

Introduction

Despite the strong and accumulating evidence that higher nurse staffing levels in hospitals and nursing homes result in safer patient care, there is wide variation in nurse staffing levels across hospitals and nursing homes. (Institute of Medicine, 2004)

At the present time California is the only state in the nation that has mandated patient-to-nurse staffing ratios in nongovernmental acute care hospitals. Under the regulations that took effect on January 1, 2004, California hospitals are required to have no more than six patients per nurse in general medical-surgical units, four patients per nurse in emergency departments, two patients per nurse in intensive care and labor units, and one patient per nurse in operating rooms. Outside of California, the actual number of patients cared for by nurses in acute care hospitals may vary widely from these standards. Some hospitals that are designated as “magnet” hospitals typically have lower-than-average patient-to-nurse ratios and are usually quite successful in attracting and retaining a greater proportion of staff nurses than is common elsewhere. Other hospitals find themselves with higher patient-to-nurse ratios as a result of cost-cutting efforts or because of difficulty in recruiting and retaining a larger number of nurses. Regardless of any specific hospital’s circumstances, a number of research projects conducted over the past decade have demonstrated that lower patient-to-nurse staffing ratios are frequently associated with a better quality of work life for nurses, and this in turn is associated with lower nursing turnover, reduced errors and untoward events among patients, and a general increase in the quality of patient care. In addition, there is some evidence that reducing the ratio of patients-to-nurses may have financial benefits that exceed the costs associated with recruiting and retaining a larger cadre of direct-care nurses. A summary of several of these research studies is presented in a companion paper, “The Business Case for Reducing Patient-to-Nursing Staff Ratios and Eliminating Overtime for Nurses,” that was prepared for the Michigan Nurses Association.

The purpose of this report is to examine the hypothetical costs and the hypothetical savings that may be encountered by an acute-care hospital in Michigan as a result of reducing its patient-to-RN staffing ratio from five patients-per-RN to four patients-per-RN. This exercise is conducted twice in this report—once for a model 200-bed acute-care hospital and a second time for a model 50-bed acute-care hospital. In each case, the assumptions made about the hospitals are derived from recent and reputable sources of hospital information in Michigan. The factors that are applied to each scenario are drawn from data presented and fully cited in the accompanying report, “The Business Case for Reducing Patient-to-Nursing Staff Ratios and Eliminating Overtime for Nurses,” released by the Michigan Nurses Association on June 8, 2004.

Scenario #1: 200-Bed Model Hospital

For illustrative purposes, the first model hospital consists of 200 licensed and operating beds with an average occupancy rate of 75%.¹ Other assumptions include an average length of stay of 4.8 days.² Almost 30% of the patients discharged annually from this model Michigan facility are surgical patients.³ For purposes of this exercise, the operating assumption is that the model hospital has an average ratio of five patients for each RN providing direct patient care during all shifts for the entire year. The exercise described here estimates the additional costs associated with reducing the patient-to-staff ratio to only four patients per RN and any savings or cost reductions that may similarly be directly associated with reducing the patient-to-nursing staff ratio.

¹ According to the Health Care Advisory Board, as related in a telephone conversation with Cheryl Miller, Senior Manager for Strategic Planning, Trinity Health, Novi, Michigan, May 2004.

² Michigan Inpatient Data Base, 2000.

³ Ibid.

Table 1: Assumptions Regarding the 200-Bed Model Hospital

Characteristic	Assumption	Notes
Beds	200	
Occupancy	75%	Average occupancy, Health Care Advisory Board
Average length of stay (ALOS)	4.8 days	Source: 2000 Michigan Inpatient Data Base
Discharges	11,406	Estimated from occupancy and ALOS figures.
Normal newborns	912	8.0% average. Source: 2000 Michigan Inpatient Data Base
Medical-surgical discharges	10,494	92.0% average. Source: 2000 Michigan Inpatient Data Base
Surgical discharges	3,117	29.7% average. Source: 2000 Michigan Inpatient Data Base
Beginning ratio	5 patients per RN	
Ending ratio	4 patients per RN	
Beginning turnover rate	10%	Annual turnover in health care is 20.7% according to the Saratoga Institute, reported in Kosel K. and T. Olivio's <i>The Business Case for Work Force Stability</i> , Voluntary Hospitals of America (VHA) Research Series, 2002, p. 6. Other estimates put the RN turnover ratio at approximately 13% per year.
Ending turnover rate	5%	Turnover rate at "magnet" hospitals is estimated at slightly below 5%.
Estimated turnover cost	100% of RN salary	Source: Kosel, K. and T. Olivio's <i>The Business Case for Work Force Stability</i> , VHA Research Series 2002, pp. 6-7.
Estimated annual RN salary	\$50,000	\$50,000 annual salary is used for the convenience of calculations. Data from the 2003 Occupational Employment Statistics from the U.S. Department of Labor, Bureau of Labor Statistics, report the mean annual salary for RNs in Michigan at \$51,000.

1. Additional Staffing Costs, 200-Bed Model Hospital

A 200-bed acute-care hospital that is operating at an average 75% capacity during three shifts per day, 365 days per year, with an average length of stay of 4.8 days and an average ratio of five patients per RN who provides direct bedside care will require a staff cadre of slightly more than 131 RNs. For purposes of this exercise, the estimated RN staff size is rounded to 131. If RNs at

this hospital earn an average of \$50,000 per year, total annual RN salaries are calculated to be \$6,550,000.⁴

Keeping all other operational factors constant (e.g., number of beds, occupancy, average length of stay, percentage of surgical patients, and so on), a reduction of the patient-to-RN ratio from five patients per RN providing bedside care to a ratio of four patients per RN will require the addition of 32.8 RN full-time equivalents (FTEs) to the staff. At an estimated \$50,000 per nurse, this addition will add \$1,640,000 to the annual staff budget of \$6,550,000 for a base staff budget of \$8,190,000. In addition, annual RN staff turnover is estimated to average 10% of the staff each year at the higher patient-to-staff ratio. The cost of replacing 13.1 RNs each year is \$655,000 (13.1 RNs at \$50,000 recruitment costs each).

In addition, as noted above, the cost of replacing a nurse who leaves (including the cost to recruit new staff, hire temporary staff to fill in, and train new staff) is estimated at approximately one full year's salary. Assuming that the cost of adding new RN staff to the hospital is as expensive as the cost of replacing current RNs through turnover, the costs for recruiting 32.8 additional nurses will add \$50,000 per additional nurse in the year in which the staff is recruited. In this case, then, the cost of expanding from 131 RNs to 163.8 RNs will add another \$1,640,000 in one-time recruitment and related costs to the original RN budget of \$6,550,000.

Based on these figures, the total budget-year outlay to account for 10% turnover in the RN staff in Year 1 and to recruit an additional 32.8 nurses to the staff in Year 1 to begin working in Year 2 (the first year of planned reductions in patient-to-RN ratios) will be \$8,845,000—a 35.0% increase in costs before a single additional nurse is hired.

Table 2: Total First-Year RN Staff, Turnover, and Recruitment Costs in a 200-Bed Model Hospital

Staffing Event	Cost Type	# of RNs	Cost	Total
Original RN staff	Base salary	131.0	\$50,000	\$6,550,000
Turnover @ 10%	Recruitment costs	13.1	\$50,000	\$655,000
Recruit additional RNs	Recruitment costs	32.8	\$50,000	\$1,640,000
Total RN costs in Year 1				\$8,845,000

The salary costs of RNs in each successive year will continue to grow; however, the rate of growth will not be excessive due to a reduction in turnover leading to fewer nurses being replaced annually (from 10% of 131 or 13 RNs to 5% of 163.8 or 8 RNs) and no extraordinary recruitment costs to increase staff dramatically after the first year. These figures are also calculated with the built-in assumption that salaries will grow at an average of 4.0% per year. The annual cost of the original bedside RN staff and the annual costs of the expanded bedside RN component after a reduced patient-to-nurse ratio is implemented are illustrated in Figure 1.

⁴ For purposes of this exercise, benefits have not been calculated. Benefits typically add between 25% and 33% to the base salary.

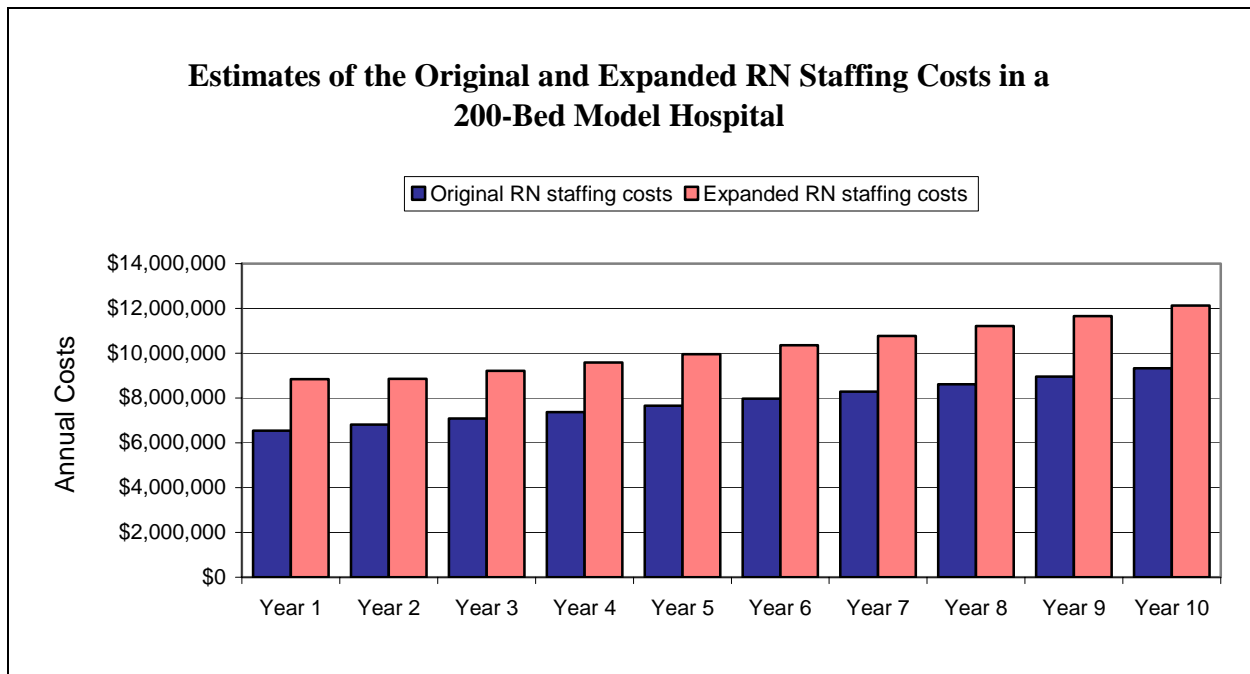


Figure 1

2. Reduced Turnover Costs, 200-Bed Model Hospital

Despite the increase in nursing staff costs associated with a reduced patient-to-RN staff ratio, the uniform finding of the VHA report *The Business Case for Work Force Stability* (Kosel and Olivio, 2002) is that the costs of staff turnover for health care organizations—in both time and money—is significant, and that any reduction in staff turnover will result in demonstrable savings. VHA estimates turnover costs for nursing staff at between 50% and 150% of annual salaries, with higher turnover costs for more highly skilled and responsible nursing categories. The cost of replacing a medical-surgical RN, for example, is approximately one full year’s salary for that position. Using the data in Table 1, above, the average cost of replacing a medical-surgical RN in a model 200-bed hospital in Michigan is approximately \$50,000. While reducing the patient-to-nurse ratio from five patients per RN to four patients per RN will require a higher annual budget for RNs that provide direct patient care, a reduced patient-to-nurse staffing ratio is also expected to reduce the hospital’s rate of RN turnover each year. Each increase of one FTE RN will add \$50,000 to the personnel budget, and any decrease in staff turnover will reduce the cost associated with replacing an RN by an equivalent \$50,000. In subsequent years, these figures are inflated by 4.0% per year to account for anticipated salary increases.

Several studies in recent years have verified that reductions in the ratio of patients to nurses are associated with increases in the quality of care provided, reductions in complications and adverse events during hospitalization, reductions in the length of stay, and reductions in overall patient costs. Reductions in the ratio of patients to nurses are also strongly associated with increases in staff satisfaction and reductions in nursing staff turnover (Gelinas, Bohlen, and DeJoy, 2002; Kosel and Olivio, 2002).

Based on these findings, the increased costs of expanding the RN staff at a 200-bed acute-care facility will lead to reduced RN turnover and reduced future costs associated with recruiting and

hiring replacement staff. More important, the research cited in “The Business Case for Reducing Patient-to-Nursing Staff Ratios . . .” indicate that there will be savings that result from lower patient-to-RN ratio in terms of reduced costs of complications and adverse events among inpatients, reduced patient length of stay, and reduced overall patient costs.

The Cost of Reducing Turnover: There are significant costs associated with any proposed change in patient-to-nurse staffing ratios. As noted in Table 1, the assumption in this example is that a 25% increase in the size of the RN cadre at the model 200-bed hospital will result in a decline in the annual turnover rate among RNs from 10% yearly to 5% yearly.⁵ If this assumption is correct, the cost of replacing 13 RNs each year (10% of 131 RNs) at \$650,000 will be reduced to \$425,880 in Year 2 for replacing 8.2 RNs each year (5% of 163.8 RNs), a savings of \$224,000 in advertising, interviewing, transportation, background checks, and all of the other expenses associated with hiring staff. Assuming a 4% average increase in RN salaries in each subsequent year, the cost of staff, the cost of turnover, and the savings from reduced turnover levels will all grow. RN salaries and turnover costs over 10 years are illustrated in Figure 2.

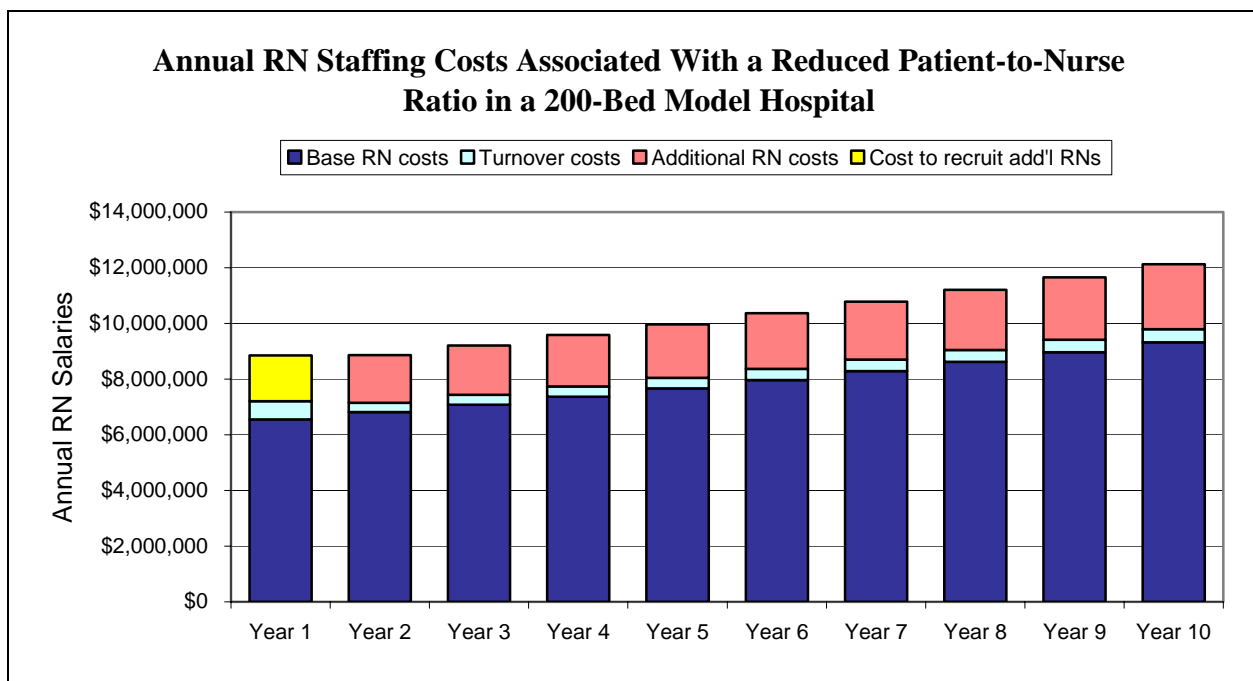


Figure 2

Reduced Costs From Complications and Adverse Events: A number of studies have identified specific costs associated with adverse events or complications related to patient-to-nurse staffing levels, especially for surgical patients. As noted in one study, “nurses, as patient advocates are responsible for protecting patients from adverse outcomes, especially those patients at a higher risk of adverse events” (Cho, et al., p. 78). Typical complications that may be reduced in

⁵ The nationwide turnover rate for nurses in 2001, as reported by First Consulting Group for the American Hospital Association, was 13%. The starting assumption of 10% turnover, therefore, is a conservative one. The assumption of a 5% turnover rate at a low turnover hospital is also a conservative estimate. The turnover rate for “magnet” hospitals is currently approximately 4.8%. Reducing RN turnover at a model hospital to a rate consistent with the RN turnover rate at a “magnet” hospital, therefore, is a reasonable assumption.

association with lower patient-to-nurse ratios include urinary tract infections, pneumonia, shock, upper gastrointestinal bleeding, longer length of stay, higher 30-day mortality rates, and higher failure-to-rescue rates (Stanton and Rutherford, 2004).

Hospital-acquired pneumonia is the most common complication identified in the numerous studies that have investigated the relationship between nurse staffing levels, complications, and medical costs. Hospital-acquired pneumonia among surgical patients is estimated to add between \$22,390 and \$28,505 per patient to hospital costs (Cho, et al., 2003). In one major study funded by the Agency for Healthcare Research and Quality, lower patient-to-nurse ratios reduced the rate of hospital-acquired pneumonia from approximately 2.2% of all surgical patients to approximately 1.3% of all surgical patients. (Ibid.)

Based on the assumptions in Table 1, this model hospital has 3,117 surgical discharges in a typical year. A decline from 2.2% to 1.3% represents a reduction from 68 to 41 surgical patients with hospital-acquired pneumonia each year. Using the lowest estimate of additional costs associated with hospital-acquired pneumonia (\$22,390 per case), this represents a savings in *additional* medical costs of \$604,530 per year; using a high estimate of \$28,505 per case, this could represent a savings of as much as \$769,635 in *additional* costs each year. For purposes of this exercise, the more conservative estimate of \$604,530 in savings from a reduction in hospital-acquired pneumonia associated with a reduced patient-to-nurse ratio is used for Year 2 of the example. This figure is then increased by 5% in subsequent years as an estimate of the impact of medical-cost inflation. *Estimates of potential savings from reductions in hospital-acquired pneumonia among medical patients or reductions in other nosocomial infections among all medical or surgical patients have not been estimated and are not included in this report.*

Other studies of the relationship between nurse staffing levels, adverse events, and medical costs reported between \$2,013 and \$4,500 in additional costs per patient resulting from adverse drug events in hospitals with higher patient-to-nurse staffing levels (Classen, et al., 1997; Cho et al., 2003). Expanding Cho's estimate of 1.06% adverse drug events to all patients except newborns and estimating the cost per event at the lower level of \$2,013 per patient, the 200-bed model hospital is likely to initially experience 111 adverse drug events per year at an annual cost of almost \$225,000. If reducing the number of patients per nurse results in preventing as few as one-fourth of these events, the 200-bed model hospital is likely to experience 28 fewer adverse drug events during the course of a typical year. At \$2,013 per event, this would save the hospital more than \$56,000 per year. These estimates are also increased by 5% per year to account for medical-cost inflation.

Reduced Length of Stay and Reduced Overall Medical Costs: Research sponsored by the VHA indicates a reduction in average length of stay (ALOS) from 5.02 days in a "high turnover" hospital (21.6% – 43.8% annual turnover) to 4.81 days in a "medium turnover" hospital (12.0% – 21.6%). There is an additional ALOS reduction from 4.81 days to 3.81 days associated with reducing turnover from "medium" to "low" (4.0% – 12.0%) (Gelinas, Bohlen, and DeJoy, p. 8). Average costs per discharge were also shown to have declined in relation to the change in turnover, from \$7,190 in a "high turnover" hospital to \$6,120 in a "medium turnover" hospital, and an additional reduction to \$5,268 in a "low turnover" hospital.

For purposes of this exercise, the most conservative average reduction in costs of \$852 per discharge, excluding newborns, is assumed. This figure is the reduction in patient costs estimated by VHA associated with reducing turnover from a “medium” level (12.0% to 21.6% per year for all skilled hospital staff) to “low” turnover (4.0% to 12.0%) in the 235 hospitals studied. Excluding newborns, the 200-bed model hospital has 10,494 discharges per year. At \$852 per discharge, the 200-bed model hospital will reduce its annual costs by approximately \$8.9 million during the first year of a reduced patient-to-nurse staffing ratio, according to these figures.

The potential savings from reduced pulmonary complications, reduced adverse drug events (ADEs), and the overall reduction in patient costs are illustrated in Figure 3. These figures include an inflation adjustment of 5% per year to account for the anticipated growth in medical costs in the future.

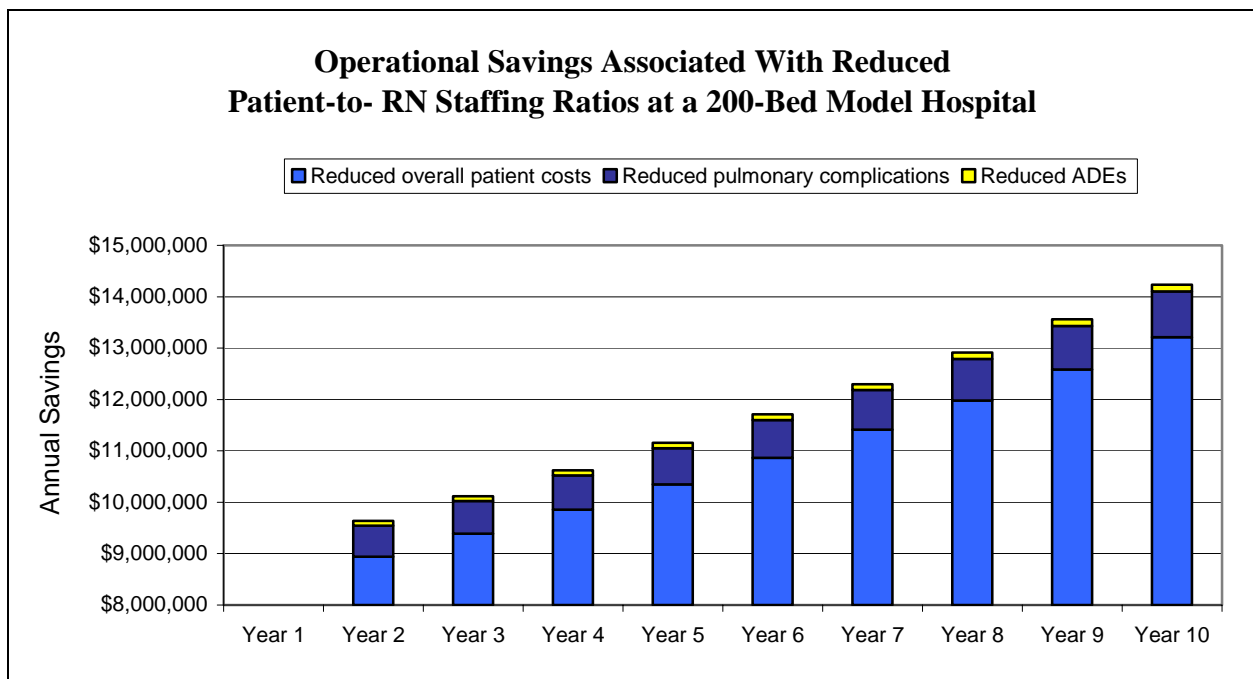


Figure 3

3. Net Costs and Net Savings, 200-Bed Model Hospital

Based on the data presented above, it is clear that although there are significant costs associated with the expansion of the RN cadre in a typical, 200-bed hospital, there are also significant savings that are associated with reducing the patient-to-RN ratio from five patients per RN to four patients per RN on all shifts at the hospital. Taking into account an average annual increase in RN salaries of 4%, the hospital’s RN staffing costs will increase from approximately \$8 million in Year 1 prior to reduction of the patient to staff ratio to approximately \$12 million in Year 10.

On the other side of the ledger, reduction in the patient-to-RN ratio has a number of financially beneficial effects, including reductions in pulmonary and other complications among surgical patients, a reduction in adverse drug events (ADEs) and other life-threatening events, and an

overall reduction in patient costs.⁶ Based solely on the cost-reduction estimates associated with reducing the incidence of hospital-acquired pneumonia, ADEs, and overall reduced patient costs, the 200-bed model hospital may expect to see savings of \$9.6 million within a year of reducing the overall patient-to-nurse ratio from 5-to-1 to 4-to-1. As hospital costs grow as a result of inflation between Year 1 and Year 10, savings will also grow, reaching more than \$14 million by Year 10 (see Figure 3, above).

An illustration of the additional costs and corresponding savings that are projected for the 200-bed model hospital over ten years is found in Figure 4.

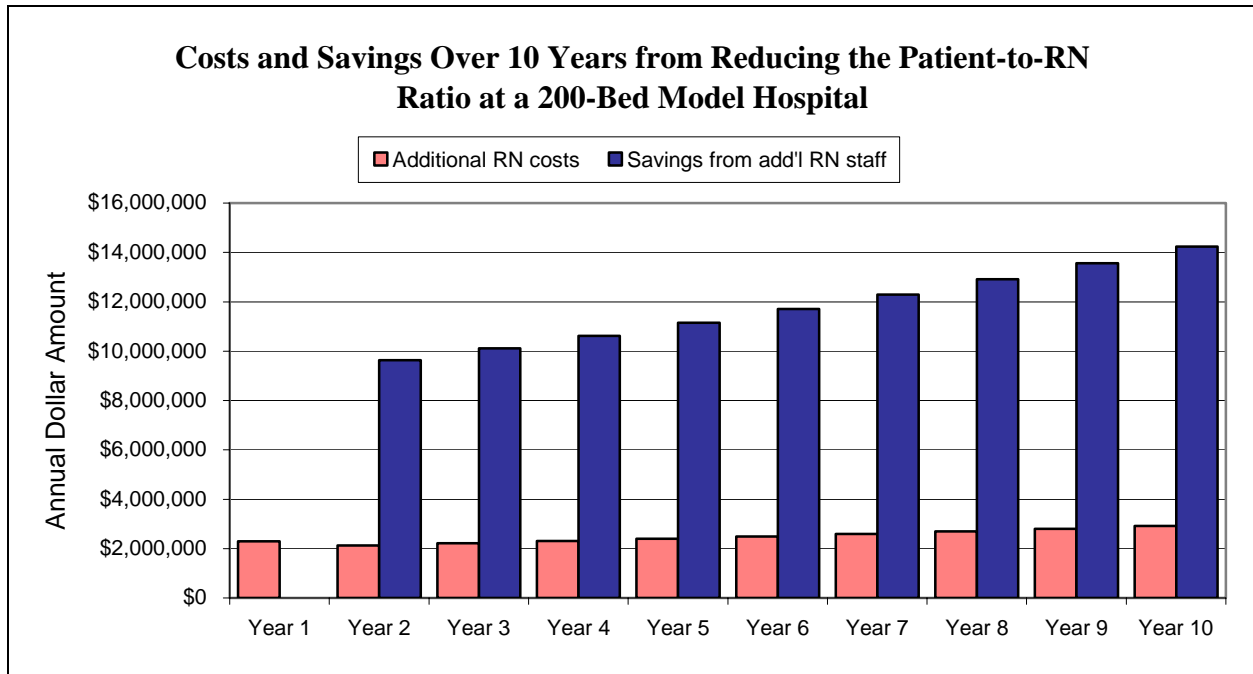


Figure 4

Taking into account both the estimated costs and estimated savings over the 10-year period used for illustration, the net savings realized by the 200-bed model hospital are estimated to increase from approximately \$7.5 million in the first year after reducing the patient-to-nurse ratio to more than \$11 million in Year 10 of the illustration (see Figure 5).

⁶ There are likely to be additional reductions in complications among medical patients, but no definitive estimates of the financial impact of this have been found in the literature.

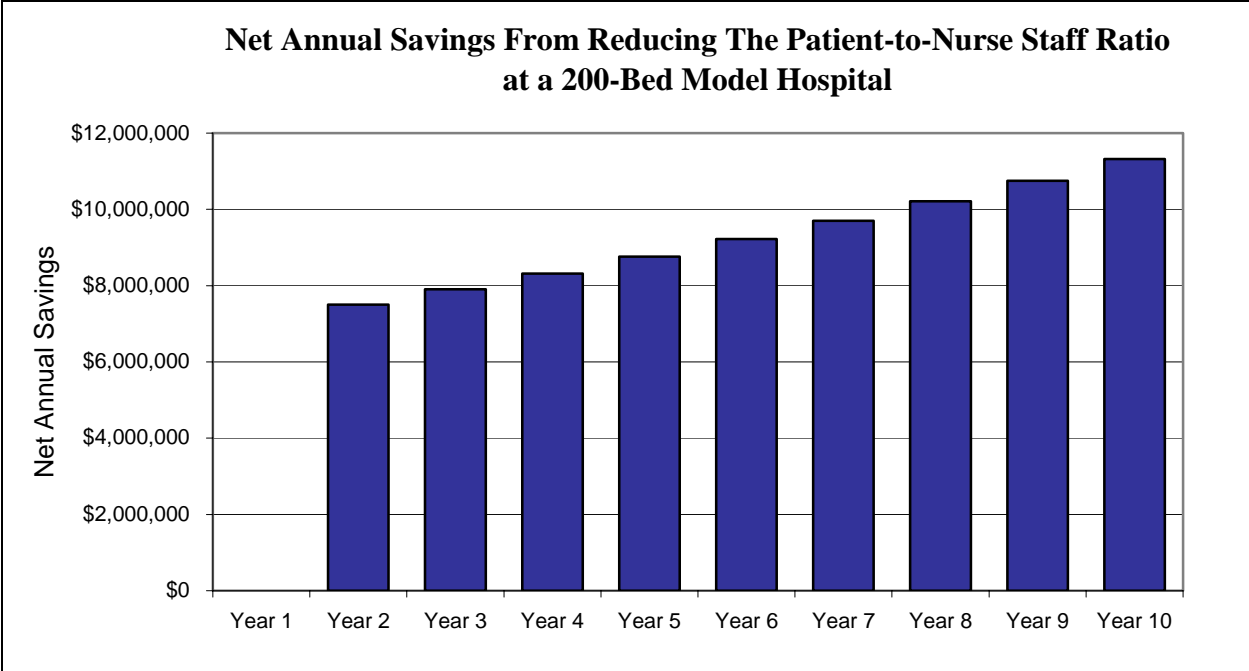


Figure 5

Scenario #2: 50-Bed Model Hospital

In order to illustrate the impact that reducing the patient-to-nurse ratio may have on a smaller hospital, all of the same assumptions have been applied to a 50-bed model hospital. Recognizing, however, that the addition of more RNs to the staff of a relatively small hospital may impose a somewhat greater burden than at a larger hospital due to the flexibility and economies of scale afforded in larger institutions, estimates of additional staff costs have been rounded upward in this example.

Table 3: 50-Bed Model Hospital Assumptions

Characteristic	Assumption	Notes
Beds	50	
Occupancy	75%	Average occupancy, Health Care Advisory Board.
Average length of stay (ALOS)	4.8 days	Source: 2000 Michigan Inpatient Data Base
Discharges	2,852	Estimated from occupancy and ALOS figures.
Normal newborns	228	8.0% average. Source: 2000 Michigan Inpatient Data Base
Medical/surgical discharges	2,624	92.0% average. Source: 2000 Michigan Inpatient Data Base
Surgical discharges	779	29.7% average. Source: 2000 Michigan Inpatient Data Base
Beginning ratio	5 patients per RN	
Ending ratio	4 patients per RN	
Beginning turnover rate	10%	Annual turnover in health care is 20.7% according to the Saratoga Institute, reported in Kosel K. and T. Olivio's <i>The Business Case for Work Force Stability</i> , VHA Research Series, 2002, p. 6. Other estimates put the RN turnover ratio at approximately 13% per year.
Ending turnover rate	5%	Turnover rate at "magnet" hospitals is estimated at slightly below 5%.
Estimated turnover cost	100% of RN salary	K. Kosel and T. Olivio's <i>The Business Case for Work Force Stability</i> , VHA Research Series 2002, pp. 6-7.
Estimated annual RN salary	\$50,000	\$50,000 annual salary is used for the convenience of calculations. Data from the 2003 Occupational Employment Statistics from the U.S. Department of Labor, Bureau of Labor Statistics, report the mean annual salary for RNs in Michigan at \$51,000.

1. Additional Staffing Costs, 50-Bed Model Hospital

With an average of five patients for each RN involved in direct patient care, the base RN cadre at a 50-bed model hospital is 32.8 or 33 RN full-time equivalents. Bringing this staff size to an average of four patients per RN requires an addition of 10 (9.5 rounded up to 10) RNs at an initial cost of \$50,000 per RN or \$500,000 in Year 1. (See Table 4, below) Total staff size at the beginning of Year 2, therefore, will be 43 RNs. The cost of recruiting these additional 10 RNs along with the estimated cost of 10% RN turnover in Year 1 and 5% RN turnover in Year 2 (after the patient-to-nurse staffing level is reduced from five to four) is illustrated in Figure 6.

Table 4: Total First Year RN Staff, Turnover, and Recruitment Costs in a 50-Bed Model Hospital

Staffing Event	Cost Type	# of RNs	Cost	Total
Original RN staff	Base salary	33.0	\$50,000	\$1,650,000
Turnover @ 10%	Recruitment costs	3.3	\$50,000	\$165,000
Hire additional RNs	Recruitment costs	10.0	\$50,000	\$500,000
Total RN costs in Year 1				\$2,315,000

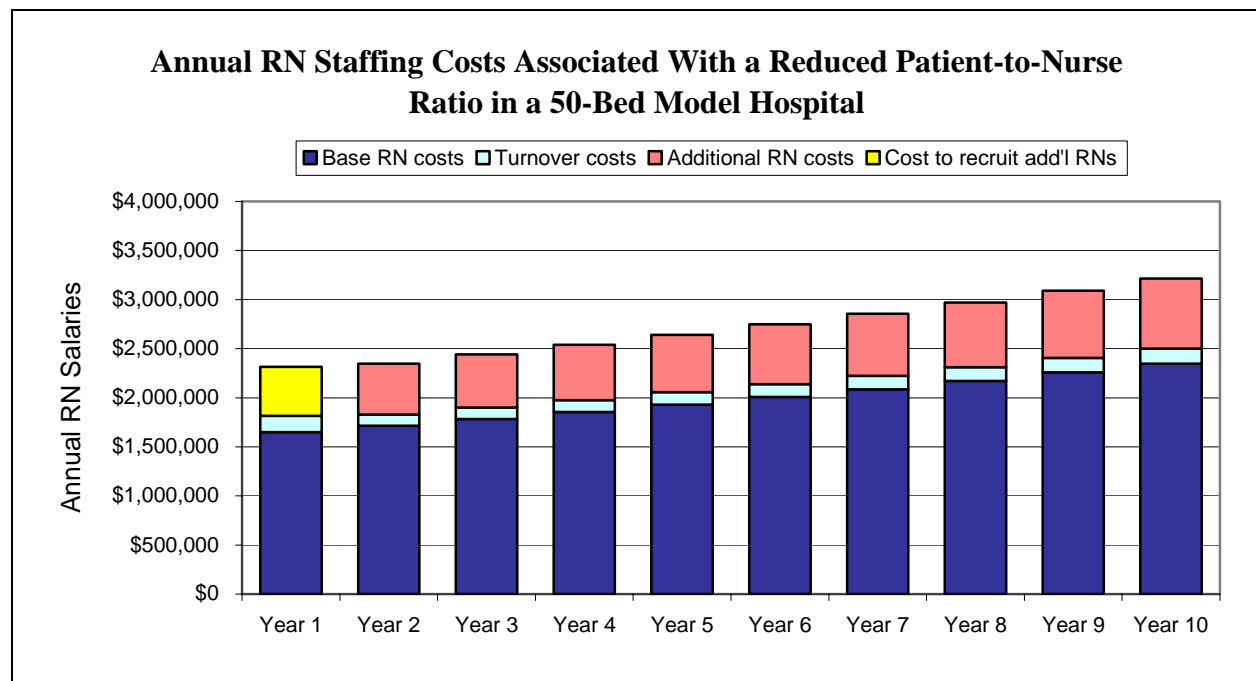


Figure 6

Total personnel costs for RNs increases from \$2,315,000 in Year 1 (including turnover costs and the cost of recruiting an additional 10 RNs) to approximately \$3.2 million in Year 10.

2. Reduced Turnover Costs, 50-Bed Model Hospital

Using the same estimate of lower turnover associated with reduced patient-to-staffing ratios, RN turnover at the 50-bed model hospital may be expected to decline from 3 RNs in Year 1 (10% of 33 RNs) to 2.15 RNs in Year 2 and subsequent years (5% of 43 RNs), resulting in an immediate savings of more than \$50,000 in turnover costs.

Reduced Costs From Complications, Adverse Events, and Overall Medical Costs: Using the same statewide estimates from the 2000 Michigan Inpatient Data Base, there are an estimated 2,852 total discharges during the course of a typical year at the 50-bed model hospital. Eight percent, or 228 discharges, are normal newborns; the remaining 2,624 discharges are medical or surgical patients. Of these 2,624 discharges, an estimated 779 (29.7%) are surgical patients. Savings associated with this reduction have been computed for three factors:

- A reduction of \$22,390 for every case of hospital-acquired pneumonia among surgical patients that is eliminated as a result of a lower patient-to-RN ratio.
- A reduction of \$2,013 for each adverse drug event among all medical and surgical patients that is prevented as a result of a lower patient-to-nurse ratio.
- A reduction of \$852 in overall costs for every medical-surgical discharge associated with lower staff turnover rates.

Savings for a 50-bed model hospital in the first year in which lower patient-to-RN staffing ratios are implemented are estimated at \$156,000 from reduced hospital-acquired pneumonia, \$14,000 in lower costs associated with a 25% reduction in adverse drug reactions, and as much as \$2.2 million in reduced overall inpatient costs. By Year 10, total savings from these three consequences associated with lowering the patient-to-RN ratio may reach as much as \$3.5 million annually.

As noted earlier, other potential savings associated with reduced patient-to-RN ratios have been identified, but there is too little detail in the literature to estimate their impacts on a per-patient basis.

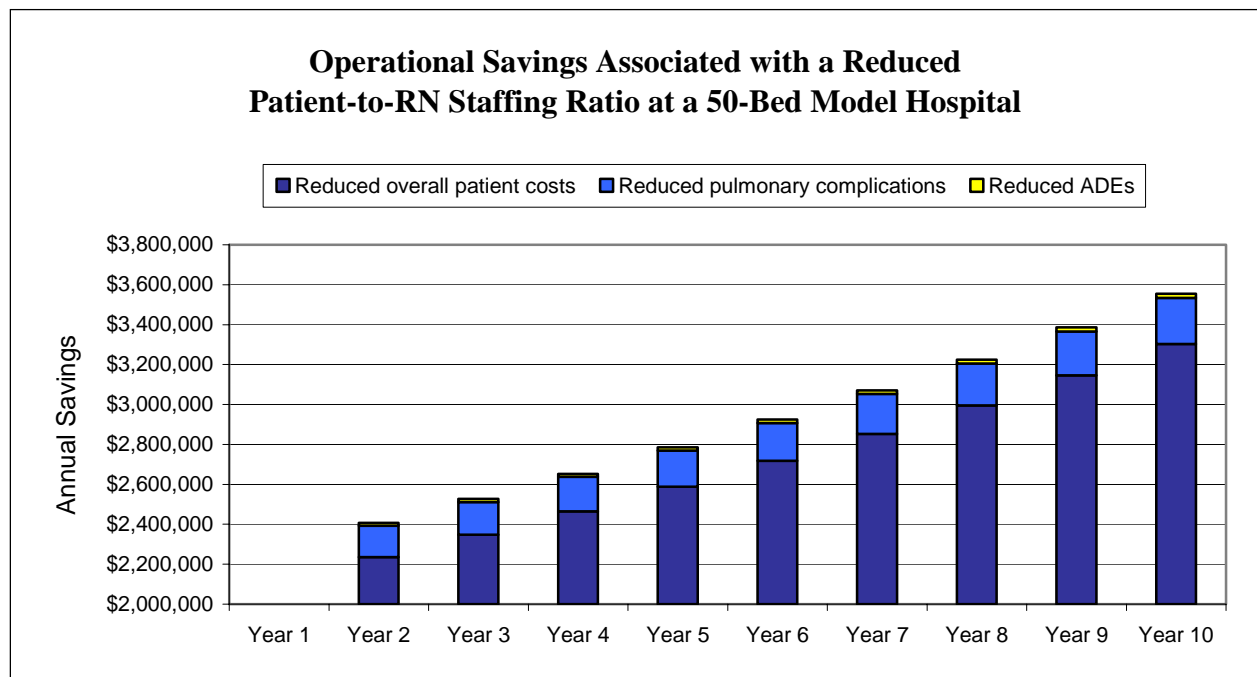


Figure 7

3. Net Costs and Net Savings, 50-Bed Model Hospital

The estimated additional costs for expanding the RN staff devoted to patient care and the estimated savings associated with reducing the patient-to-RN staffing ratio are illustrated in Figure 8. While both figures increase over time, when an estimate of medical-cost inflation is built into the model, the savings described earlier clearly outpace the additional staffing costs.

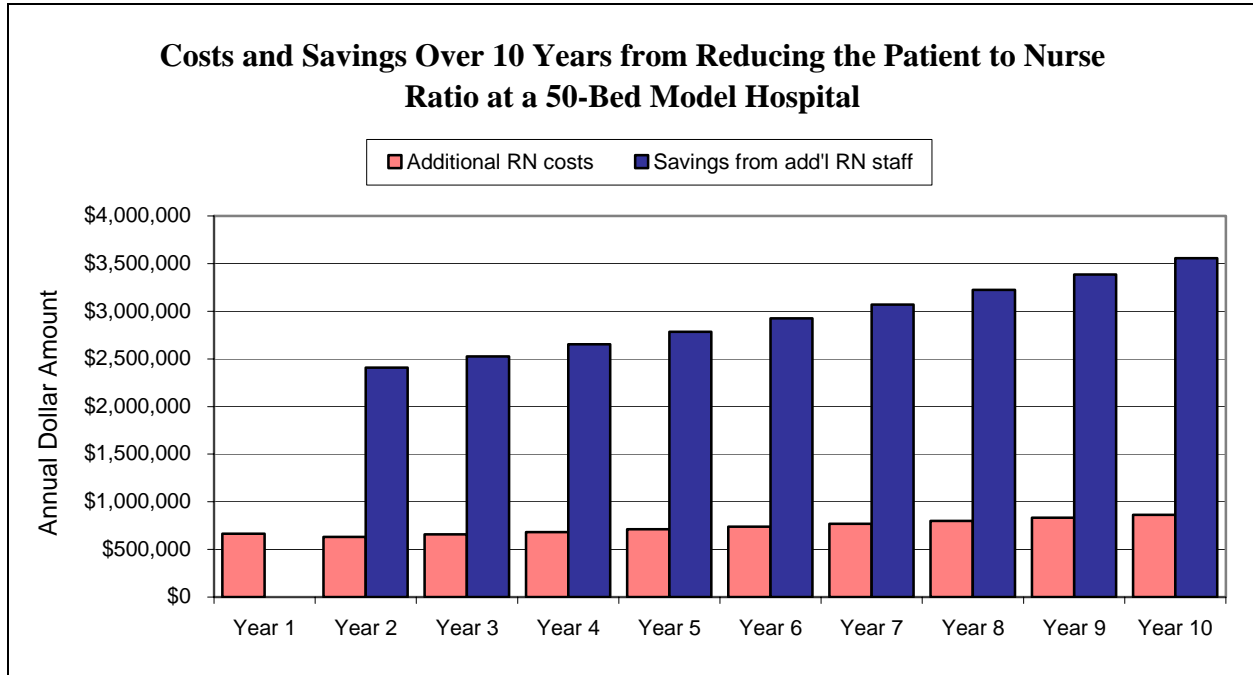


Figure 8

The net savings that may be realized through a reduction in the average number of patients per RN are illustrated in Figure 9. Starting at slightly more than \$1.5 million in Year 2, net savings from reduced pulmonary complications, reduced adverse drug events, and overall per-patient savings associated with a reduced patient-to-staff ratio and reduced staff turnover may exceed \$2.5 million by Year 10.

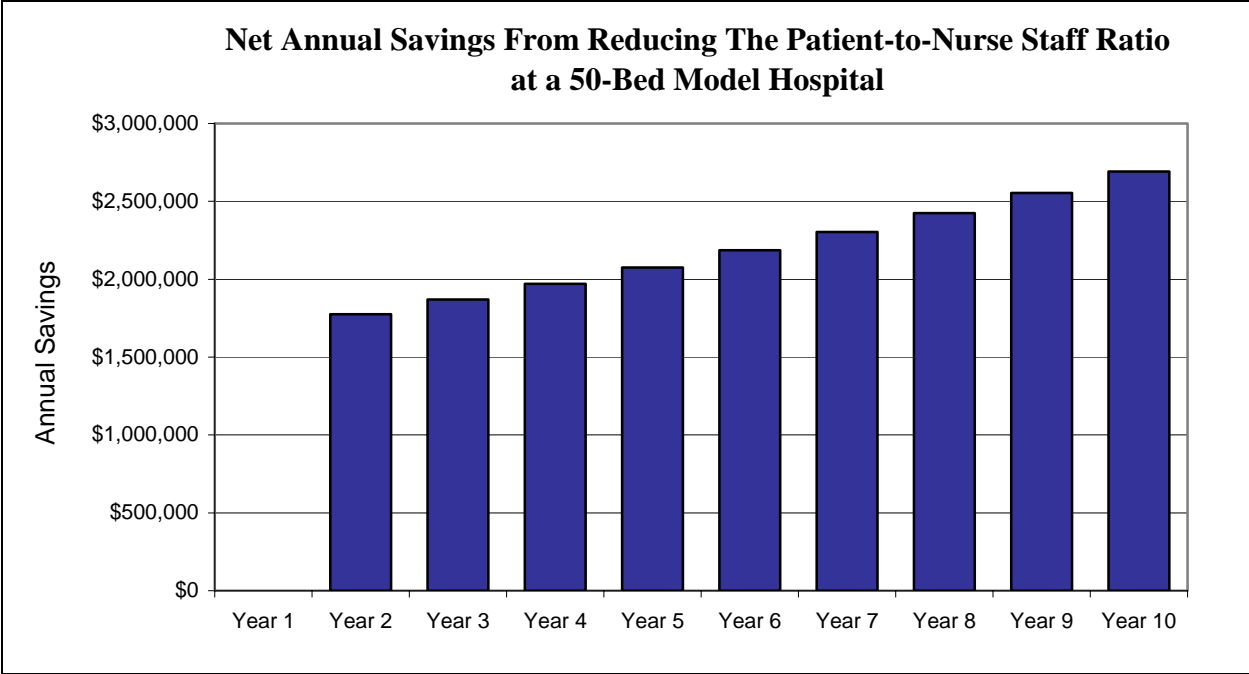


Figure 9

Sources of Information

- Cho, S., S. Ketefian,, V.H. Barkauskas, and D.G. Smith, “The Effects of Nurse Staffing on Adverse Events, Morbidity, Mortality, and Medical Costs,” *Nursing Research* 52 (2): 71-79.
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