Research Article

A Ratio Model for Benchmarking and Forecasting Hospital Facility Operating Expenses in Washington State: Plant, Property, and Equipment as a Key Metric

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ABSTRACT

The purpose of this research is to evaluate the feasibility of using ratios between common hospital utilization, or financial metrics, and facility operating expenses as a model for budget forecasting and benchmarking. The researchers reviewed each U.S. state's department of health website for the availability of hospital utilization reports, and financial statements, and assessed the strength of association between these metrics and hospital facility operating expenses. Although many states report some hospital utilization and financial metrics to the public, Washington was the only state to report these utilization metrics and financial statements along with detailed cost information for facility operations. Correlations were used to evaluate the strength of the relationship between various utilization and financial metrics with facility operating expenses at Washington hospitals; this research shows there is moderate to strong associations between facility operating expenses and several utilization metrics including available beds, admissions, and gross square feet (GSF). Additionally, this research shows there is a strong association between hospital facility operating expenses and plant, property, and equipment (PPE), a common balance sheet value. The researchers illustrate, via the development of a ratio model, how health care facility and finance professionals can benchmark or rationalize facility operating expenses to support overall hospital profit margin impact. Moreover, this ratio model can be used to predict or forecast future operating expenses for planned capital construction projects to better understand total facility lifecycle costs.

Introduction

With increasing pressures to improve profit margins, healthcare organizations must effectively manage expenses to ensure long-term financial wellbeing in meeting the sizable and growing demand for healthcare within the communities they serve (Deloitte, 2017; BLS, 2014). Physical facilities managed by healthcare organizations, including hospitals and clinics, are critical to supporting many important healthcare services (FEMA, 2019). The operation and maintenance of these critical facilities, however, is a major expense that must be accurately budgeted and forecasted to meet accounting best-practices, justify spend, and positively impact hospitals' financial performance (Vraciu, 1979; King et al., 2012; Markin, 1992). Nevertheless, there are limited models available to aid facility and finance professionals in budgeting, forecasting, and benchmarking hospital facility operating expenses.

The most common metric used in establishing facility operating expense benchmarks is building gross square feet (GSF) (NASEM, 2019 pp. 64; IFMA, 2020). Yet using the GSF metric within a ratio model can be problematic as this information is typically not publicly available, space calculations can be inconsistent, and it is unclear if there is any significant correlation between GSF and hospital facility operating expenses (GSA, 2012; NASEM, 2019;). The purpose of this research, therefore, is to explore publicly available utilization and financial metrics and their strength of association to hospital facility operating expenses in developing a reliable and easy-to-use ratio model for budget forecasting and benchmarking. As Washington is the only state to publicly report hospital utilization and financial statements, along with facility operating expenses, the ratio model developed from this research may be unreliable beyond the United States Northwest region. In addition to this geographic limitation, this research focuses on hospital property types within the healthcare industry. Future research on the strength of association between publicly available metrics and facility operating expenses within other property types and industries is warranted. Understanding associations between publicly available metrics and overall hospital operating expense is also merited.

Literature review

An extensive literature review found limited published research on models used for budget forecasting and benchmarking hospital facility operating expenses. The National Academies of Science, Engineering, and Medicine produced a report for the Veterans Health Administration that recommended a model for facilities staffing (NASEM, 2019). This hospital facility staffing model was developed through committee feedback; this committee recommended building square feet, managed acres of land, building age, and building condition as key metrics. Ancillary metrics considered for a facility staffing model included deferred maintenance, climate zone, capital investment, projects under construction, dollars of construction, building complexity, equipment value, building height, and facility workload. Facility expenses were not part of this model.

The International Facility Management Association, in collaboration with the American Society for Healthcare Engineering and the Canadian Healthcare Engineering Society, produced hospital facilities benchmark reports in 2010, 2013, and most recently in 2020 from members' self-reported survey data (IFMA, 2020). This report provides a ratio model for hospital facility staffing within engineering and environmental services work groups using GSF, admissions, available beds, and property, plant, and equipment (PPE) as key metrics. A ratio model for total hospital facility operating expenses was not included, although average facility operating costs for maintenance, utilities, environmental services, and laundry were benchmarked using the GSF metric.

Methodology

There is insufficient empirical data to understand strength of association between publicly available hospital metrics and facility operating expenses. To identify commonly used and available hospital utilization and financial metrics, literature was reviewed along with each US state's department of health website. Many states publicly reported one or more hospital utilization metrics including available beds, patient days, licensed beds, discharges, admissions, and GSF. Key word searches, to find hospital utilization information on states' department of health websites, included the following: hospital utilization, data, profiles, survey, services, and annual report. Twelve states reported available hospital beds (Washington, California, Minnesota, Illinois, Michigan, Indiana, Ohio, Texas, South Carolina, North Carolina, Pennsylvania, and Massachusetts). Eleven states reported patient days or length of stay (Washington, California, Montana, Minnesota, Illinois, Indiana, Texas, Mississippi, West Virginia, Pennsylvania, Massachusetts). Ten states reported licensed hospital beds (Washington, California, Minnesota, Illinois, Michigan, Indiana, South Carolina, West Virginia, Pennsylvania, and Massachusetts). Nine states reported hospital discharges (California, Montana, New Mexico, Indiana, Mississippi, West Virginia, Delaware, Pennsylvania, and Vermont). Seven states reported hospital admissions (Washington, Minnesota, Illinois, Texas, Mississippi, Pennsylvania, Massachusetts). One state reported hospital GSF (Washington).

TABLE 1.—Commonly Reported Hospital Utilization Metrics by US States

Metric	Percentage of states reporting
Available beds	24%
Patient days	22%
Licensed beds	20%
Discharge	18%
Admissions	14%
Plant, property, and equipment	14%
Gross square feet	< 1%

Some states provided hospital financial information. Key word searches, to find hospital financial information on states' department of health websites, included the following: financial, income, balance sheet, statement, and annual report. Seven states reported PPE values (Washington, Oregon, California, West Virginia, Delaware, New Jersey, and Connecticut). PPE was identified as a metric of interest as it accounts for long-term tangible assets including buildings, leasehold improvements, land, fixtures, furniture, and equipment (GAO, 2002). Washington, however, was the only state to publicly report detailed cost account information at the facility level: plant, housekeeping, cafeteria and dietary, laundry and linen, transportation, and biomedical cost centers. Only plant and housekeeping cost centers were evaluated for this research as they are largest and most common externally benchmarked expenses within healthcare facility management (IFMA, 2020). Key utilization and financial metrics were analyzed against facility operating expenses for Washington hospitals to understand strength of correlation and develop a ratio model for budget forecasting and benchmarking.

Data Analysis and Results

Of the 22 states that reported one or more hospital utilization metric, including PPE values, the most common were available beds, patient days, licensed beds, discharges, admissions, PPE, and GSF (Table 1). Only a single state provided GSF data, suggesting this information is not, generally, publicly available. Washington State had 94 community hospitals report utilization and PPE metrics in 2018, for available beds average at 138, patient days at 34,872, admissions at 6,566, PPE values at $233,749,706, and GSF at 366,434 (Table 2). Most (71%) hospitals in Washington State have an area less than 500,000 GSF (Figure 1), mirroring the national average of most U.S. hospitals having a size less than 500,000 GSF (Call et al, 2018).

TABLE 2.—Washington State Hospitals Annual Utilization and Plant, Property, and Equipment Averages

Metric	Percentage of hospitals reporting	Average
Available beds	88%	138
Patient days	88%	34,872
Admissions	99%	6,566
Plant, property, and equipment	99%	$223,749,706
Gross square feet	100%	366,434

TABLE 3.—Washington State Hospitals Annual Plant Operating Expense Averages

Plant cost accounts	Average
Maintenance	$2,196,960
Utilities	$1,928,041
Salaries, wages, and benefits	$1,741,221
Depreciation	$1,677,988
Other*	$447,464
Total plant operating expense	$7,991,674

* Includes professional fees, supplies, purchased services—other, leases/rentals, other direct expenses, and recoveries.

The 2018 financial reports from Washington hospitals include information at the Plant and Housekeeping cost centers levels. These cost centers include the following roll-up accounts to generate total adjusted direct expense: salaries & wages, employee benefits, professional fees, supplies, purchased services – utilities, purchased services – other, depreciation, leases/rentals, other direct expenses, and recoveries; purchased services – other for the plant cost center are called maintenance hereafter. As recoveries adjusted direct spend by less than one percent, and plant and housekeeping cost centers did not report any indirect expenses, adjusted direct expense is called total operating expense hereafter. A summary of key account averages is provided for the 90 hospitals that reported plant costs (Table 3) and the 84 hospitals that reported housekeeping costs (Table 4).

Pearson Correlation Coefficients were performed between hospital utilization metrics, including PPE values, and facility operating expenses for plant and housekeeping (Tables 5 - 6) to assess correlation strength as measured by Cohen (1988): strong = $r > .5$, moderate = r .3 - .5, and weak = $r < .3$; statistical significance is achieved with $p < .05$. The GSF size category (large and small hospitals) was created as an initial exploratory analysis of the data that indicated hospitals under 100,000 GSF exhibited a different correlational pattern than facilities greater than 100,000GSF.

For large hospitals, PPE values have a strong correlation to total plant and housekeeping operating expenses, including all roll-up expenses with the exception of a moderate PPE correlation with "other – housekeeping" (Table 6); available beds, patient days, admissions, and GSF utilization metrics have a strong correlation to total plant operating expense, including all roll-up expenses, with the exception of GSF moderate correlation with the "other – plant" roll-up expense. These utilization metrics also have a

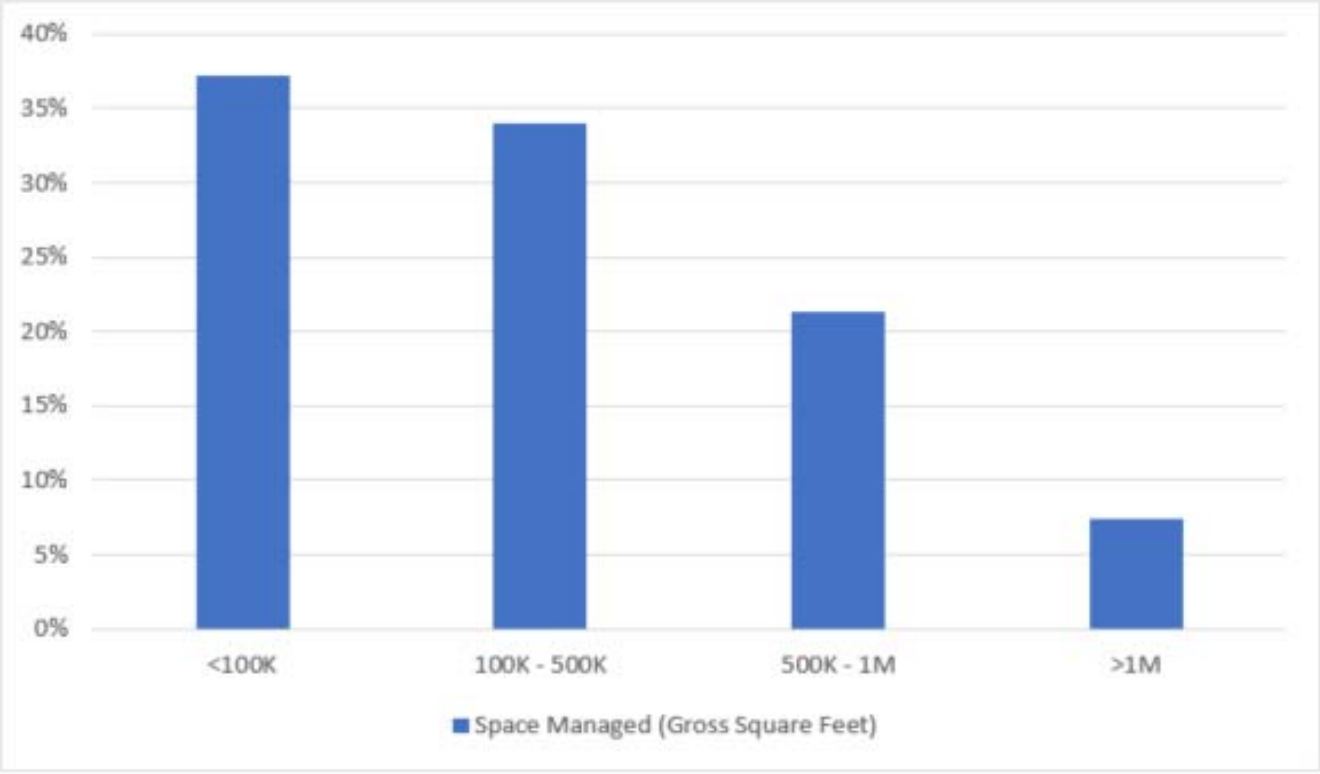

FIGURE 1.—Distribution of GSF of Sample Hospitals.

TABLE 4.—Washington State Hospital Annual Housekeeping Operating Expense Averages

Housekeeping cost accounts	Average
Salaries, wages, and benefits	$1,933,825
Supplies	$364,619
Other*	$325,107
Total housekeeping operating expense	$2,623,551

* Includes professional fees, purchased services—other, leases/rentals, other direct expenses, and recoveries.

strong correlation to total housekeeping operating expense, but the majority of roll-up costs have moderate or weak correlations. This data suggests that these utilization metrics should be reliable sources in developing a ratio model for predicting hospital facility operating expenses at large hospitals; however, considering correlations strengths for facility expense totals and roll-up expenses, PPE should be considered the key metric in the development of a ratio model for forecasting large hospital facility operating expenses.

For small hospitals, only PPE values and admissions have strong correlations to both total plant and housekeeping operating expenses; roll up expenses for plant are strong with the exception a weak and moderate correlation to "depreciation", respectively (Table 5). Available beds, admissions, GSF, and PPE value have a strong correlation to total housekeeping operating expenses, but only PPE has a majority of housekeeping roll-up expenses with strong correlations. This data analysis again suggests, even at small hospitals, PPE values should be considered a key metric in developing a ratio model for forecasting facility operating expenses. Nevertheless, the admission metric is also reliable within a small hospital model.

Discussion

A ratio model for forecasting or benchmarking hospital facility operating expenses in Washington State is provided in Tables 8 and 9. Ratios were calculated by dividing the average annual operating expenses by the average annual hospital utilization or financial metric values. For example, the average annual plant operating expense for Washington State hospitals was $7,991,674 (Table 3) with average balance sheet PPE dollar value at 223,749,706 (Table 2). Consequently, the ratio of total plant operating expense to admissions is $0.036 (Table 7). With a strong correlation between total plant operating expenses and PPE values, a reliable prediction can be made for a hospital's total plant operating expense if the PPE value is known. Operating expense roll-up accounts also have a unique ratio for each metric. This allows expense forecasts to be made independent from other roll-up costs. However, caution should be used when predicting roll-up costs independently as strength of association varies by metric.

Although other utilization metrics have moderate to strong association to plant and housekeeping operating expenses, it can be argued that PPE is the most reliable metric to reference in this ratio model due to its strength of correlation for both total plant and housekeeping operating expenses and their subsequent roll-up expenses. Furthermore, although not always publicly available, is a standard and consistently measured value found in most organization's balance sheet. If PPE is not available, admissions is another reliable metric based on correlation strengths, followed by GSF, available beds, and patient days.

Table 9 provides an illustration for notional application on this ratio to forecast hospital plant operating expenses using PPE. The illustration assumes a hospital has a PPE value of $350,000,000. The PPE multipliers for each plant cost account, based on the ratios provided in the ratio model (Table 7), are then calculated to benchmark the hospital's annual operating expenses, or forecast a hospital's future annual operating expenses if the facility is under development with assets not yet in service (i.e. "construction in progress"). This same application for forecasting facility operating expenses can be used for the other utilization metrics where ratios are provided in the model (Table 7 - 8).

TABLE 5.—Pearson Correlation Coefficients Between Key Washington State Utilization/Financial Metrics and Facility Operating Expenses for Large Hospitals (> 100K SF)

Cost accounts	Available beds	Patient days	Admissions	Gross square feet	Property, plant, and equipment
Total plant operating expense	.777	.791	.758	.788	.829
Maintenance	.628	.656	.574	.456	.563
Utilities	.685	.736	.674	.849	.864
Salary, wages, and benefits	.699	.726	.636	.626	.850
Depreciation	.689	.522	.632	.725	.622
Other	.662	.700	.712	.494	.516
Total housekeeping operating expense	.868	.907		.849	.831
Salary, wages, and benefits	.842	.870	.807	.772	.726
Supplies	.285	.325	.251	.323	.706
Other	.267	.283	.277	.431	.354

Notes. All correlations for plant operating expenses are significant (2-tailed) at $p < .001$, $N = 55$. All correlations for housekeeping operating expenses are significant (2-tailed) at $p < .05$, $N = 50$.

TABLE 6.—Pearson Correlation Coefficients Between Key Washington State Utilization/Financial Metrics and Facility Operating Expenses for Small Hospitals

Cost accounts	Available beds	Patient days	Admissions	Gross square feet	Property, plant, and equipment
Total plant operating expense	.411	.242	.720	.430	.634
Maintenance	.399	.215	.669	.360	.562
Utilities	.285	.148	.468	.744	.546
Salary, wages, and benefits	.274	.128	.651	.456	.662
Depreciation	.405	.383	.546	–.200	–.020
Other	.414	.335	.670	.314	.641
Total housekeeping operating expense	.552	.382	.711	.666	.635
Salary, wages, and benefits	.392	.215	.605	.724	.604
Supplies	.435	.334	.485	.393	.661
Other	.393	.477	.383	–.071	–.049

Notes. All correlations for plant operating expenses are significant (2-tailed) at $p < .05$, $N = 25$. All correlations for housekeeping operating expenses are significant (2-tailed) at $p < .05$, $N = 35$.

TABLE 7.—Ratio Model for Predicting Hospital Plant Operating Expenses in Washington State

	Ratio for operating expense to metric				
Plant cost account	Plant, property, and equipment	Admission	Gross square feet	Available bed	Patient day
Maintenance	$0.010*	$341*	$6.11	$16,215	$64.17
Utilities	$0.009*	$292	$5.23*	$13,899	$55.00
Salaries, wages, and benefits	$0.008*	$268*	$4.80	$12,740	$50.42
Depreciation	$0.007	$255*	$4.58	$12,161	$48.12
Other	$0.002*	$61*	$1.09	$2,896	$11.46
Total operating expense	$0.036*	$1,217*	$21.81	$57,911	$229.17

* Strong correlation ($r > .5$).

TABLE 8.—Ratio Model for Predicting Hospital Housekeeping Operating Expenses in Washington State

	Ratio for operating expense to metric				
Housekeeping cost account	Plant, property, and equipment	Admission	Gross square feet	Available bed	Patient day
Salaries, wages, and benefits	$0.009*	$296*	$5.30*	$14,068*	$55.67
Other	$0.002	$56	$1.00	$2,662	$10.53
Supplies	$0.001*	$48	$0.86	$2,281	$9.03
Total operating expense	$0.012*	$400*	$7.16*	$19,011*	$75.23

* Strong correlation ($r > .5$).

TABLE 9.—Notional Application of Ratio Model for Predicting Hospital Plant Operating Expenses in Washington State Using Plant, Property, and Equipment (PPE) Multiplier

Hospital metric: PPE	Cost account	Multiplier (PPE ratio)	Formula	Annual operating expense (prediction)
$350,000,000	Maintenance	$0.010	= 0.010 * 350,000,000	$3,500,000
	Utilities	$0.009	= 0.009 * 350,000,000	$3,150,000
	Salaries, wages, and benefits	$0.008	= 0.008 * 350,000,000	$2,800,000
	Depreciation	$0.007	= 0.007 * 350,000,000	$2,450,000
	Other	$0.002	= 0.002 * 350,000,000	$700,000
	Total plant operating expense	$0.036	= 0.036 * 350,000,000	$12,600,000

Conclusion

This research shows there is a strong correlation between hospital facility operating expenses and plant, property, and equipment (PPE), a common balance sheet value. As a result, an easy-to-use and reliable ratio model was developed to forecast or benchmark hospital facility operating expenses by referencing PPE, and other hospital utilization metrics. This ratio model can support health care facility professionals in measuring, managing, and

rationalizing facility operating expenses in driving toward greater efficiencies and overall hospital profit margin impact. Additionally, this ratio model can be used to predict or forecast future operating expenses for planned capital construction projects to better understand total facility lifecycle costs. Future research is warranted to understand correlations between publicly available metrics and expenses for other hospital cost centers. Future research is needed to understand correlations between plant, property, and equipment values to facility cost centers for industries outside of healthcare.

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