Workload Indicators of Staffing Need Method in Determining Anesthesia and Surgical Technologist Staff in Operating Room

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Research

Keywords: Workload Indicators of Staffing Need (WISN), Anesthesia technologist, Surgical technologist, Operating room, Iran

Posted Date: December 31st, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-136794/v1>

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Abstract

Background: Human resources in health are limited, and a variety of healthcare services are increasing, especially in developing countries. This study aimed to determine the anesthesia and surgical technologist staff for operating room based on the Workload Indicators of Staffing Need (WISN).

Methods: This cross-sectional descriptive study was conducted at Shahid Madani Medical and Training Hospital in 2019. The data collected through interview and hospital documents observation. The WISN method was used to analyze and determine staffing need.

Results: The WISN ratio for anesthesia and surgical technologist staff were 1.60 and 4.94, respectively. In other words, in both categories, this ratio is >1.00 .

Conclusions: WISN results can used to assess staffing capacity and capability over the previous year and the policy and financial implications due to staff shortages or surplus. As the workload of staff is an important issue and the staff have a right to have a standard workload in their position, then determining this workload is an essential issue in healthcare organization. Also, WISN method work as a human resource management tools, it improves health managers to make right decision about staffing needs and then better manage of organization's resources.

Keywords: Workload Indicators of Staffing Need (WISN); Anesthesia technologist; Surgical technologist; Operating room; Iran

Background

Human resources (H.R.) are the most important asset of the health system's effectiveness and efficiency. They play a very important role in running and delivering health care in hospitals(1). H.R. could also play a leading role in promoting the reconciliation of human rights and human resource objectives and practices in organizations(2). Organization without adequate or competence staffs is impossible to achieve its optimum performance(1, 3).With a numerous of problems and reducing resources, the need to optimize utilization of the available resources is critical(4). On the other hand, the over-supply of these resources also creates major problems, especially in terms of costs imposed on the health system(5). As a result, this issue is giving rise to the cost of provision of health care services(6). In low-income countries health workforce shortages has been identified as one of the main challenges of health(7). How to plan and manage human resources for health is essential in ensuring good quality healthcare and the sustainability of healthcare systems(8).Due to the nature of the health system, the lack of attention to the number of manpower required in hospital wards affects the efficiency and effectiveness of services(6). The operating room is one of the most complex work environments in the hospital that plays a major role in care activities(9). The calculation of the exact needs of the number of health workforce can support hospital labor productivity(1).

Human resources planning are the process by which organizations determine the amount of employees based on place, skills, and behaviors needed to achieve their goals(1, 3).In this regard, the most important step is to determine the current supply of forces and then predict the number of cases needed in the future to identify existing gaps and subsequent corrective planning(5, 10). Oftentimes, inappropriate uses of health personnel in inappropriate proportions leads to

54 inadequate fulfill the resources required to the demand for services by the population(11). These
 55 imbalances lead to spending too much time on activities requiring little time(12). Estimating the
 56 number of human resource required is a necessary and inevitable step for hospital managers and
 57 officials(6).In this regard, one of the scientific, practical and at the same time simple methods
 58 which was first introduced by the World Health Organization in the field of health, is the
 59 workload indicator of staffing need (WISN)(1, 5).

60 Worldwide, various methods and models have been designed and used to estimate health
 61 manpower. The WISN method in attempt to address the human resource constraints was
 62 developed by Shipp in 1998 and made popular by the WHO. This method computes the number
 63 of health cadres required, based on the workload of a particular health facility(12, 13). Managers
 64 can use WISN findings to planning and projection of human resources for health that helps to
 65 determining appropriate levels of health staff(4, 12). Most of these methods rely on the current
 66 supply of forces and do not pay attention to the type of service provided and the necessary time
 67 for it(5). WISN results can be used in the determination of staffing norms and standards, to
 68 estimate the size of the staffing deficit or surplus, to assess the workload pressure of health
 69 workers and staffing capacity and capability(10).The WISN method as a complete and
 70 comprehensive human resource management tool can help to determining the optimal number
 71 and distribution of health workforce at health facilities at all levels(8).

72 Ghorbani et al (2019) findings, 40 standard nurses were calculated. The studied hospital had 4
 73 nursing staff shortages. The working pressure ratio is 0.91in this study. In the current study, the
 74 nursing staff shortage is observed and this shortage caused a high working pressure on the nurses
 75 working in the study area. Considering the vital role of nurses in the emergency department, it is
 76 recommended to employ and distribute the manpower based on the requirement and workload in

the department(14). The purpose of study of Noprianty et al (2020) was to determine the analysis of the needs of nurses based on the WISN method. The results showed that the need for nurses is 28 people, while which are available is 24 nurses, with the WISN Ratio result, it is found that 0.8 is less than 1. The results of this study can be taken into consideration in reducing the number of nursing staff in the morning shift and added the afternoon shift(15).Based on the research Joarder and et al (2020) assessed the current workload and staffing need of physicians and nurses for delivering optimum healthcare services at the Upazila Health Complexes (UpHCs) in Bangladesh. Physicians have very high (WISN ratio 0.43) and nurse high (WISN ratio 0.69) workload pressure. 50% of nurses' time is occupied with support activities, instead of nursing care. There are different workloads among the same staff category in different health facilities. If only the vacant posts are filled, the workload is reduced. In fact, sanctioned number of physicians and nurses is more than actual need(16).

For a variety of reasons, including a lack of funding for employment, a lack of employment licenses in some occupations, and a lack of proper use of hospital bed capacity, these hospitals often do not comply with the Ministry of Health's human resource standards(3).The application of appropriate, scientific and logical methods in estimating the required human resources not only leads to productivity and employee satisfaction, but also maintains the quality of services provided(5). The WISN approach allowed us by measuring the demand and supply improve many types of decisions regarding health workforce planning and management(10). WISN method can aid the policy-makers in optimizing utilization of existing human resources. Given the importance of human resource planning, the purpose of this paper was to use the WISN method to calculate the number of anesthesia and surgical technologist staff.

Methods

We conducted a cross-sectional descriptive study in the operating room of the Shahid Madani Medical and Training Hospital. This study was conducted using the WISN methodology that was recommended in 1998 by the WHO. This method calculates actual and (required) number of personnel with the workload of a given health facility and shows the level of staff shortage or surplus. Population in this study was the entire anesthesia cadre. Data were collected through structured interviews and by reviewing annual service statistics from each hospital's records. The structured interviews included available staff time, workload components (i.e. Health Service Activities, Support and Additional Activities) and staff time spent on each activity (i.e. Activity Standards). Based on the WISN user's manual the method steps are described as follows:

Step 1: Available Working Time (AWT)

AWT is the time a health worker has available in one year to do his/hers work; taking into account authorized and unauthorized absences.

$$AWT = [A - (B + C + D + E)] \times F$$

A = working hours per month

B = the number of days off for annual leave in a year

C = the number of off-duty days due to sickness

D = the number of public holidays

E = the number of off-duty days due to other leaves (such as training, etc).

F = the number of work time

123 ***Step 2: Determining working components:***

124 Workload components include health services, support and additional activities, i.e. work
125 activities that take up most of a health worker's daily working time.

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127 ***Step 3: Activity Standards***

128 An activity standard (AS) is the time necessary for a well-trained, skilled and motivated worker
129 to perform an activity to professional standards in a given circumstance. There are two types of
130 activity standard: service standard and allowance standard. Service standard is main activities of
131 personnel during their service provision that performed by all members of the staff category.
132 Allowance standards are the activity standards for support and additional activities.

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134 ***Step 4: standard workload***

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136 The standard workload is the amount of work within a health service workload component that
137 one health worker can do in a year. This was calculated using the formula;

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$$139 \text{ Standard workload} = \frac{\text{Available Working Time}}{\text{Activity Standard}}$$

140

141 ***Step 5: Allowance factors***

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143 Allowance standards are in 2 types:

144 Category allowance standards (CAS): Support or additional activities performed by all members
145 of the staff cadre.

146 Individual allowance standards (IAS): Support or additional activities performed by certain
147 members of the staff cadre activities.

148 Allowance factors are two types of factors as category and individual allowance factors.

149 The category allowance factor (CAF) is a multiplier that is used to calculate the total number of
150 health workers, required for support and health service activities.

$$151 \quad CAF = \frac{1}{1 - \sum CAS\%}$$

152 The individual allowance factor (IAF) is the staff requirement to cover additional activities of
153 certain cadre members.

$$154 \quad IAF = \frac{IAS}{AWT}$$

155

156 ***Step 6: Workload-Based Staffing Requirements***

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$$158 \quad \text{WISN staff requirement} = \left[\frac{\text{Annual workload} \times \text{CAF}}{\text{Standard workload}} \right]$$

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160 ***Step 7: Analysis and interpretation of results***

161 The seventh step is the analysis and interpretation of the above results.

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Data analysis and interpretation

The results analyzed using two ways, the difference and the ratio. The first way is comparing the “Difference” between current and required staffing levels. This difference identifies understaffing or overstaffing. By using the WISN ratio can assess the work pressure of health workers in daily work. If the ratio is >1 , there are additional personnel and if it is <1 , there is personnel shortage. Whatever it is lower than one, the working pressure is higher. This step was also performed in Excel using the results of previous steps.

Results

The present study applied WISN method in determining staffing requirements for anesthesia and operating room cadre. Based on the formula $[A-(B+C+D+E)] \times F$, the AWT for cadres was calculated and estimated to be 1575. According to the results, 9 duties were recognized as the components of the main activity for anesthesia. Working hours per month (A) is 365; B is 15, the number of days off for annual leave in a year; C is 3.5, the number of off-duty days due to sickness; D is 78, the number of public holidays; E is 6, the number of days off due to other leave; and F is 6, the number of work time. Table 1 presents the main activities, the working time and the standard workload of each health service activity for both cadres.

The findings show that the number of anesthesia and surgical technologist staff required performing the main activities and care in the operating room based on the formula

$\frac{\text{Total statistics in 2018}}{\text{Standard workload}}$ is 7.1 and 3.44 people, respectively (Tables 1 and 2).

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Table 1. Estimate the required number of anesthesia staff based on the main activities

Main activities	Unit time	Standard workload	Total statistics in 2018	Estimated number of staff
Ensuring the operation and efficiency of anesthesia devices and equipment	2 min/operation	$3 \times 1575 = 47250$	2054	0.04
Preparation of drugs required for existing anesthesia facilities according to the type of operation and the patient's age	15 min/operation	$4 \times 1575 = 6300$	2054	0.32
Control the patient's name with a clear list of operations and files and bracelets	10 min/operation	$6 \times 1575 = 9450$	2054	0.21
Explain the anesthesia process and do some routine things like sticking glue	3 min/operation	$20 \times 1575 = 31500$	2054	0.06
Intravenous administration	2 min/operation	$30 \times 1575 = 47250$	2054	0.04
Transfer the patient to the ICU	3 min/operation	$20 \times 1575 = 31500$	2054	0.06
Collaboration in VF cardiopulmonary resuscitation	4 min/operation	$15 \times 1575 = 23625$	2054	0.08
Collaboration in BLF cardiopulmonary resuscitation	20 min/operation	$3 \times 1575 = 4752$	2054	0.43
Anesthesia administration during surgery until surgery is completed	270 min/operation	$0.22 \times 1575 = 350$	2054	5.86
Total				7/1

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Table 2. Estimate the required number of surgical technologist staff based on the main activities

Main activities	Unit time	Standard workload	Total statistics in 2018	Estimated number of staff
Communicating and providing the necessary training to the patient and prepare mentally and physically	5 min/operation	$12 \times 1575 = 18900$	2054	0.1
Controlling the patient's name with a specific file and bracelet and place all devices and equipment around the surgical bed according to accessibility	20 min/operation	$3 \times 1575 = 4725$	2054	0.4
Helping surgeons and scrubs in wearing gown and gloves	10 min/operation	$6 \times 1575 = 9450$	2054	0.21
Washing hands according to the instructions	5 min/operation	$12 \times 1575 = 18900$	2054	0.1
Covering the patient with sterile covers	10 min/operation	$6 \times 1575 = 9450$	2054	0.21
Participating in cardiovascular resuscitation operations in the operating room	20 min/operation	$3 \times 1575 = 4725$	2054	0.43
Unpacking primary covers, sterling packages, yarns and other devices and providing a safe area	30 min/operation	$2 \times 1575 = 3150$	2054	0.65
Counting and recording yarn, gas, etc. before finishing with the surgical team and collecting them after use	15 min/operation	$4 \times 1575 = 6300$	2054	0.32
Helping with surgical dressings and control the observance of sterile tips during surgery	5 min/operation	$12 \times 1575 = 18900$	2054	0.1
Removing the covers and prepare the patient for transfer to the ICU and remove the equipment related to the previous surgery and prepare the room for the next operation.	30 min/operation	$2 \times 1575 = 3150$	2054	0.6
Assisting in moving the patient to the ICU	15 min/operation	$4 \times 1575 = 6300$	2054	0.32
Total				3.44

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202 Similarly, working time for support and additional activities, (i.e. category allowance standards,
 203 individual allowance standards, category allowance factor and individual allowance factor,
 204 respectively), was recorded as demonstrated in Tables 3-6. These data were calculated based on
 205 the formulas mentioned in the fifth step of WISN.

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Table3. Estimation of time spent on support activities for anesthesia staff

Support Activities	CAS	CAS %	CAF
Written and oral report of the patient's latest condition (vital signs, anesthesia, medications, level of consciousness, skin color, etc.) to the ICU nurse and the patient's connection to the monitoring system	10 minutes a day	$10 \div 60 = 0.16$	$1 \div (1 - 4.12\%) = 1.04$
Participate in an internal conference	An hour a week	$(1 \div 36) \times 100 = 2.7$	
Participate in monthly training	Two hours a month	$(2 \times 12) \div 1575 \times 100 = 1.25$	
Total CAS%		4.12%	

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Table4. Estimation of time spent on support activities for surgical technologist staff

Support Activities	CAS	CAS %	CAF
Completion and submission of oral and written reports on the status of the surgical area	15 minutes a day	$15 \div 60 = 0.25$ $(0.25 \div 6) \times 100 = 4.2$	$1 \div (1 - 5.5\%) = 1.05$
Nursing report	5 minutes a day	$5 \div 60 = 0.08$ $(0.08 \div 6) \times 100 = 1.3$	

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Table5. Estimation of Individual Allowance Standards for anesthesia staff

Additional Activities	IAS	Annual IAS	IAF
Requesting anesthesia defects such as medicine, equipment and ...	Two hours a week	$2 \times 52 = 104$	$176 \div 1575 = 0.11$
Writing a monthly schedule	6 hours a month	$6 \times 12 = 72$	
Total IAS		$104 + 72 = 176$	

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Table6. Estimation of Individual Allowance Standards for surgical technologist staff

Additional Activities	IAS	Annual IAS	IAF
Participating in meetings, seminars, conferences	45 minutes a week	$(45 \div 60) \times 52 = 39$	$176 \div 1575 = 0.11$
Intra-departmental meetings	90 minutes a month	$(90 \div 60) \times 12 = 18$	
Total IAS		$18 + 39 = 57$	

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218 After obtaining the required data, the required number of human resources for both categories of
 219 staff was estimated to be 7.49 and 3.64, respectively using the relevant formula. The WISN

calculation was based on the annual workload data for 2018/2019 fiscal year. The WISN ratio was obtained by dividing the existing staff by the total required staff expressed as a percentage. The calculated number for anesthesia staff (7.49) is for the total of 6 operating rooms. There are 2 anesthesia forces in each operating room, and our calculated number is 7.49 for the total of 6 operating rooms, it indicates that approximately 8 staff members are required to cover 6 operating rooms. In addition, operations performed in all 6 operating rooms are usually performed simultaneously. Therefore, in ideal conditions, one anesthesia staff (n=6) with 2 auxiliary staff to support operating rooms is sufficient for each operating room.

The calculated number for surgical technologist staff (3.64) is for the total of 6 operating rooms. There are 3 surgical technologists in each operating room that indicates approximately 4 staff members are required to cover 6 operating rooms. Therefore, in ideal conditions, one surgical technologist for each operating room (n=6) to support operating rooms is sufficient.

According to our results, if the WISN ratio for both categories of staff is >1.00 , the staff is more than sufficient to cope with the workload (Tables 7 and 8).

Table7. Existing staffing levels and staff required for anesthesia staff

Cadres	Exiting number of staff at 2019	WISN Staff required	Existing gap as at 2018/2019	WISN ratio
Anesthesia staff	$2 \times 6 = 12$	$(7.1 \times 1.4) + 0.11 = 7.49$	$12 - 7.49 = +4.51$	$12 \div 7.49 = 1.60$

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Table8. Existing staffing levels and staff required for surgical technologist staff

Cadres	Exiting number of staff at 2019	WISN Staff required	Existing gap as at 2018/2019	WISN ratio
surgical technologist staff	$3 \times 6 = 18$	$(3.68 \times 1.07) + 0.3 = 3.64$	$18 - 3.64 = +14.36$	$18 \div 3.64 = 4.94$

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241 **Limitations**

242 The results of this study cannot be generalized because the varying quality and quantity of
 243 service delivery. Some service statistics data, which were essential for establishing standard
 244 workloads, were not readily available due to research in the operating room that requires special
 245 conditions. Thus, the accuracy of this study's results is directly depends on the accuracy of the
 246 service statistics of each hospital.

247

248 **Discussion**

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250 The present study showed that due to the volume of work in the operating room of the hospital
 251 and the time spent for the relevant activities, 8 anesthesia staff and 4 surgical technologist staff is
 252 needed, which currently 12 and 6 people are working in this ward, respectively. Therefore,
 253 according to the calculations, there is an excess of force. There are also studies where have
 254 evaluated the required number of staff in the variety wards of hospital with this method.

255 The workload and human resource requirement were evaluated in a study conducted in
 256 Pharmacy Installation of Santa Maria Hospital Pekanbaru 2017, and it was concluded that total
 257 requirement of pharmaceutical work force during effective day is 40 persons, while requirement
 258 during holiday accounted for 21 persons and make it totally 61 persons. Therefore, an additional
 259 required seven people to cope with the workload at the Pharmacy unit of Santa Maria
 260 Hospital(17).

261 The World Bank has instituted a WISN Study in 75 Health Facilities of Malawi targeting 8
 262 priority health cadres. WISN analysis indicated that staff in the Northern Zone is working under

greatest workload pressure with Medical Officers and Clinical Technician under greatest pressure. In the Central East Zone there were no Medical Officers, Nursing Officers, Pharmacy technicians, and Laboratory Technicians posted to the facilities targeted in the study consequently the remaining four cadres were under extreme workload pressure. Similarly, the Central West Zone has high pressure having only 20% of Medical Officers, Nurse Midwife Technicians, Laboratory Technicians and Medical Assistants required(18).

Another study analyzed the real needs of nurses on staff WISN. The results obtained based on the calculation of nurses with WISN method indicated required number of nurses in the medical-surgical nurses as many as 54 people. This study concluded the number of nurses in the medical-surgical general hospital Bali is still lacking as many as 30 people. It is suggest to the hospital management to increase gradually the number of nurses in the medical room(19).

Prytherch et al. (2019) concludes that there is an oversupply of doctors and nurses at primary health care (PHC) and a shortage of family doctors working at the level of health centers. Consequently, a more rational health workforce planning based on well-grounded methodology such as WISN has potential to contribute to more efficient and effective health service delivery in Tajikistan(20).

Study was conducted to assess the current workload and staffing need of physicians and nurses for delivering optimum healthcare services at the Upazila Health Complexes (UpHCs) in Bangladesh. Physicians have very high (WISN ratio 0.43) and nurse high (WISN ratio 0.69) workload pressure. In fact, sanctioned number of physicians and nurses is more than actual need. It is evident that high workload pressures prevail for physicians and nurses at the UpHCs. This reveals high demand for these health workforces in the respective sub-districts(16).

285 The WISN tool was used in assessing the staffing requirements of the frontline health workforce
286 for select primary level facilities in Rivers State in Nigeria. Findings showed Health facilities in
287 Port Harcourt City Local Government Area (PHALGA) had a WISN ratio of 0.63 and a shortage
288 of 31 nurses/midwives. There was also a shortage of 12 community health practitioners with a
289 WISN ratio of 0.85. ObioAkor Local Government Area had (OBALGA) a shortage of 50
290 nurses/midwives and 24 community health practitioners; and WISN ratios of 0.60 and 0.79 for
291 nurses/midwives and community health practitioners respectively(21).

292 The study was conducted by Farahi Shahgholi aimed to calculation of workload and estimation
293 of the required number of health staff related to family medicine program in East Azerbaijan
294 province based on WISN. The results showed that significant obligations for 25000 populations
295 were consisted of family health services (0.87), prevention of disease (1.067), health schools and
296 health education (0.105). In total, 2.042 health care staffs should be recruited for providing
297 health care services for 25000 populations. Proportion of extraordinary health services and
298 coefficient of extraordinary health services were estimated 24.1% and %1.32 respectively(22).

299 WISN was utilized to analyze and determine the requirement of nurses for a high volume
300 academic Emergency Department. The WISN ratio was 0.90 which indicates that the current
301 staff strength was inadequate. The Emergency Department requires 13 more full time staff nurses
302 for it to function optimally. In case of reallocation of certain relevant duties to phlebotomists or
303 nursing assistants, the requirement of staff nurses is 102. Consequently, a skill mix ratio of 82%
304 nurses to 18% nursing assistants and phlebotomists is suggested(23).

The results of WISN ratio can be used in all health facilities and all types of health staff to estimate the requirement number of staff based on the workload. Also, these calculations can be used to review staffing levels and workload pressures(24).

Recommendations

Similar studies are required at different job categories in order to determine the shortage or extra of staff and the possibility of comparison with similar groups in other hospitals. Findings also help to conduct of WISN study at a larger scale and inclusion of WISN as a tool to improving quality of care. Our findings proposed reallocation of staff based on workload in order to avoid wasting resources.

Conclusions

Human resource management and planning is a big challenge, especially in developing countries. On the other hand, resources for the health sector are scarce and demand is increasing instead. The WISN method is a simple, easy to calculate the requirements of hospital ward staff. This method is also useful to identify staffing inequities between facilities by comparing the calculation results. Such an analysis can also help to assess distribution of staffing between similar types of health facilities in order to estimate the size of the staffing deficit or surplus. More importantly, the WISN tool allows policy-makers improving health workforce planning and management. This study can aid the decision making about transfer and allocate functions between categories of staff. Through the results of these calculations can be anticipated workloads of planned future services, changed conditions of employment and health needs of the population. Consequently, these results create an opportunity to get organizations to take greater responsibility for human rights and go beyond just economic and legal motives for social reform.

327 Also, results from our study can be contributed to evaluate imbalance (shortage and excess) and
 328 improve the current operation of health services.

329 **List of abbreviations**

330 WISN: Workload indicators of staffing need; WHO: World health organization; AWT: Available
 331 working time; AS: Activity Standard; CAS: Category allowance standards; IAS: Individual
 332 allowance standards; CAF: Category allowance factor; IAF: Individual allowance factor; PHC:
 333 Primary health care; UpHCs: Upazila Health Complexes; PHALGA: Port Harcourt City Local
 334 Government Area; OBALGA: Obio Akpor Local Government Area had.

335

336 **Declarations**

337 **Ethics approval and consent to participate**

338 Ethical approval such as explaining the purposes of the research, obtaining oral consent, keeping
 339 their information anonymous was obtained from the participating hospitals.

340 **Consent for publication**

341 Not applicable

342 **Availability of data and materials**

343 The datasets used and/or analyzed during the current study are available from the corresponding
 344 author on reasonable request.

345 **Competing interests**

346 The authors declare that they have no competing interests.

347

348 **Authors' contributions**

349 R.B. and R.K.Z. designed and directed the project. R.K.Z., R.B. and R.A.M. contributed to the
 350 design and implementation of the research. Z.M., N.B. and E.E. performed the measurements,
 351 processed the experimental data, and performed the analysis. R.A.M. contributed to the
 352 interpretation of the results. R.B. drafted the manuscript. R.K.Z. and R.A.M. were involved in
 353 planning and supervised the work.

354 **Acknowledgements**

355 The author would like to thank the operating room staff of Shahid Madani hospital that
 356 contributed. This paper highlights findings from an undergraduate students' internship. Authors
 357 appreciate all people who contributed in this study.

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References

1. Napirah MR, Sulistiani AO. Analysis of the optimal number of staff needed using workload indicator of staffing needed (WISN) method in laboratory unit of public hospital anutapura palu. *Public Health of Indonesia*. 2015;1(1).
2. Palthe J. Managing human rights and human resources: the dual responsibility of global corporations. *Journal of Academic Perspectives Volume*. 2010(3):1.
3. Shafii M, Sadat Hashemi F, Askari R, Pakdaman M, S B. Estimation of the required staffing capacity of selected hospitals in Yazd city, Iran, in accordance with staffing standards of Iranian Ministry of Health and Medical Education in year 2017. *Health Information Management*. 2019;16(2):57-64.
4. Musua P, Nyongesa P, Shikhule A, Birech E, Kirui D, Njenga M, et al. Workload indicators of staffing need method in determining optimal staffing levels at Moi teaching and referral hospital. *East African Medical Journal*. 2008;85(5):232-9.
5. Azimi Naibi B, Mohebbifar R, Rafiei S. Estimating the number of required nurses in an emergency department of a hospital in Qazvin: Application of WISN method. *The Journal of Qazvin University of Medical Sciences*. 2018;22(2):28-37.
6. Forati H, Mahdian Z. Survey of the causes and solutions to reduce defensive medicine in view of residents in mashhad university of medical sciences in 2016. 2017.
7. Hagopian A, Mohanty MK, Das A, House PJ. Applying WHO's 'workforce indicators of staffing need'(WISN) method to calculate the health worker requirements for India's maternal and child health service guarantees in Orissa State. *Health policy and planning*. 2012;27(1):11-8.
8. Gialama F, Saridi M, Prezerakos P, Pollalis Y, Contiades X, Souliotis K. The implementation process of the Workload Indicators Staffing Need (WISN) method by WHO in determining midwifery staff requirements in Greek Hospitals. 2019.
9. Christian CK, Gustafson ML, Roth EM, Sheridan TB, Gandhi TK, Dwyer K, et al. A prospective study of patient safety in the operating room. *Surgery*. 2006;139(2):159-73.
10. Shipp P, Organization WH. Workload indicators of staffing need (WISN): a manual for implementation. World Health Organization, 1998.
11. Kayani NS, Khalid SN, Kanwal S. A study to assess the workload of lady health workers in Khanpur UC, Pakistan by applying WHO's WISN method. *Athens J Health*. 2016;3:65-78.
12. Govule P, Mugisha JF, Katongole SP, Maniple E, Nanyingi M, Onzima R. Application of workload indicators of staffing needs (WISN) in determining health workers' requirements for Mityana general hospital, Uganda. *International Journal of Public Health Research*. 2015;3(5):254-63.
13. McQuide PA, Kolehmainen-Aitken RL, Forster N. Applying the workload indicators of staffing need (WISN) method in Namibia: challenges and implications for human resources for health policy. *Human resources for health*. 2013;11(1):64.
14. Ghorbani A, Vaziri Seta M, Rajaei R, Jamaly Z, Najafi M, Najafi M. Estimating required number of nurses in emergency department of Imam Ali hospital affiliated by Alborz province using WISN method. *Evidence Based Health Policy, Management and Economics*. 2019;3(4):250-8.
15. Noprianty R, Febianti SA, Fikri J. Analysis of nurses staff needs using workload indicate staff need in pediatric ward with time motion study. *JMMR* 2020;9(1):13-22.

16. Joarder T, Tune SNBK, Nuruzzaman M, Alam S, de Oliveira Cruz V, Zapata T. Assessment of staffing needs for physicians and nurses at Upazila health complexes in Bangladesh using WHO workload indicators of staffing need (WISN) method. *BMJ open*. 2020;10(2).
17. Susanto MN, Permanasari VY, editors. Staffing needs analysis in the pharmacy unit of Santa Maria Hospital Pekanbaru 2017. Proceedings of the International Conference on Applied Science and Health; 2018.
18. Mziray E, Gorgens M, McCauley P. Analysis of human resources for health in Malawi: Implementation of WISN study in seventy-five facilities. World Bank; 2017.
19. Ernawati NLAK, Nursalam N, Djuari L. Kebutuhan riil tenaga perawat dengan metode workload indicator staff need (WISN). *Jurnal Ners*. 2017;6(1):85-92.
20. Prytherch H, Kasymova Z, Lechthaler F, Kiefer S, Yarbava S, Hojimatova Z, et al. Bringing greater transparency to health workforce planning in Tajikistan: using the WISN approach. *European Journal of Public Health*. 2019;29(Supplement_4):ckz185. 616.
21. Okoroafor S, Ngobua S, Titus M, Opubo I. Applying the workload indicators of staffing needs method in determining frontline health workforce staffing for primary level facilities in Rivers state Nigeria. *Global Health Research and Policy*. 2019;4(1):35.
22. Farahi Shahgholi J, Nadrian H, K G. Calculation of workload and estimation of the required number of health staff related to family medicine program in East Azerbaijan province based on WISN. 2018.
23. Wundavalli LT, Kumar P, Dutta S. Workload indicators of staffing need as a tool to determine nurse staffing for a high volume academic emergency department: An observational study. *International emergency nursing*. 2019;46:100780.
24. Ekawati A. The analysis of workload and need of nurse with WISN method in inpatient room in hospital X in Yogyakarta. *JMMR*. 2018;7(1):69-75.