ORIGINAL ARTICLE

Comparison of nursing staffing ratio in selected safety net and non-safety net hospitals in the United States

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ABSTRACT

Objective: This study investigated the differential association between nurse staffing in safety-net hospitals (SNHs) and non-SNHs.
Methods: This retrospective cross-sectional study utilized multilevel mixed-effects linear regression models and included data from 1,228 hospitals.
Results: The results showed that SNHs in the top quartile of disproportionate share hospital (DSH) payments had lower nurse staffing ratios (β = -0.86; p-value < .001), indicating a lower nurse-to-patient ratio, compared to non-SNHs. This association persisted even after adjusting for the county and hospital factors.
Conclusions: These findings suggest that nurse staffing in SNHs may be impacted by the financial challenges associated with providing uncompensated care to vulnerable populations. Understanding the differences in nurse staffing between SNHs and non-SNHs can provide insights for improving quality of care. Further research is required to explore the impact of nurse staffing on patient outcomes in SNHs.

Key Words: Nurse staffing ratio, Safety-net hospitals, Hospital characteristics, Community hospital, Quality care

1. INTRODUCTION

Patients who are unable to pay for medical services may seek care at hospitals with a disproportionate share of uncompensated care, also known as safety-net hospitals (SNHs). Uncompensated care relates to the lack of reimbursement received by hospitals related to charity care for the uninsured and/or bad debt write-offs, in which privately insured patients cannot pay for services rendered or Medicare is not reimbursed for services rendered for a variety of reasons.[1] According to the American Hospital Association (AHA), in 2019, uncompensated hospital care amounted to approximately $41.61 billon and has only increased due to the COVID-19 pandemic.[2,3] The Institute of Medicine (IOM) defines SNHs as hospitals that provide care to a large share of vulnerable, racial, and ethnic minority patients regardless of their ability to pay but also identifies several mechanisms that can be used to define SNHs.[1] These mechanisms include: (1) a disproportionate-share hospital (DSH) payments,

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(2) Medicaid and uninsured caseload, and (3) uncompensated care.[1] Due to the availability of AHA data, our study utilizes the uncompensated care-led definition of SNHs.

Despite the many definitions available for SNHs, common characterizations among these definitions are that: (1) SNHs are often strategically placed within communities with a large proportion of underserved individuals and (2) SNHs struggle to balance the provision of high-quality care with resource constraints.[2,4] Therefore, SNHs are increasingly susceptible to challenging economic events.[5,51] For example, the December 2017 Tax Cuts and Jobs Act moved to zero out of the dollar amount and percentage of income penalties for the individual mandate, which was implemented under the 2010 Affordable Care Act. The Congressional Budget Office estimates that this move will result in approximately 13 million additional uninsured individuals by 2027 and cuts to DSH payments.[7] A reduction in payments essential for operational costs can result in a reduction in both services and workforce. Registered nurse wages and benefits constitute a substantial portion of hospital expenditure;[8] therefore, hospitals may attempt to reduce nursing staffing levels to reduce costs to ensure not only profitability but also survival.[9,10] It is well established in healthcare literature and research that SNHs typically serve populations with limited financial resources, higher rates of uninsured or underinsured patients, and face social determinants of health challenges. These factors often result in higher patient volumes in SNHs than in non-SNHs.[11] However, SNHs may face staffing challenges because of financial constraints or other factors, resulting in inadequate nurse-to-patient ratios. Increasing the volume of care in SNHs may require hiring more nurses to achieve safe staffing levels and to provide optimal care to patients.[12] However, these actions may be counterproductive to hospitals' goals of ensuring their viability. For example, research has shown that nurse staffing is positively associated with hospital profitability.[13] Moreover, higher nurse staffing levels have been associated with an estimated 4,370 lives saved and $720 million in cost savings.[14]

The existing research provides evidence of a link between higher levels of nursing staffing and better patient outcomes; however, the evidence is inconclusive.[15–21,21–24] For instance, some studies have suggested that higher nurse staffing is not linked to improved patient outcomes. Studies have shown that SNHs are likely to have higher readmission rates than non-SNHs[25–28] and are financially penalized, given their larger proportion of poor, uninsured, and vulnerable patients. Similarly, patients with congestive heart failure mortality were found to be higher in SNHs despite their increased nurse staffing levels; however, this is attributable to the inherent nature of SNHs to serve more vulnerable populations who are more prone to negative patient outcomes.[29] Other studies found no differences in the quality of patient outcomes when examining hospital-acquired infections between SNHs and non-SNHs.[30] However, these inconsistencies may be a result of the variation in the data sources used to measure nursing staffing and the way nursing staffing is defined.[31,32] The California nurse staffing mandate has successfully produced higher nurse staffing ratios, and research has shown that these improvements did not come at the cost of a reduced skill mix, as anticipated by some opponents of the mandate.[33] Research has also shown that nurse staffing level is associated with nurse outcomes. For instance, an increased patient-to-nurse ratio (lower nurse staffing has been associated with poor nurse health outcomes).[22] These outcomes include, but are not limited to, increased job stress, intent to leave, emotional exhaustion, and the perception of care.[34] Similarly, adequate nurse staffing has been linked to better outcomes for both patients and nurses.[35]

Determining the optimal nurse staffing ratios is vital for meeting hospital performance goals. The nurse staffing ratio is associated with several driving expenses, such as longer length of stay, higher odds of hospital mortality, and higher readmission rates, all of which can vary over time.[36] Therefore, it can be difficult for SNHs to maintain higher nurse staffing ratios. Currently, the nurse staffing levels and ratios within SNHs remain unclear in the existing literature. As such, this study aimed to compare SNHs to non-SNHs nursing staffing levels as measured by the ratio of direct care nurses to staffed beds.

2. METHODS

Secondary cross-sectional design was used to analyze the 2019 Census Bureau data of acute care hospitals in the United States (U.S.). Also, 2019 hospital-level data from the American Hospital Association (AHA) Annual Survey and county-level data from the Area Health Resource Files (AHRF) was used. The sample was limited to large- or medium-sized non-federal general medical and surgical hospitals with complete data (n = 1,228) in the United States (U.S.) to ensure homogeneity of the sample. Small hospitals (< 100 beds) were exempt as none were designated as SNHs.

2.1 Variables

The primary dependent variable was nurse staffing ratio. Hospitals reported the total number of nurses who provided direct patient care and bed size, which were obtained from the AHA Annual Survey. This ratio was operationalized by dividing the total number of nurses by the number of hospital beds.

The primary independent variable for this study was safety-net provider status (dichotomized as yes/no). SNHs can be

defined in two ways. First, hospitals were identified as safety-net providers based on the standard definition of Medicaid Inpatient discharges operationalized as one standard deviation above the state median or mean.[4] SNH status was defined by the top quartile of the DSH payment index.[4]

Key hospital characteristics were identified that have been found to influence hospital staffing in recently published studies.[37] Hospital size (small < 100 beds, medium $\geq$ 100 beds and < 200 beds, and large $\geq$ 200 beds), ownership status (government federal and non-federal, for-profit, and not-for-profit), teaching status (teaching and non-teaching), location (urban, rural), part of a system (yes/no), Medicare percentage, and Medicaid percentage, and hospital market competition were all included in the analysis. Medicare and Medicaid percentages were calculated by dividing the number of total Medicare or Medicaid inpatient days by facility inpatient days and multiplied by 100.[38] Market competition was operationalized by using the Herfindahl-Hirschman Index (HHI), whereby an HHI close to 0 indicates a purely competitive market.[39]

Key county characteristics were identified that have been shown to be associated to access to care.[40] The health professional shortage area (HPSA) of primary care services was included. HPSA designations are used to identify areas and population groups within the U.S. that are experiencing a shortage of primary care professionals. The ratio used to determine this destination is a population-to-provider ratio of at least 3,500 to 1 or 3,000 to 1, if there are unusually high needs in the community. High need in the community is classified as a county with a medically underserved population.[41] The median household income per 100,000 people and the total population residing in the county per 100,000 population were included.

2.2 Statistical methods

Descriptive statistics (frequencies/percentages and means/standard deviation) of the hospital and county characteristics were used to summarize the findings. To examine the association between SNHs and nurse staffing ratios by fitting a mixed-effects multivariable linear regression accounting for clustering at the county level. Nurse staffing ratio followed a normal distribution pattern. Pearson correlation coefficient and variance inflation factor (VIF) to assess for multicollinearity were used. Akaike and Schwarz's Bayesian information criteria were used to determine the model fit. Variables with a p-value < .05 were considered statistically significant in our fitted model. All analytical analyses were conducted using STATA version 17MP software.

3. Results

Our overall sample consisted of 1,228 hospitals in the U.S. (see Table 1). Most hospitals were part of a system (82%), teaching (81.60%), were medium-sized (71.34%), had not-for-profit status (78.18%), and belonged in South (36.81%). The mean number of nurses providing direct patient care was 704.28 with a standard deviation (SD) of 723.06 for the total sample. The average number of nurses per 1000 inpatient days was 8.01 (*SD* = 3.28). The average case-mix index was 1.75 with an SD of 1.75. The mean HHI was 0.31 (*SD* = 0.26), indicating a less than competitive market. The average Medicare percentage was 50.75 (*SD* = 12.53), and the average Medicaid percentage was 21.68 (*SD* = 12.43). The median county income per $10,000 was 6.62 (*SD* = 1.70), and the total county population per 100,000 people was 1.72 with an *SD* of 2.63.

If SNH status was defined by Medicaid Inpatient Discharge, *N* = 433 (35.26% of the sample) were SNHs, in that their Medicaid Inpatient Discharge (MID) was one standard deviation above the state mean. If the SNH status was defined by the DSH payment index, then *N* = 495 (40.31% of the sample) were SNHs in that they belonged to the top quartile of the DSH payment index. In considering both definitions of SNHs, there were no major differences in the definition of demographics with respect to teaching status, system status, ownership, hospital size, and region. The average number of nurses who provide direct patient care increases greatly from the total sample under both SNH definitions, and there is an in-between definition difference as well: 1,203.40 (*SD* = 940.47) in the MID-related definition and 1,141.12 (*SD* = 907.57) in the DSH-related definition. The average degree of competition (HHI) in the market decreases when comparing the total sample to both SNH definitions (0.27 for the MID-related definition and 0.28; DSH-related definition). The average number of nurses per 1,000 inpatient days does not differ between the overall sample and the MID-related definition of SNHs but it does decrease from 8.01 to 7.68 (*SD* = 2.24) for the DSH-related definition of SNHs. The mean Medicare percentage of both definitions of SNHs decrease from the total sample (50.75 total sample vs. 43.77 of MID-related safety-net definition vs. 45.46 of DSH-related safety-net definition) while the mean Medicaid percentage increases (21.68 total sample vs. 27.90 of MID-related safety-net definition vs. 25.65 of DSH-related safety-net definition.

Table 1. Description of U.S. hospitals in 2019 (N = 1,228)

	Total (N = 1,228)		Safety-net hospitals			
			Medicaid inpatient discharge (One standard deviation above the state mean) (N = 433)		DSH payment index (Top quartile) (N = 495)	
	N	**Percent**	***N***	**Percent**	***N***	**Percent**
Teaching status						
• No	226	18.40	21	4.85	39	7.88
• Yes	1,002	81.60	412	95.15	456	92.12
Part of a system						
• No	221	18.00	75	17.32	90	18.18
• Yes	1,007	82.00	358	82.68	405	81.82
Ownership						
• Government (Federal and Non-Federal)	148	12.05	68	15.70	93	18.79
• For Profit	120	9.77	39	9.01	40	8.08
• Not-For-Profit	960	78.18	326	75.29	362	73.13
Hospital size						
• Medium	876	71.34	163	37.64	195	39.39
• Large	352	28.66	270	62.36	300	60.61
Region						
• Northeast	261	21.25	76	17.55	104	21.01
• Midwest	293	23.86	119	27.48	100	20.20
• South	452	36.81	151	34.87	223	45.05
• West	222	18.08	87	20.09	68	13.74
	Mean	***SD***	**Mean**	***SD***	**Mean**	***SD***
Nurses that provide direct patient care	704.28	723.06	1,203.40	940.47	1,141.12	907.57
Nurses per 1,000 inpatient days	8.01	3.28	8.01	3.84	7.68	2.24
Case mix index	1.75	0.28	1.90	0.26	1.88	0.27
Herfindahl-Hirschman index	0.31	0.26	0.27	0.22	0.28	0.24
Medicare percentage	50.75	12.53	43.77	10.86	45.46	10.90
Medicaid percentage	21.68	12.43	27.90	11.43	25.65	12.02
Median county income per $100,000	6.62	1.70	6.19	1.39	6.31	1.54
Total county population per 100,000	1.72	2.63	1.79	2.56	1.86	2.45

Note. *SD* = Standard Deviation

Table 2 highlights the findings of our mixed-effects multivariate linear regression analysis. While controlling for both hospital and county characteristics, compared to non-SNHs, SNHs had a (β (coefficient) = 0.86-unit lower nursing staffing ratio when the DSH-related definition of SNHs is applied; 95% CI (confidence interval) = -1.29, -0.43). When the MID-related definition of SNHs is applied, SNHs, compared to non-SNHs, have a 0.29-unit lower nursing staffing ratio, but this result is not statistically significant (95% CI: -0.74, 0.15). Additional associations between the nursing staffing ratio and the hospital and county characteristics were found. For for-profit hospitals (β = -1.59; 95% CI: -2.35, -0.84 for MID; β = -1.76; 95% CI: -2.51, -1.01 for DSH) and not-for-profit hospitals (β = -0.58; 95% CI: -1.14, -0.01 for MID; β = -0.67; 95% CI: -1.23, -0.11 for DSH) were associated with a reduced nursing staffing ratio. The magnitude of reduction in the nursing staffing ratio was greater among for-profit hospitals in both SNH definitions, and between safety-net provider definitions, the magnitude of reduced nursing staffing ratio was greatest in the DSH-related SNH definition for both hospital ownership types. Amongst MID-defined SNHs, large hospitals (vs. small) were associated with a reduced nursing staffing ratio (β = -0.52; 95% CI: -0.98, -0.06); conversely, the association between hospital size and nursing staffing

ratio was not statistically significant amongst DSH-defined SNHs (β = -0.25; 95% CI: -0.71, 0.21). Hospitals belonging to the Midwest (β = 1.45; 95% CI:0.67, 2.24 MID; β = 1.38; 95% CI:0.59, 2.17; DSH) and West (β = 1.82; 95% CI:0.94, 2.69 MID; β = 1.70; 95% CI:0.83, 2.58 for DSH), compared to the Northeast region of the U.S., were associated with higher nursing staffing ratios. The magnitude of the increase in nursing staffing ratio was greater in the West among both SNH definitions, and between SNH definitions, the nursing staffing ratio was highest in both the Midwest and West among MID-defined SNHs (vs. DSH-defined). Neither teaching affiliation nor system affiliation had statistically significant associations with nursing staffing ratios in either the applied SNH definition.

The case mix index was associated with a 2.97-unit increase (95% CI: 2.27, 3.67) in the nursing staffing ratio among MID-defined SNHs and with a 3.07-unit increase (95% CI: 2.38, 3.77) in the nursing staffing ratio among DSH-defined SNHs. Medicare percentage was associated with a 0.02-unit increase in nursing staffing ratio among both MID- and DSH-defined SNHs (95% CI: 0.01, 0.04; 95% CI: 0.00, 0.03, respectively). Median county income per 10,000 was also associated with an increase in nursing staffing ratio among both MID- and DSH-defined SNHs (β = 0.17; 95% CI: 0.01, 0.33 for MID; β = 0.16; 95% CI: 0.00, 0.32 for DSH). Neither HHI nor total county population per 100,000 had statistically significant associations with nursing staffing ratios in either of the applied SNH definitions.

Table 2. Mixed multivariable linear regression of nursing staffing ratio and safety-net hospitals (N = 1,228)

	Safety-Net Hospital			
	One standard deviation above the state mean for Medicaid inpatient discharges		Top quartile of received disproportionate share hospital (DSH) payment	
	COEF	95% CI	COEF	95% CI
Safety-net provider (reference: no)				
• Yes	-0.29	[-0.74, 0.15]	-0.86***	[-1.29, -0.43]
Ownership (reference: government)				
• For profit	-1.59***	[-2.35, -0.84]	-1.76***	[-2.51, -1.01]
• Not-for-profit	-0.58*	[-1.14, -0.01]	-0.67*	[-1.23, -0.11]
Teaching affiliation (reference: non-teaching)				
• Teaching	0.16	[-0.30, 0.63]	0.24	[-0.22, 0.70]
Hospital size (reference: medium)				
• Large	-0.52*	[-0.98, -0.06]	-0.25	[-0.71, 0.21]
System affiliation (deference: not part of a system)				
• Part of a System	-0.32	[-0.77, 0.14]	-0.29	[-0.74, 0.16]
Region (reference: Northeast)				
• Midwest	1.45***	[0.67, 2.24]	1.38***	[0.59, 2.17]
• South	0.27	[-0.47, 1.01]	0.36	[-0.39, 1.10]
• West	1.82***	[0.94, 2.69]	1.70***	[0.83, 2.58]
Herfindahl-Hirschman index	0.5	[-0.43, 1.42]	0.5	[-0.43, 1.42]
Case mix index	2.97***	[2.27, 3.67]	3.07***	[2.38, 3.77]
Medicare percentage	0.02**	[0.01, 0.04]	0.02*	[0.00, 0.03]
Median county income per $100,000	0.17*	[0.01, 0.33]	0.16*	[0.00, 0.32]
Total county population per 100,000	-0.07	[-0.29, 0.16]	-0.05	[-0.28, 0.17]
AIC	6,247.33		6,233.76	
BIC	6,334.25		6,320.69	

Note. * $p < .05$, ** $p < .01$, *** $p < .001$; COEF = Coefficients; 95% confidence intervals (CI) in brackets; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion

4. DISCUSSION

SNHs in the U.S. play an important role in providing healthcare and health-related services to disadvantaged populations such as the uninsured and Medicaid beneficiaries.[42,43] Because these hospitals often provide necessary but unprofitable services to vulnerable patients,[4] it is critical to explore the extent to which these SNHs have an impact on their resource allocations, which ultimately influences hospital quality and outcomes.[44] Defined SNHs as one standard deviation above the state median or mean and the top quartile of the disproportionate share hospital (DSH) payment index, this study examined the effect of hospital safety-net status on hospital nurse staffing ratios, controlling for hospital and community confounding factors. The findings from this study indicated that SNHs had a significantly lower nurse staffing ratio than non-SNHs, suggesting that these hospitals could not allocate resources to one of the most critical workforces in the hospital operations to fund their nurse staffing However, this effect is only significant with the DHS definition. One major factor is that SNHs generally have lower budgets and fewer resources than other hospitals, which can make it difficult for them to hire and retain enough nurses. Consequently, they to rely on a smaller number of nurses to care for a larger number of patients, leading to higher nurse-to-patient ratios.

SNHs are often located in areas with high poverty rates and a shortage of healthcare providers, making it more difficult to recruit and retain nurses. SNHs may need to lay off staff or reduce salaries to compensate for the loss of Medicaid reimbursement. This can exacerbate the existing shortage of healthcare providers, increase workload for remaining staff, and decrease morale among employees. Consequently, the quality of care provided by the hospital may suffer, and patients may experience longer wait times or reduced access to care.[45] Moreover, SNHs often care for patients with complex medical conditions and require more intensive nursing care. This can make it even more challenging to maintain adequate staffing levels, as these patients may require more frequent monitoring and specialized care. These factors can contribute to lower nurse staffing ratios in SNHs.[42] It is worth noting that lower nurse staffing ratios can have negative impacts on patient outcomes and the quality of care provided. Advocates for SNHs argue that these hospitals require more resources to provide the same level of care as other hospitals and that investing in these hospitals can improve health outcomes for underserved populations.

State and local budget cuts to Medicaid reimbursements increase the pressure on SNHs and threaten their ability to meet their communities' needs.[4] Although many SNHs are struggling, state and federal government policies may help these hospitals. Policy examples include but are not limited to Medicaid expansion, enhanced reimbursement rates, and grants and funding programs. States that expand Medicaid under the Affordable Care Act (ACA) can provide additional coverage to low-income individuals, reducing the burden on SNHs to provide uncompensated care. Medicaid expansion can also increase the amount of Medicaid reimbursements received by SNHs, helping alleviate some financial pressure.[46] States can implement policies that provide enhanced reimbursement rates to SNHs, recognizing the higher costs associated with serving low-income and vulnerable populations. These enhanced rates can help offset the impact of budget cuts and ensure that SNHs have the necessary resources to provide quality care to their communities.[47]

Compared to government hospitals, both for-profit and not-for-profit hospitals had significantly lower nurse staffing ratios. Several factors may contribute to the difference in nurse staffing ratios between for-profit and non-profit hospitals compared with government hospitals. One factor is the financial incentive for for-profit hospitals to keep costs low and maximize profits. Nurse staffing can be a significant expense for hospitals, and for-profit hospitals may attempt to reduce costs by maintaining lower staffing levels.[48] In contrast, non-profit hospitals may prioritize patient care over profits and invest more resources in the nursing staff. Another factor is the different patient populations in these types of hospitals. Government hospitals often serve a larger proportion of uninsured or underinsured patients, who require more complex care and have greater healthcare needs.[2] These patients may require more nursing care, leading to higher staffing ratios. Finally, government hospitals more regulations and oversight than for-profit and non-profit hospitals, resulting in higher staffing requirements. For example, government hospitals may be required to maintain certain nurse-to-patient ratios to meet the safety and quality standards.

Our finding of lower nurse staffing ratios among large hospitals compared to their medium counterparts is consistent with previous literature.[49] In addition, compared to the hospitals in the Northeast region, the hospitals located in the Midwest and West had significantly higher nursing staffing ratios. This may be the result of nursing staffing ratio mandates in the West and Midwest, such as in California, Oregon, Washington, and Minnesota. Furthermore, hospitals with a higher case mix index and Medicare patients also had significantly higher nursing staffing ratios, reflecting that more complex patients in these hospitals required more intensive nursing care. Finally, hospitals located in wealthier areas with a higher median income had significantly higher nurse staffing ratios, reflecting the impact of supply on hospitals.

5. Conclusions

This study provides important insight into the relationship between SNH's and nursing to patient ratio. The results demonstrated that SNHs had significantly higher nurse-to-patient ratios than did those without SNH. Since higher nurse-to-patient ratios are often associated with lower patient outcomes and higher mortality rates,[50] our findings are especially important for policymakers, as they continue to focus on developing and evaluating policies that improve hospital patient outcomes and reduce patient harm and mortality rates under value-based purchasing.[?] Therefore, both administrators and policymakers should consider and understand the impact of hospitals designated as SNH's and non-SNHs, and their association with patient outcomes and mortality.

Given that the United States health care system will continue to focus on improved efficiency, value, and higher quality of care and its association with nurse-to-patient ratios, policymakers should identify resources to aid SNH's achieve the needed nurse-to-patient ratios. Policies that require lower nurse-to-patient ratios should also be identified. However, one challenge to increasing the nursing workforce at SNH facilities is that they are often located in areas of lower-socioeconomic status. SNH's in these areas may experience challenges in recruiting qualified healthcare professionals. Therefore, policies must also be considered that encourages the relocation of qualified nursing staff to SNH facilities and locations.

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Authors contributions

NZ and HYH led the conceptualization of the study; AFT, HYH and AS gathered and integrated the data; NZ, AFT, HYH, MZ, DRH and AS wrote the first and subsequent drafts; HYH created the tables, and MZ completed the revisions of the final draft; AFT and AS completed editing of the final draft. NZ, MZ and DRH validated the data and presentation. HYH reviewed and provided edits to the final draft, and supervised the project.

Ethical statement

Informed patient consent was not required because no patient clinical or identity data was collected, and no patient interventions were completed during the course of study. Therefore ethical review board approval was not required and waived.

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Conflicts of Interest Disclosure

The author declares that there is no conflicts of interest.

Ethics approval

The Publication Ethics Committee of the Sciedu Press. The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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