DETERMINANTS OF HOSPITAL PROFITABILITY: ADVANCED PRACTICE REGISTERED NURSES, LOCATION, TEACHING STATUS, AND OWNERSHIP

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ABSTRACT

This study examined the impacts of advanced practice registered nurses (APRN) on hospital profitability. In addition, we investigated the control effects of hospital characteristics such as hospital location, teaching status, ownership control on the impacts of APRNs on hospital profitability. We collected data from the 2017 American Hospital Association U.S. Hospital Survey dataset. Three profitability measures used were Operating Margin, Return on Equity (ROE), and Return on Asset (ROA). We developed ANOVA models and regression models to test four research hypotheses. The results showed statistical significance supporting the hypotheses. APRN positively impacted profitability in the U.S. hospitals studied. The results indicated that hospitals in the metro area would be more profitable. Hospitals owned by the government or private non-profit organizations were less profitable. Teaching hospitals were less profitable.

INTRODUCTION

The cost of healthcare has been on the rise for decades (Gapenski et al., 1993). While patients have carried most of this cost (Timmons, 2017), hospitals have borne some of the burdens, too. The Advanced Practice Registered Nurse (APRN) and Registered Nurse (RN) professions could offer some respite to the financial impacts of the changing industry in the United States (Bai & Anderson, 2016).

Demand for primary care is increasing due to many factors such as the Affordable Care Act, population growth, and an increase in life expectancies. Improving health care in the U.S. is essential, and it should be both accessible and cost-effective. Previous studies showed APRNs to be cost-effective providers of primary care. These studies discussed APRNs as a solution to meeting the anticipated primary care provider shortages in the U.S. However, they expressed concerns that reduced or restricted scope of practice in many states could make this difficult. These regulations on APRN practice can potentially impact the health care system negatively

and reduce access to primary care. Policymakers must construct a bipartisan resolution and remove restrictions on APRNs. Using APRNs could prove a viable and effective strategy to meet the increasing demands for primary care. Thus, we raised a research question – do APRNs provide a financial benefit to individual hospitals?

To answer the research question, we conducted an empirical study. First, we conducted a literature review and developed four research hypotheses. Next, we collected sample data from the 2017 American Hospital Association U.S. Hospital Survey dataset. We then determined three profitability measures – Operating Margin, Return on Equity (ROE), and Return on Asset (ROA). Following that, we proposed ANOVA and regression models for hypothesis testing. Lastly, we discussed the results and provided directions for a future study in the conclusion section. This study supported the practice of APRNs in hospital settings by producing evidence that APRNs had a positive impact on profitability.

LITERATURE REVIEW

APRNs in the U.S.

APRNs are nurses with a graduate degree in advanced nursing and frequently function as primary care providers (American Nurses Association, 2021). According to the National Council of State Boards of Nursing (2021), there are four APRN types - Certified Nurse Practitioner (CNP), Clinical Nurse Specialist (CNS), Certified Registered Nurse Anesthetist (CRNA), and Certified Nurse-Midwife (CNM).

In particular, the role of APRNs as primary care providers is expected to be more important over time due to the increasing demand for primary care, combined with the projected shortage of primary care physicians (American Association of Medical Colleges, 2020). The AAMC also reported that the high use of APRNs could significantly reduce the projected physician demand and thus mitigate the projected shortage of physicians (2020). The demand for APRNs is accordingly increasing. In 2019, there were 263,400 APRN jobs, and the number is projected to increase by 117,700, or 45%, by 2029 (U.S. Bureau of Labor Statistics, 2021). Considering the projected employment growth rate for physicians and surgeons is only 4% for the same period, it looks clear that the demand for APRNs is increasing significantly faster than that of doctors (U.S. Bureau of Labor Statistics, 2021). Prior literature has generally documented that APRNs provide effective and sufficient patient care (Steinwachs et al., 2011). Woo et al. (2017) also reported that APRNs' involvement in emergency and critical care yielded better outcomes in terms of length of hospital stay, medical cost, and consultation time, among others.

Determinants of Hospital Profitability

Since 2020, the COVID-19 pandemic has severely impaired the financial health of U.S. hospitals. American Hospital Association (AHA) estimated that total losses for hospitals in 2020 could be as large as 323.1 billion dollars (2020). They also estimated that the lingering effect of COVID-19 would likely decrease hospital revenues by at least 53 billion dollars in 2021 (AHA, 2021). Prior literature has documented several factors that affect the hospital profitability, such

as ownership type (Horwitz, 2005; Horwitz & Nichols, 2009), market share (Capps & Dranove, 2004; Keeler et al., 1999), hospital size, and teaching status (White et al., 2014), or location (Bai & Anderson, 2016; Turner et al., 2015). Also, Bai and Zare (2020) found that labor costs represent more than 40% of the total hospital operating costs. The literature indicates a significant relationship between the proportion of certain employee types and overall profitability. However, there is little evidence of such a relationship.

HYPOTHESIS DEVELOPMENT

APRN and Hospital Profitability

Hiring more APRNs proportionally to doctors can improve hospital profitability by reducing labor costs. Labor represents significant hospital costs (Bai & Zare, 2020). In addition, labor is the biggest driver of hospital operating expenses (LaPointe, 2018). Consequently, controlling labor costs is critical for hospitals to maintain or increase financial profitability. While APRNs have expanded the legal scope of practice compared to registered nurses (RNs), hiring APRNs still costs significantly less than hiring doctors. For example, according to the Bureau of Labor Statistics (2021), the median annual salary for three types of APRNs (i.e., CNP, CRNA, and CNM) was $117,670 in 2020, while $208,000 for physicians and surgeons. Bai and Anderson (2016) also suggested that employing APRNs rather than physicians can impact profitability positively by directly reducing labor costs. Richter and Muhlestein (2017) documented that patient experience is strongly associated with profitability. Thus, if hiring APRNs leads to a decrease in the quality of patient service, it will negatively impact profitability. However, prior studies have provided evidence that APRNs give a quality of patient care comparable to physicians (McCleery et al., 2014) and that hiring more APRNs is associated with positive outcomes (Aiken et al., 2021). For example, Aiken et al. (2021) found that hospitals with more APRNs had significantly better patient care quality and safety in terms of 30-day mortality ratio, 7-day readmissions, etc. In addition, Aiken et al. (2021) found that nurses in the hospital with more APRNs were less likely to experience burnout and more likely to report higher job satisfaction and greater willingness to stay in their jobs. These findings suggest that hiring more APRNs can have an indirect positive impact on profitability via reducing labor costs related to the turnover of nurses. Controlling turnover costs allows hospitals to maintain their margins, productivity, and quality of care (Mahoney et al., 2018). Finally, studies on the financial impact of allowing APRNs to treat and prescribe medications to patients support the theory that their impact is positive (Poghosyan et al., 2012; Maier, 2015; Morgan et al., 2019; Perry, 2009; Timmons, 2017). Thus, we hypothesize that a higher proportion of APRNs to doctors will impact hospital profitability positively.

H1 *If a hospital hires more APRNs proportionally to doctors, then the hospital will be more profitable.*

Hospital Location and Hospital Profitability

Hospital location is an important factor influencing hospital profitability because of its relation to market share and management strategy (Robinson and Luft, 1985; Walker, 1993). Previous studies reported that hospitals in metropolitan or urban settings had a few advantages over those in rural areas. Most of a hospital's patients reside in its vicinity, indicating that location determines its market share (Robinson and Luft, 1985). Hospitals in metropolitan areas are more likely to provide more patient services and operate more efficiently (Walker, 1993). In contrast, hospitals in rural locations are more likely to perform uncompensated care (Hultman, 1991) and have lower occupancy rates (Goldstein et al., 2002). Younis (2003) found that rural hospitals had significantly lower profitability than urban hospitals had. Similarly, Bai and Anderson (2016) found that being in a rural location had decreased hospital profitability. In DuPont analysis, Turner et al. (2015) also found hospital location impacted hospital profitability. Therefore, we hypothesize that hospital location will impact hospital profitability.

H2 Hospital location will impact hospital profitability.

Teaching Hospital Status and Hospital Profitability

We identified teaching hospital status as another possible variable for our study. In the United States, one can split hospitals into teaching hospitals and non-teaching hospitals. Gapenski et al. (1994) reported teaching hospitals had negative associations with hospital profitability. Research has documented that teaching hospitals are more likely to engage in costly activities such as research, teaching, and charity care (Jha et al., 2009) and have inefficiencies (Rosko et al., 2018). Younis, Rice, and Barkoulas (2001) found that teaching status had a negative effect on profitability. Younis et al. (2003) also reported a negative association between teaching status and profitability among hospitals in Florida. Bai and Anderson (2016) explored the effect of teaching hospital status on hospital profitability. In DuPont analysis, Turner et al. (2015) found hospital teaching status negatively impacted hospital profitability. Therefore, we hypothesize that teaching hospital status will impact hospital profitability.

H3 Teaching hospital status will impact hospital profitability.

Hospital Ownership Control and Hospital Profitability

While some hospitals are for-profit organizations, most hospitals are non-profit. Likewise, while governments run some hospitals, most are private. An early study by Valvona and Sloan (1988) found that for-profit hospital chains had significantly higher margins and ROE. Shen et al. (2005) reviewed a rich body of literature and reported that for-profit hospitals were more profitable than non-profit hospitals. Likewise, Bai and Anderson (2016) reported for-profit hospitals were more likely to be more profitable than non-profit hospitals. Gapenski et al. (1993)

found that government-run hospitals were less profitable than privately-owned hospitals. Thus, we hypothesize that hospital ownership control will impact hospital profitability.

H4 Hospital ownership control will impact hospital profitability.

METHODOLOGY

Data

We used data obtained from the 2017 American Hospital Association (AHA) Annual Survey. AHA distributed this survey to all hospitals in the United States and its territories. AHA designed this voluntary survey to develop a comprehensive database with information on each hospital's organizational structure, service lines, utilization, finances, insurance models, payment models, and staffing for the given fiscal year. The AHA database included two separate data files. The APRN data was in the primary data file, while profitability variables were in the hospital financial data file. We merged two files. Our starting data consisted of 6,261 participating hospitals. The data decreased to 5,956 hospitals after adjusting for rows without MCR Numbers, our hospital identifier. In addition, we deleted two hospitals located in American Samoa and the Marshall Islands due to many missing values in the data. To maintain only data related to hospitals employing APRNs, we further reduced the data to exclude hospitals that reported zero FTE APRNs or all FTE physicians. To assess the APRN proportion, we divided the remaining proportions into quartiles. The final count for hospitals included in our analysis was 2,023.

APRN Proportion Variable

We proposed APRN Proportion to measure the level of APRN employment to doctors in a hospital. We computed each hospital's APRN proportion by dividing the number of full-time equivalents (FTE) APRNs by the sum of FTE APRNs and FTE doctors in the hospital. We collected FTE APRN and FTE doctor data from the 2017 AHA dataset.

$$APRN\ Proportion = FTE\ APRN \div (FTE\ Doctors + FTE\ APRN)$$

Profitability is a financial performance indicator showing whether administrators are running a hospital properly. We proposed three variables to measure hospital profitability. The three measures were Operating Margin, ROE, and ROA.

Operating Margin Variable

Turner et al. (2015) and Bai and Anderson (2016) used Operating Margin to measure hospital profitability. Operating Margin is a financial metric that calculates income after operating-related expenses. We used Operating Margin Ratio as a proxy to measure the operating margin. The operating margin ratio measures the hospital's ability to control its operating expenses. It was computed by dividing the difference between total revenue and a sum of

operating expenses and taxes paid by total revenue. We collected Operating Margin Ratio data from the 2017 AHA dataset.

Operating Margin Ratio = [Total Revenue - (Operating Expense + Taxes Paid)] ÷ Total Revenue

Return on Equity (ROE) Variable

ROE measures a firm's ability to use equity to generate earnings. Turner et al. (2015) used ROE to measure hospital profitability. This variable was computed by dividing Net Income by Equity. We collected ROE data from the 2017 AHA dataset.

ROE = Net Income ÷ Equity (at year-end)

Return on Assets (ROA) Variable

ROA considers net income (revenue minus expenses) instead of total revenue. ROA measures how a hospital uses assets to generate earnings. Watkins (2000) used this variable to measure hospital profitability. ROA was computed by dividing Net Income by Assets. We collected ROA data from the 2017 AHA dataset.

ROA = Net Income ÷ Assets (at year-end)

ANOVA and Multiple Regression Models

We proposed an ANOVA model to examine the effects of APRNs on hospital profitability. We transformed the APRN proportion variable into the quartile variable to run the ANOVA model. Thus, the quartile approach created four groups. We grouped hospitals into the top 25%, top 50%, top 75%, and the bottom 25% APRN proportion groups. The dependent variables were the profitability variables, while the independent variable was the APRN proportion quartile variable. If data did not meet the ANOVA model assumptions, this study used the Robust Test of Equality of Means as an alternative model (Welch, 1951). The one-way ANOVA model was expressed as:

$$Y_{ij} = \mu + \tau_j + e_{ij}$$

where Y_{ij} = Observations (Hospital Profitability)
$\mu_j = \mu + \tau_j$ = the Mean of the Observations for the j^{th} Treatment Group
μ = the Grand Mean of the Observations
j = 1, 2, 3, 4^{th} Treatment Group (APRN Proportion Quartile)
i = 1, …, I (I = Total Number of Hospitals)
e_{ij} = Random Errors

In addition, we proposed a multiple regression model to explore how APRN proportion was related to hospital profitability. Profitability was a dependent variable in the proposed

model, while APRN proportion was an independent variable. To enhance the model reliability and explanatory power, statistical modeling included pertinent variables such as teaching hospital, hospital location, and hospital ownership controls as independent variables. The regression model was expressed as:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + e_i$$

where Y_i = Hospital Profitability
X_1 = APRN Proportion
X_2 = Teaching
X_3 = Location
X_4 = Ownership Control 1 (Government/Non-Government)
X_5 = Ownership Control 2 (Profit/Non-Profit)
i = 1, …, I (I = Total Number of Hospitals)
e_i = Random Errors

RESULTS

Descriptive Statistics

Of the included hospitals in our final sample, 1,179 were located in metropolitan areas (58.3%), 457 in rural areas (22.6%), and 387 in micro (small city) areas (19.1%). 162 hospitals reported teaching (8.0%), while 1,861 reported non-teaching (92.0%). Of the hospitals, 1,353 were both non-government-owned and non-profit (66.9%), 499 were government-owned but non-Federal (24.7%), 168 were for-profit (8.3%), and 3 were Federal government-owned (0.1%). Hospital sizes were calculated by the number of beds, ranging from fewer than 25 to over 500. 1,597 reported having between zero and 299 beds (78.9%). 426 reported having over 300 (21.1%). The results determined that the level of APRN prescription and treatment authority was split somewhat evenly, 610 (30.2%) hospitals allowed full authority, 786 (38.9%) allowed limited authority (38.9%), and 627 (31.0%) allowed no prescription authority without a physician's direction, as shown in Table 1.

Table 1
Descriptive Statistics of Sample Data

Location	Frequency
Metro	1179
Micro	387
Rural	457
Total	**2023**

Ownership	Frequency
Gov't, Federal	3
Gov't, Non-Fed	499
Non-Gov't, Non-Profit	1353
For-profit	168
Total	**2023**

Teaching	Frequency
Teaching	162
Non-Teaching	1861
Total	**2023**

Bed Size	Frequency
< 25 Beds	213
25 - 49 Beds	429
50 - 99 Beds	314
100 - 199 Beds	415
Bed Size	**Frequency**
200 - 299 Beds	226
300 - 399 Beds	155
400 - 499 Beds	96
500 - 599 Beds	175
Total	**2023**

Authority	Frequency
Full	610
Limited	786
Restricted	627
Total	**2023**

Among 2023 hospitals, 979 reported hospital financials. Of these, we collected 979 cases of the three profitability variables. Table 2 shows descriptive statistics of the profitability variables.

Table 1
Descriptive Statistics of Profitability Variables

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Operating Margin Ratio	979	-27.730	20.052	-3.031	8.017
ROE	979	-15.800	26.722	5.761	8.380
ROA	979	-9.882	16.883	3.405	4.988

ANOVA Model Results

We ran one-way ANOVA models to test differences among four APRN groups in terms of profitability. The test results showed statistical significance for all variables ($p < 0.01$). The findings from the Robust Test of Equality of Means of hospital profitability by APRN proportion in quartiles determined that a statistically significant relationship exists between an increased APRN proportion and the OM ($p < 0.001$), ROE ($p = 0.004$), and ROA ($p = 0.000$) of a hospital. In a sample of 245 hospitals, those with APRN proportions in the fourth quartile experienced a

more favorable OM (-0.330 ± 8.766), higher ROE (7.359 ± 8.466), and higher ROA (4.626 ± 5.473) than the other three quartiles. Table 3 shows the ANOVA model results.

Table 3
Hospital Profitability by APRN Proportion Quartiles

	Quartile	APRN Prop	n	Mean	SD	Welch F	p-value
Operating Margin	Q1	<.7191	244	-4.692	7.0578	14.389	0.000
	Q2	<.8222	245	-4.347	7.7319		
	Q3	<.9215	245	-2.762	7.7126		
	Q4	<.9993	245	**-.330**	8.7663		
ROE	Q1	<.7191	244	5.234	7.7294	4.512	0.004
	Q2	<.8222	245	4.710	8.5389		
	Q3	<.9215	245	5.738	8.5692		
	Q4	<.9993	245	**7.359**	8.4656		
ROA	Q1	<.7191	244	3.061	4.2656	6.182	0.000
	Q2	<.8222	245	2.715	4.9757		
	Q3	<.9215	245	3.214	4.9761		
	Q4	<.9993	245	**4.626**	5.4728		
		Total	979				

Note: Welch F = Welch Statistic for Robust Test of Equality of Means (Asymptotically F distributed)

Post-hoc LSD test results showed that hospitals with a lower proportion of APRNs (Quartile 1 and Quartile 2) had significantly lower operating margins than that of Quartile 3 (-2.76 ± 7.71, p = 0.007) and Quartile 4 (-0.33 ± 8.77, p < 0.001). Hospitals with APRN proportions in the fourth quartile had greater ROE (7.36 ± 8.47) and ROA (4.63 ± 5.47) than the first three quartiles (p < .01).

Regression Model Results

We developed the best-fit model per each dependent variable measuring hospital profitability, using the stepwise method. All three best-fit models showed statistical significance (p < 0.01). Model 1 used Operating Margin as a dependent variable. Model 1 results showed statistical significance [Adjusted $R^2 = 0.144$, $F = 33.8$, $p < 0.001$]. Of the independent variables, APRN proportion ($p < 0.001$), rural location ($p < 0.001$), non-federal government ($p < 0.001$), private non-profit ($p < 0.05$), and teaching ($p < 0.01$) variables showed statistical significance on hospital profitability. Variance inflation factors show no serious multicollinearity within the model. All VIFs are less than five.

Model 2 used ROE as a dependent variable. Model 2 results showed statistical significance [Adjusted $R^2 = 0.062$, $F = 33.573$, $p = 0.003$]. Of the independent variables, only metro location ($p < 0.001$), and non-federal government ($p < 0.001$) variables showed statistical significance on hospital profitability. No serious multicollinearity was found in Model 2 (VIF < 5).

Model 3 used ROA as a dependent variable. Model 3 results showed statistical significance [Adjusted $R^2 = 0.061$, $F = 22.060$, $p = 0.000$]. Of the independent variables, only APRN proportion ($p < 0.05$), metro location ($p < 0.001$), and non-federal government ($p < 0.001$) variables showed statistical significance on hospital profitability. There was no serious multicollinearity (VIF < 5). Table 4 reported the regression model results.

Table 4
Regression Model Results

	Model 1	**Model 2**	**Model 3**
Dependent Variable	Operating Margin	ROE	ROA
Constant	-1.871	4.089	2.014
APRN Proportion	1.158***		0.0310*
Metro Location		3.532***	1.575***
Rural Location	-3.623***		
Gov Non-Fed	-6.991***	-2.366***	-1.789***
Non-Gov Non-Profit	-2.463*		
Teaching	-2.391**		
Adjusted R^2	0.144	0.062	0.061
F	33.800	33.573	22.060
p-value	0.000	0.003	0.000
Observations	978	978	978

*p < 0.05, **p < 0.01, ***p < 0.001

DISCUSSION

Our empirical results provided strong support for H1, which was our main hypothesis – the higher APRN proportion to doctors, the higher the hospital profitability. First, ANOVA results in Table 3 showed that hospitals in the highest APRN proportion group (Quartile 4) had significantly higher profitability in terms of all three measures (i.e., Operating Margin, ROE, and ROA) than those in the lowest APRN proportion group (Quartile 1). The mean difference between the two groups are 4.362, 2.215, and 1.565 for Operating Margin, ROE, and ROA, respectively. These results provided initial evidence that hospitals hiring more APRNs proportional to doctors are more profitable. Moreover, regression model results in Table 4 generally supported our main hypothesis. Model 1 and 3 provided evidence that APRN proportion to doctors had a positive and significant impact on hospital profitability in terms of Operating Margin (ROA) when the models included control variables such as location, teaching hospital status, and ownership control. To our knowledge, this is the first study to provide direct evidence that hiring more APRNs compared to physicians has a positive financial impact (i.e., Operating Margin and ROA).

In addition, evidence showed that data supported other hypotheses (i.e., H2 – hospital location, H3 – teaching hospital status, and H4 – hospital ownership), consistent with prior

literature. Regression results in Table 4 supported that hospital location significantly impacted hospital profitability (H2). In line with Bai and Anderson (2016) and Turner et al. (2015), evidence suggested that hospitals in rural areas were less profitable (i.e., Operating Margin), while hospitals in metro areas were more profitable (i.e., ROE and ROA). H3 was partially supported by our regression model results as well – teaching hospital status had an impact on hospital profitability. Our results suggested that teaching hospital status lowered Operating Margin but had no significant impact on ROE and ROA. The results were somewhat consistent with Bai and Anderson (2016), which reported that teaching hospitals had negative median net income. Finally, regression results supported H4 – ownership control matter on hospital profitability. Non-federal government hospitals were significantly and negatively associated with all three profitability measures. Non-government (i.e., private) non-profit hospitals were negatively associated with Operating Margin but had no significant association with other measures.

The findings of this study contribute to the healthcare literature by providing direct evidence that hiring more APRNs leads to higher hospital profitability. Prior studies have generally focused on the cost-effectiveness of utilizing APRNs (Bauer, 2010; Chenoweth et al., 2005; Kapu et al., 2014). In addition, while Bai and Anderson (2016) and Turner et al. (2015) examined the factors associated with hospital profitability, they did not include APRN proportion to the physician in their models. Also, this study has implications for hospital managers. The findings from this study may encourage hospitals to increase APRN staffing proportionally to that of physicians. Evidence showed that the higher the APRN proportion, the higher the hospital's profitability. We have determined that the most profitable hospitals belong to the fourth quartile (92% to 99%) of APRN proportion to the physician.

CONCLUSION

This study examined the impacts of APRN proportions on hospital profitability. Using the 2017 American Hospital Association Annual Survey data, we found that increasing APRN staffing proportionally to physicians positively impacted hospital profitability in terms of Operating Margin and ROA, except for ROE. Also, consistent with the prior literature, we found that hospital location, teaching status, and ownership control were significantly associated with hospital profitability.

Our study has several limitations. First, this study only examined the financial impact of hiring more APRNs. APRNs may impact other areas in hospital administration. Second, this study used only three control variables – location, teaching status, and ownership control. Third, this study used single-year data. Therefore, the findings of this study have limited external validity. The 2017 AHA data provided financial data up to three periods per hospital, but there were many missing values in the second and the third period. We used the first period (i.e., the latest fiscal year) data because such missing values might affect the average outcome. Thus, we stayed with the present data in this study. We will explore this possibility in our future studies.

Future studies may investigate if APRN practice authority levels impact hospital profitability, efficiency, and quality since APRNs have three authority levels. Also, further

studies may extend our analysis by including additional control variables such as hospital system, network, size, etc. In addition, this research framework may apply to other countries in different healthcare environments in terms of regulations and insurance. This study provided empirical evidence of the significant impacts of APRNs on hospital profitability in the U.S. The findings suggest hiring more APRNs can lead to higher profitability.

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