 No. 3 Manuscript, available at <http://www.nursingworld.org/MainMenuCategories/ANAMarketplace/ANAPeriodicals/OJIN/TableofContents/Volume122007/No3Sept07/MandatoryNursetoPatientRatios.aspx>. (Last visited April 2, 2013)

²³ Cheryl Clark, Does Nurse-Patient Ratios Improve Care?, HealthLeaders Media, Jan. 25, 2010, available at <http://www.healthleadersmedia.com/page-2/NRS-245408/Does-Mandating-NursePatient-Ratios-Improve-Care>. (Last visited April 25, 2013)

room in California.²⁴ In order to comply with the ratio, California hospitals would need to have enough nurses to meet the ratio of 1:4 plus at least one extra nurse to cover for when the nurses on duty have to leave the emergency for any reason including breaks or trips to the bathroom. This would result in the hospitals having to keep a ratio of 1:3.9 or less to stay in compliance.

Since meeting these ratios require hiring more nurses for all the hospitals, it will divert money currently being spent on hiring other types of employees or buying new technology.²⁵ A spokesman for the Service Employees International Union-United Healthcare Workers West (SEIU-UHW), which represents all kinds of hospital workers, said, “The reality is that front-line hospital workers are going to bear the brunt of [cuts] - - we think there will be hundreds if not thousands of layoffs.”²⁶ Due to the large impact meeting nurse-to-patient ratios will have on other hospital staff and overall spending, it is imperative that hospitals try to meet these ratios in the most cost effective way possible. Several different methods have been suggested to handle the burden of cost regarding mandatory minimum nurse-to-patient ratios including penalties for poor quality care and high rates of preventable medical error and different ways of billing for nursing care.

According to one article from the Journal of Health Care Finance, one way to ensure quality care would be to establish incentives and penalties.²⁷ The plan would result in monetary

²⁴ John Kasprak, California RN Staffing Ratio Law, February 10, 2004, available at <http://www.cga.ct.gov/2004/rpt/2004-R-0212.htm>. (Last visited April 25, 2013)

²⁵ Janet M. Coffman, et al, Minimum Nurse-To Patient Ratios In Acute Care Hospitals In California, Health Affairs, Sept 2002, vol. 21 no. 5 53-64, available at <http://content.healthaffairs.org/content/21/5/53.long>. (Last visited April 25, 2013)

²⁶ Dave Jamieson, Health Care Unions in California Split Over Nurse-To-Patient Ratios, The Huffington Post, June 16, 2012, available at http://www.huffingtonpost.com/2012/06/16/health-care-unions-california-nurse-to-patient-ratio_n_1602969.html. (Last visited April 25, 2013)

²⁷ Charles Andel, et al, The Economics of Health Care Quality and Medical Errors, The Journal of Health Care Finance, Fall 2012, Vol. 39, available at http://www.mediregs.com/economics_of_quality_care. (Last visited April 25, 2013)

finances and penalties for hospitals with high rates of preventable medical error and preventable readmissions.²⁸ In addition to the fines, lists of which hospitals performed poorly in these categories would be made publically available.²⁹ While this is a penalty for poorly performing hospitals, it is also a benefit and incentive for hospitals that have very low rates of error and preventable readmissions. When people are injured, and if given a choice of which hospital to attend, they will most often choose the hospitals with the lowest rates of error that are available to them. This encourages hospitals to maintain low error rates and may drive the very poorly performing hospitals out of business if their error rates are high enough.

These penalties would help hospitals with the costs arising from mandatory nurse-to-patient ratios because they would gain more patients if they follow the ratios. Since minimum nurse-to-patient ratios reduce preventable medical error, hospitals that follow the ratios would be listed as a better hospital on the list of hospitals the penalty program would try to form. These hospitals would attract more patients and the hospital would see more income generated due to the decreased error rate from following the nurse-to-patient ratios. By allowing hospitals to earn money through following the nurse-to-patient ratio they would not only try to meet the ratios, but would implement other quality control programs to increase overall patient health and reduce health care costs.

The federal government has also tried to help hospitals implement nurse-to-patient ratios by passing the Nurse Reinvestment Act and the American Recovery and Reinvestment Act. The Nurse Reinvestment Act (NRA), passed in 2002, provides scholarships and loans to nursing

²⁸ Id.

²⁹ Id.

students if they agree to work in hospitals that have a critical shortage of nurses.³⁰ It also has measures in place to encourage nurses to receive advanced degrees by offering loan forgiveness for those nurses who agree to teach at nursing schools.³¹ The NRA assists hospitals trying to meet minimum nurse-to-patient ratios by offering financial aid to the nurses. In this way, the scholarship would subsidize the hospital's staffing costs while allowing the hospital to hire more nurses.

The Act also helps hospitals deal with the supply problem that arises when trying to meet minimum nurse-to-patient ratios. Some hospitals may have trouble meeting the nursing ratios because there are not enough nurses in the area to hire. The Act tries to fix this problem by offering financial incentives to encourage more people to become nurses by making it cheaper for new nurses to be trained and offering money to nurses who agree to work in areas that have a shortage of nurses. Once there are enough nurses trained and available to work, hospitals should not have a problem meeting minimum nurse-to-patient ratios.

The NRA did help provide nurses for hospitals, but the problem of the nursing shortage was so important that the government passed the American Recovery and Reinvestment Act of 2009 (ARRA). It was passed in part to reinforce, "federal support of nursing by expanding the funding of current programs and creating new opportunities for nursing, education, and research."³² The ARRA allocated \$500 million to help meet the problem of a nursing shortage.³³

³⁰ Mark W. Stanton, M.A., Hospital Nurse Staffing and Quality of Care, Agency for Healthcare Research and Quality, Research in Action Issue 14, March 2004, available at <http://www.ahrq.gov/research/findings/factsheets/services/nursestaffing/index.html#Strategies>. (Last visited April 25, 2013)

³¹ H.R. 3487, 107th Congress, available at <http://www.gpo.gov/fdsys/pkg/BILLS-107hr3487enr/pdf/BILLS-107hr3487enr.pdf>. (Last visited April 25, 2013)

³² Charles Alexandre, RN, MS, et al, Legislative: The American Recovery and Reinvestment Act of 2009: What's in it for Nursing?, The Online Journal of Issues in Nursing, Vol. 14, Issue 3, September 2009, available at

The money was set aside for loan repayment, scholarships and training reimbursement and support the incentives laid out in the NRA.³⁴

A third way to address the problem of high nursing costs is to change the way hospitals bill for nursing hours. Currently, hospitals treat nursing costs as a lump sum that arises from averaging the costs for a standard patient day. This treats the cost of nursing care the same whether the nurse is treating a patient in the emergency room or in the ward. “The problem with this approach is that per diem room rates hold all nursing care constant; thus, it does not influence the relative weights of the diagnosis-related group (DRG), despite known variability in nursing intensity by DRG.”³⁵ This can result in overcharging for nursing costs when they are in the ward and undercharging when the patient is in the emergency room. Therefore, depending on how a hospital calculates its nursing expenses, it may lose a lot of potential money that nurses can generate for the hospital. For example, if the hospital averages the cost per hour of nursing care, they will find more hours for nursing in the ward because the ward is larger than the emergency room and has more patients in it at any time compared to the emergency room. Therefore if the cost of a nurse watching patients in the ward is less than the cost of a nurse in the emergency room, the hospital will charge less than it should for nursing care provided in the emergency room because the large amount of nursing hours in the ward at the lower cost will cause the average nursing cost to be skewed toward a lower cost.

<http://www.nursingworld.org/MainMenuCategories/ANAMarketplace/ANAPeriodicals/OJIN/TableofContents/Vol142009/No3Sept09/American-Recovery-and-Reinvestment-Act.html>. (Last visited April 25, 2013)

³³H.R. 3487, 107th Congress, available at

<http://usgovinfo.about.com/gi/dynamic/offsite.htm?site=http://thomas.loc.gov/cgi-bin/bdquery/z%3Fid107:HR03487>; (Last visited April 25, 2013)

³⁴Id.

³⁵ John M. Welton, Rates and Inpatient Nursing Care, Health Affairs, May 2007, vol 26, no. 3, available at <http://content.healthaffairs.org/content/26/3/900.1.full>. (Last visited April 25, 2013)

To fix this inaccurate method of billing, and to generate more money from nurses, some people have argued for hospitals to employ a nursing intensity billing model. This would, “...unbundle nursing care costs and billing from the traditional and archaic “room and board” charge and to instead establish costs based on the intensity of the care received by each patient.”³⁶ Nursing charges would be based on what type of procedure the nurses are involved in and how much they do in each procedure. This would change how much hospitals can charge for certain procedures, which would provide more money from the nursing staff to cover the increased costs of meeting nurse-to-patient ratios.

The nursing intensity billing model would make hospitals bill based on how many actual hours a nurse worked which has an added benefit of generating data that can be used in the future to see how much time a nurse spends with a patient. This new set of data would help influence how nurse-to-patient ratios are set because it would create a record of how many hours of care each patient would need based on their problem instead of where they are. Once hospitals have enough information about how many hours patients need based on their disease, they can attempt to revise the current nurse-to-patient ratios to a set of ratios that are more accurate and personalized

³⁶ John M. Welton, PhD, RN, Mandatory Hospital Nurse to Patient Staffing Ratios: Time to Take a Different Approach, The Online Journal of Issues in Nursing, Vol. 12-2007 no. 3, September 2007, available at <http://www.nursingworld.org/MainMenuCategories/ANAMarketplace/ANAPeriodicals/OJIN/TableofContents/Volume122007/No3Sept07/MandatoryNursetoPatientRatios.aspx>. (Last visited April 25, 2013)

Part V – Conclusion

As the studies above have shown, mandating minimum nurse-to-patient ratios is effective at reducing the rate of preventable medical error that occurs in hospitals. States should follow in California's footsteps and implement some level of mandatory ratios that is based on acuity. This method provides the most flexibility for nurses and allows for patients with severe problems to be accorded the proper amount of nursing care they require. By implementing these ratios, hospitals will be able to save more patients and reduce the rate of preventable medical error.

However, states should not implement these ratios unless they have laid the ground work for hospitals to be able to afford to pay for the increase in nursing staff. The state legislatures should take into consideration that hospitals do not usually have a large profit margin and that requiring hospitals to hire a large number of nurses will result in laying off other hospital staff and slowing the rate at which hospitals can purchase new medical technology/devices to care for their patients.

The best way to prepare for mandated minimum nurse-to-patient ratios would be for the state to make hospitals aware of the Nurse Reinvestment Act and the American Recovery and Reinvestment Act of 2009. These Acts provide funding for hospitals and nurses that are in areas with a nursing shortage, and ease the burden on hospitals of having to pay for a larger nursing staff. This should allow hospitals to hire more nurses without being overly concerned about the cost normally associated with them due to government money providing the hospital and nurses with monetary backing.

States should also start developing penalties and incentives for hospitals based on their rate of preventable medical error and the level of quality care they provide. The penalties and incentives program would make hospitals self-interested in maintaining low rates of preventable medical error by fining them for performing poorly and helping those hospitals which have low rates attract new patients. The fines would encourage hospitals to meet minimum nurse-to-patient ratios because they are a proven way of reducing the rate of preventable medical error and lowering the rate of error would help hospitals avoid the fines that would be charged for having a high error rate. In order to be properly implemented, the penalties and incentives would require a mandatory error reporting system so penalties and benefits are given fairly and to the proper hospitals. This way, all errors are reported and the state can get an accurate rate of preventable medical error that occurs in hospitals.

Finally, the medical industry should shift from charging for nursing staff as part of a room charge to nursing intensity billing. This change in how hospitals bill for nursing would result in hospitals collecting the appropriate amount of money from insurance for the amount of nursing provided. This would allow hospitals to hire the amount of nurses needed for mandatory nurse-to-patient ratios because each nurse would be earning the hospital more money from the insurance company than if the hospital collected nursing fees as part of a room charge. By making nursing care more affordable to hospitals, it eliminates the problem of high cost as a barrier to hiring enough nurses for mandatory nurse-to-patient ratios and allows hospitals to provide a higher level of care with a lower rate of preventable medical error.