

A Study on Nurses' Perspectives of Work Schedules

Hemşirelerin Çalışma Çizelgelerine Bakışları Üzerine Bir Araştırma

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Abstract

Aim: This descriptive study was conducted to analyze the existing situation and nurses' perspectives on work schedules.

Method: The study sample consisted of 207 nurses who worked at 23 state hospitals. The data were collected with a 40-item questionnaire developed by the researchers. Descriptive statistics, Kruskal-Wallis, Mann-Whitney U, chi-square, and Spearman's correlation tests were used for data analysis.

Results: The mean numbers of beds, nurses, daily hospitalized patients, and patients in the unit on the last shift were 24.23 (SD=15.01), 14.79 (SD=10.48), 9.16 (SD=8.2), and 12.10 (SD=10.28), respectively. Of the nurses, 49% had a rotating shift, 54.8% were dissatisfied with the shift system, and nurse scheduling was mostly prepared on paper by the clinic's responsible nurses and then loaded onto a computer.

Conclusion: Fair and objective criteria and software should be used to prepare schedules with mostly fixed shifts and convenient work hours, without wasting time on manual scheduling. These results indicate factors that need to be taken into consideration in the preparation of nurses' work schedules and workforce planning.

Keywords: Nursing, schedule, work.

Öz

Amaç: Bu tanımlayıcı araştırma, mevcut durumu ve hemşirelerin çalışma çizelgelerine bakış açılarını analiz etmek amacıyla yapılmıştır.

Yöntem: Araştırmanın örneklemini, 23 devlet hastanesinde çalışan 207 hemşire oluşturmuştur. Veriler, araştırmacılar tarafından geliştirilen 40 soruluk form ile toplanmıştır. Verilerin analizinde tanımlayıcı istatistikler, Kruskal-Wallis, Mann-Whitney U, ki-kare ve Spearman korelasyon testleri kullanılmıştır.

Bulgular: Ortalama yatak sayısı, hemşire sayısı, günlük yatan hasta sayısı ve servisteki son vardiyadaki hasta sayısı sırasıyla 24,23 (SS=15,01), 14,79 (SS=10,48), 9,16 (SS=8,2) ve 12,10 (SS=10,28) olarak saptanmıştır. Hemşirelerin %49'u dönüşümlü vardiyaya sahip olup %54,8'i vardiyalı çalışma sisteminden memnun değildir. Hemşire çizelgeleri çoğunlukla klinik sorumlu hemşireleri tarafından kağıt üzerinde hazırlanıp bilgisayara yüklenmektedir.

Sonuç: Elde çalışma çizelgesi hazırlanması nedeniyle zaman kaybetmenin önlenmesi ve çoğunlukla sabit vardiyalar ve uygun çalışma saatleri ile çizelge hazırlamak amacıyla adil ve yansız ölçütlere dayalı yazılım programları kullanılmalıdır. Burada elde edilen sonuçlar, hemşirelerin çalışma programlarının hazırlanmasında ve işgücü planlamasında dikkate alınması gereken etmenleri göstermektedir.

Anahtar Sözcükler: Hemşire, çizelge, çalışma.

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Introduction

Nurse staffing plans are generally monthly work schedules that are prepared by considering various factors including labor agreements, overtime, and breaks (Lim et al., 2016). Nurse scheduling includes the daily, weekly, or monthly planning of working hours, shifts, and days off for each nurse (M'Hallah & Alkhabbaz, 2013). The recommendations of the ILO state that the normal weekly work hours of the nursing staff should not exceed the work hours determined for the workers in the relevant country in general, i.e., 40 hours, and normal working hours should not exceed 8 or 12 hours (International Labour Organization [ILO], 2005). Work schedules should follow national regulations and the rules of hospitals; take the preferences, demands, skills, and expertise of nurses into consideration; and be effective, neutral, and fair (Lim et al., 2016; M'Hallah & Alkhabbaz, 2013).

Models of nurse staffing include simple handmade schedules (Wise et al., 2015), evidence-based models of professional associations, such as the American Nurses Association (American Nurse Association, [ANA], 2012), and mathematical models of professional enterprises, which include heuristic and meta-heuristic algorithms, generic algorithms, and computer software (Farasat & Nikolaev, 2016; Legrain et al., 2015). Although various models and software have been developed (Karaatlı, 2010; Yılmaz, 2012), most of the staffing in Türkiye is based on the professional experiences and individual judgments of responsible nurses, who prepare the schedules manually on paper before computerizing them. This method is time-consuming and does not take certain principles and restrictions into consideration. This, in turn, leads to discussions about the fairness of the schedules and communication problems among nurses. In addition, there is insufficient scientific evidence on the factors taken into consideration while preparing nursing schedules and the opinions of nurses about these schedules.

By revealing the existing situation of the nursing shift system in Türkiye and nurses' perspectives, this study can provide primary data to develop new models of standard and objective nurse scheduling and contribute to national and international literature as well as to effective time management and human resource planning in nursing management.

Human resource planning in nursing involves planning based on the quality and number of nurses in the workforce to provide effective and safe health care services centered on specific standards and the implementation and evaluation of these plans (Huber, 2017).

Nurse scheduling should ensure that patient needs are met, health care is provided continuously and fairly to all patients, personnel are satisfied with their shifts, the plan is fair, sustainable, and flexible, resources are used wisely, and the cost is considered an important factor (Needleman et al., 2011). During the preparation of schedules, not only patient care hours and the expertise, experiences, qualifications, and skills of nurses, but also the time spent on issues indirectly related to patient care, including data collection to improve the quality of care and coordination of orientations, practices, and medical along with annual leaves should be considered (Bingham & Ruhl, 2015).

The working conditions, duties, and responsibilities of nurses are determined by national laws and regulations. As a result of the differences in shift work systems, some health institutions have three 8-hour shifts (Lin et al., 2014), whereas others implement a combination of 8-hour and 16-hour shifts. In addition, nurses can work in shifts such as early, late, split, and day or night shifts of 4 hours in the morning and 4 hours at night, or shifts for 8-10-12 hours a day (ILO, 2018). Depending on their preferences, nurses may either work day or night shifts (Eren et al., 2018).

Nursing schedules, which are mostly prepared by responsible nurses (Varlı et al., 2017), require weekly and monthly planning to achieve multiple and sometimes conflicting goals, such as fair distribution of the workload and the minimization of cost (Legrain et al., 2015). Manual scheduling on paper is time-consuming and has limited potential to provide a reasonable solution, depending on the complexities of laws, regulations, and labor contracts (Bagheri et al., 2016). As a subjective method, manual scheduling has the potential of privileging or punishing health workers, which may cause conflict among them and loss of motivation (Mueller, 2000). In addition, manual scheduling causes loss of time, non-compliance with rules, failure to meet demands, satisfaction problems, and difficulties in restructuring task changes to be made in the process (Arslan & Özcan, 2022; Gradišar et al., 2022).

This research was carried out to determine the current situation, opinions, and suggestions of nurses about the work systems, to create the basic data for the development of a software program that will contribute to saving time in the management of nursing services, and that will make the planning of nursing staff fair and objective. In addition, it is thought that the research will contribute to the national and international literature on the subject.

Method

Purpose and Type of the Study: The purpose of this descriptive study is to explore the current situation and identify the problems and perspectives of nurses regarding the nursing shift work system.

Study Questions: The study aimed to answer the following research questions:

- What are the characteristics of the existing shift work system for nurses?
- What are the factors that are considered when assigning shift work?
- What are the opinions of the nurses about the schedules and shift system?

Population and Sample of the Study: The population of the study consisted of 3760 nurses working in 23 institutions that gave permission to practice. It was calculated that the sample size of the study should be at least 188 nurses (Raosoft, 2004) with a 5% margin of error and 95% confidence interval. The number of nurses to be included in the sample from each hospital was obtained by multiplying the strata weight determined ($188/3760 = 0.050$) for the stratified sampling method and the number of nurses in each hospital. For example, the nurses to be sampled from the hospital with 116 nurses were determined to be 6 based on the calculation of $116 \times 0.050 = 5.8$. Nurses were excluded if they had been working for less than six months, refused to participate, or were on annual or medical leave. As a result, the study was conducted with the voluntary participation of 207 nurses.

Data Collection Tools: For data collection, a 40-question survey form was prepared based on existing literature (Al-Kandari & Thomas, 2008; Cho et al., 2016; Stimpfel et al., 2015; Van Oostveen et al., 2015). The survey included questions about the position, years of experience in nursing, type of unit, years of experience in the unit, number of beds and nurses in the unit, the mean number of daily hospitalized patients, the characteristics of shift work and scheduling including the frequency and designers of scheduling, factors influencing the decisions on scheduling, satisfaction with and effects of nursing shifts, and nurses' opinions.

Data Collection: After obtaining ethical and institutional permissions, a date was selected for each hospital for data collection. Next, the directors of health care services were met at each hospital to determine the units available for data collection, and the nurses were visited between September 10 and December 12, 2018, from 08.00 am to 12.00 pm. Volunteers were asked to complete the survey, which took approximately 20–30 minutes.

Data Analysis: The data collected were analyzed using the IBM SPSS 22.0 statistical program (IBM Statistical Package for Social Sciences-SPSS; Armonk, NY, USA). Numbers, percentages, means, and standard deviations were used as descriptive statistics. Mann-Whitney U and Kruskal-Wallis tests were used to compare variables that did not show normal distribution. The chi-square test was used to compare nominal variables, whereas Spearman's correlation analysis was used to explore the relationship between continuous variables. Statistical significance was set at $p < 0.05$.

Ethical Considerations: Ethical approval was obtained from the non-invasive clinical trials ethics committee of the university where the research was conducted (No. 16969557-1172, dated 06.07.2018). The participants were informed about the aim and scope of the research, and their written informed consent was obtained. The identities of the participants were kept confidential.

Limitations: The findings of this study were limited to Turkish state hospitals which had similar administrative methods and nurse scheduling procedures.

Results

Table 1. Descriptive characteristics of nurses (N:207)

Descriptive characteristics	n	%	Mean	SD
Age			35.13	6.96
Gender				
Female	190	91.3		
Male	17	8.2		
Marital status				
Married	157	75.5		
Single	50	24.5		
Number of children				
0	65	31.8		
1	52	25.0		
2	74	35.6		
3	16	7.7		
Education level				
Vocational high school of healthcare	27	13.4		
Associate degree	38	18.3		
Bachelor's degree	104	50.0		
Master's degree	25	12.0		
Doctoral degree	13	6.3		
Years of total experience				
≤ 1	9	4.3		
1-5	21	10.1		
6-10	53	25.5		
11-15	38	18.3		
16-20	39	18.8		
≥ 21	47	23.1		
Position				
Clinic nurse	152	73.1		
Clinic responsible nurse	40	19.6		
Other*	15	7.3		
Years of experience in the current unit				
≤ 1	49	23.6		
1-5	91	43.8		
6-10	36	17.4		
11-15	19	9.1		
16-20	12	6.1		
Unit				
Emergency service	8	3.8		
Intensive care unit	61	29.4		
Surgical unit	59	28.5		
Medical units	57	27.5		
Units without inpatient facilities**	22	10.5		

*Supervisor, responsible nurse of hospital

**Unit that participates in evening, night, or weekend shifts

The mean age of the participants was 35.13 years (SD=6.96), most were female (91.3%), 75.5% were married, 68.3% had children, 50% graduated from a university, and 85.7% had six or more years of nursing experience. Furthermore, 73.1% were staff nurses, and 44.8% had 1–5 years of experience in their current unit (Table 1).

Table 2. Characteristics of units where nurses work (N:207)

Characteristics	n	%	Mean	SD	Median
Bedbound patients and patients requiring intensive care					
Yes	141	67.8			
No	67	32.2			
Is there shift work?					
Yes	190	91.3			
No	17	8.7			
Nurses without shift work other than clinical responsible nurse due to maternity, breastfeeding, or disability leave					
Yes	136	65.4			
No	71	34.6			
Fixed shift					
Yes	36	17.3			
No	48	23.5			
Changeable	123	59.2			
Shift start time is constant for every nurse					
Yes	170	81.7			
No	18	9.2			
Changeable	19	9.1			
Daily work hours (excluding clinical responsible nurse)					
8 hours	124	59.6			
16 hours	19	9.1			
24 hours	17	8.2			
Other*	49	23.1			
Type of weekly shift					
Permanent day shift	66	31.7			
Permanent night shift	27	13			
Always evening shift	1	0.5			
Rotating shift	102	49			
Other**	11	5.8			
Number of beds per unit			24.23	15.01	
Number of nurses in the unit			14.79	10.48	
Average number of nurses on each shift excluding clinical responsible nurse					
Day shift			4.50	3.31	
Evening shift			3.10	2.54	
Night shift			3.04	2.40	
Weekend shift			3.08	2.6	
Number of daily hospitalized patients			9.16		8.2
Number of patients in the last shift			12.10		10.28
Day, evening, and night shifts per month					
Night shifts per month			7.01		3.95
Day shifts per month			10.77		7.4

*5 or 6.5 work hours due to breastfeeding leave

**Breastfeeding leave, permanent half-day shift

The average number of nurses in the unit was 14.79 (SD=10.48), the average number of beds was 24.23 (SD=15.0), and the average number of inpatients per day was 9.16 (SD=8.2). Excluding clinical responsible nurses, the mean number of nurses working the day shift was 4.50 (SD=3.31), whereas the mean number of nurses working the evening, night, and weekend shifts was 3.04 (SD=2.40). The number of night and day shifts per month was 7.01 (SD=3.95) and 10.77 (SD=7.4), respectively. Finally, 49.0% of the participants reported rotating shifts (Table 2).

Table 3. Process of nurse scheduling (N:207)

Characteristics	n	%
Frequency of scheduling		
Weekly	39	18.8
Monthly	168	81.2
Scheduling is planned by		
Himself/Herself	14	6.7
Clinic responsible nurse	168	81.3
Supervisor/Floor responsible nurse	3	1.4
Hospital responsible nurse/Director	22	10.6
Software used for scheduling		
Yes	142	68.3
No	65	31.7
Factors influencing decisions on shifting* (n = 190)		
Total number of nurses per unit	169	81.3
Nurses' last assigned shift	138	66.3
Nurses' preferences	102	49.0
Minimum number of consecutive shifts	96	46.2
Workload and number of patients in each shift	34	16.3
Nursing skills and qualifications	28	13.5
Nurses' professional experience	24	11.5
Patients' care needs	17	8.2
Nurses' level of education	10	4.8
Other**	4	1.9

*More than one response was given.

**Other includes issues about education and work contract

The findings on the process of nurse scheduling showed that 81.2% of the participants reported monthly scheduling, and 81.3% stated that the nurse's schedule was prepared manually by the clinic's responsible nurses and then uploaded to a computer. The main factors influencing nurse scheduling were the total number of nurses in the unit (81.3%), the nurses' last assigned shifts (66.3%), the nurses' preferences (49.0%), and the minimum number of consecutive shifts (46.2%) (Table 3).

The main positive effects of nurse scheduling expressed by the participants were improved relationships between colleagues (31.3%), better nursing care planning (30.8%), and higher patient satisfaction (27.9%). On the other hand, the main negative effects of nurse scheduling were on family life (72.1%), private life (71.6%), and medical errors (56.3%). Furthermore, 39.9% of the participants were satisfied with the existing nurse scheduling system, whereas 54.8% were highly dissatisfied or dissatisfied. Finally, participants suggested that the shortage of nurses should be addressed (42.1%), at least two nurses should work the evening, night, and weekend shifts (11.8%), and the scheduling should be fair (11.8%) (Table 4).

Table 4. Opinions of participants about nurse scheduling (N:207)

Positive effects of nurse scheduling on*	n	%
Relationship between colleagues	65	31.3
Nursing care planning	64	30.8
Relationship between nursing and other disciplines	59	28.4
Patient satisfaction	58	27.9
Career advancement plans	49	23.6
Quality of patient care	46	22.1
Family life	38	18.3
Private life	36	17.3
Patient complaints	36	17.3
Medical errors	29	13.9
Negative effects of nurse scheduling on*		
Family life	150	72.1
Private life	149	71.6
Medical errors	117	56.3
Quality of patient care	102	49.0
Career advancement plans	101	48.6
Relationship between colleagues	101	48.6
Patient complaints	91	43.8
Patient satisfaction	89	42.8
Relationship between nursing and other disciplines	85	40.9
Nursing care planning	80	38.5
Satisfaction with shift work and hours		
Strongly dissatisfied	46	22.6
Dissatisfied	67	32.2
Satisfied	83	39.9
Strongly satisfied	11	5.3
Suggestions about scheduling		
Shortage of nurses should be addressed.	32	42.10
At least 2 nurses should be scheduled for evening, night, and weekend shifts.	9	11.84
Scheduling should be fair.	9	11.84
Day off after evening, night, and weekend shifts should be reorganized.	8	10.52
Evening, night, and weekend shifts should be reduced.	6	7.89
Teams with fixed day or night shifts should be formed.	5	6.57
24-hour shifts at weekends should be avoided.	5	6.57
Senior nurses should not be scheduled for evening, night, or weekend shifts.	4	5.26
Weekly 40 hours of work should be formed.	3	3.94
Demands of nurses should be taken into consideration.	6	7.88
24-hour shifts should be avoided.	2	2.63
Other**	17	22.35

*More than one response was given, and percentage was calculated according to n.

**Other: 8-hour shift should be established, equipment needs should be met, physicians should be available on every shift, and paperwork should be reduced.

Table 5. Comparison of nurses' work hours on night shifts and their satisfaction status according to descriptive characteristics (N:207)

Working time in night shift (7.01 ± 3.95 = 10.96)				Statistical Evaluations	
	Median	Minimum	Maximum	Test	p
	6,92	0	15		
Number of Children					
None^a	5.7	0	15	KW= 8.838	p=0,032* a<b,c,d
1b	7.76	0	15		
2c	7,65	0	15		
3d	6.75	1	10		
Clinic/unit name studied					
Emergency Service ^a	7,28	1	15	KW= 22.42	p<0.001 b>a,c,d,e
Intensive care units^b	8,67	0	15		
Surgical Units ^c	7.14	0	12		
Medical Units ^d	6,11	0	12		
Non-Bed Service ^e	3,41	0	9		
Satisfaction with the way of working					
	Very dissatisfied	Highly dissatisfied	Satisfied	Very Satisfied	
Number of children					
None	5	18	38	1	X ² =25,46 p=0.002**
1	9	25	11	4	
2	18	20	27	5	
3	5	4	6	1	
Name of the clinic/unit studied					
Emergency Service	2	2	4	0	X ² =42,42 p<0.001
Intensive Care Units	13	30	14	1	
Surgical Unit	8	23	23	2	
Non-Internal Unit	13	11	28	3	
Obstetric Unit	1	1	12	5	

KW: Kruskal Wallis test, X²: chi-square test

*p<0.05, **p<0.01

In addition, the number of night shift work hours of the nurses who worked in the intensive care units (ICU) was significantly higher than those of the nurses working in surgical ($p<0.01$) and medical units ($p<0.01$) and the units without inpatient facilities (KW=22.427, $p<0.001$). In addition, the level of satisfaction of the nurses who worked in the ICU was significantly higher than that of the nurses working in the units without inpatient facilities ($p<0.001$) but lower than the nurses working in the medical ($p<0.05$) and surgical units ($\chi^2=42,42$, $p<0.001$) (Table 5).

Discussion

In accordance with the legislation on provincial organization personnel standards, which is mandated by the Ministry of Health, state hospitals are classified according to their roles, service purposes, and the population of the region, and the health personnel who can work in these institutions are categorized according to their bed capacity. According to this classification, planning should be done for up to 30 nurses in clinics with 1 to 24 patient beds (Sağlık Bakanlığı [SB], 2017). In our research findings, the units in the institutions where the participants work were determined as clinics with 24 or more beds and requiring critical decision-making (intensive care units are the majority) with an average of 15 nurses in each unit. This finding shows that hospitals do not comply with the standard nurse ratios required by the legislation regarding provincial personnel standards of the Ministry of Health.

One of the reasons for Türkiye's inability to meet this standard is the shortage of nurses. Although this shortage is a global problem, Turkey ranked last in terms of nurses per capita among the countries in the Organization for Economic Cooperation and Development (OECD). According to OECD data, there were an average of 8.2 nurses per 1,000 people in OECD countries in 2017, ranging from 2.3 per 1.000 in Türkiye to 18 per 1.000 in Norway and Switzerland (OECD, 2020). Nursing staff or patient-to-nurse ratios are crucial for maintaining health care standards (Kortbeek et al., 2015), and each country has its own regulations on these issues (Aiken et al., 2010). Furthermore, ICN (2018) recommends that governments should take action to ensure safe staffing levels. However, the patient-to-nurse ratio is not the actual indicator of the nursing workload. Most of the nurses in the present study had rotating shift work, with a minimum of two and a maximum of four consecutive shifts per week. This finding was parallel to the studies which reported a high frequency of rotating nursing shifts in Türkiye (Yeşilçiçek Çalık et al., 2015; Uz & Kitiş, 2017). Studies in other countries, on the other hand, reported 8–12-hour fixed and rotating shift schedules for nurses (Cho et al., 2016; Dall'Ora, et al., 2022).

The number of participants working the night shift was lower than those working day shift, and the numbers of patients in the last shift and the number of daily hospitalized patients were 12 and 9, respectively. These findings indicate that various factors, including the severity of disease, different nursing demands, the effects of nursing intensity, workload, and patient rotation on nurses' workloads, should be considered when calculating the required number of nursing staff. In addition, the number of night shifts was higher for ICU nurses without children than nurses with children in other units. This finding may be related to the higher number of younger participants without children and who work in the ICU in our study (Stimpfel et al., 2015; Stimpfel et al., 2019).

Nursing schedules in the current study were mostly manually prepared by the clinic's responsible nurses on a monthly basis and then transferred onto a computer. Although this finding was contrary to previous studies, which reported that software was not widely used for nurse scheduling (Gradišar et al, 2022; Karaatlı, 2010; Yilmaz, 2012), it was observed in this study that nursing schedules were ultimately computerized. When planning shift schedules, the number of patients per nurse; the total hours of nursing care; the combination of nursing skill levels; preferences of nurses; uncertainties about demands, duration, and resources; and the number and characteristics of nurses were taken into consideration (Endacott et al, 2022; Legrain et al., 2015; Van Oostveen et al., 2015). Parallel to the findings in the literature, the total number of nurses in the unit, the last assigned shift, the preferences of nurses, and the minimum number of consecutive shifts were the main factors influencing the decisions on shift scheduling in our study. However, the care needs of patients had less significance in the decisions.

Although a significant proportion of the participants stated that the shift work system had a positive impact on their career advancement plans, patient satisfaction, and the relationship between nurses and other health professionals, more than 70% of the participants expressed the negative effects of the system on their family and private life, and more than half of them underlined the possibility of an increase in medical errors (Yeşilçiçek Çalık et al., 2015; Gradišar et al, 2022; Svirsko et al, 2019). On the other hand, more than half of the participants were dissatisfied with the shift work system. Participants working in the units without inpatient facilities were more satisfied than those working in the emergency services and medical units. These findings were supported by the studies reported that the nurses working in day shifts had positive perceptions about their work environment, fewer emotional problems (Li et al, 2022; Luceño-Moreno et al, 2020), and less work stress (Luceño-Moreno et al, 2020; Sarıçam, 2012) than the nurses working in the night or rotating shifts. However, despite their workload during the night shift, the participants who worked in the ICU were more satisfied than the nurses working in the units without inpatient facilities, but less satisfied than the nurses working in the medical and surgical units. This finding was supported by a study which reported that the level of personal success was higher for surgical and ICU nurses when their professional duties were explicitly defined (Sarıçam, 2012).

The participants suggested that the shortage of nurses should be addressed, that at least two nurses should be scheduled for evening, night, and weekend shifts and that scheduling should be fair. Other studies on nurse scheduling reported the shortage of nurses as the primary problem (Kortbeek et al., 2015; Sarıçam, 2012), which was also supported by the findings of the present research regarding the inadequate patient-to-nurse ratio. Our findings implied that effective human resource plans to employ the required number of nurses, fair scheduling, and consideration of personal preferences were crucial to maintaining nurses' work satisfaction (Farasat & Nikolaev, 2016).

Conclusions and Recommendations

The majority of the participating nurses worked rotating shifts, and the number of participants working night shifts was lower than their counterparts working day shifts. Although intensive care nurses worked more night shifts, their satisfaction was higher. However, half of the nurses were dissatisfied with the existing shift work system. Furthermore, the nursing schedules were mostly prepared by the clinic's responsible nurses on paper monthly and then uploaded to a computer. The participants suggested that the shortage of nurses should be addressed, at least two nurses should be scheduled for evening, night, and weekend shifts, and the scheduling should be fair.

The findings of this study imply that public policies can be implemented to address the nursing shortage, and new models and software that take into account the total number of patients and nurses in a unit, the experience and education levels of nurses, the intensity of patient needs, and the preferences of nurses can be used for fair and objective nurse scheduling.

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