A STUDY ON UTILIZING DATA DRIVEN OPTIMIZING STAFFING LEVEL IN MATHURAM HOSPITAL IN TRICHY

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ABSTRACT
This study explores the use of data-driven methodologies to optimize staffing levels in hospitals. By leveraging advanced analytic and machine learning algorithms, hospitals can effectively forecast patient demand, allocate resources efficiently, and ensure adequate staffing levels across various departments. This abstract highlights the significance of adopting innovative techniques to enhance patient care, improve staff satisfaction, and optimize operational efficiency within healthcare facilities. Balancing Patient Needs and Staffing Resources: A Framework for Optimal Hospital Staffing Levels. Achieving optimal staffing levels in hospitals requires a delicate balance between meeting patient needs and efficiently allocating staffing resources. This abstract presents a comprehensive framework that integrates patient acuity, workload distribution, and staff skill mix to determine the ideal staffing levels across different units within a hospital setting. By implementing this framework, healthcare institutions can enhance patient outcomes, mitigate staff burnout, and optimize resource utilization, ultimately improving overall quality of care.
KEY WORDS: *Hospital staffing- Optimization-Data-driven approaches-Patient demand-Resource allocation-Operational efficiency-Patient care- Staff satisfaction- Workload distribution-Staff burnout-Quality of care-Strategic staffing- Performance improvement-Staffing models.*

INTRODUCTION

In today's rapidly evolving healthcare landscape, the effective management of hospital staffing levels is paramount to ensuring high-quality patient care, operational efficiency, and staff satisfaction. With increasing patient volumes, fluctuating demand patterns, and resource constraints, hospitals are faced with the complex challenge of balancing patient needs with staffing resources. Traditional staffing methods often rely on subjective assessments and historical trends, leading to sub-optimal resource allocation and potential gaps in care delivery. To address these challenges, there is a growing recognition of the importance of leveraging data-driven approaches to optimize hospital staffing levels.

By harnessing the power of advanced analytics, machine learning algorithms, and predictive modeling techniques, healthcare institutions can gain valuable insights into patient demand dynamics, workload patterns, and staffing requirements across different departments and shifts.

Data-driven staffing optimization offers several key advantages over traditional methods. Firstly, it enables hospitals to forecast future patient volumes with greater accuracy, allowing for proactive workforce planning and resource allocation. Secondly, it facilitates the identification of staffing inefficiencies and opportunities for improvement, leading to enhanced operational efficiency and cost savings. Additionally, data-driven approaches empower healthcare leaders to tailor staffing levels based on specific patient acuity levels, ensuring that resources are allocated where they are most needed.Moreover, by integrating data from various sources such as electronic health records, patient flow systems, and staff scheduling software, hospitals can create comprehensive staffing models that take into account multiple factors influencing patient care delivery. These models can be continuously refined and updated in real-time to adapt to changing patient needs and operational requirements, thereby enabling hospitals to maintain optimal staffing levels under dynamic conditions. In this context, this paper aims to explore the utilization of data-driven approaches to optimize hospital staffing levels. We will examine the underlying principles of data-driven staffing optimization, highlight best practices and case studies from leading healthcare institutions, and discuss the potential benefits and challenges associated with implementing such approaches.

By leveraging data-driven insights, hospitals can enhance patient outcomes, improve staff satisfaction, and achieve sustainable performance improvements in today's increasingly complex healthcare environment.

REVIEW OF LITERATURE

- **Serrano, B et al (2024)** We study the feature-based news vendor problem, in which a decision-maker has access to historical data consisting of demand observations and exogenous features. In this setting, we investigate feature selection, aiming to derive sparse, explainable models with improved out-of-sample performance. Up to now, state-of-the-art methods utilize regularization, which penalizes the number of selected features or the norm of the solution vector.
- **Bhati D at el (2023)** This comprehensive review delves into the critical role of effective hospital administration in shaping patient outcomes within the healthcare ecosystem. Exploration of key components, strategies, measurement methodologies, and future trends elucidates the multifaceted nature of hospital administration. Key findings underscore the profound impact of administrative decisions and practices on patient safety, satisfaction,

and overall well-being. The review highlights the importance of patient-centered care and interdisciplinary collaboration for enhancing patient outcomes.

- **Lou, Z. (2023)** Predictive modeling in healthcare involves the development of data-driven and computational models which can predict what will happen be it for a single individual or for an entire system. The adoption of predictive models can guide various stakeholders' decision making in the healthcare sector, and consequently improve individual outcomes and the cost-effectiveness of care. With the rapid development in healthcare of big data and the Internet of Things technologies, research in healthcare decision-making has grown in both importance and complexity. One of the complexities facing those who would build predictive models is heterogeneity of patient populations, clinical practices, and intervention outcomes, as well as from diverse health systems.
- **vanHulzen et al (2022)** Healthcare managers are confronted with various Capacity Management decisions to determine appropriate levels of resources such as equipment and staff. Given the significant impact of these decisions, they should be taken with great care. The increasing amount of process execution data – i.e. event logs – stored in Hospital Information Systems (HIS) can be leveraged using Data-Driven Process Simulation (DDPS), an emerging field of Process Mining, to provide decision-support information to healthcare managers. .
- **Zhou, J at el (2022)** A PICC catheter maintenance network was established and managed to monitor the maintenance of catheters in placed patients throughout the process, providing homogeneous PICC catheter continuity of care for patients. Model-driven thinking is an idea for simulation system development. Model-driven architecture (MDA) is a design methodology that implements model-driven thinking and is widely used in simulation system development. Based on the requirements of nursing, the data-driven model is mainly divided into interface layer and functional service layer; this study adopts MDA technology which can detach the functions of the system from the platform, based on domain knowledge, and the metamodel adopts XSD-based data model to generate the PIM model, which is stored in the model librar.
- **Hegarty, H., el at., (2022)** The relationship between nurse stafng levels and patient safety is well recognized. Inadequate provision of nursing staf is associated with increased medical error, as well as higher morbidity and mortality. Defning what constitutes safe nurse staffing levels is complex. A range of guidance and planning tools are available to

inform staffing decisions. The Society for Acute Medicine (SAM) recommend a 'nurse-to-bed'ratio of greater than.

- **El Zaemey, S et al., (2021)** For over two decades, research has extensively examined the link between nurse staffing, nursing workloads, skill mix and quality of patient care. This work has been facilitated by the development and adoption of Nurse Sensitive Outcomes (NSOs), as a direct measure of a nurse's contribution to quality patient care. An NSO is defined as a hospital acquired patient event that is considered sensitive to nurse staffing levels.
- **M., Demir etal . , (2021)** The increasing pressures on the healthcare system in the UK are well documented. The solution lies in making best use of existing resources (e.g. beds), as additional funding is not available. Increasing demand and capacity shortages are experienced across all specialties and services in hospitals. Modelling at this level of detail is a necessity, as all the services are interconnected, and cannot be assumed to be independent of each other. Our review of the literature revealed two facts.
- **Ordu, M., Demir, E., & Davari, S. (2021)** Given the escalating healthcare costs around the world (more than 10% of the world's GDP) and increasing demand hospitals are under constant scrutiny in terms of managing services with limited resources and tighter budgets. Hospitals endeavour to find sustainable solutions for a variety of challenges ranging from productivity enhancements to resource allocation. For instance, in the UK, evidence suggests that hospitals are struggling due to increased delayed transfers of care, bed-occupancy rates well above the recommended levels of 85% and unmet A&E performance targets. In this paper, we present a hybrid forecasting-simulation-optimization model for an NHS Foundation Trust in the UK. Using the Hospital Episode Statistics datasets for A&E, outpatient and inpatient services, we estimate the future patient demands for each specialty and model how it behaves with the forecasted activity in the future. Discrete event simulation is used to capture the entire hospital within a simulation environment.
- **Ordu, M., Demir, et al., (2021)**The increasing pressures on the healthcare system in the UK are well documented. The solution lies in making best use of existing resources (e.g. beds), as additional funding is not available. Increasing demand and capacity shortages are experienced across all specialties and services in hospitals. Modelling at this level of detail is a necessity, as all the services are interconnected, and cannot be assumed to be independent of each other. Our review of the literature revealed two facts.

RESEARCH METHODOLOGY

Research Problem:

The research problem for this study is to examine how Mathuram Hospital can utilize data-driven optimization techniques to determine the optimal staffing levels across various departments and shifts. This is crucial for ensuring efficient patient care, minimizing staff burnout, and maintaining cost-effective operations.

1. Analyze historical patient volume, acuity, and staffing data to identify patterns and trends
2. Develop predictive models to forecast future staffing needs based on anticipated patient demand
3. Implement data-driven staffing algorithms to dynamically adjust personnel levels in real-time
4. Evaluate the impact of data-driven staffing optimization on patient outcomes, staff satisfaction, and operational costs

Sources of Data:

The source of data involves both primary and secondary data.

Primary data:

Conducting research study where in employee of Mathuram Hospitalwere given questionnaire type survey to collect primary data because of its extreme flexibility.

Secondary data:

Secondary data needed for conducting this research work was collected both internally and externally. The required data for collected from Hospital patient flow, company website.

Objectives of the Study:

i. To Determine the optimal nurse-to-patient ratio to ensure quality care while controlling costs.
ii. To identify factors affecting staffing needs, such as patient acuity levels, case mix, and nursing skill mix.
iii. To evaluate the impact of staffing levels on patient outcomes, including mortality rates, readmission rates, and patient satisfaction scores.
iv. To assess the financial implications of staffing decisions, considering both direct labor costs and potential savings from improved efficiency.
v. To explore the relationship between staffing levels and nurse job satisfaction, burnout, and turnover rates.

vi. To examine the effectiveness of different staffing models, such as flexible staffing arrangements or nurse-patient assignment algorithms.
vii. To analyze the regulatory requirements and accreditation standards related to staffing levels and patient safety.
viii. To investigate the impact of staffing shortages or surpluses on operational efficiency and patient care delivery.

Primary Objective:

i. Assessing current staffing levels and their alignment with patient demand and operational needs.
ii. Analyzing the impact of staffing levels on patient outcomes, including factors like wait times, mortality rates, and readmission rates.
iii. Evaluating the efficiency of staffing allocation across different departments and shifts.
iv. Examining the relationship between staffing levels and employee satisfaction, burnout, and turnover rates.
v. Investigating the financial implications of staffing decisions, including labor costs, revenue generation, and budget constraints.

Secondary Objective:

i. To determine the factors that are majorly considered while adequate staffing nurses
ii. To have a clear view about flaws that arises while needed patient demand.
iii. To acquire the details regarding the adequacy staffing level.
iv. To analyse staffing level.

HYPOTHESIS:

H1, H2, H3, H4, Hn.....is taken as null hypothesis

H1a, H2a, H3a, H4a,… .....are taken as alternative hypothesis

H1-There is no significant relationship between the Staffing shortages lead to longer patient wait times &optimizing staffing level

H1a-there is significant relationship between the Staffing shortages lead to longer patient wait times &optimizing staffing level

H2-there is no significant relationship between Adequate staffing levels contribute to improved patient satisfaction and Optimizing staffing level

H2a-there is a significant relationship between Adequate staffing levels contribute to improved patient satisfaction and Optimizing staffing level

H3-there is no significant relationship between the Proper staffing levels reduce the likelihood of medical errors and Optimizing staffing level

H3a-There is a significant relationship between the Proper staffing levels reduce the likelihood of medical errors and Optimizing staffing level

H4-There is no significant relationship between the Adequate staffing levels improve the quality of patient care and Optimizing staffing level.

H4a-There is a significant relationship between the Adequate staffing levels improve the quality of patient care and Optimizing staffing level.

H5-There is no significant relationship between the Staffing shortages result in decreased efficiency in delivering care and Optimizing staffing level.

H5a-there is a significant relationship between the Staffing shortages result in decreased efficiency in delivering care and Optimizing staffing level.

H6- There is no significant relationship between the age and Optimizing staffing level

H6a- there is a significant relationship between the age and Optimizing staffing level

H7 – There is no significant relationship between the gender and Optimizing staffing level

H7a- There is significant relationship between the gender and Optimizing staffing level

H8 -There is no significant relationship between the qualification and Optimizing staffing level

H8a-There is a significant relationship between the qualification and Optimizing staffing level

H9 -There is no significant relationship between the Marital status and Optimizing staffing level

H9a-There is a significant relationship between the Marital status and Optimizing staffing level

H10 -There is no significant relationship between the Experience and Optimizing staffing level

H10a-There is a significant relationship between the Experience and Optimizing staffing level

H11 -There is no significant relationship between the Designation and Optimizing Staffing Level.

H11a-There is a significant relationship between the Designation and Optimizing Staffing Level.

Scope of the Study:

Optimizing staffing levels in hospitals for research methodology involves assessing the current staffing structure, analyzing workload, considering patient needs, and implementing evidence-based strategies to ensure efficient and effective research operations. This includes determining the appropriate mix of researchers, clinicians, support staff, and administrative personnel to

support research activities while maintaining quality patient care. Additionally, utilizing data analytic and continuous evaluation can help refine staffing decisions over time to adapt to changing research priorities and resource constraints.

Population and Sample:

A population is the entire group that you want to draw conclusions about. A sample is the specific group that you will collect data from. The size of the sample is always less than the total size of the population. In research, a population doesn't always refer to people. It can mean a group containing elements of anything you want to study, such as objects, events, organizations, countries, species, organisms, etc.

Sampling Design:

A sample design is a definite plan for obtaining a sample from a given population. It refers to the technique or the procedure the researcher would adopt in selecting items for the sample. Sample design also leads to a procedure to tell the number of items to be included in the sample i.e., the size of the sample. Hence, sample design is determined before the collection of data. In this study, I have collected the data among the employees of the firm.

Sampling Technique:

in this study was purposive sampling. This is based on the intention or the purpose of study. Only those elements will be selected from the population which suits the best for the purpose of our study. As the sample is collected only from the employees it is said as purposive sampling.

Data Analysis and Interpretation:

Data interpretation is the process of reviewing data and arriving at relevant conclusions using various analytical methods. Data analysis assists researchers in categorizing, manipulating, and summarizing data to answer critical questions. This process analyzes and revises data to gain insights and recognize emerging patterns and behaviors. These conclusions will assist you in making an informed decision based on numbers while having all the facts at your disposal.

Tool for Analysis:

The tools used to analyze the data in this study are:

- ✓ Neural Network

DATA ANALYSIS & INTERPRETATION

NEURAL NETWORK

Table 1

Relationship between Respondent Proper staffing levels enhance communication among healthcare teams.

Case Processing Summary			
		N	Percent
Sample	Training	91	75.8%
	Testing	29	24.2%
Valid		120	100.0%
Excluded		0	
Total		120	

Network Information			
Input Layer	Factors	1	Proper staffing levels enhance communication among healthcare teams.
	Covariates	1	You work for more than 6 days a week but not more than 12 hours a day.
	Number of Units[a]		6
	Rescaling Method for Covariates		Standardized
Hidden Layer(s)	Number of Hidden Layers		1
	Number of Units in Hidden Layer 1[a]		3
	Activation Function		Hyperbolic tangent
Output Layer	Dependent Variables	1	Designation
	Number of Units		1
	Rescaling Method for Scale Dependents		Standardized
	Activation Function		Identity
	Error Function		Sum of Squares
a. Excluding the bias unit			

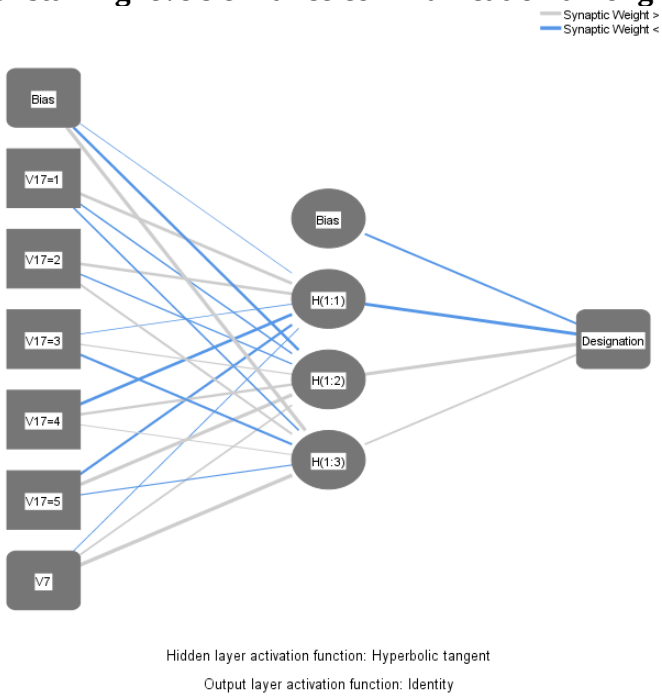
HYPOTHESIS:

H1 - there is no significant relationship between Experience &Optimizing Staffing Level.

H1a - there is a significant relationship between Experience &Optimizing Staffing Level.

Fig. 1

Respondent Proper staffing levels enhance communication among healthcare teams.



Interpretation :

From The above table & chart it is inferred that the significant value is .000 which is less than P < 0.05 it shows that there is significant association between the Proper staffing levels enhance communication among healthcare teams.

Table 1.1

Relationship between Respondent Adequate staffing levels lead to better coordination of patient care.

Network Information			
Input Layer	Factors	1	Adequate staffing levels lead to better coordination of patient care.
	Covariates	1	You work for more than 6 days a week but not more than 12 hours a day.
	Number of Units[a]		6
	Rescaling Method for Covariates		Standardized
	Number of Hidden Layers		1

Hidden Layer(s)	Number of Units in Hidden Layer 1[a]		3
	Activation Function		Hyperbolic tangent
Output Layer	Dependent Variables	1	Designation
	Number of Units		1
	Rescaling Method for Scale Dependents		Standardized
	Activation Function		Identity
	Error Function		Sum of Squares
a. Excluding the bias unit			

Model Summary

Training	Sum of Squares Error	32.310
	Relative Error	.828
	Stopping Rule Used	1 consecutive step(s) with no decrease in error[a]
	Training Time	0:00:00.02
Testing	Sum of Squares Error	14.043
	Relative Error	.694
Dependent Variable: Designation		
a. Error computations are based on the testing sample.		

Case Processing Summary

		N	Percent
Sample	Training	79	65.8%
	Testing	41	34.2%
Valid		120	100.0%
Excluded		0	
Total		120	

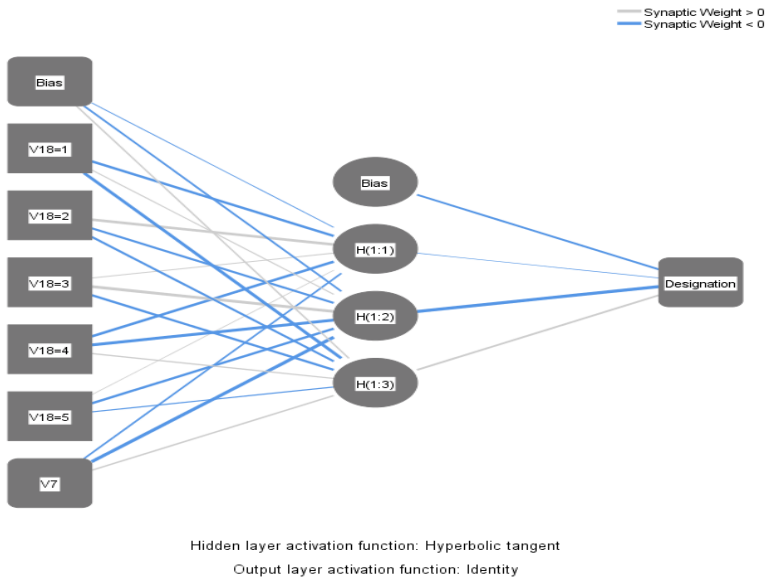
HYPOTHESIS:

H1 - there is no significant relationship between Experience &Optimizing Staffing Level.

H1a - there is a significant relationship between Experience &Optimizing Staffing Level.

Fig. 1.1

Respondent Adequate staffing levels lead to better coordination of patient care.



Interpretation:

From The above table & chart it is inferred that the significant value is .000 which is less than P < 0.05 it shows that there is significant association between the Adequate staffing levels lead to better coordination of patient care.

Table 1.2

Relationship between Respondent Inadequate staffing levels negatively impact employee morale.

Network Information			
Input Layer	Factors	1	Inadequate staffing levels negatively impact employee morale.
	Covariates	1	You work for more than 6 days a week but not more than 12 hours a day.
	Number of Units[a]		6
	Rescaling Method for Covariates		Standardized
Hidden Layer(s)	Number of Hidden Layers		1
	Number of Units in Hidden Layer 1[a]		3
	Activation Function		Hyperbolic tangent
Output Layer	Dependent Variables	1	Designation
	Number of Units		1
	Rescaling Method for Scale Dependents		Standardized
	Activation Function		Identity
	Error Function		Sum of Squares
a. Excluding the bias unit			

Case Processing Summary		
	N	Percent

Sample	Training	88	73.3%
	Testing	32	26.7%
Valid		120	100.0%
Excluded		0	
Total		120	

Model Summary		
Training	Sum of Squares Error	29.484
	Relative Error	.678
	Stopping Rule Used	1 consecutive step(s) with no decrease in error[a]
	Training Time	0:00:00.02
Testing	Sum of Squares Error	6.991
	Relative Error	.525
Dependent Variable: Designation		
a. Error computations are based on the testing sample.		

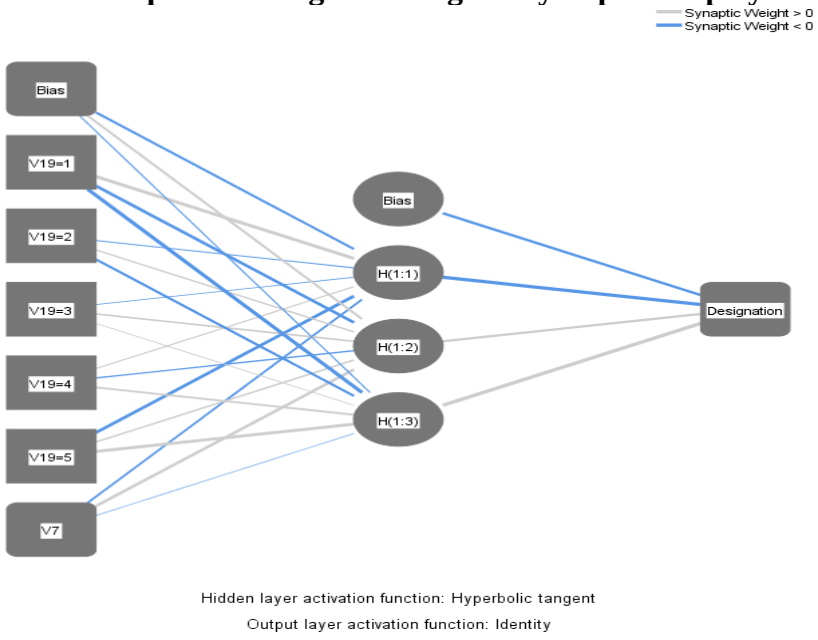
HYPOTHESIS:

H1 - there is no significant relationship between Experience &Optimizing Staffing Level.

H1a - there is a significant relationship between Experience &Optimizing Staffing Level.

Fig. 4.20

Respondent Inadequate staffing levels negatively impact employee morale.



Interpretation:

From The above table & chart it is inferred that the significant value is .000 which is less than $P < 0.05$ it shows that there is significant association between the inadequate staffing levels negatively impact employee morale.

Table 1.2

Relationship between Respondent Staffing shortages increase the workload on existing staff members in Optimizing Staffing Level.

Network Information			
Input Layer	Factors	1	Staffing shortages increase the workload on existing staff members.
	Covariates	1	You work for more than 6 days a week but not more than 12 hours a day.
	Number of Units[a]		6
	Rescaling Method for Covariates		Standardized
Hidden Layer(s)	Number of Hidden Layers		1
	Number of Units in Hidden Layer 1[a]		1
	Activation Function		Hyperbolic tangent
Output Layer	Dependent Variables	1	Designation
	Number of Units		1
	Rescaling Method for Scale Dependents		Standardized
	Activation Function		Identity
	Error Function		Sum of Squares

Training	Sum of Squares Error	25.866
	Relative Error	.690
	Stopping Rule Used	1 consecutive step(s) with no decrease in error[a]
	Training Time	0:00:00.03
Testing	Sum of Squares Error	11.659
	Relative Error	.830

Case Processing Summary			
		N	Percent
Sample	Training	76	63.3%
	Testing	44	36.7%
Valid		120	100.0%
Excluded		0	
Total		120	

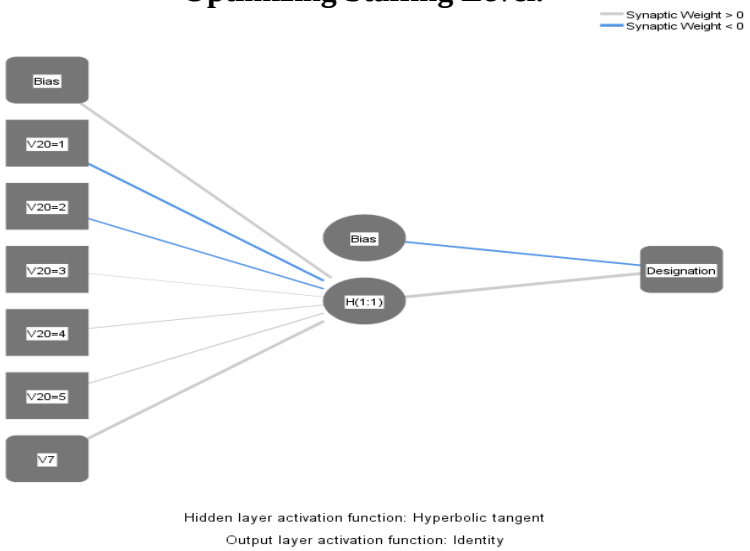
HYPOTHESIS:

H1 - there is no significant relationship between Experience &Optimizing Staffing Level.

H1a - there is a significant relationship between Experience &Optimizing Staffing Level.

Fig. 1.2

Respondent Staffing shortages increase the workload on existing staff members in Optimizing Staffing Level.



Interpretation:

From The above table & chart it is inferred that the significant value is .000 which is less than P < 0.05 it shows that there is significant association between the Staffing shortages increase the workload on existing staff members in Optimizing Staffing Level.

Table 1.3

Relationship between Respondent Adequate staffing levels reduce the risk of staff burnout in Optimizing Staffing Level.

Case Processing Summary			
		N	Percent
Sample	Training	81	67.5%
	Testing	39	32.5%
Valid		120	100.0%
Excluded		0	
Total		120	

Network Information			
Input Layer	Factors	1	Adequate staffing levels reduce the risk of staff burnout.
	Number of Units[a]		5

Hidden Layer(s)	Number of Hidden Layers		1
	Number of Units in Hidden Layer 1[a]		4
	Activation Function		Hyperbolic tangent
Output Layer	Dependent Variables	1	Salary
	Number of Units		5
	Activation Function		Softmax
	Error Function		Cross-entropy

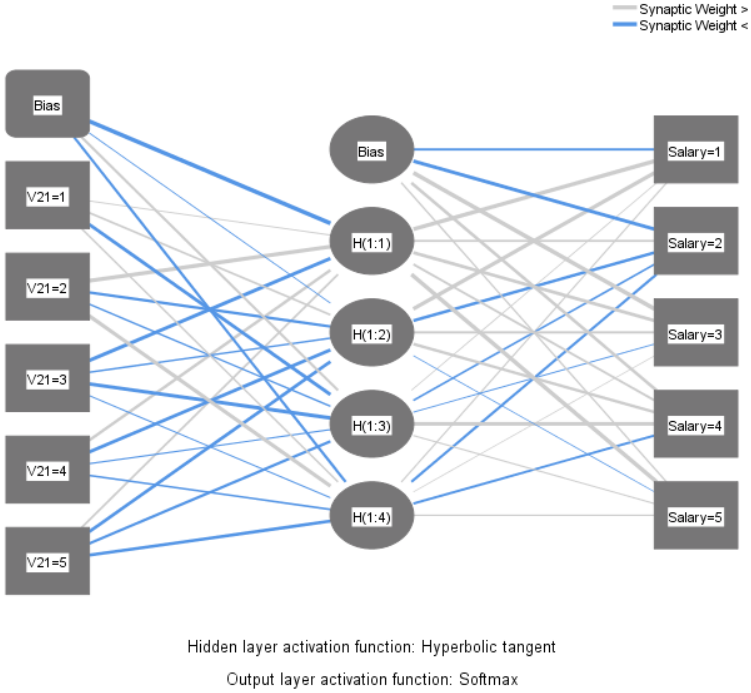
HYPOTHESIS:

H1 - there is no significant relationship between Experience &Optimizing Staffing Level.

H1a - there is a significant relationship between Experience &Optimizing Staffing Level.

Fig. 1.3

Respondent Adequate staffing levels reduce the risk of staff burnout.



Interpretation :

From The above table & chart it is inferred that the significant value is .000 which is less than $P < 0.05$ it shows that there is significant association between the Respondent Adequate staffing levels reduce the risk of staff burnout in Optimizing Staffing Level.

FINDINGS, SUGGESTIONS, & CONCLUSION

- ✓ From table the p value (.004) is less than the significance level (0.05) it accepts the alternative hypothesis and concludes that there is significant relationship between the age and Optimizing Staffing Level in hospital.

- ✓ From table the p value (.000) Is less than the significance level (0.05) it accepts the alternative hypothesis and concludes that there is significant relationship between the gender and Optimizing Staffing Level in hospital.
- ✓ From table the p value (.000) Is less than the significance level (0.05) it accepts the alternative hypothesis and concludes that there is significant relationship between the qualification and Optimizing Staffing Level in hospital.
- ✓ From table the p value (.000) Is less than the significance level (0.05) it accepts the alternative hypothesis and concludes that there is significant relationship between the marital status and Optimizing Staffing Level in hospital.
- ✓ From table the p value (.000) Is less than the significance level (0.05) it accepts the alternative hypothesis and concludes that there is significant relationship between the experience and Optimizing Staffing Level in hospital
- ✓ From the table p value (.000) Is less than the significance level (0.05) it accepts the alternative hypothesis and concludes that there is significant relationship between the high patient workload , work schedule and Optimizing Staffing Level
- ✓ From the table p value (.000) Is less than the significance level (0.05) it accepts the alternative hypothesis and concludes that there is significant relationship between financial stress ,job retention and Optimizing Staffing Level.
- ✓ From the table p value (.000) Is less than the significance level (0.05) it accepts the alternative hypothesis and concludes that there is significant relationship between Mental and physical health and Optimizing Staffing Level.
- ✓ From the table p value (.000) Is less than the significance level (0.05) it accepts the alternative hypothesis and concludes that there is significant relationship between incentives and work life balance working environment and Optimizing Staffing Level

SUGGESTION:

To determine the nurse-to-bed ratio for different departments in a healthcare facility, let's break it down by department, using common standards. The actual ratios can vary depending on country, specific hospital policies, and regulatory requirements. Here's a general overview:

Intensive Care Unit (ICU)

Nurse-to-Bed Ratio: Typically 1:1 or 1:2

Inpatient (IP) Ward

Nurse-to-Bed Ratio: Commonly 1:4 to 1:6

Outpatient (OP) Department

Nurse-to-Patient Ratio: Varies widely based on patient volume and type of care, but might be around 1:20 to 1:30, depending on the services provided.

1. ICU :

- Assume 10 beds in ICU.

- With a 1:2 ratio, you need 5 nurses per shift. With 3 shifts a day, you need 15 nurses.

2. Inpatient Wards :

- Assume 30 beds in inpatient wards.

- With a 1:5 ratio, you need 6 nurses per shift. With 3 shifts a day, you need 18 nurses.

3. Outpatient Department:

- Assume the outpatient department serves about 50 patients per day.

- With a 1:25 ratio, you need 2 nurses per shift. With typically one main shift per day, you need 2 nurses.

For other departments, the staffing would typically not include nurses but rather respective specialized staff such as lab technicians, receptionists, and administrative staff.

In this example, the total number of nurses needed would be 35. This is a simplified calculation and actual needs may vary based on the specific operations, patient acuity, and institutional policies.

1. **ICU**

Bed count: 10

Nurse-to-bed ratio: 1:2

Required nurses per shift: 5

Total nurses needed (3 shifts): 5 * 3 = 15

2. **Inpatient Wards**

Bed count: 30

Nurse-to-bed ratio: 1:5

Required nurses per shift: 6

Total nurses needed (3 shifts): 6 * 3 = 18

3. **Outpatient Department**

Estimated daily patients: 50

Nurse-to-patient ratio: 1:25

Required nurses per shift: 2

Total nurses needed (1 shift): 2

2. Calculate the Total Required Staff

Summing up the required staff for each department:

ICU nurses: 15

Inpatient nurses: 18

Outpatient nurses: 2

Laboratory technicians: 10

Reception staff: 10

Administrative staff: 20

Total required staff: 75

3. Compare with Current Staffing Levels

Compare the total required staff with the current staff. If your current staffing is 150 and the required is 75, you have 75 additional staff members. This indicates potential over-staffing.

Assuming current staffing distribution:

ICU: 12 nurses (needs 15) – Understaffed by 3

Inpatient: 25 nurses (needs 18) – Overstaffed by 7

Outpatient: 5 nurses (needs 2) – Overstaffed by 3

Laboratory: 12 technicians (needs 10) – Overstaffed by 2

Reception: 10 staff (matches need) – Adequately staffed

Administration: 30 staff (needs 20) – Overstaffed by 10

4. Make Adjustments

Based on the analysis, reallocate staff to address under-staffing and reduce over-staffing where possible. By conducting a detailed analysis and comparing the actual staffing levels with the required levels based on operational needs and standards, you can identify areas of over-staffing and under-staffing and take appropriate actions to optimize staff distribution

CONCLUSION

This project aims to optimize staffing levels in a hospital with 150 staff members, addressing over-staffing and under-staffing issues across various departments. By evaluating current staffing against industry standards and operational needs, the project seeks to enhance efficiency, reduce costs, and improve patient care quality. By implementing these recommendations, the hospital can achieve a more balanced workforce that is aligned with patient needs, leading to improved operational efficiency and enhanced quality of care. This project lays the foundation for ongoing monitoring and optimization of staffing levels, ensuring that the hospital remains responsive to changing demands and continues to deliver high-quality healthcare services. Future research could explore additional strategies for staffing

optimization and evaluate the long-term impact of these interventions on patient outcomes and organizational performance.

REFERENCE

1. Bhati, D., Deogade, M. S., & Kanyal, D. (2023). Improving patient outcomes through effective hospital administration: a comprehensive review. Cureus,15(10).

2. Bren, A., & Saghafian, S. (2019). Data-driven percentile optimization for multiclass queueing systems with model ambiguity: Theory and application. INFORMS Journal on Optimization, 1(4), 267-287.

3. Buerhaus, P. I., & Needleman, J. (2000). Policy implications of research on nurse staffing and quality of patient care. Policy, Politics, & Nursing Practice

4. Cavouras, C. A. (2002). Nurse staffing levels in American hospitals: A 2001 report. Journal of Emergency Nursing, 28(1), 40-43.

5. Demir, E., & Davari, S. (2021). A hybrid analytical model for an entire hospital resource optimisation. Soft Computing, 25, 11673-11690.

6. Gao, Z., Shan, X., Shan, S., & Khasawneh, M. T. (2019). Staffing optimization in standardised care management processes. Journal of the Operational Research Society, 70(3), 459-471.

7. Gao, Z., Shan, X., Shan, S., & Khasawneh, M. T. (2019). Staffing optimization in standardised care management processes. Journal of the Operational Research
Society, 70(3), 459-471.

8. Ghanes, K., Wargon, M., Jouini, O., Jemai, Z., Diakogiannis, A., Hellmann, R.& Koole, G. (2015). ‗Simulation-based optimization of staffing levels in an emergency department'. Simulation, Vol.91,No.10,pp. 942-953.

9. Ghanes, K., Wargon, M., Jouini, O., Jemai, Z., Diakogiannis, A., Hellmann, R., ... & Koole, G. (2015). Simulation-based optimization of staffing levels in an emergency department. Simulation, 91(10), 942-953.

10. Griffiths, P., Recio- Saucedo, A., Dall'Ora, C., Briggs, J., Maruotti, A., Meredith, P., ... & Missed Care Study Group. (2018). The association between nurse staffing and omissions in nursing care: A systematic review. Journal of advanced nursing, 74(7), 1474-1487.

11. Harrington, C., Dellefield, M. E., Halifax, E., Fleming, M. L., & Bakerjian, D. (2020). Appropriate nurse staffing levels for US nursing homes. Health services insights, 13, 1178632920934785.

12. He, J., Staggs, V. S., Bergquist-Beringer, S., & Dunton, N. (2016). Nurse staffing and patient outcomes: a longitudinal study on trend and seasonality. BMC nursing, 15, 1-10.

13. Hu, Y., Chan, C. W., & Dong, J. (2021). Prediction-driven surge planning with application in the emergency department. Submitted to Management Science.

14. Lou, Z. (2023). Three essays of healthcare data-driven predictive modeling (Doctoral dissertation, Purdue University).

15. M., Jouini, O., Jemai, Z., Diakogiannis, A., Hellmann, R., ... & Koole, G. (2015). Simulation-based optimization of staffing levels in an emergency department. Simulation, 91(10), 942-953.

16. Majid, B., Pasha Abgarmi, H., Yousefi, S., Alizadeh, A., & Mahmoudzadeh, H. (2017). Simulation-based optimization for improving hospital performance. International Journal of Hospital Research, 6(2), 72-84.

17. Min, A., & Scott, L. D. (2016). Evaluating nursing hours per patient day as a nurse staffing measure. Journal of nursing management, 24(4), 439-448.

18. R. Sathya; V.C. Bharathi; S. Ananthi; T. Vijayakumar; Rvs Praveen; Dhivya Ramasamy, **"**Real Time Prediction of Diabetes by using Artificial Intelligence," 2024 2nd International Conference on Self Sustainable Artificial Intelligence Systems (ICSSAS), DOI: 10.1109/ICSSAS64001.2024.10760985

19. Rvs Praveen;B Vinoth;S. Sowmiya;K. Tharageswari;Purushothapatnapu Naga Venkata VamsiLala;R. Sathya, "Air Pollution Monitoring System using Machine Learning techniques for Smart cities," 2024 2nd International Conference on Self Sustainable Artificial Intelligence Systems (ICSSAS), DOI: 10.1109/ICSSAS64001.2024.10760948

20. RVS Praveen;U Hemavathi;R. Sathya;A. Abubakkar Siddiq;M. Gokul Sanjay;S. Gowdish, "AI Powered Plant Identification and Plant Disease Classification System," 2024 4th International Conference on Sustainable Expert Systems (ICSES), DOI: 10.1109/ICSES63445.2024.10763167

21. Neeraj Kumar;Sanjay Laxmanrao Kurkute;V. Kalpana;Anand Karuppannan;RVS Praveen;Soumya Mishra, "Modelling and Evaluation of Li-ion Battery Performance Based on the Electric Vehicle Tiled Tests using Kalman Filter-GBDT Approach" 2024 International Conference on Intelligent Algorithms for Computational Intelligence Systems (IACIS), DOI: 10.1109/IACIS61494.2024.10721979

22. Tushar Dhar Shukla;G. Radha;Dharmendra Kumar Yadav;Chaitali Bhattacharya;Rvs Praveen;Nikhil N. Yokar, "Advanced Student Success Predictions in Higher Education with Graph Attention Networks for Personalized Learning", 2024 First International Conference on Software, Systems and Information Technology (SSITCON), DOI: 10.1109/SSITCON62437.2024.10796791

23. V. Yamuna;Praveen RVS;R. Sathya;M. Dhivva;R. Lidiya;P. Sowmiya, "Integrating AI for Improved Brain Tumor Detection and Classification" 2024 4th International Conference on Sustainable Expert Systems (ICSES), DOI: 10.1109/ICSES63445.2024.10763262

24. Rvs Praveen;Aktalina Torogeldieva;B Saravanan;Ajay Kumar;Pushpa Rani;Bhimanand Pandurang Gajbhare, "Enhancing Intellectual Property Rights(IPR) Transparency with Blockchain and Dual Graph Neural Networks" 2024 First International Conference on Software, Systems and Information Technology (SSITCON), DOI: 10.1109/SSITCON62437.2024.10795998

25. Sarthak Sharma;Suman Vij;RVS Praveen;S. Srinivasan;Dharmendra Kumar Yadav;Raj Kumar V S, "Stress Prediction in Higher Education Students Using Psychometric Assessments and AOA-CNN-XGBoost Models," 2024 4th International Conference on Sustainable Expert Systems (ICSES), DOI: 10.1109/ICSES63445.2024.10763288

26. RVS PRAVEEN et al.: NEXT-GENERATION CIRCUITS FOR INDUSTRY 4.0 USING INNOVATIONS IN SMART INDUSTRIAL APPLICATIONS, ICTACT JOURNAL ON MICROELECTRONICS, OCTOBER 2024, VOLUME: 10, ISSUE: 03, DOI: 10.21917/ijme.2024.0323