Hospital Profitability and Average Daily Patient-to-Nurse Ratio in Public and Private Hospitals in Taiwan

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A B S T R A C T

Taiwan's National Health Insurance system is notable for its comprehensive medical service coverage. This study analyzed the impact of patient-to-nurse ratio on the profitability of Taiwan's public and private hospitals. Patient-to-nurse ratio serves as a crucial measure of resource allocation and nursing quality. Since the implementation of the National Health Insurance system in Taiwan, hospitals of different levels of care have reduced nursing manpower out of consideration of operational costs, when a safe patient-to-nurse ratio was achieved, the nurse turnover rate decreased, which lowered training costs. The research highlighted differences in how these ratios affect profitability, providing insights for policymakers to enhance medical expense management and resource distribution. During the COVID-19 pandemic, private hospitals prioritized profitability and operational efficiency by adjusting patient-to-nurse ratio, while public hospitals aimed to serve societal needs. Despite this community focus, public hospitals' ability to adjust ratios for profit was limited by governmental control and conservative operations, making private hospitals generally more profitable.

Keywords: hospital profitability, public hospitals and private hospitals, average daily patient-to-nurse ratio

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1. Introduction

Following Taiwan's handling of the COVID-19 epidemic, the quality of its health care has been praised by countries worldwide. This quality of care is made possible by nurses, of whom the world is facing a shortage to which Taiwan is no exception. Following the implementation of the National Health Insurance global budget payment system in July 2002, because of the high number of nurses, they bore the brunt of cost reduction measures, which ironically laid the foundations of the current nursing shortage. Hospitals in Taiwan are now experiencing an unprecedented shortage of nursing staff, investigations into the reasons for which have identified high patient-to-nurse ratio as a key indicator of staff turnover. Fan (2021) asserted that on average, one out of every four new nurses will resign; moreover, the turnover rate among new nurses is greater than 22.5% in medical centers and close to 29% in district hospitals; the result is a triple loss involving disappointed employers, frustrated students, and dissatisfied patients. The number of patients under a nurse's care is correlated with patient safety; when patients are seriously ill and dependent, they require greater attention from nurses, and lowering the patient-to-nurse ratio is an urgent concern (Jones, 2009).

According to nursing statistics compiled by Taiwan's Ministry of Health and Welfare (MOHW), as of 2021, the nursing practice rate in Taiwan was only 63.5%; that is, only 60% of nurses with licenses chose to work as nurses; furthermore, the patient-to-nurse ratio in Taiwan remains higher than those in Europe and the United States. These statistics can be partly attributed to Taiwan's sub-replacement fertility, the complexity of hospital evaluation documents, and hospitals' inability to meet society's high expectations for medical care, which have led to low willingness to engage in nursing work by those who are not registered nurses (Wang, 2017). By contrast, the U.S. state of California was the first to legislate patient-to-nurse ratio in hospital wards. Aiken (2002) revealed that California's A.B. 394 recommends a patient-to-nurse ratio of 5:1 in acute care settings. Aiken (2013 and 2014) further contended that each additional patient exacerbates working conditions for nurses, increasing patients' risk of death by 7% and increasing nurses' physical and mental exhaustion by 23% and job dissatisfaction by 10%. Since the implementation of Taiwan's National Health Insurance global budget payment system, hospitals at every level have rushed to cap the number of nurses on staff to save on operating costs, resulting in staffing shortages. Excessive patient loads and long working hours have led to high nurse turnover rates and low practice intentions. To improve hospital patient-to-nurse ratio, the patient-to-nurse ratio was formally introduced as a hospital evaluation item in 2015, and the following patient-to-nurse caps were formally implemented on May 1, 2019: 9:1 in medical centers, 12:1 in regional hospitals, and 15:1 in district hospitals. By contrast, since mandating strict patient-to-nurse ratio, California has enjoyed lower patient mortality rates and higher nurse retention rates by offering nursing staff reasonable salaries, benefits, and manpower (Aiken et al., 2010). The authors hope that Taiwan can learn from California's example and strengthen the sustainability of its medical system.

Medical staffing is a primary factor affecting medical service quality and hospital performance. Nevertheless, staff shortages are common in MOHW-affiliated hospitals. This problem is no longer confined to individual hospitals and is unavoidable regardless of the geographical locations of the hospitals and whether the hospitals have access to sufficient medical resources. Studies have demonstrated that reducing the allocation of clinical care staffing below a reasonable standard out of financial considerations results in a decline in the quality of patient care, affecting the hospital's medical revenue (Liang et al., 2012; Schubert et al., 2012; Butler et al., 2011). Overly high patient-to-nurse ratio create heavy workloads, compromising nurse retention. This study used hospitals' profitability as a metric of financial performance to examine whether variations in hospital type result in variations in hospital profits; this analysis was extended to a discussion of whether the hospitals were public or private hospitals to assist related authorities in planning and allocating medical resources.

2. Literature Review

If patient-to-nurse ratio are overly high, the consequent adverse effects on nurse health and job stress can lead to turnover (Asakura et al., 2020; Aiken et al., 2014). Furthermore, heavy workloads can aggravate physical stress and social pressure on nurses, increasing their turnover intentions (Lanz & Bruk-Lee, 2017; Alghamdi, 2016). To improve nurse working environments, the MOHW has formally mandated patient-to-nurse ratio as part of hospital evaluations since 2015, tying such ratios to insurance reimbursements for hospital stays and diagnoses; these ratios were formally made into law in 2019 (MOHW). Several articles on nursing staff problems in Taiwan were published in international nursing journals in the years leading up to this study (Chang & Lin, 2020; Chang et al., 2019; Lee et al., 2019; Hung & Wu, 2019), Weiss et al. (2011) pointed out that increasing the hospital's clinical nursing manpower and reducing the overtime hours of nurses can not only reduce patients' re-hospitalization or emergency treatment within 30 days after discharge, but also reduce overall medical costs, thereby enhancing the hospital's profitability. but most investigations into the factors influencing turnover have been inferential discussions on turnover intentions. Furthermore, patient-to-nurse ratio and workloads have always been focal points in discussions of the demands on clinical nursing staff; consequently, nurse workload have been increasingly recognized for its role in staff turnover, staffing shortages, and nursing quality (Lanz & Bruk, 2017; Alghamdi, 2016).

Numerous studies have demonstrated that enacting patient-to-nurse ratio-related laws can lower nurses' workloads, improving turnover rates and care quality while reducing training costs; these improvements also lower hospital staffing costs and overall costs. For example, Aiken (2010) observed that in 2006, two years after implementing nurse staffing mandates, workloads for nurses in California decreased significantly, especially when compared with those of hospitals in New Jersey and Pennsylvania; furthermore, once a safe patient-to-nurse ratio was established, turnover rates among nurses declined, reducing hospital training costs—for every nurse that departs, the hospital must spend US $42,000 to train a replacement. When high patient-to-nurse ratio lead to high nurse turnover, for every percentage point increase in the patient-to-nurse ratio, the hospital must spend an average of US $300,000 each year. Increasing the clinical nurse staff of hospitals reduces patient readmissions or emergency visits within 30 days of being discharged and lowers total medical costs (Weiss et al., 2011; PricewaterhouseCoopers' Health Research Institute, 2007).

The comparison revealed that the ratio in Taiwan was the highest in the world. Since the implementation of the National Health Insurance system in Taiwan, hospitals of different levels of care have reduced nursing manpower out of consideration of operational costs, which has resulted in inadequate nurse staffing, an excess of patients requiring care, extended working hours, high turnover rates among nurses, and a lower willingness for nurses to pursue the profession. To improve the patient-to-nurse ratio in hospitals, the ratio was officially included as an item for hospital evaluation in 2015. On February 1, 2019, the Ministry of Health and Welfare revised Article 12-1 of the Establishment Standards for Medical Institutions to regulate the average daily allocation ratios for general acute beds; a patient-to-nurse ratio was thus officially legislated and put into practice on May 1 of that year. Accordingly, the stipulated number of patients to be cared by one nurse was fewer than 9 for medical centers, 12 for regional hospitals, and 15 for district hospitals. As observable in the case of California, legislation of strict, mandatory patient-to-nurse ratios can result in lower patient mortality rates and higher nurse retention rates and may lead to improvements in nurse salaries, wellbeing, and staffing (Aiken et al., 2010). These findings can serve as a reference for improved fortification of Taiwan's health-care system.

Under Taiwan's government-regulated medical system, most public and private hospitals are held to the same medical payment standards. As such, increasing hospital profits and maintaining a competitive edge is the foremost concern of every hospital. Several factors affect a hospital's business performance, such as cost habits, management orientation, and medical quality (Berger et al., 2020; Karim et al., 2018; Kuo et al., 2015; Yan & Yang, 2013). Lin et al. (2022) conducted an empirical analysis of various types of public hospitals in Taiwan from 2019 to 2020 and discovered that medical centers are financially stronger than local and regional hospitals and that lower patient-to-nurse ratio can improve business performance; nevertheless, studies on the correlation between business

performance and medical quality as well as the differences in profitability between public and private hospitals have been scant. Research conducted outside Taiwan has also uncovered a correlation between medical efficiency and medical quality (Huang & Gao, 2023; Gao et al., 2022; Mckay & Deily, 2008; Mennicken et al., 2011). Operational efficiency is determined by operational cost activities such as personnel expenses, outpatient medical expenses, inpatient medical expenses, medical costs, marketing expenses, and duration of hospital stays. These varied cost activities exemplify the lack of a unified definition of hospital business performance.

Taiwan law has mandated that hospitals' medical service declarations be publicly disclosed in their financial reports since 2015. This study analyzed the profitability and patient-to-nurse ratio of public and private hospitals in Taiwan to examine differences in patient-to-nurse ratio between public and private hospitals and to identify factors critical for improving hospital performance and hospital management. The study findings can serve as management suggestions and directions for decision-makers. Accordingly, the following hypotheses are developed:

H1: Average daily patient-to-nurse ratio is positively correlated with hospital profitability

3. Research Method

3.1 Sample Selection

The financial reporting of hospital medical service claims began in 2015, and the data for 2021 was updated in September 2022. The sample in this study comprised both public and private hospitals; data from 2015 to 2021 were collected and calculated manually. Data sources were outpatient and inpatient records from the National Health Insurance Administration's third-generation warehousing Clinic, detailed hospitalization files, personnel statistics within medical management subsystems, and public statistics on beds in medical institutions (as of September 2022). Hospitals were differentiated by level into medical centers, regional hospitals, and district hospitals to clarify whether variations in patient-to-nurse ratio resulted in differences in profitability among public and private hospitals. A regression analysis was performed on the 1,270 samples. The distribution of public and private hospitals by year presented in Panel A of Table 1 indicates that private hospitals accounted for nearly 75% of the sample; furthermore, most private hospitals were district hospitals, comprising 36.06% of the sample. Most public hospitals were regional hospitals, comprising 13.62% of the sample.

Table 1: Sample Distribution

Panel A: Hospital Type-Public Hospitals and Private Hospitals			
Hospital Type / Year [a]	Public Hospitals	Private Hospitals	Total
2015	38(2.99%)	71(5.59%)	109(8.58%)
2016	40(3.15%)	106(8.35%)	146(11.50%)
2017	41(3.23%)	106(8.35%)	147(11.57%)
2018	52(4.09%)	160(12.60%)	212(16.69%)
2019	59(4.65%)	158(12.44%)	217(17.09%)
2020	60(4.72%)	161(12.68%)	221(17.40%)
2021	58(4.57%)	160(12.60%)	218(17.17%)
Total	348(27.40%)	922(72.60%)	1,270(100.00%)

Panel B:Hospital Level Distribution by Public Hospitals and Private Hospitals				
Hospital Level / Hospital Type	Medical Centers	Regional Hospitals	District Hospitals	Total
Public Hospitals	42(3.31%)	173(13.62%)	133(10.47%)	348(27.40%)
Private Hospitals	91(7.17%)	373(29.37%)	458(36.06%)	922(72.60%)
Total	133(10.47%)	546(42.99%)	591(46.54%)	1,270(100%)

[a] Data Sources: The Third Generation Warehouse Outpatient and Inpatient Detail Files from the National Health Insurance Administration (latest data update: September 2022), the Medical Personnel Category Statistics File from the Medical Affairs Management Subsystem, and the Official Statistics File of Hospital Beds in Medical Institutions.

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[1] Disclosure of Financial Statements for Medical Service Institutions. https://www.nhi.gov.tw/ch/cp-6422-c4b77-3068-1.html

3.2 Research Design and Proxies

3.2.1 Empirical Models

As the data originates from the financial statement disclosures of medical service institutions under the National Health Insurance global budget payment system, there are no fixed effects or year effects. An empirical analysis of correlations between patient-to-nurse ratio and profitability among the various types of public and private hospitals was performed using an ordinary least square regression model expressed as follows:

$$HNPM_{i,t} = \alpha_0 + \alpha_1 DNPR_{i,t} + \alpha_2 OPDE_{i,t} + \alpha_3 BIHE_{i,t} + \alpha_4 BIHD_{i,t}$$
$$+\alpha_5 HB_{i,t} + \alpha_6 HC_{i,t} + \varepsilon_{i,t} \quad\quad (1)$$

where:
HNPM	:	hospital profit margin = (medical revenue - medical costs) / medical revenue;
DPNR	:	average daily patient-to-nurse ratio;
OPDE	:	outpatient medical expenses (hundred million);
BIHE	:	inpatient medical expenses (hundred million);
BIHD	:	inpatient days (ten thousand days);
HR	:	medical revenue (hundred million);
HC	:	medical costs (hundred million);
ε	=	residual term.

3.3 Related Variables and Operational Definitions

3.3.1 Dependent Variable: Hospital Profit Margin (*HNPM*)

Lin et al. (2022) and Dong (2015) used hospital financial performance indicators such as net profit margin to measure hospital profitability. In this study, a public or private hospital's net profit margin (*HNPM*) was calculated using the following equation: (medical revenue – medical costs)/medical revenue (for the year).

3.3.2 Independent Variable: Average Daily Patient-to-Nurse Ratio (*NPR*)

California nurses enjoy reasonable salaries and benefits in part because of strict caps on patient-to-nurse ratio (Aiken et al., 2010). Patient-to-nurse ratio refers to the average number of patients in each nurse's care in a hospital and is calculated as number of beds × occupancy rate × 3 ÷ the total number of nurses working each day across three shifts.

3.3.3 Control Variables

From the perspective of efficiency-related indicators, Lee (2003) made a comparison between Taiwan and countries in the Organization for Economic Co-operation and Development (OECD) and found that, in hospitals in Taiwan, the overall input items (the number of physicians and the number of beds) are lower than those in other countries; however, the hospitals had considerably high productivity, which led to average health-care quality and high health-care satisfaction.

Operational efficiency is enhanced through the effective management of operational costs, including outpatient medical expenses (*OPDE*), inpatient medical expenses (*IPME*), inpatient days (*IPD*), and overall healthcare costs (*HC*). Operating revenue is assessed using metrics such as medical revenue (*HR*); higher occupancy rates generally correlate with improved efficiency and contribute to a more favorable evaluation of the hospital's financial performance (Huang and Gao, 2023: Lin et al., 2022: Chien et al., 2014: Mckayand Deily, 2008: Clement et al, 2007: Deily and Mckay, 2006). Moreover, consideration of hose both financial and nonfinancial factors; hospitals with missions and goals yield higher performance.

4. Empirical Results

4.1 Descriptive Statistics

Table 2 presents a descriptive statistical analysis of the sample, differentiating hospitals by type into public hospitals (*n* = 348) and private hospitals (*n* = 922) for comparisons. Private hospitals

outperformed public hospitals in *HNPM*, indicating that private hospitals have greater operational and managerial flexibility, enabling them to adapt more quickly to market demands and enhance their efficiency and profitability. Furthermore, average daily patient-to-nurse ratio (*DPNR*), *OPDE, BIHE, BIHD*, and *HC* were lower among private hospitals, indicating that these hospitals exhibit superior cost control systems and financial performance.

Table 2: Descriptive Statistics

Distribution of Hospital Type									
	Total (n=1,270)			Public Hospitals (n=348)			Private Hospitals (n=922)		
Variables [a]	Mean	Median	Std. Dev	Mean	Median	Std. Dev	Mean	Median	Std. Dev
HNPM	0.0189	0.017	0.0604	0.0136	0.015	0.0524	0.0209	0.019	0.0631
DPNR	9.3932	9.400	1.7890	9.8756	9.900	1.6261	9.2108	9.200	1.8146
OPDE	14.1475	6.955	19.7817	14.6796	5.880	23.8507	13.9466	7.590	18.0200
BIHE	10.9863	4.685	16.9529	12.6728	5.090	20.4878	10.3498	4.525	15.3742
BIHD	14.6153	9.895	16.5588	18.5493	13.085	18.5510	13.1304	7.655	15.4946
HR	30.1689	13.940	43.9859	32.0598	13.465	51.7430	29.4552	14.120	40.6845
HC	27.4247	12.935	39.8663	28.8166	12.965	43.9749	26.8993	12.815	38.2134

[a] *HNPM: hospital profit margin = (medical revenue - medical costs) / medical revenue; DPNR: average daily patient-to-nurse ratio; OPDE: outpatient medical expenses (hundred million); BIHE: inpatient medical expenses (hundred million); BIHD: inpatient days (ten thousand days); HR: medical revenue (hundred million); HC: medical costs (hundred million).*

4.2 Correlation Matrix

Table 3 presents the Pearson correlation coefficients between variables. A significant and positive correlation exists between *HNPM* and *DPNR*, indicating that fewer patients per nurse are associated with faster patient recovery and shorter hospital stays, accelerating bed turnover and improving the hospital's overall efficiency. The results of a correlation analysis also revealed negative correlations between *HNPM* and *OPDE, BIHE, BIHD, HR,* and *HC*, indicating that effective management and optimization can help hospitals achieve sustainable development and higher profitability. Furthermore, the variance inflation factor values for the empirical results, presented subsequently, were all lower than 10 and within acceptable levels, indicating the absence of multicollinearity problems between the independent variables.

Table 3: Correlation Matrix

Variables [a,b]	*HNPM*	*DPNR*	*OPDE y*	*BIHE*	*BIHD*	*HR*	*HC*
HNPM	0.0221	1.0000					
DPNR	0.0608*	0.0183	1.0000				
OPDE	-0.1640*	0.1095*	-0.4149*	1.0000			
BIHE	-0.1775*	0.0796*	-0.2848*	0.6850*	1.0000		
BIHD	-0.1947*	0.0614	-0.0798	0.6848*	0.5943*	1.0000	
HR	-0.1410	0.1058*	-0.3704*	0.5485*	0.6310*	0.5685*	1.0000
HC	-0.1393*	0.0580	-0.3662*	0.2333	0.5280*	0.5783*	0.4902*

[a] *HNPM: hospital profit margin = (medical revenue - medical costs) / medical revenue; DPNR: average daily patient-to-nurse ratio; OPDE: outpatient medical expenses (hundred million); BIHE: inpatient medical expenses (hundred million); BIHD: inpatient days (ten thousand days); HR: medical revenue (hundred million); HC: medical costs (hundred million).*

[b] Pearson correlations in the lower diagonal. * Indicates significance at the 5 percent level.

4.3 Multivariate Analysis

4.3.1 Hospital Profit Margin and Average Daily Patient-to-Nurse Ratio: Public Hospitals and Private Hospitals

This study used multiple regression analysis methods to test the hypotheses and used the ordinary least squares method to make the relevant estimations. The results of tests on whether differences in *HNPM* due to average *DPNR* varied between public hospitals and private hospitals are presented in

Table 4. Private hospitals' *DPNR* and *HNPM* (hereinafter *"HPNM I")* met the 1% threshold of significance ($t = 3.46$, $p < 0.01$); this may be because private hospitals are more likely to implement flexible and innovative operational structures that employ incentives and advanced technologies, enabling the hospital to manage patient-to-nurse ratio more effectively. *HNPM I* was negatively correlated with *BIHE* and *HC* and positively correlated with *OPDE* because private hospitals often provide added-valued services such as luxury hospital rooms and additional convenient facilities to increase total revenue from hospital stays.

Table 4: Hospital Profit Margin and Average Daily Patient-to-Nurse Ratio:

Public Hospitals and Private Hospitals

Variables [a]	Pred.Sign	Total		Public Hospitals		Private Hospitals	
		Coef.	*t*-value [b]	Coef.	*t*-value	Coef.	*t*-value
CONSTANT		-0.0254	-2.53**	-0.0390	-1.73*	-0.0265	-2.30**
DPNR	−/+	0.0039	3.77***	0.0047	2.18*	0.0041	3.46***
OPDE	−/+	0.0014	2.24**	0.0015	1.42	0.0013	1.67*
BIHE	−/+	-0.0035	-4.49***	-0.0015	-1.22	-0.0034	-3.26**
BIHD	−/+	0.0006	2.10**	0.0008	2.13**	0.0004	0.98
HR	−/+	0.0030	6.15***	0.0026	2.24**	0.0035	5.86***
HC	−/+	-0.0027	-7.37***	-0.0033	-2.76***	-0.0030	-7.03***
Adj. R^2		27.16%		16.42%		17.89%	
Nobs.		1,270		348		922	

[a] *DPNR: average daily patient-to-nurse ratio; OPDE: outpatient medical expenses (hundred million); BIHE: inpatient medical expenses (hundred million); BIHD: inpatient days (ten thousand days); HR: medical revenue (hundred million); HC: medical costs (hundred million).*

[b] Asterisks *, **, *** indicate two-tailed significance at the 0.10, 0.05, and 0.01 levels, respectively.

4.3.2 Hospital Profit Margin and Average Daily Patient-to-Nurse Ratio: Public Hospitals and Private Hospitals- Hospital Level

The empirical analysis of *DPNR* and *HNPM* further differentiated public hospitals and private hospitals into medical centers, regional hospitals, and district hospitals. Public hospitals only exhibited a significant and positive correlation between *DPNR* and *HNPM* at the district level ($t = 4.89$, $p < 0.01$), whereas private hospitals exhibited significant and positive correlations between *DPNR* and *HNPM* at every level.

Among public hospitals, district hospitals are typically frontline hospitals with limited resources. Increasing the patient-to-nurse ratio in such hospitals may improve resource utilization efficiency and lower operating costs; however, greater numbers of nurses may lead to improved service quality and patient satisfaction, increasing hospital profitability. The medical services provided at medical centers and regional hospitals are typically specialized and complex, and higher patient-to-nurse ratio may have an adverse effect on service quality and patient safety, offsetting improvements in profitability from reductions in nursing staff. Because medical centers and regional hospitals must provide high-quality nursing, changes to patient-to-nurse ratio may not have as pronounced an effect on profits as in district hospitals.

Private hospitals tend to be market-oriented and profit-oriented, and are consequently more flexible in using nursing resources to enhance their operational efficiency. Whether they are medical centers, regional hospitals, or district hospitals, private hospitals tend to ensure the efficient utilization of resources in providing nursing services. Assuming that a hospital can maintain its quality of service, high patient-to-nurse ratio may suggest that a hospital is capable of providing services to more patients at a lower cost, resulting in higher profitability. Furthermore, private hospitals tend to implement tighter cost control and operational management policies that enable them to derive greater economic benefits from higher patient-to-nurse ratio.

Table 5: Hospital Profit Margin and Average Daily Patient-to-Nurse Ratio: Public Hospitals and Private Hospitals-Hospital Level

| | | Public Hospitals | | | | | | Private Hospitals | | | | | |
| | | Medical Centers | | Regional Hospitals | | District Hospitals | | Medical Centers | | Regional Hospitals | | District Hospitals | |
Variables [a]	Pred. Sign	Coef.	*t*-value [b]	Coef.	*t*-value	Coef.	*t*-value	Coef.	*t*-value	Coef.	*t*-value	Coef.	*t*-value
CONSTANT		-0.0565	-0.98	0.0139	0.79	-0.1473	-4.51***	-0.1324	-2.97***	-0.0487	-2.94***	-0.0191	-1.11
DPNR	+/−	0.0064	0.82	-0.0001	-0.05	0.0132	4.89***	0.0158	2.69***	0.0059	3.29***	0.0034	1.88*
OPDE	+	0.0002	0.26	0.0038	4.75	0.0001	0.03	-0.0012	-1.52	-0.0009	-0.77	0.0062	4.15***
BIHE	+	-0.0004	-0.37	-0.0040	-3.05***	-0.0040	-0.74	0.0002	0.22	-0.0021	-1.57	-0.0088	-3.05***
BIHD	+/−	0.0000	0.05	0.0013	4.41***	0.0027	4.31***	-0.0002	-0.40	0.0007	1.78*	-0.0003	-0.23
HR	−	0.0017	2.86***	0.0029	2.29**	0.0619	12.19***	0.0051	7.66***	0.0057	7.63***	0.0020	2.04**
HC	+	-0.0018	-2.99***	-0.0035	-3.01***	-0.0630	-12.18***	-0.0046	-11.02***	-0.0049	-8.19***	-0.0020	-2.83***
Adj. R^2		57.03%		19.33%		60.33%		66.54%		21.45%		7.10%	
Nobs.		42		173		133		91		375		456	

[a] DPNR: average daily patient-to-nurse ratio; OPDE: outpatient medical expenses (hundred million); BIHE: inpatient medical expenses (hundred million); BIHD: inpatient days (ten thousand days); HR: medical revenue (hundred million); HC: medical costs (hundred million).
[b] Asterisks *, **, *** indicate two-tailed significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table 6: Hospital Profit Margin and Average Daily Patient-to-Nurse Ratio: Hospital Level - 2019 and 2020

| | | 2020 | | | | | | 2021 | | | | | |
| | | Medical Centers | | Regional Hospitals | | District Hospitals | | Medical Centers | | Regional Hospitals | | District Hospitals | |
Variables [a]	Pred. Sign	Coef.	*t*-value [b]	Coef.	*t*-value	Coef.	*t*-value	Coef.	*t*-value	Coef.	*t*-value	Coef.	*t*-value
CONSTANT		-0.0664	-0.36	-0.0169	-0.43	-0.0326	-1.26	-0.2389	-1.45	-0.0425	-1.28	-0.0126	-0.71
DPNR	+/−	0.0105	0.43	0.0033	0.81	0.0043	1.65	0.0341	1.54	0.0067	1.87*	0.0024	1.35
OPDE	+	-0.0035	-1.50	0.0035	1.51	-0.0053	-2.07**	-0.0001	-0.05	0.0010	0.45	-0.0025	-1.45
BIHE	+	-0.0033	-1.04	0.0007	0.29	-0.0052	-1.14	0.0007	0.24	-0.0012	-0.48	-0.0014	-0.49
BIHD	+/−	0.0007	0.32	0.0009	1.47	0.0025	2.35**	-0.0006	-0.22	0.0005	0.75	0.0009	1.21
HR	−	0.0051	2.35**	0.0077	4.48***	0.0685	14.50***	0.0012	0.73	0.0085	4.18***	0.0438	11.20***
HC	+	-0.0027	-2.65**	-0.0108	-6.69***	-0.0706	-14.77***	-0.0013	-1.09	-0.0095	-5.28***	-0.0452	-11.29***
Adj. R^2		0.1849		0.3821		67.26%		-7.31%		29.86%		56.06%	
Nobs.		19		79		122		19		79		120	

[a] DPNR: average daily patient-to-nurse ratio; OPDE: outpatient medical expenses (hundred million); BIHE: inpatient medical expenses (hundred million); BIHD: inpatient days (ten thousand days); HR: medical revenue (hundred million); HC: medical costs (hundred million).
[b] Asterisks *, **, *** indicate two-tailed significance at the 0.10, 0.05, and 0.01 levels, respectively.

4.4. Additional Tests: Hospital Profit Margin and Average Daily Patient-to-Nurse Ratio: Hospital Level - 2019 and 2020

The COVID-19 pandemic posed severe challenges to hospitals and medical personnel worldwide in 2020 and 2021. Increased health insurance premiums for Taiwan's citizens imposed in 2021 have also raised concerns. Table 6 presents the results of the empirical analysis of *DPNR* and *HNPM* in 2020 and 2021. The results indicate that in 2020—the beginning of the epidemic in Taiwan—numerous hospitals were engaged in response and adaptation, which enabled private hospitals in 2021 to develop clearer operational strategies for the new normal; private regional hospitals, in particular, faced greater demands for medical services and therefore had to improve their operational efficiency. By 2021, private regional hospitals may have already implemented operational strategies such as optimized allocation of nurses or adjustments to the patient-to-nurse ratio to provide services to more patients and maintain profitability. By contrast, public hospitals had to focus on responding to the epidemic to benefit society, which may have limited their flexibility in adjusting patient-to-nurse ratio to enhance profitability.

5. Conclusion and Recommendations

This study explored the correlation between the profitability of public and private hospitals in Taiwan and their average daily patient-to-nurse ratio, analyzing variations across different hospital types. The study results revealed significant and positive correlations between patient-to-nurse ratio and profitability among private hospitals at every level. By contrast, a significant correlation was only observed in public hospitals at the district level. Furthermore, private hospitals typically outperformed public hospitals in profitability, which may be due to their operational strategies and management models. During the epidemic in 2020, the correlation between patient-to-nurse ratio and profitability was not marked among public hospitals, whereas a positive correlation between these variables was maintained among private hospitals. This finding may be explained by public hospitals prioritizing patient care and responsibility over profit, whereas private hospitals focused more on profit.

On the basis of these findings, this study suggests that the government draft reasonable and comprehensive patient-to-nurse ratio guidelines that account for differences between hospitals at varying levels and learn from examples overseas; these guidelines should also be revised on the basis of factors such as the number of hospital beds, the severity of the patient conditions, and the professional experience of nurses. Furthermore, public hospitals should strive to optimize their resource allocation and management models to enhance efficiency and improve profitability. The government can enhance planning and cultivate medical personnel resources to resolve the nurse staffing shortage.

The association between hospital profitability and patient-to-nurse ratio in this study was examined only among public and private hospitals in Taiwan using publicly available data, which may be incomplete or contain errors. Future studies can explore the effects of hospital scale on patient-to-nurse ratio and profitability to offer a more comprehensive understanding of the effects of patient-to-nurse ratio on the quality of medical services, hospital profitability, and the devl industry thatnslated into policy suggest.

References

Aiken, L. H. (2002). Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *JAMA*, *288*(16), 1987-1993. http://doi.org/10.1001/jama.288.16.1987

Aiken, L. H., Sloane, D. M., Cimiotti, J. P., Clarke, S. P., Flynn, L., Seago, J. A., Spetz, J., & Smith, H. L. (2010)

Implications of the California nurse staffing mandate for other states. *Health Services Research*, *45*(4), 904-921. http://doi.org/10.1111/j.1475-6773.2010.01114.x

Aiken, L. H., Sloane, D. M., Bruyneel, L., Heede, K. V. D., & Sermeus, W. (2013). Nurses' reports of working conditions and hospital quality of care in 12 countries in Europe. *International Journal of Nursing Studies*, *50*(2), 143-153. http://doi.org/10.1016/j.ijnurstu.2012.11.009

Aiken, L. H., Sloane, D. M., & Bruyneel, L. (2014). Nurse Staffing and Education and Hospital Mortality in Nine European Countries: A Retrospective Observational Study. *The Lancet*, 383 (9931), 1824-1830. https://doi.org/10.1016/S0140-6736(13)62631-8.

Alghamdi, M. G. (2016). Nursing workload: A concept analysis. *Journal of Nursing Management*, *24*(4), 449-457. https://doi.org/10.1111/jonm.12354

Asakura, K., Asakura, T., Satoh, M., Watanabe, I., & Hara, Y. (2020). Health indicators as moderators of occupational commitment and nurses' intention to leave. *Japan Journal of Nursing Science*, *17*(1), e12277. https://doi.org/10.1111/jjns.12277

Berger, M., Sommersguter-Reichmann, M., & Czypionka, T. (2020). Determinants of soft budget constraints: How public debt affects hospital performance in Austria. *Social Science and Medicine*, *249*, 1-11. https://doi.org/10.1016/j.socscimed.2020.112855

Butler, M., Collins, R., Drennan, J., Halligan, P., O'Mathuna, D.P., Schultz, T.J., Vilis, E. (2011). Hospital Nurse Staffing Models and Patient And Staff-Related Outcomes. *Cochrane Database Systemic Review*, 6 (7), https://doi.org/10.1002/14651858.CD007019.pub2

Chang, Y. P., Lee, D. C., Chang, S. C., Lee, Y. H., & Wang, H. H. (2019). Influence of work excitement and workplace violence on professional commitment and turnover intention among hospital nurses. *Journal of Clinical Nursing*, *28*(11-12), 2171-2180. https://doi.org/10.1111/jocn.14808 (Original work published in Chinese)

Chang, C. M., & Lin, H. F. (2020). A Study on the Turnover Behavior Factors and Workload of Nursing Staff. *Chang Gung Nursing*, 32 (1), 18-31. https://doi.org/10.6386/CGN.202103_32(1).0002

Fan, C. Y. (2021). Application of blended teaching in nursing courses. *Chang Gung Medical Newsletter*, *37*(3), 14-15. https://www.cgmh.org.tw/tw/News/ArticleInfo/A1/D1AJ33G001

Gao, Q. L., Lin, C. S., & Huang, Y. T. (2022). Effects of patient-to-nurse ratios, hospital management, and health-care quality indicators in Taiwan. *Journal of Business and Economic Management* , 10(4), 72-83. https://doi.org/10.15413/jbem.2022.0103

Huang, Y. T., Gao, Q. L. (2023). Hospital Financial Performance Based on Nurse-Patient Ratio and Tw-Drgs in The Post-Pandemic Era: A Comparative Analysis of Taiwan Before and After COVID-19. *International Clinical and Medical Case Reports Journal,* 2(1), 1-20.

Hung, S. Y., & Wu, T. H. (2019). An extended dea model for hospital performance evaluation considering medical manpower shortage and quality of care: taking acute care hospitals in Taiwan as examples. *Journal of Business Administration*, *44*(4), 57-89. https://doi.org/10.3966/102596272019120444003 (Original work published in Chinese)

Jones, G. (2009). A staffing ratio customised to meet patient needs can be a flexible friend. *Nursing Standard*, 23(48), 32-32. http://doi.org/10.7748/ns.23.48.32.s41

Karim, S. A., Pink, G. H., Reiter, K. L., Holmes, G. M., Jones, C. B. & Woodard, E. K. (2018). The effect of the magnet recognition signal on hospital financial performance. *Journal of Healthcare Management*, *63*(6): e131-e146. https://doi.org/10.1097/JHM-D-17-00215

Lanz, J. J., & Bruk-Lee, V. (2017). Resilience as a moderator of the indirect effects of conflict and workload on job outcomes among nurses. *Journal of advanced nursing*, *3*(12), 2973-2986. https://doi.org/10.1111/jan.13383

Lee, C. H. (2003). Efficiency of health care system in Taiwan. *Taiwan Journal of Public Health*, *22*(2), 89-96. https://doi.org/10.6288/TJPH2003-22-02-04

Liang, Y. W., Chen, W. Y., Lee, J. L., & Huang, L. C. (2012). Nurse staffing, direct nursing care hours and patient mortality in Taiwan: The longitudinal analysis of hospital nurse staffing and patient outcome study. *BMC Health Services Research*, *12*(1), 1-8. https://doi.org/10.1186/1472-6963-12-44

Lin, C. C., Huang, Y. T., Gao, Q. L., & Lin, C. S. (2022). An Analysis of the Correlation between Financial Performance and the Nurse-Patient Ratio: Evidence from Different Hospital Levels in Taiwan. *International Review of Accounting, Banking and Finance*, 14(1)(Spring), 27-40.

McKay, N.L., Deily, M.E. (2008). Cost inefciency and hospital health outcomes. *Health Economics*, 17, 833-848. https://doi.org/10.1002/hec.1299

Mennicken, R., Kuntz, L., & Schwierz, C. (2011).The trade-of between efciency and quality in hospital departments. *Journal of Health Organization and Management*, 25, 564–577. https://doi.org/10.1108/1477726111 1161897 2.

Ministry of Health and Welfare, Taiwan, ROC. (2019). Provide comprehensive labor rights protection for medical personnel. https://www.mohw.gov.tw/cp-4257-47453-1.html

PricewaterhouseCoopers' Health Research Institute. (2007). What Works: healing the healthcare staffing shortage. Retrieved from http://council.brandeis.edu/pubs/Prince14/PwC%20Shortage%20Report.pdf

Schubert, M., Clarke, S. P., Aiken, L. H., & de Geest, S. (2012). Associations between rationing of nursing care and inpatient mortality in Swiss hospitals. *International Journal for Quality in Health Care*, *24*(3), 230-238. https://doi.org/10.1093/intqhc/mzs009

Schubert, M., Clarke, S. P., Aiken, L. H., & de Geest, S. (2012). Associations between rationing of nursing care and inpatient mortality in Swiss hospitals. *International Journal for Quality in Health Care*, *24*(3), 230-238. https://doi.org/10.1093/intqhc/mzs009

Wang, J. L., Chiou, S. T., Chien, L. Y., & Huang, N. (2017). Factors associated with intention to leave the organization or to leave the profession among clinical nurses in Taiwan. *Journal of Healthcare Management*, *18*(2), 105-123. http://doi.org/10.6174/JHM2017.18(2).105

Weiss, M. E., Yakusheva, O., & Bobay, K. L. (2011). Quality and cost analysis of nurse staffing, discharge preparation, and postdischarge utilization. *Health Services Research*, *46*(5), 1473-1494. https://doi.org/10.1111/j.1475-6773.2011.01267.x

Yan, Y. H., & Yang, C. W. (2013). Hospital Governance Mechanisms and Hospital Governance Effectiveness. *NTU Management Review*, 23 (S1), 57-82. https://doi.org/10.6226/NTURM2013.SEP.OG018