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Standard workload-based estimation of nursing manpower requirement in the ICU of a tertiary care teaching hospital: A time and motion study

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Abstract:

BACKGROUND: The safety of patients remain at risk due to a higher workload and lower nurse-to-patient ratio. However, in India, most hospitals still adhere to long-known nurse staffing norms set by their statutory or accreditation bodies. Therefore, the present study was undertaken to recommend a standard workload-based estimation of nursing manpower requirement in the ICU of a tertiary care teaching hospital.

MATERIALS AND METHODS: It was a descriptive, observational, time and motion study was conducted in the medicine ICU of a tertiary care teaching hospital. Data collection was done by using demographic and clinical profile sheet of patients, NPDS-H dependency assessment scale, time and activities record sheet, and WHO WISN tool. The nurses' activities were observed by nonparticipatory and non-concealment technique. Data analysis was done using descriptive statistics and the WHO WISN tool.

RESULTS: The bed occupancy rate and the average length of stay in the medicine ICU were 93.23% and 7.18 days respectively. Distribution of dependency level of the medical ICU patients was very high (41.67%), low-high (33.33%), and medium-high (25.0%) dependency level. Considering available resources and workload in tertiary care hospitals in India, the study recommended a nurse-to-patient ratio of 1:1.2 in each shift for the medicine ICU of a tertiary care hospital.

CONCLUSION: The study suggested minimum nurse-to-patient ratio in medical ICU should be 1:1.2 with provision of power to ICU incharge nurse to allocate nurses according to the workload in different shifts. Also, nurse staffing norms in hospitals need to be estimated or selected with serious consideration of health care demands when employing nurse staffing norms.

Keywords:

Nursing manpower, nurse-to-patient ratio, time and motion study, workload

Introduction

In today's world, human resources are recognized as a strategic factor of an organization. Human resource development contributes to the development of countries and organizations, and health organizations are primarily responsible for promoting and maintaining the health status of the community.[1,2] However, there is a global shortage of health workers, particularly nurses and midwives, who account for over half of the current shortage.[3] It was reported that raising the nurse-to-patient ratio from 1:4 to 1:6 increased patient mortality by 7%, while increasing the ratio to 1:8 increased the mortality rate to 14%. The enactment of standardized nurse staffing norms continues to stir debate throughout the world, as health care institutes with varying resources struggle to recruit nurses with adequate nurse-to-patient ratios.[4] Further extending the fact that enforced nurse-to-patient ratios did not benefit the outcomes intended.[5] As these laws and regulations give rise to external

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restrictions, individual organizations retain substantial flexibility in their staffing strategies. Therefore, some organizations, such as the American Nurses Association and the American Organization of Nurse Executives support evidence-based nurse-to-patient ratios.[6] In India, however, most hospitals adhere to long-established nurse-to-patient ratio or nurse staffing norms stated by the statutory or accreditation bodies, including the Staff Inspection Unit (SIU), Indian Nursing Council (INC), Medical Council of India (MCI), and National Accreditation Board for Hospitals and Health Care Providers (NABH).

As there is no invariable strategy to estimate staffing numbers, the concept of an ideal level of nurse staff planning is a bit controversial. As a general rule, staffing requirements are calculated using facility-based ratios or staffing standards. However, these methodologies not only have significant flaws but also fail to take into account vast geographic differences in health care demand and providers.[7] As a result, nurse staffing levels should rely on a mix of patient health care needs (acuity and dependency level), patient throughput, nursing competency, and ancillary staff availability.[5] The patient dependence scale is a relatively precise scale for categorizing patients based on the amount and complexity of their nursing care demands in order to determine the ideal staffing levels to address these needs.[8,9] Health managers, if they have to regulate their valuable manpower resources well, require a better and more consistent way to make staffing decisions. The World Health Organization's (WHO) Workload Indicators of Staffing Need (WISN) is one such method, which utilizes nurses' workload to estimate nursing manpower requirement in hospitals.[7]

The optimal nurse-to-patient ratio must be identified in order to aid in the time distribution of nursing care activities, which will not only minimize nurses' workload but also improve patient safety and satisfaction.[10] Furthermore, in today's world, the complexity of treatment and technological advancements have increased.[11] In addition, studies are very limited to address the question of nursing manpower measurement for all clinical departments of the hospital. In India, no study has been undertaken in the previous ten years to determine the nurse-to-patient ratio based on the available workload and dependency level in the ICU. As a result, the current study is being conducted to estimate nursing manpower requirements based on patient dependency levels and standard workload in selected hospital units.

Materials and Methods

Study design and setting

A descriptive observational time and motion study was conducted among nurses of a tertiary care teaching hospital in Uttarakhand, India.

Study participants and sampling

The samples were patients admitted and activities performed by the nurses working during the study period in the ICU of AIIMS, Rishikesh. This study was conducted in June 2021. Patients were selected by consecutive sampling technique followed by work sampling of activities performed by nurses working in the selected ICU of a tertiary care hospital. Inclusion criteria were nurses working as nursing officers and willing to participate in the study; Also, the activities performed by the nurses working in ICU during the study period and patients who were admitted in the ICU during the study period. The exclusion criteria were patients who were less than 18 years of age and all the activities performed on them.

Data collection tool and technique

The researcher employed a nonparticipatory and non-concealment observation technique to collect data. The researcher acted solely as a nonparticipant observer throughout the study. The following tools were used to collect data for the study.

Demographic and clinical profile sheet of patients

It is a self-structured close-ended questionnaire. It consists of items related to the socio-demographic and clinical profiles of the patients. It includes age, gender, clinical diagnosis, any surgery, date of admission, and date of surgery.

Northwick Park dependency assessment scale-Hospital (NPDS-H)

It is a standardized tool available in the public domain. This tool was developed in Northwick Park hospital, Great Britain, published in 1999, and modification was done in 2004. Permission to use the tool for the study was obtained from the author of the NPDS-H tool.[12]

Description of the NPDS-H tool: It provides an assessment of patient care needs. It is an ordinal scale incorporating activities of daily living, safety awareness, behavioral management, and communication. NPDS-H is an extension of the original NPDS. NPDS-H includes the basic care needs section, which consists of 12 basic care needs/psychological needs ordinal questions, scoring 0–65, and the in-patient nursing care needs section, which contains 8 dichotomous and 8 ordinal questions, scoring 0–35. The total score of the tool is 0–100. Higher scores are indicative of increased dependence on assistance for all care needs. This tool has to be filled by the nurse or the carer who knows the patient's care needs well.

Validity and reliability of the tool: It is shown to be a valid and reliable tool. The Interrater reliability (rho) of the NPDS tool is 0.80.[13]

Daily nursing care activities and frequency record sheet

It is a self-structured worksheet. It was prepared to record all major nursing care activities performed by the nurses working in the medicine ICU.

Time record sheet of nursing care activities

It is a self-structured worksheet. It was prepared to record the time to complete each selected nursing activity performed by the nurses.

Workload indicator of staffing need (WISN) WHO tool

It is a standardized tool available in the public domain, prepared by Peter Shipp, published by WHO in 1998, and revised in 2008.[14] The permission to use this tool for the present study was taken from the copyrighted authors of the WISN tool. It is a human resource management tool. The WISN method is based on a health care worker's workload, with activity (time) standards applied for each workload component. This method determines how many health workers of a particular type are required to cope with the workload of a given health facility; assesses the workload pressure of the health care workers in that facility. It provides two types of results—differences and ratios. The difference between the actual and calculated number of health care workers shows the level of staff shortage or surplus for the particular staff category and health facility type for which WISN has been developed.

Data collection

Daily patients' census of the selected ward was obtained. After providing a participant information sheet, informed consent from patients/their legal guardians was also obtained. Demographic data of all the patients who met the inclusion criteria were collected using the "demographic and clinical profile sheet of patients" for a period of 30 days. The daily dependency level of the patients' was assessed using "The Northwick Park Dependency Assessment Hospital Scale (NPDH-S)" for a period of 30 days. After categorizing the patients' dependency level, every day, a cubicle of the ward was selected for the observation of the nurses' activities for a total of 9 days (3 days for each morning, evening, and night shifts) and time was recorded. The time was recorded by the researcher through nonparticipatory and non-concealment observation methods. For the morning, evening, and night shifts, observations were made from 8 am to 2 pm, 2 pm to 8 pm, and 8 pm to 8 am, respectively. At least three observations and the average time of the three observations were considered as the standard time needed to perform that activity for each dependency level patient. After recording the time of the activities, the frequency of the activities was logged for the next 15 days (5 days for each morning, evening, and night shifts) for all patients in the ward. These activities and the frequency of the activities were recorded on the 'Daily Nursing Care Activities and Frequency Record Sheet' by the researcher. Total nursing care activities performed for each dependency level patient were summed up for standard workload estimation using the WHO WISN tool. At the end of data collection, all the participants were thanked for their participation in the study.

Ethical consideration

This study is the part of the research project for which ethical approval was obtained from the institutional ethics committee under the IEC reference letter number—AIIMS/IEC/19/915, Reg. No. 246/IEC/Ph.D./2019. Prior to the commencement of the study, permission was also obtained from the Senior Nursing Officers of each ward for the overall investigation. The participant information sheet was provided to all participants and written informed consent was taken after a complete explanation of the study. The participants were informed that the participation was voluntary. Confidentiality of information and anonymity of the participants were also assured throughout the study.

Data analysis

The data were entered in a Microsoft Excel sheet, cleaned, and checked for missed variables. Further data were labeled and categorized. The data analysis was done using Microsoft Excel 2016. Descriptive statistics were used to express the patients' dependency level and nursing care activities in frequency and percentages, and the WHO WISN tool was used to estimate nursing manpower requirements.

Results

The bed occupancy rate and the average length of stay (ALS) in the medicine ICU were 93.23% and 7.18 days, respectively as shown in Table 1. It was noted that most of the patients had very high (41.67%), low-high (33.33%), and medium-high (25.0%) dependency levels of the

Table 1: Bed occupancy rate in the Medicine ICU

Variables	No. of days (in 30 days)
New admissions	179
Transfer in	18
Transfer out	34
Discharges	151
On LAMA/Abscond	33
Total beds	1170
Vacant beds	85
Total occupied beds	1085

*LAMA - Leave Against Medical Advice

$$\textbf{Bed Occupancy Rate (BOR)} = \frac{\text{No. of inpatient days in a given month}}{\text{No. of available bed days in that month}} \times 100$$

$$=611\times00 / 840=72.73\%$$

Average Length of Stay (ALS)=Total inpatients days/no. of discharges

$$=1085/151=7.18$$

patients as demonstrated in Table 2. It was observed that out of all nursing care activities, the maximum performed activities were taking vitals and giving IV medication in all three shifts as illustrated in Table 3. It was observed that the maximum number of nurses were required for giving IV medications (0.20) followed by writing notes (0.17). Overall, nurses required for low-high dependency patients were 0.64 as shown in Table 4. (0.54) followed by writing notes (0.37). The number of nurses required for giving IV medications (0.54) was higher than for writing notes (0.37). Overall, nurses required for medium-high dependency patients were 1.72 as displayed in Table 5. It was reported that the maximum number of nurses were required for giving IV medications (0.58) followed by writing notes (0.4). Overall, nurses required for very high dependency patients was 1.94 illustrated in Table 6. The basic nursing staff requirement for admission and discharge of all dependency level patients was found to be 4.7 as shown in Table 7. The category allowance standard (CAS), which encompasses all support activities, observed that most time was spent updating census and medication

Table 2: Patients' categorization based on their dependency level as admitted to the medicine ICU

Dependency level	Dependency score	Frequency (%)
Low-high	26-30	4 (33.33)
Medium-high	31-45	3 (25.0)
Very high	> 46	5 (41.67)
Total		12 (100)

Table 3: Frequency of nursing care activities performed by nurses working in the ICU in various shifts

Activities	Morning shift *f* (%)	Evening shift *f* (%)	Night shift *f* (%)	Total (M+E+N) *f* (%)
Discussion with doctors	9 (45.0)	4 (20.0)	7 (35.0)	20 (100)
Vitals	73 (24.58)	76 (25.59)	148 (49.83)	297 (100)
Bedding	10 (52.63)	05 (26.31)	04 (21.05)	19 (100)
Dressing	0 (0.0)	0 (0.0)	1 (100.0)	1 (100)
Oral medication	1 (33.33)	1 (33.33)	1 (33.33)	3 (100)
IV medication	34 (31.77)	31 (28.97)	42 (39.25)	107 (100)
Hand & take over	34 (31.69)	32 (32.65)	32 (32.65)	98 (100)
IV cannulation	0 (0.0)	1 (100.0)	0 (0.0)	1 (100)
IV cannula removal	0 (0.0)	1 (100.0)	0 (0.0)	1 (100)
RBS	14 (27.45)	10 (19.61)	27 (52.94)	51 (100)
Foleys catheterization	1 (50.0)	1 (50.0)	0 (0.0)	2 (100)
Foleys removal	1 (50.0)	1 (50.0)	0 (0.0)	2 (100)
IO monitoring	19 (32.76)	11 (18.96)	28 (48.27)	58 (100)
Blood sampling	10 (33.33)	13 (43.33)	07 (23.33)	30 (100)
COVID sample	2 (50.0)	1 (25.0)	1 (25.0)	4 (100)
Sent for billing	1 (16.67)	3 (50.0)	2 (33.33)	6 (100)
Urine Sample	3 (60.0)	2 (40.0)	0 (0.0)	5 (100)
Sent for ECG/X ray	6 (33.33)	3 (16.67)	9 (50.0)	18 (100)
S/C injection	4 (22.22)	3 (16.67)	11 (61.11)	18 (100)
CPT	5 (22.72)	4 (18.18)	13 (59.09)	22 (100)
ABG sampling	2 (50.0)	1 (25.0)	1 (25.0)	4 (100)
Oxygen application	2 (50.0)	1 (25.0)	1 (25.0)	4 (100)
Nebulization	8 (34.78)	2 (8.69)	13 (56.52)	23 (100)
IM injection	1 (100.0)	0 (0.0)	0 (0.0)	1 (100)
NG aspiration	1 (100.0)	0 (0.0)	0 (0.0)	1 (100)
Blood transfusion	0 (0.0)	0 (0.0)	1 (100.0)	1 (100)
Infusion	1 (25.0)	2 (50.0)	1 (25.0)	4 (100)
Report collection	1 (50.0)	1 (50.0)	0 (0.0)	2 (100)
Suctioning	6 (18.75)	10 (31.25)	16 (50.0)	32 (100)
RT Feed	16 (38.09)	10 (23.81)	16 (38.9)	42 (100)
Bladder irrigation	0 (0.0)	1 (100.0)	0 (0.0)	1 (100)
Notes writing	34 (34.69)	32 (32.65)	32 (32.65)	98 (100)
Patient positioning	37 (30.08)	36 (29.27)	50 (40.65)	123 (100)
Foleys care	17 (100.0)	0 (0.0)	0 (0.0)	17 (100)
Oral care	17 (100.0)	0 (0.0)	0 (0.0)	17 (100)
Changing clothes	17 (100.0)	0 (0.0)	0 (0.0)	17 (100)
Tracheostomy care	17 (100.0)	0 (0.0)	0 (0.0)	17 (100)
Total	404 (34.62)	299 (25.62)	464 (39.76)	1167 (100)

*IV - Intravenous, ABG - Arterial Blood Gas, RBS - Random Blood Sugar, RT - Ryle's Tube, IO - Intake Output, S/C - Subcutaneous, I/M - Intramuscular, CPT - Chest Physiotherapy, OT - Operation Theatre, ECG - Electrocardiography, COVID - Coronavirus Disease, M - Morning, E - Evening, N - Night

Table 4: Nurses requirement for low-high dependency level patients based on standard workload in the medicine ICU

Nursing activity Low high dependency (M+E+N)	Activity standard (unit time)	Frequency	AWT	Total workload 9/3=3 Frequency/3×365	Basic staff requirement Total workload/Standard workload
Vitals	1.32	36	103680	4380	0.055763889
Bedding	2.4	5	103680	608.3333333	0.01408179
IV medication	10.82	16	103680	1946.666667	0.203153292
Hand over	1.4	18	103680	2190	0.029571759
RBS	3.03	5	103680	608.3333333	0.01777826
Assist in Foleys catheterization	9.43	2	103680	243.3333333	0.02213188
Foleys removal	3.04	2	103680	243.3333333	0.007134774
IO monitoring	2.03	10	103680	1216.666667	0.023821695
Blood sample	8.2	2	103680	243.3333333	0.019245113
S/C injection	3.24	2	103680	243.3333333	0.007604167
Nebulization	3.14	7	103680	851.6666667	0.025793146
Positioning	2.23	9	103680	1095	0.023551794
Writing notes	12.22	12	103680	1460	0.172079475
Doctors rounds	3.5	4	103680	486.6666667	0.016428755
Total	66.0				0.638139789

*IV - Intravenous, RBS - Random Blood Sugar, RT - Ryle's Tube, IO - Intake Output, S/C - Subcutaneous, AWT - Available Working Time

Table 5: Nurses requirement for medium-high dependency level patients based on standard workload in the medicine ICU ward

Nursing activity Medium-high dependency (M+E + N)	Activity standard (unit time)	Frequency	AWT	Standard Workload 103680/AS	Total Workload 9/3=3 Frequency/3×365	Basic staff requirement Total workload/ Standard workload
Vitals	1.63	60	103680	63607.36196	7300	0.11476659
Bedding	2.4	3	103680	43200	365	0.008449074
IV medication	22.05	21	103680	4702.040816	2555	0.543381076
Hand over	2.99	18	103680	34675.58528	2190	0.063156829
RBS	3.03	10	103680	34217.82178	1216.6667	0.03555652
IO Monitoring	2.03	11	103680	51073.89163	1338.3333	0.026203864
Blood Sample	6.36	6	103680	16301.88679	730	0.044780093
COVID Sample	2.9	1	103680	35751.72414	121.66667	0.003403099
Sent for billing	3.4	2	103680	30494.11765	243.33333	0.007979681
Urine sample	2.97	1	103680	34909.09091	121.66667	0.003485243
Sent for ECG/Consultation	3.68	9	103680	28173.91304	1095	0.038865741
S/C injection	3.24	1	103680	32000	121.66667	0.003802083
ABG	4.06	1	103680	25536.94581	121.66667	0.004764339
Nebulization	3.14	2	103680	33019.10828	243.33333	0.00736947
Suctioning	5.56	10	103680	18647.48201	1216.6667	0.065245628
RT feed	12.8	21	103680	8100	2555	0.315432099
Patient positioning	2.23	22	103680	46493.27354	2676.6667	0.057571052
Writing notes	17.44	18	103680	5944.954128	2190	0.36837963
Doctors rounds	3.5	03	103680	29622.85714	365	0.012321566
Total	105.41					1.724913677

*IV - Intravenous, ABG - Arterial Blood Gas, RBS - Random Blood Sugar, RT - Ryle's Tube, IO - Intake Output, S/C - Subcutaneous, AWT - Available Working Time

refilling followed by updating and maintaining the registers. In total, the CAS was 43.51% as depicted in Table 8. The Individual Allowance Standard (IAS) was calculated to be 144 hours in a year as shown in Table 9.

Tables 4–6 show that the highest number of nurses were required for medium-high dependency (1.7), followed by very high dependency (1.9) level of the patients. In a year, there are 365 possible working days. Of these, 5 are gazetted and restricted holidays; 96 are days off; 10 are medical leaves; and 38 are earned and casual leaves. Therefore, it was observed that in the medicine ICU, the total working days available in a year were 216. In one day, the average number of working hours was 8 hours. A total of 1728 working hours were available each year. Using the WHO WISN method, nurses' staff calculations were conducted and the required nurse-to-patient ratio was found to be 1:1.2 based on the workload available in the medicine ICU.

Table 6: Nurses requirement for very high dependency level patients based on standard workload in the medicine ICU

Nursing activity Very high dependency (M+E+N)	Activity Standard (unit time)	Frequency	AWT	Standard workload 103680/AS	Total workload 26/3 Frequency/8.67×365	Basic staff requirement Total workload/ Standard workload
Vitals	1.63	189	103680	63607.36196	7956.747405	0.125091611
Bedding	3.04	9	103680	34105.26316	378.8927336	0.011109509
IV medication	24.3	59	103680	4266.666667	2483.852364	0.582152898
Hand & Take over	3.76	52	103680	27574.46809	2189.158016	0.079390761
IV cannulation	3.25	1	103680	31901.53846	42.09919262	0.00131966
Foleys care	4.3	11	103680	24111.62791	463.0911188	0.019206132
Removal of IV cannula	1.53	1	103680	67764.70588	42.09919262	0.000621255
RBS	3.03	30	103680	34217.82178	1262.975779	0.036909882
IO monitoring	2.03	37	103680	51073.89163	1557.670127	0.030498364
Blood sample	6.36	16	103680	16301.88679	673.5870819	0.041319578
Writing notes	18.8	52	103680	5514.893617	2189.158016	0.396953807
COVID sample	3.08	2	103680	33662.33766	84.19838524	0.002501264
Sent for billing	3.4	4	103680	30494.11765	168.3967705	0.005522271
Urine sample	2.97	2	103680	34909.09091	84.19838524	0.002411933
Sent for ECG/X ray consultation	3.7	5	103680	28021.62162	210.4959631	0.007511912
S/C injection	3.24	15	103680	32000	631.4878893	0.019733997
ABG	4.06	3	103680	25536.94581	126.2975779	0.004945681
Nebulization	3.14	11	103680	33019.10828	463.0911188	0.014024943
IM injection	2.75	1	103680	37701.81818	42.09919262	0.001116636
Suctioning	3.55	64	103680	29205.6338	2694.348328	0.092254404
RT feed	12.1	73	103680	8568.595041	3073.241061	0.358663357
Patient positioning	2.23	87	103680	46493.27354	3662.629758	0.078777627
Oral care	4.99	11	103680	20777.55511	463.0911188	0.022288047
Doctors rounds	3.5	5	103680	29622.85714	210.4959631	0.007105863
Total	124.74					1.94143139

*IV - Intravenous, ABG - Arterial Blood Gas, RBS - Random Blood Sugar, RT - Ryle's Tube, IO - Intake Output, S/C - Subcutaneous, I/M - Intramuscular, COVID - Coronavirus Disease, ECG - Electrocardiography, AWT - Available Working Time

Table 7: Nurses requirement for all dependency level patients based on standard workload in the medicine ICU

Nursing Activity	Activity Standard (unit time)	Frequency	AWT	Standard Workload 103680/AS	Total Workload Frequency/30×365	Basic Staff Requirement Total Workload/Standard workload
Admission of the patient	10	156	103680	10368	2201.7	0.212355324
Discharge of the patient	10	143	103680	10368	1837.166667	0.177195859
Total						4.694036041

AWT - Available Working Time

Calculation of Staff requirements, based on WISN

In this formula:

AWT is the total available working time:

- A is the number of possible working days in a year = 365 days
- B is the number of days off for gazetted and restricted holidays in a year = 3 + 2 = 5 days
- C is the number of days off in a year = 8 × 12 = 96 days
- D is the number of days off due to medical leave in a year = 10 days
- E is the number of days off due to earned leave and casual leave = 30 + 8 = 38 days
- F is the average number of working hours in one day. = 6 + 6 + 12 = 24/3 = 8 hours

AWT = [365 – (5 + 96 + 10 + 38)] × 8
AWT = 216 days/year × 8 = 1728 hours/year
Available working time in a year = 1728 hours

- Low-high level = 0.638 nurses
- Medium-high level = 1.725 nurses
- Very high level = 1.941 nurses

Total staff needed for health care activities = 0.638 + 1.725 + 1.941 + 0.389 = 4.694 or 5 nurses.

Calculation of individual allowance factor (IAF)

IAF = Annual total IAS/AWT = 144/1728 = 0.08

IAF = 0.08

Table 8: Setting Category Allowance Standards

Workload components (Support activities)	CAS (Actual working time)	CAS % (Percentage working time)
Housekeeping management	6 min per day	1.25% = [(6/60)/8] × 100
Arranging articles in wards	12 min per day	2.5% = [(12/60)/8] × 100
Writing in line register	6 min per day	1.25% = [(6/60)/8] × 100
Assignment register writing	10 min per day	2.08% = [(10/60)/8] × 100
Sending/Update census	30 min per day	6.25% = [(30/60)/8] × 100
Medication register update	20 min per day	4.17% = [(20/60)/8] × 100
Medicine arrangement/Medication refill	30 min per day	6.25% = [(30/60)/8] × 100
CSSD sending	15 min per day	3.12% = [(15/60)/8] × 100
Dressing trolley arrange	15 min per day	3.12% = [(15/60)/8] × 100
Consumption check	10 min per day	2.08% = [(10/60)/8] × 100
Material	5 min per day	1.04% = [(5/60)/8] × 100
Bed side lockers	5 min per day	1.04% = [(5/60)/8] × 100
Fridge check	15 min per day	3.12% = [(15/60)/8] × 100
Crash cart	15 min per day	3.12% = [(15/60)/8] × 100
Board update	5 min per day	1.04% = [(5/60)/8] × 100
Laundry/Blanket counting	10 min per day	2.08% = [(10/60)/8] × 100
Total CAS%		43.51%

Table 9: Setting Individual Allowance Standard

Staff category: Nursing officers in medicine ICU of a tertiary care teaching hospital				
Workload group	**Workload components**	**No. of staff performing the work**	**IAS (actual working time per person)**	**Annual IAS (for all staff performing activity)**
Additional activities of certain nursing officer	Supervision of students	1	5 h/year	90 h
	Workshops/CNE	1	3 days/year	54 h
	Total IAS in a year			144 h

Total staff requirement = Staff required for health service activities × Total CAS percentage + Total IAF in a year

= 5 × 1.77 + 0.08 = 9.93 or 10 nurses

- Average no. of admitted patients/beds in a month = 12
- Required nurse-to-patient ratio in medical ICU = 12/10 = 1:1.2

Discussion

The World Health Report 2014 estimates that 20%–40% of all resources allocated to the health sector are wasted. To reduce resource waste, it is imperative to increase efficiency in using available resources, and the first step in this process is to carry out a performance analysis or efficiency assessment.[15] Measures such as bed occupancy and length of stay provide an indication of the functional status of a hospital.[16] The bed occupancy rate (BOR) is the percentage of patients occupying available beds in a hospital at any given time. At BOR of 80%–90%, hospitals can be considered to be operating efficiently.[17] In recent years, BOR in South-East Asian hospitals has been about 80%, while in other countries like Indonesia it is between 55% and 60% in both public and private hospitals.[15] However, in the present study, it was found to be below 80% in the medical ICU (72.73%). As data collection was done during COVID-19 crisis, there is a possibility that the lower bed occupancy rate was due to the COVID-19 pandemic. It was explained that after the lockdown onset, there was a decline in the daily occupancy rate of beds reserved for COVID-19 cases at a tertiary hospital, demonstrating that this measure leads to a sustainable reduction in bed occupancy rates to prevent health services from collapsing and overloading.[17]

The ALS refers to the number of days each admitted patient stayed in the hospital.[15] Length of hospital stay (LOS) is another important indicator of the use of medical services that is used to assess the efficiency of hospital management, patient quality of care, and functional evaluation.[18] In our study, the LOS was reported as 7.2 days in the ICU. In previous studies, the ALS in ICUs in North India, South India, Nepal, and the USA was 5.75, 6.22, 4.0, and 5.2 days, respectively.[19] A possible explanation for the disparity found in the average LOS is due to the different patterns of illness and disease among the population of that particular clinical area.[20]

The results of our study revealed that in intensive care units, the majority of activities occurred at night, followed by morning and evening shifts. In contrast, Williams, Harris, and Turner-Stokes 2009, revealed that direct care activities were primarily concentrated early

in the morning and to a lesser extent in the evening, as the proportions fluctuated throughout the day.[21] According to another study conducted in India, most activities are conducted during morning and afternoon shifts, rather than evening shifts, although the study did not observe activities done during the night shifts.[22] The reason could be the result of the extended hours of duty, the night shift is likely to have more activity than the morning and evening shifts, that is, 12 hours during the night shift and 6 hours during morning and evening shifts. Additionally, the nursing officer during the night shift handled some of the morning tasks, such as bedding and basic patient care. These responsibilities, however, were handled by the morning shift nursing officer in other clinical areas and hospitals. In our study IV medications, documentation, and vitals taking were the most time-consuming activities in the ICU. This is likely due to the fact that medications must be carefully administered and monitored, and patients' vitals must be regularly checked in order to ensure their safety. A similar study showed three subcategories accounted for most of nursing practice time: documentation, medication administration, and care coordination.[23]

One of the nursing's strongest stakeholders and lobbyists include the American Nurses Association (ANA) and the American Hospital Association (AHA), both opposing mandatory nurse-to-patient ratios.[24] As a result of growing evidence, in 2018, the International Council of Nurses released a position statement on safe staffing, urging nursing organizations and governments to adopt evidence-based staffing policies.[25] In our study, we attempted to estimate the nurse-to-patient ratio based on standard workload and recommended the nurse-to-patient ratio as 1:1.2 in the medical ICU. DH guidance (2003), British Association of Perinatal Medicine (2001), UK,[26] Canada MIS Database, CIHI (2014–2015),[27] European Federation of Critical Care Nursing Associations (2007), UK[28] recommends a nurse-to-patient ratio of 1:1 in ICU, opposed to California (2008), USA[29] laws and NNU RNs sponsor National Ratio Legislation, USA,[29] that support 1:2 ICU norms. A study conducted in Chandigarh, India, used K. Hurst's algorithm to calculate the nursing manpower requirements and showed that CTVS ICU requires a nurse-to-patient ratio of 1:1.5, CTVS step-down ICU requires a nurse-to-patient ratio of 1:1.3.[30] Using existing SIU and NABH standards, a nurse-to-patient ratio of 1:1 is almost consistent with our study, which found a 1:1.2 ratio for ventilator beds in ICUs.

Even though the SIU's recommended nurse-to-patient ratio corresponds with this study, the SIU norms do not specify whether the suggested nurse-to-patient ratios are for shifts or days. Furthermore, because of the additional 45 posts for offs and 10% leave reserves, SIU norms may inflate the total number of nurses. Similar to the NABH norms, this study estimated nurse staffing norms by taking into account all leaves and the number of working days. It is noted that unadjusted staffing ratios tend to underestimate workloads and often overestimate staffing requirements.[31]

Limitation and recommendation

Despite its intuitive appeal, this time-motion study has some limitations for setting nursing standards such as the due to the Hawthorne effect. The multitasking of nurses could not be accounted for time recorded for activities performed by the nurses due to a single observer. There are recommendations for replicating similar studies in other clinical areas, such as wards, and it can also be replicated with a very long observation period. Furthermore, a multicentric study can be conducted that involves government and private hospitals to assess the nursing manpower requirement based on the standard workload. Mixed method studies can be done which also include qualitative data regarding nursing perspectives on the factors affecting the nurse-to-patient ratio. Other technologically advanced methods of observation such as CCTV and video recordings can be used instead of the human observant.

Conclusion

The current study found that nurse staffing norms are almost identical to NABH norms, with minor variations. Considering available resources and workload in tertiary care hospitals in India, the study recommended a nurse-to-patient ratio of 1:1.2 in each shift for the medicine ICU of a tertiary care hospital. In addition, ICU nurse incharge should have the flexibility to allocate nurses according to the workload in different shifts. It is suggested that nurse staffing norms in hospitals be estimated or selected with serious consideration of health care demands when employing nurse staffing norms.

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Ethical consideration

This study is the part of the research project for which ethical approval was obtained from the institutional ethics committee under the IEC reference letter number- AIIMS/IEC/19/915, Reg. No. 246/IEC/Ph.D./2019. Prior to the commencement of the study, permission was also obtained from the Senior Nursing Officers of each ward for the overall investigation. The participant information sheet was provided to all participants and written informed consent was taken after a complete explanation of the study. The participants were informed that the participation was

voluntary. Confidentiality of information and anonymity of the participants were also assured.

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Conflicts of interest

There are no conflicts of interest.

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