WHITE PAPER

ANA
AMERICAN NURSES ASSOCIATION

The Business Case for Higher Levels of Nurse Staffing in the Hospital Setting

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Prepared for American Nurses Association

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Executive Summary

Background and Rationale

The United States spends over $1 trillion in hospital care per year, with hospital expenditures comprising nearly a third (32.3%) of all healthcare expenditures.[1] Hospital expenditures are expected to grow at 5.5% per year between 2016 and 2025, faster than the expected growth rate of the gross domestic product over the same time period.[2] In many parts of the U.S. healthcare system, there is a desire to achieve greater value for the expenditures made, and stakeholders are actively putting systems into place to increase quality while decreasing cost (i.e., increasing value). For example, the Centers for Medicare & Medicaid Services (CMS) intends to link 90% of its payments to care quality by 2018, with half of its payments flowing through Alternative Payment Models.[3] This desire for greater value holds true within the hospital industry, which sees many of its payments tied to care quality metrics such as readmission rates.[4]

Quality measurements shared among the top performing hospitals include the following:[5]

1. Fewer complications;
2. Lower mortality;
3. Lower readmission rates;
4. Shorter length of stay (LOS);
5. Higher score on patient ratings; and
6. Higher average operating margins than their peers.

An inference that can be made from the ratings is that the top performers are able to provide greater "value" to the system by delivering higher quality care at a lower cost than their peers—something ever more desired in the U.S. healthcare system. Indeed, numerous public and private initiatives have been instituted to address the above-cited desired benchmarks that distinguish high performers from their peers. And, as integral members of patient care teams, nurses play an important role in helping hospitals achieve high performance characteristics.

In a previous paper, the American Nurses Association (ANA) collaborated with Avalere Health to report on the association between nurse staffing levels and improvements in quality of care and patient outcomes.[a] The report found that a number of studies support the value of increasing nurse staffing as it relates to improved patient outcomes and quality of care. Nurse staffing was found to have a positive effect on such outcomes as hospital-acquired conditions (HACs), mortality, and hospital readmissions.

In this second paper, ANA and Avalere explore the business case for increasing nurse staffing to achieve not only improvements in the quality of care explored in the first paper, but also decreased LOS, and the net financial impact of both on hospital budgets. Further, we present a simple quantitative tool to assist nursing personnel in working with hospital management to examine the financial impact of increasing nurse staffing levels in order to improve four quality measures and decrease LOS. In most cases, the model will show a positive net financial benefit to the hospital from such actions.

[a] That paper, titled "Optimal Nurse Staffing to Improve Quality of Care and Patient Outcomes," is available at: http://www.nursingworld.org/Avalere-WhitePaper-on-NurseStaffing.

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Methods

Avalere re-examined the findings made in the first paper and the supporting literature, focusing on building a quantitative base on which to model the financial impact of changes in nurse staffing. We conducted a targeted (supplemental) review of peer-reviewed literature, government reports, and other publicly available evaluations of nurse staffing and patient outcomes published between 2000 and 2016.

Avalere developed a simple, Microsoft® Excel (2013)-based cost calculator to measure the impact on hospital budgets of reductions in five nursing-sensitive quality indicators through adjustments to nurse staffing. Three major phases of work were completed to build the model. The first phase was to develop quantitative relationships between nursing levels and four of the five quality indicators. These indicators were derived from an analysis of available information in a representative sample of hospitals that contributed information to the Press Ganey National Database of Nursing Quality Indicators® (NDNQI) during the first quarter of 2016. The four quality measures assessed were rates per 1,000 applicable patient days of: falls, catheter-associated urinary tract infections (CAUTI), central line-associated bloodstream infections (CLABSI), and ventilator-associated pneumonia (VAP). The second phase was to develop quantitative relationships between increasing nursing care hours and the fifth performance indicator, decreasing LOS, using data points from the literature. The two initial phases of work provided the base information for the third phase, construction of a customizable model that shows, in net dollar terms, the impact of an increased number and type of nurse staffing hours on all five of the quality and outcome measures cited above.

In order to validate our findings, Avalere consulted with a group of key opinion leaders, hospital administrators, nurse managers, and technical experts to provide critique and additional insights.

Key Findings

From the Literature Search

The top performing U.S. hospitals share these characteristics in comparison to their peers:

1. Fewer complications;
2. Lower mortality;
3. Lower readmission rates;
4. Shorter LOS; and
5. Higher average operating margins.

As integral members of patient care teams, nurses play an important role in helping hospitals achieve high performance characteristics. Research has shown that increases in nurse staffing levels or a mix richer in registered nurses (RNs) can help hospitals achieve the desired characteristics.

- Complications
  - Estimates of the overall direct costs of HACs to U.S. hospitals ranges from $28 billion to $45 billion per year[6]
  - Four studies, including a literature review of 28 additional studies, indicate that increases in nurse staffing can reduce HACs and that there is net benefit from increasing nurse staffing and reduced HACs[7,8,9,10]

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- Lower mortality
    - The overall mortality rate for hospital stays in the United States is 2.0 per every 100 inpatients[11]
    - One study finds that increasing the proportion of staff with a bachelor's degree in nursing by 10% leads to a 2% reduction in the odds of 30-day mortality[12]
- Lower readmission rates
    - Readmission rates for U.S. hospitals vary by condition and payer, from about one in five patients to nearly one in three patients[7]
    - One study found a 25% reduction in readmissions-related payment penalties in hospitals with optimized nursing staffing[7]
- Shorter LOS
    - The average LOS in U.S. hospitals is 4.5 days[8]
    - Multiple studies found a reduced length of stay associated with increased nursing levels. One study, in particular, found an average reduction of 4.64 days to about 4 days[9]
- Combined effects
    - Many studies have examined multiple outcomes associated with nursing levels and generally found positive effects associated with increased nurse staffing:
    - Several studies found net cost benefits across outcomes, ranging from a 1.5% decrease in hospital costs[13] to a 3.1% decrease in patient costs (from $11,141 to $10,793 per discharge)[14]
    - Net cost benefits are associated with a variety of factors, including improved outcomes and lower RN turnover. Cost benefits can vary, however, being dependent on multiple factors including market competition[15]

From the Cost Calculator

We present a simple quantitative tool that examines the financial impact of increasing nurse staffing levels. This tool will assist nursing and hospital management personnel to improve the four quality measures and decrease LOS outcomes. The methods used to develop the model are described in a prior section of this executive summary and will be described more extensively in the body of the paper and its appendices. To recap briefly, the model is driven by quantitative relationships between increased nursing levels and mix and improvement in the four quality measures and decreased LOS. Details on the linear regression-derived relationships and the associated methodology are described in **Appendix B**.

In most use cases the result will be that the savings realized by increasing nurse staffing hours or the proportion of RNs in the skill mix will exceed the costs effected from these tactics.

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Conclusions

The Business Case for Nurse Staffing

Increased nurse staffing is demonstrated in many cases to be a net cost-beneficial means to improve selected aspects of quality of care and decrease the length of time patients spend in acute care hospitals. Often, an increase in the ratio of RNs to other personnel in the care mix produces an even more beneficial effect than simply raising the overall number of hours of nursing care. Increasing the ratio of RNs to other nursing personnel may, in some instances, yield net cost benefits even without increasing the total number of hours of nursing care per patient. The ANA Staffing Cost Calculator Tool© (Cost Calculator) can be used as a simple means to explore the economic impact on the hospital of increasing nurse staffing or mix of nursing personnel. In conjunction with the Cost Calculator tool, institutions should develop tactical plans to deploy the additional nurses most effectively.

Limitations

The literature search and the Cost Calculator focus on nurse staffing increases as net cost-beneficial means to reduce selected HACs and lengths of time spent in acute care hospitals. While the assumption that the same principles can be applied to other settings, such as post-acute care, that hypothesis has not yet been tested.

The ANA Staffing Cost Calculator Tool© is a simple, "pilot" tool that does not include an exhaustive set of quality measures or other patient outcomes from nursing care. Many of the quantitative relationships that drive the model are taken from a large, real-world data set; this data source carries with it the power of describing acuity-reflective actual nursing practice and the drawbacks of inability to capture patterns of all nursing activity in every hospital in the United States—regardless of size, type, or other demographics. The Cost Calculator model treats achievement of quality increases or decrease in LOS as discrete events; the potential additional impact or interaction of other interventions or initiatives is not considered. Its financial projections are based on the simplified assumption that the hospital operates within a reimbursement system in which there is a positive financial impact from decreased LOS. We know this to be true in the majority of third-party payer systems. Furthermore, the Cost Calculator does not take into account the positive and negative effects of programs apart from "standard" reimbursement methods that reward or penalize hospitals financially for achievement or failure to achieve quality targets.

Additional research is needed to: 1) understand the cause and effect relationship between nursing care components and patient outcomes on an individual and interactive basis; and 2) determine the system-wide impact of findings in this paper and elsewhere with even greater accuracy.

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The Business Case for Higher Levels of Nurse Staffing in the Hospital Setting

Background and Rationale

The United States spends over $1 trillion in hospital care per year, with hospital expenditures comprising nearly a third (32.3%) of all healthcare expenditures.[16] Hospital expenditures are expected to grow at 5.5% per year between 2016 and 2025, faster than the expected growth rate of the gross domestic product over the same time period.[17] In many parts of the U.S. healthcare system, there is a desire to achieve greater value for the expenditures made, and stakeholders are actively putting systems into place to increase quality while decreasing cost (i.e., increasing value). For example, the Centers for Medicare & Medicaid Services (CMS) intends to link 90% of its payments to care quality by 2018, with half of its payments flowing through Alternative Payment Models.[18] This desire for greater value holds true within the hospital industry, which sees many of its payments tied to care quality metrics such as readmission rates.[19]

Readmission rates are only one portion of quality measurement. One organization, which has rated hospital performance for 24 years, has noted that the top performing hospitals share these characteristics in comparison to their peers:[20]

1. Fewer complications;
2. Lower mortality;
3. Lower readmission rates;
4. Shorter length of stay (LOS);
5. Higher score on patient ratings; and
6. Higher average operating margins.

An inference that can be made from the ratings is that the top performers are able to provide greater "value" to the system by delivering higher quality care at a lower cost than their peers— something desired in the U.S. healthcare system. Indeed, numerous public and private initiatives have been instituted to address the above-cited desired benchmarks that distinguish high performers from their peers. An overview of federal programs, including those using the quality indicators most pertinent to this paper, is provided in **Appendix A**. As integral members of patient care teams, nurses play a critical role in helping hospitals achieve high performance characteristics.

In a previous paper, the American Nurses Association (ANA) collaborated with Avalere Health to report on the association between nurse staffing levels and improvements in quality of care and patient outcomes.[b] The report found that a number of studies support the value of increasing nurse staffing as it relates to improved patient outcomes and quality of care. Nurse staffing was found to have a positive effect on such outcomes as hospital-acquired conditions (HACs), mortality, and hospital readmissions.

In this second paper, ANA and Avalere explore the business case for increasing nurse staffing to achieve not only improvements in the quality of care explored in the first paper, but also decreased LOS, and the net

[b]That paper, titled "Optimal Nurse Staffing to Improve Quality of Care and Patient Outcomes," is available at: http://www.nursingworld.org/Avalere-WhitePaper-on-NurseStaffing.

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financial impact of both on hospital budgets. Further, we present a simple quantitative tool to assist nursing personnel in working with hospital management to examine the financial impact of increasing nurse staffing levels in order to improve four quality measures and decrease LOS. In most cases, the model will show a positive net financial benefit to the hospital from such actions.

Methods

Avalere re-examined the findings made in the first paper and the supporting literature, focusing on building a quantitative base on which to model the financial impact of changes in nurse staffing. We conducted a targeted (supplemental) review of peer-reviewed literature, government reports, and other publicly available evaluations of nurse staffing and patient outcomes published between 2000 and 2016.

Avalere developed a simple, Microsoft® Excel (2013)-based cost calculator to measure the impact on hospital budgets of reductions in five nursing-sensitive quality indicators through adjustments to nurse staffing. Three major phases of work were completed to build the model. The first phase was to develop quantitative relationships between nursing levels and four of the five quality indicators. These indicators were derived from an analysis of available information in a nationally representative sample of hospitals that contributed information to the Press Ganey National Database of Nursing Quality Indicators® (NDNQI) database during the first quarter of 2016. The four quality measures assessed were rates per 1,000 patient days of: falls, catheter-associated urinary tract infections (CAUTI), central line-associated bloodstream infections (CLABSI), and ventilator-associated pneumonia (VAP). A detailed description of the quantitative methods used to build the model can be found in **Appendix B**.

The second phase was to develop quantitative relationships between increasing nursing care hours and the fifth performance indicator, decreasing LOS, using data points from the literature. The two initial phases of work provided the base information for the third phase, consisting of construction of a customizable model that shows in net dollar terms the impact of increased number and type of nurse staffing hours on all five of the quality and outcome measures cited above.

In order to validate our findings, Avalere consulted with a group of key opinion leaders, hospital administrators, nurse managers, and technical experts to provide critique and additional insight.

Key Findings from the Literature Search

Complications

HACs are medical conditions or complications that a patient develops during a hospital stay.[21] Examples of HACs include patient falls (with or without injury), pressure ulcers, CAUTI, CLABSI, and VAP. HACs, some of which qualify as “never events,” are unambiguous and largely, if not entirely, preventable events that occur during care management or as a result of failure to follow care protocols; they apply to all settings of care.[22]

Detail on the incidence of HACs cited above and their costs can be found in **Appendix C**; below are aggregate numbers. Between 2010 and 2013, there were an estimated 121 HACs per 1,000 acute care hospital discharges. This translates to roughly 10% of inpatient stays resulting in at least one HAC.[23,24] Costs associated with HACs have a considerable financial impact on the healthcare system. The overall direct costs of HACs to U.S. hospitals range from $28 billion to $45 billion per year.[25] When indirect costs, such as patients’ loss of productivity, are taken into account, the financial impact increases sharply to between $96 billion and $147 billion annually.[26]

Recent evidence supports the role of nursing in the prevention of HACs and the promotion of higher quality care. For example, systematic nurse surveillance is a critical aspect of patient safety leading to the

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prevention of medication errors, rescue situations, patient deterioration, and death.[27] Less exhaustion and the ability to perform tasks completely were cited as possible reasons for the link between higher staffing rates and fewer HACs. A summary of recent evidence demonstrating that an increase in nurse staffing reduces the rate of HACs is presented below.

Impact of Increased Nurse Staffing on HACs

Finding	Supporting Evidence
Higher nurse staffing levels have been shown to decrease avoidable HACs.	• A systematic review by Kane et al. reported increases in nurse staffing were associated with **decreased patient odds of experiencing cardiac arrests in the ICU (28%), pneumonia (30%), unplanned extubation (51%), and respiratory failure (60%)** ○ In addition, increased nurse staffing was associated with a **24%-31% reduction in patient LOS**.[28] • A 2013 retrospective nested-case control study reported increased nurse monitoring and nursing hours were associated with a **73% decrease in the probability of adverse outcomes such as upper airway complications, respiratory depression, and infections**.[29] • Survey data of 7,076 registered nurses (RNs) showed that a 30% reduction in nurse burnout resulted in **6,239 fewer reported surgical infections**, for an annual **cost saving of more than $69 million**.[30] • A study using 2004 NDNQI showed Magnet[c] hospitals report 5**% lower rates of patient falls** versus non-Magnet hospitals, with an additional RN hour per patient day **reducing fall rates by 3%**.[31]

Mortality, Lower Readmission Rates, Length of Stay, and Cost-Effectiveness

Other nursing-sensitive indicators such as mortality, readmission rates, and LOS have often been studied in association with HACs, but are also foci of separate studies. Many of these studies are linked to the economic impact of achievement of their reduction.

Results include a 25% reduction in readmissions-related payment penalties associated with higher nurse staffing levels;[32] a reduction in the odds of 30-day mortality associated with a 10% nurse staffing increase;[33] and reduced length of stay associated with nursing levels.[13] Importantly, additional studies find decreased costs associated with these care quality improvements. Two studies found reductions of 1.5% in hospital expenditures and 3.1% in patient care costs (from $11,141 to $10,793 per discharge), respectively.[10,11] These savings are net based on increased cost of staff and proportionally larger decrease in care costs.

[c] Magnet status is an award given by the American Nurses' Credentialing Center (ANCC), an affiliate of the American Nurses Association, to hospitals that satisfy a set of criteria designed to measure the strength and quality of their nursing. More information on this program is available at: www.truthaboutnursing.org/faq/magnet.html.

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Avalere's targeted review of the literature from 2000 to 2016 identified a number of recent studies that report an association between increased nurse staffing levels and the reduction of health resource use and cost.

Impact of Increased Nurse Staffing On Mortality, Lower Readmission Rates, Length of Stay, and Cost-Effectiveness

Finding	Supporting Evidence
Higher RN staffing levels are often associated with a reduction in hospital LOS	• A database analysis of the CMS Hospital Readmissions Reduction Program (HRRP) Supplemental Data reported hospitals with higher nurse staffing had **25% lower odds of being penalized** for Medicare beneficiary readmissions associated with heart failure, myocardial infarction, or pneumonia.[32] • Kelly et al. concluded a 10% increase in nurses with bachelor's degrees in nursing resulted in a **2% reduction in the odds of 30-day mortality** for mechanically ventilated Medicare patients.[33] • A 2009 literature review study reported increases in nurse staffing levels (defined as nurse hours per patient day) was associated with **decreases in patient risk of nosocomial complications (e.g., urinary tract infections, pneumonia, sepsis) and hospital LOS**.[34] • Kapu et al. reported adding nurse practitioners to an inpatient care team resulted in **reduced LOS** (4.64 days in the ICU compared with 4.04 days) and **lower total hospital charges** ($106,162 average hospital trauma unit charges per case compared with $97,306 hospital charges per case).[9]
Higher RN staffing levels are often associated with a reduction in hospital costs	• Needleman et al. retrospectively analyzed data from 799 nonfederal acute care general hospitals and found a **1.5% reduction in hospital expenditures** when the proportion of RN hours were increased without changing total licensed hours.[10] • Martsolf et al. reported increases in the number of RNs and LPNs per 1,000 inpatient days led to reductions in both nurse-sensitive adverse events and LOS, resulting in a **3.1% decrease in patient care costs**.[11] • Everhart et al. evaluated the financial effectiveness of nurse staffing on Florida-based acute care hospitals and found **a higher ratio of RNs per inpatient day was associated with increases in total hospital profit margin**.[15] • Needleman's 2008 review of recent publications evaluating nurse impact on patient outcomes reported **increasing the proportion of RNs was associated with net cost savings** through improved quality and fewer deaths.[35] • A retrospective cross-sectional study examining the relationship between nursing skill mix/hours per patient day and inpatient care costs per hospital admission reported **increases in RN skill mix and total nursing hours were not associated with increases in costs for surgical admissions**.[36]

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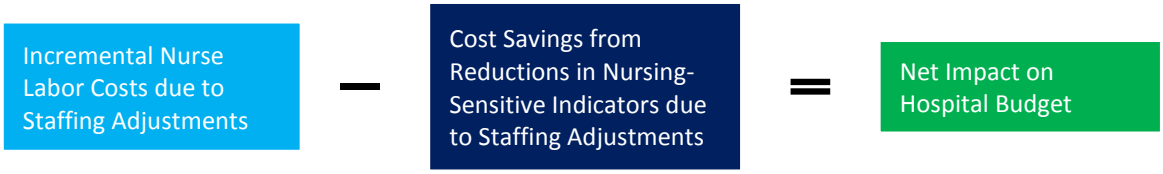
Development and Use of the Cost Calculator

Overview

A number of planning tools exist to assist hospital administrators and nursing managers in tracking and predicting nurse staffing needs based on patient acuity and available resources.[37,38,39] However, these tools generally do not account for cost offsets that may be achieved from reducing nursing-sensitive events through increased nurse staffing. To help bridge this gap, ANA commissioned Avalere Health to develop a Microsoft® Excel (2013)-based cost calculator for use by hospital-based nursing leaders, clinicians, and administrators to evaluate the business case for increased nurse staffing. The ANA Staffing Cost Calculator Tool© incorporates changes in annual nurse labor costs in relation to the annual costs of nursing-sensitive events attributable to staffing adjustments and calculates the net budgetary impact at the hospital unit level. The pilot version of the tool, described for the first time in this paper, provides budget impact calculations for five types of hospital units: adult critical care; adult step down; adult medical; adult surgical; and pediatric medical and surgical, combined. Five types of nursing-sensitive events are considered in the tool, including patient falls, CAUTI, CLABSI, VAP, and hospital LOS. The intent of the tool is for it to be used on a standalone basis to support nursing management conversations involving changes in nurse staffing, or coupled with a tactical plan for deploying additional nurse staffing resources in a manner that results in better patient outcomes and decreased net institutional costs.

A conceptual framework of the ANA Staffing Cost Calculator Tool© (Cost Calculator) is presented in **Figure 1** below. This framework was developed in consultation with a group of hospital-based nursing experts, nursing researchers, Press Ganey, Avalere Health, and ANA. ANA will initially pilot test the tool with a small number of community and academic medical centers. The tool was reviewed and validated by external researchers.

Figure 1: Conceptual Framework of the Cost Calculator



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Structure

The ANA Staffing Cost Calculator Tool© is contained in a Microsoft® Excel (2013) workbook containing nine worksheets: five available to the user and four housing background calculations.

Worksheets within Cost Calculator Workbook								
Available to the User					Background Calculation Area			
Tab 1	**Tab 2**	**Tab 3**	**Tab 4**	**Tab 5**	**Tab 6**	**Tab 7**	**Tab 8**	**Tab 9**
Cover Page	User Guide	Inputs 1: Baseline Hospital and Inpatient Unit Data	Inputs 2: Changes to Nursing Hours per Patient Day and Skill Mix	Results – Budget Impact	Budget Impact Calculations	Avoided Hospital Days Calculations	Default Data	Summary Statistics
	Overview Navigation User Inputs Data Sources Abbreviations	Hospital Characteristics	Relationships Between Nursing Hours and Nursing-Sensitive Indicators	Annual Budget Impact – Total				
		Unit Type and Patient Volume	Reductions in HAC Event Rates and All- Cause Hospital Days Due to Changes in Nurse Staffing	Annual Budget Impact – Detail on Nursing Costs				
		Current Nursing Care Hours per Patient Day and Nursing Skill Mix	Additional Modeling Assumptions (Costs of Nursing-Sensitive Outcomes and Nursing Labor per Hour)	Annual Budget Impact – Detail on Hospital Day Costs				
		Current HAC Event Rates		Annual Budget Impact – Detail on HAC Event Costs				

As the titles would imply, Worksheets 1 and 2 are a cover page and user guide (which will not be described here). Worksheets 6-9 comprise the background calculation area for the cost calculator. The methods used to produce information in these worksheets will be described in **Appendix B.**

Tab 3: Inputs 1: Baseline Hospital and Inpatient Unit Data

This worksheet has 4 areas for the user to input the data that forms the baseline for the calculations that drive the Cost Calculator. These include: 1) hospital characteristics, 2) unit type and patient volume, 3) current nursing care hours per patient day and nursing skill mix, and 4) current HAC event rates. As in most aspects of the Cost Calculator, users have the ability to either: 1) make custom inputs of actual data from their institutions or 2) apply the "suggested" values for these inputs, if their hospital unit's data are unavailable. The suggested values are mean values for nursing units grouped by type and hospital characteristics taken from an analysis of 2016 Q1 data from the NDNQI.

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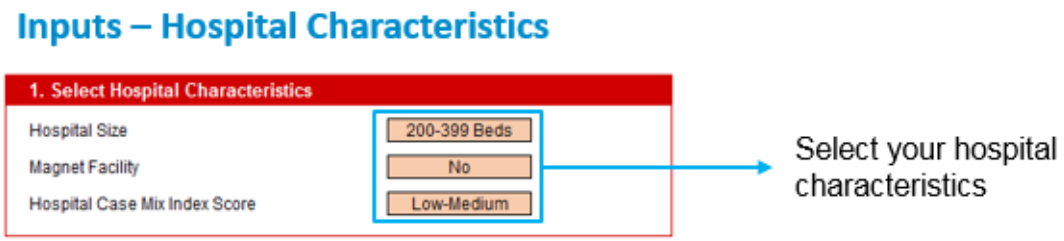
Hospital Characteristics

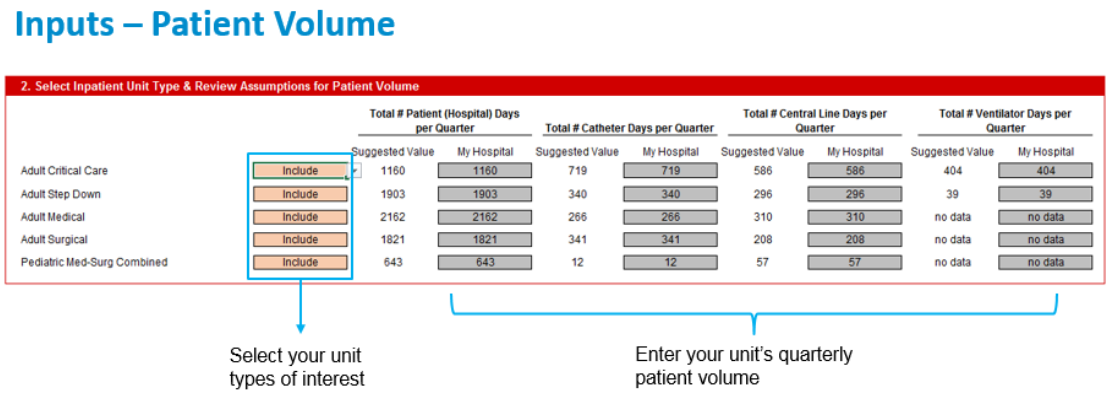
The first module of this worksheet allows users to choose the hospital characteristics using the drop-down box menus. Users can characterize their hospital with respect to bed size (<200, 200-399, >400 beds), Magnet affiliation (yes/no), and case mix index (CMI) (low/medium versus high) and can select the unit types of interest. High CMI includes hospitals with a value at least one standard deviation above the national average, while low/medium CMI includes the remaining hospitals that contribute data to NDNQI (national averages calculated within NDNQI).



Unit Type and Patient Volume

The units captured in the Cost Calculator include: adult critical care; adult step down; adult medical; adult surgical; and pediatric medical and surgical, combined. Note that the units were limited to those for which sufficiently robust data were reported in the NDNQI in Q1 2016 and are not all-inclusive.

Basic information on patient volume in the user's hospital will be entered into this module. Specifically, quarterly patient days, catheter days, central line days, and ventilator days all need to be entered by the user in this area. The quarterly day information is needed for converting nurse staffing levels into annual total numbers of RN hours, licensed vocational nurse/licensed practical nurse (LVN/LPN) hours, and unlicensed assistive personnel (UAP) hours and HAC event rates into annual total number of HAC events. These data form the baseline for the comparisons that will be made after nurse staffing has been altered.



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Current Nursing Care Hours per Patient Day and Skill Mix

Two components of current nursing staffing level are captured in the Cost Calculator, including: 1) total nursing care hours per patient day; and 2) skill mix, as defined as the percent of patient care hours delivered by RNs, LVN/LPNs, and UAPs. Note: both employee and contract hours are considered. Also, the patient care hours delivered by RNs, LVN/LPNs, and UAPs constitute the total nursing care hours per patient day.

Inputs – Current Nurse Staffing Level

3. Review Assumptions for Current Nursing Care Hours per Patient Day and Skill Mix, by Inpatient Unit

	Total Nursing Care Hours per Patient Day		% RN Care Hours to Total Nursing Care Hours		% LVN/LPN Care Hours to Total Nursing Care Hours		% UAP Care Hours to Total Nursing Care Hours	
	Suggested Value	My Hospital	Suggested Value	My Hospital	Suggested Value	My Hospital	Suggested Value	My Hospital
Adult Critical Care	16.2	16.2	90.6%	90.6%	0.1%	0.1%	9.3%	9.3%
Adult Step Down	10.1	10.1	75.0%	75.0%	1.1%	1.1%	23.9%	23.9%
Adult Medical	8.4	8.4	67.5%	67.5%	1.8%	1.8%	30.7%	30.7%
Adult Surgical	8.7	8.7	68.4%	68.4%	2.0%	2.0%	29.6%	29.6%
Pediatric Med-Surg Combined	13.2	13.2	86.3%	86.3%	1.9%	1.9%	11.8%	11.8%

Enter your unit's total nursing care hours

Enter your unit's nurse skill mix data

Current Hospital Acquired Condition Event Rates

In the last module, the Inputs 1 worksheet unit-level data are collected on current rates of HAC events (i.e., patient falls per 1,000 patient days, CAUTI per 1,000 catheter days, CLABSI per 1,000 central line days, and VAP per 1,000 ventilator days).

Inputs – Current HAC Event Rates

4. Review Assumptions for Current HAC Event Rates, by Inpatient Unit

	Falls per 1,000 Patient Days		CAUTI per 1,000 Catheter Days		CLABSI per 1,000 Central Line Days		VAP per 1,000 Ventilator Days	
	Suggested Value	My Hospital	Suggested Value	My Hospital	Suggested Value	My Hospital	Suggested Value	My Hospital
Adult Critical Care	1.26	1.26	1.13	1.13	0.84	0.84	5.54	5.54
Adult Step Down	3.05	3.05	1.16	1.16	0.76	0.76	0.11	0.11
Adult Medical	3.07	3.07	0.74	0.74	3.11	3.11	no data	no data
Adult Surgical	2.77	2.77	1.63	1.63	0.53	0.53	no data	no data
Pediatric Med-Surg Combined	1.30	1.30	0.00	0.00	0.16	0.16	no data	no data

Enter your unit's rate of falls

Enter your unit's rate of catheter-associated urinary tract infections

Enter your unit's rate of central line –associated bloodstream infections

Enter your unit's rate of ventilator associated pneumonia

Tab 4: Inputs 2: Changes to Nursing Care Hours per Patient Day and Skill Mix

This worksheet has three areas for the user to input the data that drive the estimation of changes in annual costs of nurse labor and HAC events, a day of hospital care, and the net budget impact. These include: 1) estimated relationships between nurse staffing and nursing-sensitive indicators; 2) reductions in HAC event rates and all-cause hospital days due to changes in nurse staffing; and 3) assumptions for nurse labor rates and incremental costs for the nursing-sensitive outcomes.

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Relationships between Nursing Care Hours and Nursing-Sensitive Indicators

The first area in the "Inputs 2" worksheet intakes data with respect to the incremental effects of increasing total nursing care hours by one hour per patient day (total care hours) and raising percent RN care hours by 10% (skill mix). The user can select low, moderate, or high impact level for each of the five nursing-sensitive indicators (patient falls per 1,000 patient days, CAUTI per 1,000 catheter days, CLABSI per 1,000 central line days, VAP per 1,000 ventilator days, and hospital LOS). The methodology for determining the low, moderate, and high impact levels is presented in **Appendix B**. Note: beta testing of the Cost Calculator indicated that users may not have at their disposal the data to enable custom inputs in this section or gauge the nature of available information (and possible changes) relative to values for all comparable hospital units. After different "simplification" options were tried, the low/moderate/high option shown in the model was developed for ease of use.

Inputs – Estimated Relationship between Staffing and Nursing-Sensitive Indicators

1. Estimated Relationships between Nurse Staffing and Nursing Sensitive Indicators

	Increasing Total Nursing Care Hours by One Hour per Patient Day		Increasing % RN Hours by 10%	
	Estimated Impact	Impact Level	Estimated Impact	Impact Level
Falls per 1,000 Patient Days	-0.009	Moderate	-0.039	Moderate
CAUTI per 1,000 Catheter Days	-0.035	Moderate	0.000	Moderate
CLABSI per 1,000 Central Line Days	-0.058	Moderate	-0.091	Moderate
VAP per 1,000 Ventilator Days	0.000	Moderate	-0.175	Moderate
All Cause Hospital Days	-2.0%	Moderate	-2.7%	Moderate

Examples: 1) increasing total nursing care hours by 1 hour per patient day is expected to reduce 0.078 falls per 1,000 patient days and reduce all cause hospital days by 2%.
2) increasing % RN hours by 10% is expected to reduce all-cause hospital days by 2.7%

Select impact level for increasing nursing care hours by one hour per patient day

Select impact level for increasing % RN care hours by 10%

Reductions in Hospital-Acquired Condition Event Rates and All-Cause Hospital Days Due to Changes in Nurse Staffing

This module consists of two parts: 1) staffing adjustments; and 2) estimated reductions in HAC event rates and all-cause hospital days.

In the first part, users may adjust total number of nursing care hours per patient day (total amount of nursing care) and/or the percent of RN care hours (skill mix) for each unit type of interest. The changes in total number of nursing care hours per patient day are proportionally distributed across RN, LVN/LPN, and UAP care hours. Changes in percent RN hours are proportionally absorbed by changes in percent LVN/LPN and percent UAP hours so that a total of 100% hours always results. For example, if the skill mix is 60% RN care, 20% LVN/LPN care, and 20% UAP care, one hour increase in total nursing care hours per patient day is distributed as a 36-minute increase in RN hours and a 12-minute increase for both LVN/LPN and UAP hours. Given the same baseline skill mix, for a 10% increase in percent RN care hours, the Cost Calculator would assume an equal 5% reduction in both percent LVN/LPN hours and percent UAP hours (in this example, adjusted skill mix is 70%, 15%, and 15%, respectively).

Combined with the impact levels selected in the previous module, the user's input of staffing adjustments drives the estimation of reductions in HAC event rates and all-cause hospital LOS. The estimated reductions are displayed in the second part of this module for the user to review before proceeding to next module.

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Inputs – Reductions in HAC Event Rates and All-Cause Hospital Days Due to Changes in Nurse Staffing

2. Estimated Reductions in HAC Event Rates and All Cause Hospital Days Due to Changes in Nurse Staffing

a. Adjustments to Current Nursing Care Hours and Skill Mix

	Proposed Adjustment to Total Nursing Care Hours per Patient Day (Should Not Exceed 100%)			Proposed Adjustment to % RN Care Hours to Total Nursing Care Hours (Should Not Exceed 100%)		
	Suggested Value	My Adjustment	After Adjustment	Suggested Value	My Adjustment	After Adjustment
Adult Critical Care	1	1	17.2	5%	5.0%	95.6%
Adult Step Down	1	1	11.1	5%	5.0%	80.0%
Adult Medical	1	1	9.4	5%	5.0%	72.5%
Adult Surgical	1	1	9.7	5%	5.0%	73.4%
Pediatric Med-Surg	1	1	14.2	5%	5.0%	91.3%

Staffing Adjustments

b. Estimated Total Reductions on Nursing Sensitive Indicators, by Inpatient Unit

	Falls per 1,000 Patient Days	CAUTI per 1,000 Catheter	CLABSI per 1,000 Central Line Days	VAP per 1,000 Ventilator	All Cause Hospital Days
Adult Critical Care	-0.029	-0.035	-0.104	-0.088	-3.4%
Adult Step Down	-0.029	-0.035	-0.104	-0.088	-3.4%
Adult Medical	-0.029	-0.035	-0.104	NA	-3.4%
Adult Surgical	-0.029	-0.035	-0.104	NA	-3.4%
Pediatric Med-Surg	-0.029	0.000	-0.104	NA	-3.4%

Additional Modeling Assumptions: Costs of Nursing-Sensitive Outcomes and Nursing Labor per Hour

The suggested values for hourly costs of nurse labor[40] and costs of nursing-sensitive events[41,42] are obtained from published sources, with citations shown in the Cost Calculator and elsewhere in this paper for reference. Users may tailor these inputs based on the actual costs applicable to their hospitals.

Inputs – Additional Modeling Assumptions

3. Review Additional Modeling Assumptions

a. Review Assumptions for Incremental Cost of Nursing Sensitive Outcomes

	Suggested Value	My Hospital
Falls	$7,234	$7,234
CAUTI	$1,000	$1,000
CLABSI	$17,000	$17,000
VAP	$21,000	$21,000
All Cause Hospital Day	$2,311	$2,311

Reference

1. National Scorecard on Rates of Hospital-Acquired Conditions 2010 to 2015: Interim Data From National Efforts To Make Health Care Safer. Agency for Healthcare Research and Quality. Accessible at https://www.ahrq.gov/professionals/quality-patient-safety/pfp/2015-interim.html. 2. Overview of Hospital Stays in the United States, 2012. Accessible at https://www.hcup-us.ahrq.gov/reports/statbriefs/sb180-Hospitalizations-United-States-2012.pdf

Note: The cost represents incremental difference in Medicare program cost due to the HAC.

Costs of HAC Events

b. Review Assumptions for Nursing Labor Rates per Hour

	Suggested Value	My Hospital
RN	$34.14	$34.14
LVN/LPN	$21.17	$21.17
UAP	$12.89	$12.89

Reference

Bureau of Labor Statistics. National Occupational Employment and Wage Estimates, May 2015. https://www.bls.gov/oes/current/oes_nat.htm

Costs of nurse labor

Tab 5: Results—Budget Impact

Once the user inputs are applied, the Cost Calculator employs three computations to estimate the net budget impact for the hospital unit of interest, including:

1) Calculating annual costs of nurse labor and nursing-sensitive events under the hospital unit's current nurse staffing level, patient volume, and HAC event rates;

2) Estimating the expected annual costs of nurse labor and nursing-sensitive events for the hospital unit, under the adjusted nurse staffing scenario; and

3) Calculating the net budget impact, which equates to the difference in the annual costs of nurse labor and nursing-sensitive events between the current and adjusted staffing scenarios.

Other cost components of hospital budget are assumed to be unaffected by the staffing adjustments.

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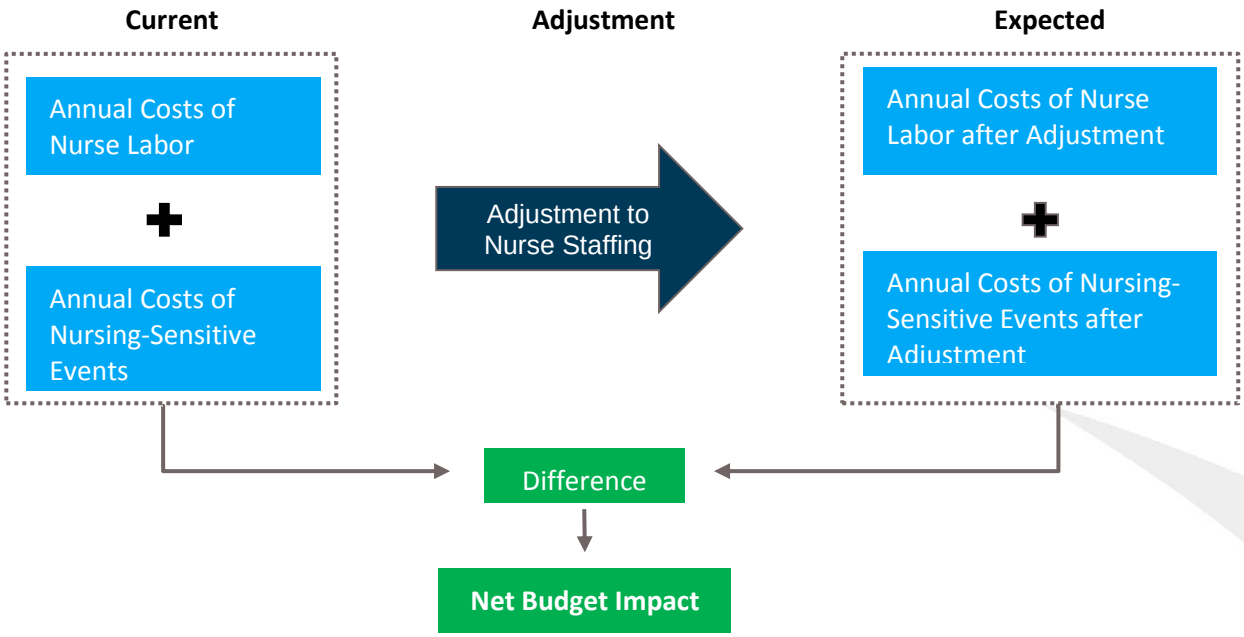
Figure 2 below is a schematic representation of how the calculations are made.

Figure 2: Methodology for Estimating Net Budgetary Impact of Nurse Staffing Adjustments



Annual Budget Impact Total

In the "Outputs" worksheet, the net annual budget impact, resulting from nursing adjustments, is presented for each unit type of interest. Displayed below is the breakdown of changes in annual costs of total nurse labor, HAC events, and all-cause hospital days.

Outputs – Budget Impact

Estimated Annual Budget Impact to my Hospital for Units of Interest

	Sample Size[1]	Change in Annual Total Nurse Labor Costs	Change in Annual Total HAC Event Cost	Change in Costs of Hospital Days	Estimated Budget Impact [2]
Adult Critical Care	424	$233,330	($24,695)	($354,713)	($146,078)
Adult Step Down	320	$308,553	($16,512)	($581,909)	($289,869)
Adult Medical	420	$321,535	($17,592)	($661,196)	($357,253)
Adult Surgical	278	$274,518	($13,539)	($557,030)	($296,051)
Ped Med-Surg Combined	74	$117,347	($3,431)	($196,564)	($82,648)

1 Sample size indicates number of U.S. hospital units contributing baseline staffing and HAC event rate data. 2 Negative budget impact represents cost savings.

Change in nurse labor costs — Cost savings from reduction in HAC events — Cost savings from reduction in LOS = **Net budget impact**

Annual Budget Impact—Detail on Nursing Costs

Details on annual total nursing care hours and associated total costs are provided for both the current nurse staffing and adjusted staffing scenarios.

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Annual Nurse Labor Costs

Estimated Annual Nursing Care Costs for Units of Interest				
	Annual Total Nursing Care Hours		Annual Total Nurse Labor Costs	
	Current	After Adjustment	Current	After Adjustment
Adult Critical Care	75,094	79,734	$2,414,041	$2,647,371
Adult Step Down	77,076	84,687	$2,228,750	$2,537,303
Adult Medical	72,860	81,508	$1,994,930	$2,316,465
Adult Surgical	63,699	70,984	$1,757,414	$2,031,932
Ped Med-Surg Combined	33,950	36,521	$1,065,324	$1,182,671

Annual Budget Impact—Detail on Hospital Day Costs

Details on annual total all-cause hospital days and associated total costs are provided for both the current nurse staffing and adjusted staffing scenarios.

Annual Costs of All-Cause Hospital Days

Estimated Annual Costs for Hospital Days for Units of Interest				
	Annual Total Hospital Days		Annual Total Costs for	
	Current	After Adjustment	Current	After Adjustment
Adult Critical Care	4639	4484	$ 10,721,527	$ 10,362,356
Adult Step Down	7611	7356	$ 17,588,751	$ 16,999,528
Adult Medical	8647	8358	$ 19,985,258	$ 19,315,752
Adult Surgical	7285	7041	$ 16,836,741	$ 16,272,711
Ped Med-Surg Combined	2571	2485	$ 5,941,328	$ 5,742,294

Annual Budget Impact—Detail on HAC Event Costs

For each type of HAC event, details on annual total costs are presented for both the current nurse staffing and adjusted staffing scenarios. Additionally, the costs of the four individual types of HAC events are summed up to provide the annual total HAC event costs.

Annual HAC Event Costs

Estimated Annual HAC Event Costs for Units of Interest										
	Annual Cost - Falls with Injury		Annual Cost - CAUTI		Annual Cost - CLABSI		Annual Cost - VAP		Annual HAC Event Costs	
	Current	After Adjustment	Current	After Adjustment	Current	After Adjustment	Current	After Adjustment	Current	After Adjustment
Adult Critical Care	$42,351	$41,395	$3,263	$3,162	$33,437	$29,317	$188,030	$185,061	$267,081	$258,934
Adult Step Down	$168,093	$166,524	$1,584	$1,536	$15,229	$13,145	$356	$69	$185,262	$181,274
Adult Medical	$192,343	$190,560	$792	$755	$65,680	$63,497	NA	NA	$258,815	$254,812
Adult Surgical	$145,757	$144,255	$2,219	$2,171	$7,555	$6,092	NA	NA	$155,530	$152,517
Ped Med-Surg Combined	$24,118	$23,588	$0	$0	$622	$222	NA	NA	$24,741	$23,811

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Case Study

The use of the Cost Calculator is perhaps best explained by showing its application in a real-life case study, such as the one shown below. Additional case studies can be found in **Appendix D**.

Case 1: Hospital with "Excess" Length of Stay for Joint Replacement

Hospital Description	250-bed community, non-Magnet hospital, with a low-to-moderate case mix
Challenge	• Despite other efforts, LOS remained 10% higher than desirable on 6 South, a dedicated knee joint replacement unit • The hospital had already increased the nursing care hours per patient day on this unit to 9.7 (above average), but the LOS problem was not solved • LOS was a concern because of Medicare and private payer bundled payment systems for this type of surgery • Nursing wanted to add more nurse hours and increase the proportion of RNs to other nursing personnel because of pressing patient need to start in-hospital rehabilitation and prepare for discharge • Hospital administrators were convinced that adding more nurse staffing would increase cost without consequent benefit

Nursing Solution Using the ANA Staffing Cost Calculator Tool®	• The Cost Calculator helped nursing make the argument:
	  ○ Nurse staffing increases will cost the hospital ~$309,000
	  ○ Hospital saves ~$626,000 because of a 5.3% decrease in LOS and a decrease in HAC rates
	  ○ Net financial benefit to the hospital will be a ~ $317,000 decrease in costs
	• The Unit 6 South nursing leadership supported its staffing request with an enhanced care protocol for patients on the unit, stressing activities needed to discharge patients "on schedule," and received approval for the request

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Case 1: Surgical Unit with Long Length of Stay for Joint Replacement

BASELINE		Beds	Magnet Hospital	Case Mix Index	
	Hospital Base Characteristics	200-399	No	Low-Medium	
		"Suggested" (Mean) Patient Days	Actual at Baseline		
	Adult Surgical Unit	1,821	2,000 (+10%) (1 Q)		
CHANGE		Hours per Pt. Day-Actual at Baseline	Hours per Pt. Day-With Change	Enriched RN Mix-Baseline	Enriched RN Mix-With Change
	Increase in Nurse Staffing	9.7	10.7	68.4%	74.7%
		Baseline	With Change		
	Hospital Days	See above	-5.3%		
IMPACT		Baseline	With Change		
	Patient Days (Annual)	8,000	7,735 – Know that they will have work to do		
		Nurse Staffing Increase	HAC Decrease	Patient Days	Overall
	Cost Changes	+$309,380	-$14,320	-$611,690	-$316,629

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Conclusion

The U.S. healthcare system's increased focus on value is driving the need to adopt nurse staffing practices that optimize patient outcomes and reduce cost. Since the implementation of the Affordable Care Act (ACA) in 2010, CMS has established a number of programs that reward hospitals for meeting certain quality, performance, and cost metrics. Staffing models in which the number of nurses and/or the nurse-to-patient ratio can be adjusted in real time will be essential to achieving the outcomes needed to succeed in this value-based healthcare system. An examination of leading quality and value indicators and their economic impact on the U.S. healthcare system sets the stage for this conclusion.

Today, over 32% of $1 trillion in U.S. healthcare expenditures is spent on patient hospitalizations. As can be seen below, poor performance costs the system billions of dollars and, more importantly, causes tens of thousands of unnecessary deaths. A marginal (1%) increase in quality on any leading indicator has the potential to save multiple billions of dollars and thousands of lives.

Economic Impact of Quality/Value Improvement

Hospital Quality/Value Metrics	Base Impact on U.S. Healthcare System	Savings from a 1% Improvement	Included in the Cost Calculator
Hospital-Acquired Conditions (HACs)	$28-$45 billion[43]	$2.8-$4.5 billion	✓
All-Cause Hospital Mortality	700,000 lives[44]	7,000 lives	
Cost of Readmissions	$41-$58 billion[45,46]	$4.1-$5.8 billion	
All-Hospital per Day Costs	$71-$72 billion[47]	$7.1-$7.2 billion	✓

Research cited throughout this paper shows all of the metrics above to be sensitive to nurse staffing. In many studies, the impact of nurse staffing has shown positive results well beyond a single percentage point — or potentially multiple times the system-wide savings shown in the chart.

The ANA Staffing Cost Calculator Tool© presented in this paper builds on methods from prior nursing studies and uses current real-world data to translate research into a practical use. The Cost Calculator is a simple tool taken from the largest real-world national database on nursing-sensitive indicators available today. It analyzes the net economic impact to a hospital of increased nurse staffing on two of the leading indicators above: HACs (four types) and hospital days. Even in its inclusion of selected quality/value indicators, use of the Cost Calculator in live hospital situations showed there to be a net economic benefit to the hospital of increasing either the absolute and/or relative number of RNs in the staffing mix. Put simply, the financial as well as clinical benefits to the hospitals exceeded the cost of employing the extra nurses. Currently in the pilot stage, the ANA Staffing Cost Calculator Tool© will be refined over time and made available to assist with nurse staffing decisions. The hope is to one day expand and refine it to quantify the impact of increased nurse staffing on a broader array of quality/value metrics.

As our healthcare system continues to implement programs that reward medical institutions for achieving quality, performance, and cost measures, it is essential that hospitals adopt nurse staffing models that promote high-quality, efficient care. It is our hope that the Cost Calculator will be a useful tool to assist nursing leaders, clinicians, and administrators in that adoption process.

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Limitations

The literature search and the ANA Staffing Cost Calculator Tool© focus on nurse staffing increases as a net cost-beneficial means of reducing selected HACs and length of time spent in acute care hospitals. While the assumption is that the same principles can be applied to other settings, such as post-acute care, the hypothesis has yet to be tested.

While a number of studies report on the association between nurse staffing and improved patient outcomes, there are challenges in quantifying the cost savings. Nursing care is not recorded on an activity-specific basis (like that of physicians for billing purposes); therefore, there are challenges in relating specific nursing inputs to patient outcomes. Measuring patient outcomes is also challenging because of the multiple factors apart from nursing care that contribute to these outcomes. Given this reality, surrogate or indirect measures such as patient falls and incidence of pressure ulcers have been used to understand the impact of nursing's contribution.

Measuring the cost-effectiveness of nursing care and varying nurse staffing levels is a complex exercise, and there are few practical estimates that show the cost-effectiveness of optimal staffing. The current published evidence on the cost-effectiveness of nursing care is commonly modeled at the hospital budget level and does not address the variation across hospital unit types. The algorithms may not be approachable for nurse leaders trying to understand and, more importantly, use information on the cost of adverse outcomes that arise from inadequate nurse staffing on individual hospital units. Thus, user-friendly tools such as the ANA Staffing Cost Calculator Tool© that compare variable nurse staffing levels and differences in patient outcomes and budgetary implications may provide tangible evidence that can be used to facilitate staffing discussion with health system administrators.

The Cost Calculator is a simple, "pilot" tool that does not include an exhaustive set of quality measures or other patient outcomes from nursing care. Many of the quantitative relationships that drive the model are taken from a large, real-world data set—something that carries with it the power of describing acuity-reflective actual nursing practice and the drawbacks of inability to capture patterns of all nursing activity in every hospital in the United States, regardless of size, type, or other demographics. The model treats achievement of quality increases or length of stay decreases as discrete events where effect overlap or interaction is not considered. The model's financial projections are based on the simplified assumption that the hospital operates within a reimbursement system in which there is a positive financial impact from decreased LOS, which we know to be true of the majority although not all payer systems. Furthermore, the Cost Calculator does not take into account the positive and negative effects of programs, apart from "standard" reimbursement, that reward or penalize hospitals financially for achievement or failure to achieve quality targets.

To conclude, increased nurse staffing is associated with reductions in cost and HACs. Additional research is needed to: 1) understand the cause and effect relationship between nursing care components and patient outcomes on an individual and interactive basis; and 2) determine the system-wide impact of findings in this paper and elsewhere with even greater accuracy.

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Appendices

Appendix A

Federal Programs Providing Incentives to Improve Quality

Efforts to Reduce Hospital-Acquired Conditions/Hospital-Acquired Infections (HACs/HAIs)

Several quality-driven programs have been established to help control the incidence and costs associated with HACs/HAIs, many of which incorporate financial incentives or penalties. Four such programs are summarized here, in part because the quality measures within them include various HACs/HAIs used in the ANA Staffing Cost Calculator Tool®, i.e., those available in the National Database of Nursing Quality Indicators® (NDNQI).

Program	Information

Hospital Inpatient Quality Reporting (IQR) Program	• Established in 2003
	• Program pays a higher annual payment update to hospitals that successfully report designated quality measures
	• Hospitals that fail to meet quality-reporting requirements are subject to a one-quarter percentage point reduction in their payment update
	• Hospitals participating in the program are required to report on the following infection-related quality measures:
	  ○ Central line-associated bloodstream infection (CLABSI)
	  ○ Catheter-associated urinary tract infection (CAUTI)
	  ○ *Clostridium difficile* infection (CDI)
	  ○ Methicillin-resistant *Staphylococcus aureus* bacteremia (MRSA bacteremia)
	  ○ Surgical site infection (SSI)

Hospital-Acquired Condition Reduction Program (HACRP)	• Created as part of the Affordable Care Act to incentivize hospitals to reduce HACs
	• Beginning in 2014, hospitals that ranked in the worst-performing quartile with respect to overall HAC quality measures received a 1% reduction in payment[48]
	• For FY 2017, the overall HAC score is based on a weighted average of scores in 2 domains, adjusted for availability of data. The domains are as such:
	  ○ Domain 1: Agency for Healthcare Research and Quality (AHRQ) Patient Safety and Adverse Events Composite (or PSI 90), a composite score expressed as the weighted average of the risk and reliability-adjusted versions of 8 indicators (pressure ulcer rate, iatrogenic pneumothorax rate, CLASBI, postoperative hip fracture rate, perioperative pulmonary embolism or deep vein thrombosis rate, postoperative sepsis rate, postoperative wound dehiscence rate, and accidental puncture or laceration rate).
	  ○ Domain 2 is based on predicted-to-observed values on the 5 IQR quality measures: CLABSI, CAUTI, SSI, MRSA bacteremia, and CDI

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Program	Information
Hospital Value-Based Purchasing (VBP) Program	• Program rewards acute care hospitals with incentive payments for meeting or exceeding a specified set of quality measures • For FY 2017, a hospital's performance in the VBP program is based on its performance on 21 quality measures, including the following HAI measures: ○ CLABSI ○ CAUTI ○ CDI ○ MRSA bacteremia ○ SSI • The VBP may result in a ±2% difference in payment for inpatient acute care services from FY 2017 onward
Hospital Readmission Reduction Program (HRRP)	• The HRRP requires the Centers for Medicare and Medicaid Services (CMS) to reduce payments for hospitals with "excess" readmissions for selected diagnoses.[49] As of FY 2017, HRRP conditions include: ○ Acute myocardial infarction ○ Pneumonia ○ Heart failure ○ Chronic obstructive pulmonary disorder ○ Total hip arthroplasty ○ Total knee arthroplasty ○ Coronary artery bypass graft • CMS tracks all unplanned Medicare patient readmissions that occur for any reason within 30 days of an initial admission for an HRRP condition • Hospitals ranked in the worst-performing quartile on the readmission rate (the working definition of "excessive") can be subject to a payment reduction of up to 3%[50]

The cumulative effect of the CMS performance-based programs can be substantial. In 2015, the average per hospital penalties for HRRP, hospital VBP, and HACRP totaled almost $800,000. The average penalty by program is presented in the table below.

Average Hospital Penalties from Selected Federal Hospital Quality Improvement Programs[51]

Regulation	Average Penalty in 2015
Hospital Readmission Reduction Program	$161,240
Hospital Value Based Purchasing Program	$91,873
HAC Reduction Program	$541,896
	Total: $795,009

Note that average data were not available for the IQR Program.

Appropriate nurse staffing can help to avoid these potential penalties by optimizing patient quality of care.

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Appendix B

Methods

Avalere re-examined the findings made in its first paper and the supporting literature, focusing on building a quantitative base on which to model the financial impact of changes in nurse staffing. That paper, titled "Optimal Nurse Staffing to Improve Quality of Care and Patient Outcomes," is available at: http://www.nursingworld.org/Avalere-WhitePaper-on-NurseStaffing. We conducted a targeted (supplemental) review of peer-reviewed literature, government reports, and other publicly available evaluations of nurse staffing and patient outcomes published between 2000 and 2016.

Avalere developed a simple, Microsoft® Excel (2013)-based tool, the ANA Staffing Cost Calculator Tool© (Cost Calculator), to measure the impact on hospital budgets of reductions in four nursing-sensitive quality indicators and hospital length of stay (LOS) through adjustments to nurse staffing. Three major phases of work were completed to build the model. The first phase was to develop quantitative relationships between nursing levels and four quality measures. These were derived from an analysis of available information in a nationally representative sample of hospitals that contributed data to the Press Ganey National Database of Nursing Quality Indicators® (NDNQI) during the first quarter of 2016. These included rates per 1,000 patient days of: falls, catheter-associated urinary tract infections (CAUTI); central line-associated bloodstream infections (CLABSI); and ventilator-associated pneumonia (VAP). Using cross-sectional data from NDNQI, Avalere estimated four sets of linear regressions models, one set for each type of HAC event, to evaluate HAC event rates in relationship to total nursing care hours per patient day and percent RN care hours for each unit type. For each type of HAC event, we arrayed the regression coefficients observed across the five unit types and designated the coefficients of smallest, median, and largest magnitude as "low," "moderate," and "high" impact levels, respectively. For example, increasing total nursing care hours by one hour per patient day is expected to reduce 0.078 (high impact), 0.009 (moderate impact), 0 (low impact) patient falls per 1,000 patient days. These impact levels are supplied in the Cost Calculator Inputs 2 worksheet for users to customize the budget impact calculation.

The second phase was to use a range of data points from the literature to develop quantitative relationships between increasing nursing care hours and decreasing LOS.

Based on aggregate data from two high-quality peer-reviewed manuscripts, we estimated that one additional nursing care hour and 10% more RN hours would reduce hospital LOS by 2.0% and 2.7%, respectively.[10,52] These estimates were confirmed with the principal investigators of the two studies to be consistent with what was found in the original analysis. As with virtually all variables in the Cost Calculator, this is also an optional input that users may modify.

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Estimated Impact of Nurse Staffing on Nursing-Sensitive Event Rates

	Increasing Total Nursing Care Hours by One Hour per Patient Day			Increasing % RN Care Hours by 10%		
	Maximum	**Median**	**Minimum**	**Maximum**	**Median**	**Minimum**
Falls per 1,000 Patient Days	-0.078	-0.009	0	-0.146	-0.039	0
CAUTI per 1,000 Catheter Days	-0.098	-0.035	0	-0.172	0	0
CLABSI per 1,000 Central Line Days	-0.240	-0.058	-0.047	-0.274	-0.091	0
VAP per 1,000 Ventilator Days	0	0	0	-0.241	-0.1745	-0.108
Hospital LOS	-1.0%	-2.0%	-3.0%	-1.4%	-2.7%	-5.4%

Note: These estimates represent average effects and may not be generalizable to individual hospitals.

The two initial phases of work provided the base information for construction of a customizable model that shows, in net dollar terms, the impact of an increased number and/or type of nurse staffing hours on all five of the quality and outcome measures cited above. Avalere consulted with a group of key opinion leaders, hospital administrators, nurse managers, and technical experts to obtain insights used in the white paper and model design, and critiqued both after completion.

The ANA Staffing Cost Calculator Tool® is a simple, "pilot" tool that does not include an exhaustive set of quality measures or other patient outcomes from nursing care. Many of the quantitative relationships that drive the model are taken from a large, real-world data set—something that carries with it the power of describing acuity-reflective actual nursing practice and the drawbacks of inability to capture patterns of all nursing activity in every hospital in the United States, regardless of size, type, or other demographics. The model treats achievement of quality increases or LOS decreases as discrete events where effect overlap or interaction is not considered. The model's financial projections are based on the simplified assumption that the hospital operates within a reimbursement system in which there is a positive financial impact from decreased LOS, which we know to be true of the majority, although not all payer systems. Furthermore, the Cost Calculator does not take into account the positive and negative effects of programs apart from "standard" reimbursement that reward or penalize hospitals financially for achievement or failure to achieve quality targets.

To conclude, increased nurse staffing is associated with reductions in cost and HACs. Additional research is needed to: 1) understand the cause and effect relationship between nursing care components and patient outcomes on an individual and interactive basis; and 2) determine the system-wide impact of findings in this paper and elsewhere with even greater accuracy.

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Appendix C

Hospital-Associated Conditions (HACs) Reported in Literature

Condition	Epidemiological Information

Falls	• Incidence of falls is 3.56 falls/1,000 patient days[53]
	• 26.1% of falls resulted in injury
	  ○ 9.8% of falls resulted in moderate injury
	  ○ 4.3% of falls resulted in major injury
	  ○ 0.2% of falls resulted in death
	• Hospital costs are higher among patients with falls versus patients without falls ($20,284 versus $6,968, respectively) and require an additional 6 days in the hospital[54]
	• Average hospitalization cost for falls among older adults ~$17,500[55]

Pressure Ulcers	• Incidence of pressure ulcers is 2.9% in acute care hospitals ○ 3.4% pressure ulcers occur in Medicare-certified skilled nursing facilities[56] • Pressure ulcers cost the U.S. healthcare system an estimated $9.1-$11.6 billion annually[57] • The mean costs per hospitalization for pressure ulcers range from $16,800[58]-$129,248[59] • Malpractice lawsuits associated with hospital-acquired pressure ulcers average an additional $250,000[60]
Catheter-Associated Urinary Tract Infection (CAUTI)	• 67.7% of hospital-reported urinary tract infections are associated with a catheter[61] • Mean costs per CAUTI episode is $758 ○ Median annual cost for CAUTIs per hospital is $3,032[62]

Central Line-Associated Bloodstream Infection (CLABSI)	• Incidence of CLABSI is 1.65 infections per 1,000 central line days
	  ○ Resulting in an estimated 18,000 CLABSIs in intensive care units (ICUs)[63] and ~71,900 infections in U.S. hospitals annually[61,64]
	  ○ CDC reported a 50% decrease in CLABSI events between 2008 and 2014[65]
	• CLABSI costs the U.S. healthcare system an estimated $0.6-$2.7 billion annually[66]
	• Average cost per event ranges from $26,000[67]-$45,814[68]

Ventilator-Associated Pneumonia (VAP)	• VAP is reported in over 39.1% of pneumonia cases ○ Approximately 49,900 VAP infections in non-neonatal ICU annually [61] • Costs associated with VAP can range from $14,000[66]-$99,598 per hospitalization[69]

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Appendix D

Additional Case Studies

CASE 2: Hospital with Excess Falls

Hospital Description	Hospital 2, a 400+ bed community teaching, non-Magnet hospital, with a high case mix
Challenge	• A confluence of external events had caused the fall rates on five nursing units (adult critical care, step down, general medical, general surgical, and pediatric) to rise to levels of 10% or higher than peer hospital benchmarks • The problem was severe enough to cause a potential accreditation threat in a hospital already experiencing financial and other stress

Nursing Solution Using the ANA Staffing Cost Calculator Tool©	• Using the Cost Calculator, nursing administration made a compelling case to hospital management that adding 2 more hours of nursing care per day per unit and enriching the staffing mix by adding 5% more registered nurses (RNs) to the skill mix would more than pay for itself while decreasing the fall rate to more acceptable levels
	• Specifically:
	  ○ Nurse staffing increases would cost the hospital $2.7 million
	  ○ Decrease in fall rates and the benefits of shortened length of stay on the five units would bring over $4.7 million in value to the hospital
	  ○ The net benefit to the hospital would be a decrease in cost of over $2.0 million
	• The hospital financial staff's back-of-the-envelope analysis supported the nurses' calculations, causing it to recommend approval of the proposal (in lieu of other projects that heretofore had been of higher priority)

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Case 2: Large Hospital with Excess Falls

BASELINE		Beds	Magnet Hospital	Case Mix Index	
	Hospital Base Characteristics	400+	No	High	
		Falls per 1,000 Patient Days - Suggested	Actual at Baseline		
	Adult Critical Care	1.01	2.00		
	Adult Step Down	2.84	3.00		
	Adult Medical	3.36	4.00		
	Adult Surgical	2.64	3.00		
	Pediatric Med-Surg	1.52	2.00		
CHANGE	Increase in Nurse Staffing	Hours per Pt. Day- Actual at Baseline	Hours per Pt. Day- With Change	Enriched RN Mix- Baseline	Enriched RN Mix- With Change
	Adult Critical Care	17.8	19.8	90.1%	95.1%
	Adult Step Down	10.6	12.6	76.5%	81.5%
	Adult Medical	9.2	11.2	70.4%	74.5%
	Adult Surgical	9.4	11.4	70.7%	75.7%
	Pediatric Med-Surg	10.8	12.8	82.2%	87.2%
IMPACT		Baseline	With Change		
	Decrease in Falls Per 1,000 Pt. Days	See rates above	-.229%		
		Nurse Staffing Increase	HAC Decrease	Patient Days	Overall
	Cost Changes	+$2,700,388	-$166,091	-$4,551,660	-$2,017,363

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CASE 3: Hospital with Above-Average Ventilator Associated Pneumonia (VAP) Days in its Adult Critical Care Unit

Hospital Description	• Hospital 3, an institution of fewer than 200 beds, with a low-to-moderate case mix
Challenge	• The hospital wished to maintain its reputation with the post-acute care institutions in the county as the premier provider of high-quality acute care and preferred referral source for patients • The nursing quality committee used the Cost Calculator to show that the hospital would: ○ Have to spend ~$160,000 in new RN salaries ○ Gain over $300,000 from the reduced VAP days ○ Experience a decrease in general critical care days, for a net improvement in hospital financial performance of $150,000 from a single adult critical care unit
Nursing Solution Using the ANA Staffing Cost Calculator Tool©	• The new administrator was "sold" on the numbers he saw in the Cost Calculator, approved the nurse staffing increase, and is investigating other "wins" that might come to the hospital in terms of increased quality and decreased cost from increased nurse staffing

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Case 3: Critical Care Unit with High Ventilator Associated Pneumonia LOS

BASELINE		Beds	Magnet Hospital	Case Mix Index	
	Hospital Base Characteristics	<200	Yes	Low-Medium	
		"Suggested" (Mean) Patient Days	Actual at Baseline		
	Adult Critical Care	904	1,000 (+11%) (1 Q) – Largely due to "excess" time on ventilator; average VAP rate		
CHANGE		Actual at Baseline	With Change		
	Increase in Proportion of RNs in Staff	88%	100%		
		Baseline	With Change		
	VAP Days per 1,000 Ventilator Days	6.64 per 1,000	-.289%		
IMPACT		Nurse Staffing Increase	HAC Decrease	Patient Days	Overall
	Cost Changes	+$164,076	-$22,743	-$298,667	-$157,333

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