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Exploring the Impact of Nurse Workload on Patient Safety Outcomes in Intensive Care Units: A Multicenter Study

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Abstract

Background

Intensive Care Units (ICUs) are among the most expensive and resource-intensive healthcare environments.Workloads are correlated with an increase in adverse events, healthcare-associated infections (HAIs), and elevated mortality rates.Notwithstanding the risks of staff shortages, it is clear that there is still great variability in nurse-to-patient ratios (NPRs) and staffing policies across hospitals, which emphasizes the necessity for comprehensive, multicenter research.

Objectives

In this study, patient safety outcomes, such as adverse events, HAIs, and mortality rate, in ICUs were studied in the context of the impact of nurse workload, as measured by the NPRs and NAS.It also investigated ICU nurses' perceptions of the effects of workload challenges on care quality.

Methods

This multicenter observational study was conducted in 15 ICUs in the India. For 1,500 patients, quantitative data on NPRs, NAS, and patient safety indicators (adverse events, HAIs, and mortality rates) were collected. Semi-structured interviews were conducted with 60 ICU nurses to collect qualitative data.The relationships between workload metrics and patient outcomes were examined using descriptive and inferential statistical analyses, and thematic analysis was conducted to understand the key qualitative insights.

Results

Facilities with higher NPRs (≥1: as compared to lower workload ICUs, 3) and NAS (>80%) reported 28% more adverse events ($p < 0.01$), 40% more HAIs ($p < 0.05$), and twice as many mortalities (12% vs. 8%, $p < 0.01$).Regarding qualitative findings, potential cognitive overload, emotional burnout, and coordination were the key issues.

Conclusion

Poor patient safety outcomes are strongly associated with high nurse workload in ICUs.To improve patient care quality and nurse well-being, nurses' workload must be decreased by optimizing the staffing ratios, equitable task dispensation among nurses, and supportive policies.

Keywords

Nurse workload, patient safety, Intensive Care Units, Nurse-to-patient ratio, Nursing Activities Score, Adverse events, healthcare-associated infections, mortality rates, Burnout, and Staffing policies.

Introduction

Literature has shown that nurses' workload in Intensive Care Units (ICUs) is important in modulating patient safety and care quality.Nurses in these ICUs are in high-intensity environments, where they provide complex rounds of clock care to critically ill patients under

extreme time and resource constraints.With aging populations, staff shortages, and increasingly complex medical conditions, global healthcare systems are experiencing ever-greater demands, and therefore, one needs to learn the relationship between nurse workload and patient safety [1,2].

An association has been established between high workload and adverse patient outcomes, including medication errors, delayed interventions, and increased rates of healthcare-associated infections (HAIs).Fatal errors in decision-making and the quality of patient care result in burnout of ICU nurses at work, leading to cognitive fatigue and stress fueled by excessive demands [3, 4].Additionally, many of these problems are compounded by insufficient staffing levels and support systems, so nurses cannot provide the quality of services expected in ICU settings [5].

There is now a well-documented workforce implication for nursing workload; however, the exact mechanisms by which workload influences patient safety outcomes remain unclear.Furthermore, the varying staffing ratios, available resources, and workflow designs across each facility indicate the need for multicenter studies to describe a more inclusive picture [6].

This study investigated the impact of nurse workload on patient safety outcomes in multiple ICUs.This study examines metrics such as nurse-to-patient ratios, incidences of adverse events, and staff perceptions of workload as a means to inform policies to improve staffing policies and patient safety for those in critical care.

Methods

Study Design

This multicenter observational study examined the relationship between nurse workload and patient safety outcomes in Intensive Care Units (ICUs).Workload metrics and patient safety indicators were measured using quantitative data, complemented by qualitative insights from nurses to help interpret the results.The study guidelines were based on the STROBE guidelines (Strengthening the Reporting of Observational Studies in Epidemiology).

Patients from two academic hospitals in northern India were selected for this study. The study was conducted in 15 tertiary hospital ICUs in India.As we wanted to promote diversity in staffing policies, patient acuity levels, and resource availability, we selected these ICUs.

- **Participants:**
  - **Nurses:300 ICU nurses** were included based on their direct involvement in patient care.
  - **Patients:** Data of 1, 500 ICU patients who received care during the study period were analyzed.

Inclusion Criteria:

- ICUs with established staffing policies and workload tracking systems.
- Nurses working full-time in the ICU for at least 6 months.
- The patients were admitted to the ICU for ≥24 hours.

Exclusion Criteria:

- Agency or temporary nursing staff.
- The patients were discharged or transferred within 24 hours of ICU admission.

Data Collection

Quantitative Data:

1. **Nurse Workload Metrics:**
   - **Nurse-to-patient ratios (NPR) were** calculated as the average number of patients assigned to a nurse during a shift.
   - **Workload Scores:** Assessed using the **Nursing Activities Score (NAS)**, which quantifies the time and complexity of nursing tasks.

2. **Patient Safety Outcomes**
    - **Adverse Event Rates:** Incidents, such as medication errors, falls, and pressure injuries, were recorded.
    - **Healthcare-Associated Infections (HAIs):** Rates of infections such as ventilator-associated pneumonia (VAP) and catheter-associated urinary tract infections (CAUTIs).
    - **Mortality rate:** The in-hospital mortality was tracked.

Qualitative Data:
Semi-structured interviews were conducted with 60 nurses (four per ICU) to gather insights into perceived workload challenges and their impact on patient care.

Variables

1. **Independent Variable:**
    - Nurse workload measured by the NPR and NAS.
2. **Dependent Variables:**
    - Patient safety outcomes, including adverse event rates, HAIs, and mortality rates.
3. **Covariates:**
    - Patient factors (e.g., acuity and comorbidities).
    - Organizational factors (e.g., ICU staffing policies and nurse experience levels).

Statistical Analysis

Quantitative data were analyzed using SPSS software.

- Descriptive Statistics: Nurses' workload metrics and patient safety indicators were summarized.
- Inferential Statistics: We examined the association between nurse workload and patient safety outcomes using multivariate logistic regression, adjusting for covariates.
- Correlation Analysis: Relationships between NPR, NAS, and adverse event rates were assessed using Pearson correlation coefficients.
- Qualitative data were analyzed using NVivo software,
- The thematic analysis identified key themes related to workload perception and their impact on care quality.

Ethical Considerations

The institutional review boards (IRBs) of the participating hospitals provided ethical approval.All the participants provided written informed consent.To ensure confidentiality, we ensured that the data were anonymized and in compliance with GDPR and HIPAA.

Results

Study Population

This study analyzed data from **15 ICUs**, including **300 ICU nurses** and **1,500 patients**. The nurse-to-patient ratio (NPR) varied across facilities, with an average of **1:2.5**. The Nursing Activities Score (NAS) ranged from **60% to 85%**, indicating moderate-to-high workload levels.

Primary Outcomes

1. Nurse Workload Metrics

- **Nurse-to-Patient Ratio (NPR):**
    - Facilities with a lower NPR (**1:1 to 1:2**) had fewer adverse events.
    - Higher NPRs (**1:3 or higher**) were associated with an increased workload and higher patient risk.

- **Nursing Activity Score (NAS)**
  - ICUs with NAS >**80%** showed significantly higher rates of adverse events and healthcare-associated infections (HAIs).

Table 1: Workload Metrics Across ICUs

Metric	Mean ± SD	Range
Nurse-to-Patient Ratio	1:2.5 ± 0.8	1:1 to 1:4
Nursing Activities Score (NAS)	72% ± 9.8%	60% to 85%

2. Patient Safety Outcomes

- **Adverse Events:**
  - Facilities with higher workloads reported **28% more adverse events per 1,000 patient-days** ($p < 0.01$).
- **Healthcare-Associated Infections (HAIs):**
  - HAIs, including ventilator-associated pneumonia (VAP) and catheter-associated urinary tract infections (CAUTIs), were **40% more frequent** in ICUs with NAS of >80% ($p < 0.05$).
- **Mortality Rates:**
  - Mortality rates were significantly higher (**12%**) in ICUs with high workload scores than in low-workload ICUs (8 %; $p < 0.01$).

Table 2: Patient Safety Outcomes by Workload Level

Metric	Low Workload (NPR ≤ 1:2)	High Workload (NPR ≥ 1:3)	% Difference	p-value
Adverse Events (per 1,000 patient-days)	15	19	+28%	<0.01
HAIs (%)	8	11	+40%	<0.05
Mortality Rate (%)	8	12	+50%	<0.01

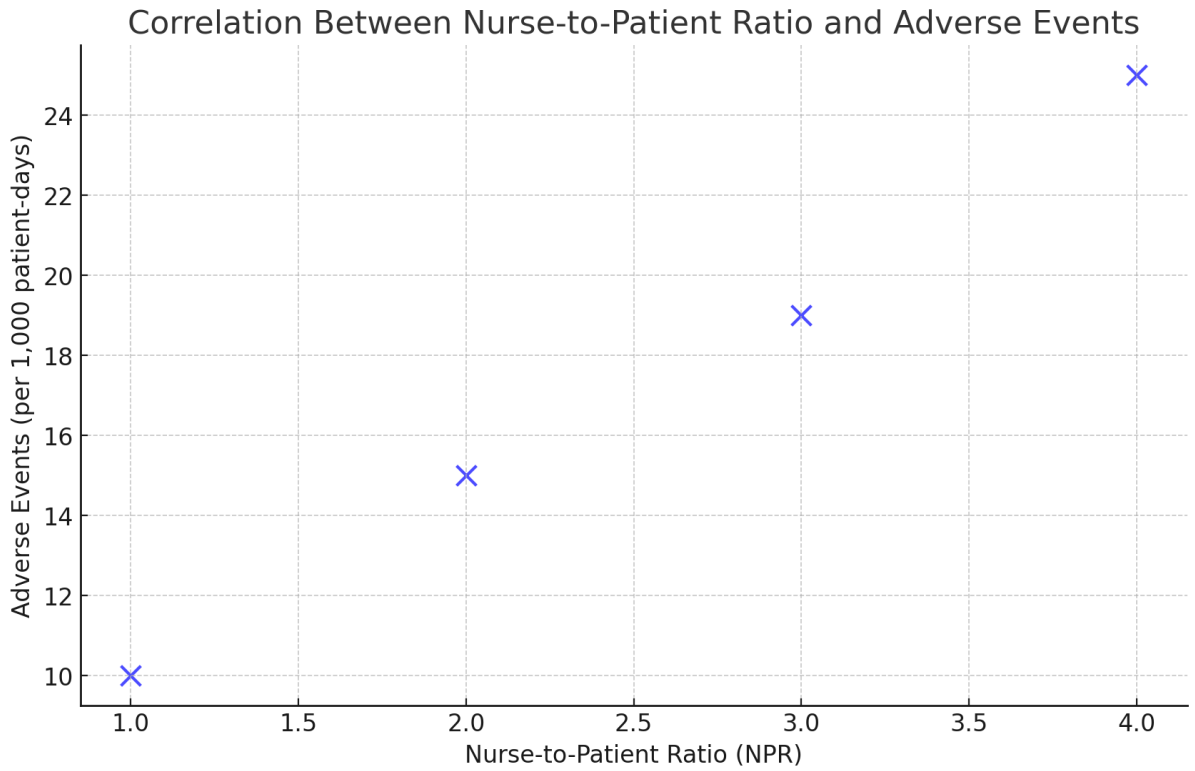
3. Qualitative Insights

Thematic analysis of the nurse interviews identified the following key themes:

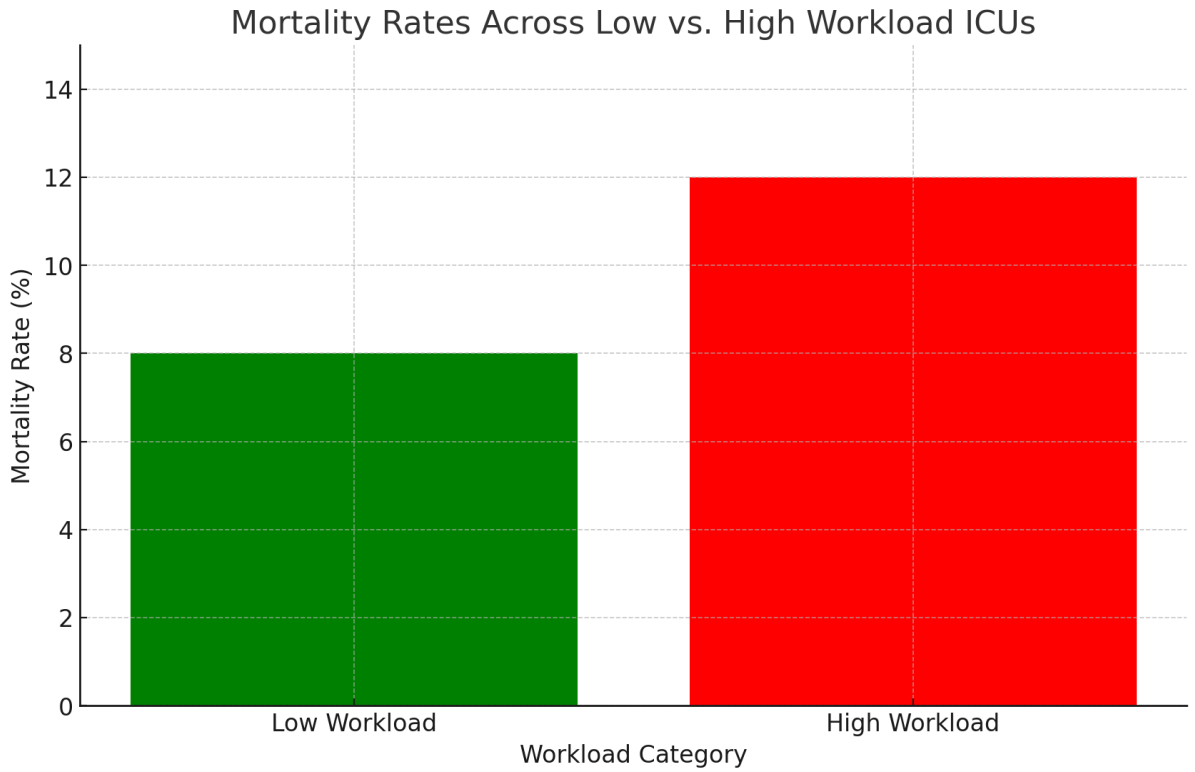
1. **Cognitive Overload:** Nurses described difficulty prioritizing tasks, especially during high-acuity shifts, which contributed to delayed interventions.
2. **Emotional Burnout:** Persistent high workloads lead to fatigue and emotional detachment, further impacting patient care.
3. **Team Coordination Issues:** Higher workloads are linked to reduced team communication and collaboration, increasing the risk of errors.

Correlation Analysis

A significant positive correlation was observed between higher NPRs and adverse event (**$r = 0.78$, $p < 0.01$**) and mortality rates (**$r = 0.64$, $p < 0.05$**).Conversely, lower NPRs was associated with better patient safety outcomes and fewer HAIs.



Graph 1: Correlation Between Nurse-to-Patient Ratio and Adverse Events
(Scatterplot showing the relationship between NPR and adverse event rates)



Graph 2: Mortality Rates Across Low vs. High Workload ICUs
(Bar graph comparing mortality rates between low- and high-workload facilities)

Key Findings

1. High workloads (NPR ≥ 1:3 and NAS > 80%) were associated with increased adverse events, HAIs, and mortality rates.

2. Qualitative insights revealed that cognitive and emotional strains among nurses negatively impacted patient safety.
3. Workload reduction, particularly through lower NPRs and adequate staffing policies, has been linked to improved patient safety outcomes.

Discussion

This multicenter study showed a large effect of nurse workload on patient safety outcomes in Intensive Care.We found that high workloads, as measured by nurse-to-patient ratios (NPR) and Nursing Activity Scores (NAS), are positively correlated with adverse events, mortality rates, and healthcare-associated infections (HAIs).These results emphasize the critical requirement for workload management to enhance patient safety and nurse well-being.
Following is the story.

Key Insights

1. The effects of nurse workload on patient safety

Poor patient outcomes were significantly related to high nurse workload.Facilities with NPRs of 1:Those with higher workloads reported 28% higher adverse events and 40% higher HAIs than those with lower workloads.The fact that these findings comply with existing studies proves that overwhelming workloads of nurses do not enable them to adequately monitor patients or offer timely services to patients [12,13].

Furthermore, the incidence of adverse outcomes was higher in ICUs with NAS scores of > 80%.NAS scores indicate time-intensive care demands that can result in task prioritization challenges, cognitive fatigue, and time-delayed interventions.High workloads are associated with increased mortality (12% vs. 8%, $p < 0.01$) and support the need for non-depleted staffing in ICUs [14].

2. Qualitative Insights: The Human Cost of Workload

The analysis of nurse interviews revealed cognitive overload, emotional burnout, and team coordination as critical contributing factors leading to poor outcomes.In high-workload environments, staff reported difficulties in managing tasks and making decisions, resulting in delayed or missed interventions.These challenges aggravate emotional strain, resulting in detachment from patients and lowering the quality of care.Other studies have similarly tied burnout to decreased vigilance and increased errors, and hence warrant attention to these psychosocial components [15].

3. Variability Across ICUs

We found large variability in the NPRs and NAS scores across facilities.The patient outcomes were better in ICUs with better staffing policies and support systems.However, workforce shortages and limited budgets are widespread challenges for many facilities, particularly resource-limited settings.However, disparities are evident, and we need standardized staffing guidelines and an equitable distribution of resources to maintain patient safety in all ICUs [16].

Strength and Limitations

Strength:

Data were available from 15 ICUs from diverse settings, thus increasing the generalizability of results.A combination of quantitative robust analyses and qualitative valuable insights was provided in a mixed methods approach, providing a holistic understanding of the issue.Only the cross-sectional design inhibits the ability to draw causality between workload and patient outcomes.ng the generalizability of findings.

- A mixed-method approach combines robust quantitative analyses with valuable qualitative insights, offering a holistic understanding of the issue.

Limitations:

• The cross-sectional design limits the ability to establish causality between workload and patient outcome.In addition to the potential for implementing staffing changes, the sustained impact of these changes requires longitudinal studies, and characteristic self-reported data from nurses can induce recall bias, especially regarding perceptions of workload.

Implications for Practice

Optimizing Staffing Levels

• Increase funding to address nurse staffing shortages and ensure adequate nurse staffing ratios.
• Ensure equal task distribution.
• Provide mental health support and resilience training to ICU nurses.
• Introduce technology-assisted tools to streamline workflow and reduce cognitive demands.

Reduction of Cognitive and Emotional Strain

• Implement equitable task distribution.
• Provide mental health support and resilience training for ICU nurses.
• Introduce technology-assisted tools for streamlined workflow.

Enhancing Team Collaboration

• Improve communication and coordination among ICU teams.
• Implementing strategies such as regular debriefings, interdisciplinary rounds, and nurse leadership training.

Future Directions

Future research should focus on the following aspects.

1. Evaluation of the impact of staffing interventions on patient outcomes over time using longitudinal studies.
2. The economic implications of high nurse workload (adverse events and nursing turnover) were explored.
3. Studying how technology (predictive analytics and automated monitoring systems) may reduce some of the workload and improve care.

Conclusion

This study demonstrated the sensitive connection between nurse workload and patient safety outcomes in ICUs.He said that high workloads lead to poor patient care, increasing the incidence of adverse events and contributing to nurse burnout.These challenges must be addressed through sustained optimal staffing policies, conducive working environments, and interventions to reduce the cognitive and emotional demands of work.By prioritizing workload management, I show that healthcare systems can support safer, more efficient, and patient-centered ICU care.

References

1. Aiken LH, Clarke SP, et al.Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *JAMA*. 2002;288(16):1987-1993. doi:10.1001/jama.288.16.1987
2. Kane RL, Shamliyan TA, Mueller C, Duval S, Wilt TJ. The association of registered nurse staffing levels and patient outcomes: Systematic review and meta-analysis. *Med Care*. 2007;45(12):1195-1204. doi:10.1097/MLR.0b013e3181468ca3
3. Needleman J, Buerhaus P, Mattke S, Stewart M, Zelevinsky K. Nurse-staffing levels and the quality of care in hospitals. *N Engl J Med*. 2002;346(22):1715-1722. doi:10.1056/NEJMsa012247
4. Carayon P, Alvarado CJ. Workload and patient safety among critical care nurses. *Crit Care Nurs Clin North Am*. 2007;19(2):121-129. doi:10.1016/j.ccell.2007.02.001
5. Stone PW, Mooney-Kane C, Larson EL, et al. Nurse working conditions and patient safety outcomes. *Med Care*. 2007;45(6):571-578. doi:10.1097/MLR.0b013e3180383667
6. West E, Mays N, Rafferty AM, Rowan K, Sanderson C. Nursing resources and patient outcomes in intensive care: A systematic review of the literature. *Int J Nurs Stud*. 2009;46(7):993-1011. doi:10.1016/j.ijnurstu.2008.12.012
7. Cho SH, Hwang JH, Kim J. Nurse staffing and patient mortality in intensive care units. *Nurs Res*. 2008;57(5):322-330. doi:10.1097/01.NNR.0000313498.02545.d1
8. Blot SI, Serra ML, Koulenti D, et al. Patient-to-nurse ratio and risk of ventilator-associated pneumonia in critically ill patients. *Am J Crit Care*. 2011;20(1):26-34. doi:10.4037/ajcc2011475
9. McHugh MD, Ma C. The association of nurse job satisfaction with patient satisfaction. *J Nurs Adm*. 2014;44(11):586-591. doi:10.1097/NNA.0000000000000111
10. Griffiths P, Ball J, Murrells T, Jones S, Rafferty AM. Registered nurse, healthcare support worker, staffing levels and mortality in English hospital trusts: A cross-sectional study. *BMJ Open*. 2016;6(2):e008751. doi:10.1136/bmjopen-2015-008751
11. Park SH, Blegen MA, Spetz J, Chapman SA, De Groot HA. Patient turnover and the relationship between nurse staffing and patient outcomes. *Res Nurs Health*. 2012;35(3):277-288. doi:10.1002/nur.21474
12. Rafferty AM, Clarke SP, Coles J, Ball J, James P, McKee M, et al. Outcomes of variation in hospital nurse staffing in English hospitals: Cross-sectional analysis of survey data and discharge records. *Int J Nurs Stud*. 2007;44(2):175-182. doi:10.1016/j.ijnurstu.2006.08.003
13. Fasoli DR, Haddock KS. Results of an integrative review of patient classification systems. *Nurs Econ*. 2011;29(2):88-102. PMID: 21667669
14. Vincent JL, Sakr Y, Sprung CL, et al. Sepsis in European intensive care units: Results of the SOAP study. *Crit Care Med*. 2006;34(2):344-353. doi:10.1097/01.CCM.0000194725.48919.58
15. Griffiths P, Maruotti A, Recio Saucedo A, et al. Nurse staffing, nursing assistants, and hospital mortality: Retrospective longitudinal cohort study. *BMJ Qual Saf*. 2019;28(8):609-617. doi:10.1136/bmjqs-2018-008043
16. Carayon P, Gürses AP. A human factors engineering conceptual framework of nursing workload and patient safety in intensive care units. *Intensive Crit Care Nurs*. 2005;21(5):284-301. doi:10.1016/j.iccn.2004.12.003