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An Innovation Scheduling Program of Nurses During Covid-19 Pandemic: A Case Study

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Abstract. The increasing number of COVID-19 patients in hospitals has impacted workload and nurse fatigue. Management of service schedules is necessary to protect the safety of patients and nurses. This case study aims to describe innovative programs in scheduling nurses during the COVID-19 pandemic. This study used the case study method, implementation analysis, and discussion with the literature. Data collection was conducted with interviews and secondary data. The samples were three heads nurse from three inpatient rooms. The process started from problem identification, problem analysis, planning of action, implementation, and evaluation. The results showed that the innovation program for scheduling during the COVID-19 pandemic could be implemented. The implementation was to prepare official schedule guidelines, simulation of the creation of official schedules, and socialization of draft guidelines for the office schedule to the Head nurse. Planning the official program during the COVID-19 pandemic required good management. Nursing managers could create schedules with excel-based formats that were easy to apply. Online socialization could be done to improve understanding. The use of information technology was necessary to create an easy, fast and workable scheduling formula. The nursing field can make policies related to scheduling during the COVID-19 pandemic, carry out implementation trials in units, monitoring and evaluating the implementation of innovative programs, and provide adequate internet connections.

Keywords: COVID-19 schedule, length of nurse shift, nurse scheduling

INTRODUCTION

Good nursing services would improve patient satisfaction. Nursing services can be applied by providing comfort and attention needed by patients and families (1). During the COVID-19 pandemic, nursing services faced a shortage of nursing staff (2) where the ratio between patients and nurses becomes disproportionate. With existing limitations, the patient needs a nurse to give attention. On the other hand, with the Covid-19 pandemic, nurses become one of the health workers who become the front line with the risk of infection, high workload, long working hours that can trigger psychological disorders (3).

The COVID-19 pandemic has led to an increase in the number of hospitalized patients impacting nurses' workloads. The research conducted by Hu et al. (2020) (4), during the COVID-19 pandemic, found that nurses experience moderate to high levels of fatigue. Fatigue will adversely affect patients' nursing care and will be at risk of work accidents (5) that need special attention. Some ways to reduce fatigue such as to set the work time of nurses. Nurses who serve in COVID-19 isolation rooms are placed in unfavorable pressure isolation rooms with specific work schedules, then quarantined for 14 days and subsequently placed in an available treatment room (6). Adjusting working hours and increasing the number of personnel on duty during the COVID-19 pandemic aims to ensure patients' and nurses' safety, thereby improving care quality (7).

Hospital X is one of the COVID-19 referral center hospitals in Indonesia that struggle to meet patients' needs consistently. The limitations of nursing personnel are indeed occurring. Mobilization of personnel is carried out from several rooms and involves volunteers to meet the power needs in the COVID-19 isolation room. Based on secondary data until September, it is known that nurses are the profession most exposed to COVID-19. The number of nurses who are sick becomes an obstacle in the creation of existing service schedules. There are often changes in the schedule of the service in an uncertain time. It results in uniformity in the design of official programs both in terms of composition and competence. The author also did secondary data retrieval. She found that the hospitals had guidelines for official schedules but still did not regulate the pandemic.

OBJECTIVE

This study aims to describe an innovation program in the management of official schedules during the COVID-19 pandemic.

METHOD

This study was a case study in the inpatient room of Hospital X in Jakarta. Analysis of implementation results was with discussion based on literature. SWOT analysis approach was applied, followed by the creation of an Internal Factor Evaluation (IFE) matrix to evaluate the company's internal factors related to the strengths and weaknesses of hospitals (RS) that were considered necessary. External Factor Evaluation (EFE) was employed to evaluate things that covered opportunities and threats in the hospital's external environment. Furthermore, to position the hospital's strategic business, it was carried out with an External Internal matrix (IE) consisting of 9 cells about EFE and IFE's total value.

The activities were started with problem identification, then continued with problem analysis, problem priority determination, planning of action preparation, implementation, and evaluation. The inpatient room was an inpatient installation consisting of a *peristi* & NICU room, a COVID-19 treatment room, and an in-house disease room. Data retrieval was collected through interviews and obtaining secondary data in hospitals. The assessment was conducted using interview techniques to three heads of the room. Interviews were conducted

using interview guidelines based on management functions such as planning, organizing, power, direction, and control. The interview was performed once for each participant for 30 minutes through mobile phone communication equipment. Secondary data was obtained from the nursing department in official schedule documents and official schedule guidelines.

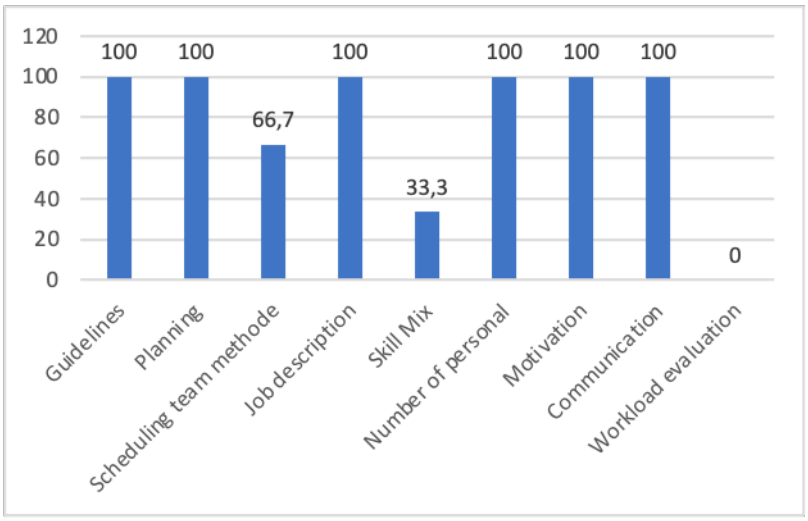
Innovation programs to anticipate problems related to burning out and nurse fatigue were in preparation of official schedule guidelines, socialization of official schedule guidelines, and simulation of official schedules to the Head nurse. The implementation's evaluation process was carried out using live interviews to find out the shortcomings and benefits of the official schedule guidelines during the COVID-19 pandemic that the author has compiled. This study process was an innovation program that already had a license from the hospital. The innovation made was by developing a nurse service schedule guide during the COVID-19 pandemic.

RESULTS

The study results at the Head nurse and Nursing Section of RS X in Jakarta already had guidelines for setting official schedules, which did not include official programs during the COVID-19 pandemic. There was no hospital policy regarding the rules for newly recovered nurses exposed to COVID-19 to work back into the service schedule shift. The interview results to the Head nurse related to the management function in scheduling the nursing service can be seen in graph 1.

Graph 1

Interview of Management Function of Head Nurse about Nursing Scheduling



The interviews and secondary data that included the creation of official schedules were still not allied and made manually. Discussions with the Nursing Department obtained decentralized data conducted by the head nurse during the official program's creation. Meanwhile, the centralization of the service schedule was carried out by the inpatient *Kasubwat*. The division of shifts in shifts on the official plan made by the Head nurse has not been seen. The service schedule was made only referring to the number of personnel and the adequacy of working hours regardless of the ratio between nurses and patients. The percentage of the number of mornings, afternoon, evening, and holiday shifts in the official

schedule in one of the COVID-19 isolation rooms showed a disproportionate composition. The number of morning shifts in the service schedule ranges from 16-40%, the number of afternoon shifts is 12-16%, the number of night shifts was 12-16%, and holidays were between 28-60%.

Based on secondary data (room schedule), it was gained that the composition of the clinical nurse level (PK) in the service schedule of each shift was not optimal due to the mobilization of energy to the new room COVID-19. The number of nurses PK III was 50%. The workload of nurses during the pandemic was considered heavy. In one of the isolation rooms of COVID-19 X, 55% of nurses were volunteers, and the remaining 45% were executive nurses.

Hospital X Jakarta has been nationally and internationally accredited. It is one of the COVID-19 referral hospitals in Indonesia. Currently accepts management residency students and leadership of FIK University of Indonesia. The location of the hospital in the center of Jakarta is often passed by the protesters making the hospital always do anticipation of energy. The results of the study were analyzed using SWOT analysis. Analysis can be seen in Table.1 to Table 4. The priority of problems is that the management for arranging the schedule during the COVID-19 pandemic can be improved.

Table 1 SWOT Analysis of head nurse management functions in inpatient rooms

No	Strength	Weakness	Opportunity	Threat
1.	The hospital has been accredited by SNARS and JCI	70% of the nurses have a D3 Nursing education	The government's reward is in the form of incentives for nurses who work in the COVID-19 area.	The increasing number of Covid-19 patients
2.	The team assignment method is used in the room	Service schedules are still being made manually	KMK No. HK.01.07 / MENKES / 169/2020 concerning the establishment of a referral hospital for infectious diseases	Public demands regarding the handling of COVID-19
3.	50% of nurses with PK III level	The service schedule guide has not regulated the provisions of the service schedule during a pandemic.	Support from the Hospital Accreditation Commission (KARS)	The risk of exposure to infectious diseases (COVID-19) to the nurse on duty.
4.	Planning for the official schedule during the pandemic has been made by the Head nurse.	There is no uniformity in making official schedules during the pandemic	There are some volunteers (BKO and AKPER RS X students)	Large-scale demonstrators passed the RS X neighborhood
5.	There is a nurse mobilization to fulfill the official schedule	Nurse qualifications (PK level) in the service schedule are not optimal	The existence of references to staff management (working hours) in the isolation room. → Reference books and related journals.	

Table 2 Matrix IFE

No	Internal Factor	Quality	Rating	Score
1.	Strength			
1.1	The hospital is SNARS and JCI accredited	0.08	3	0.24
1.2	The team assignment method is used in the room	0.1	3	0.3
1.3	50% of Nurses with PK III level	0.1	3	0.3
1.4	The Head nurse made the planning Schedule for the office during the pandemic	0.1	3	0.3
1.5	There is a nurse mobilization to fulfill the official schedule	0.12	3	0.36
2.	Weakness			
2.1	70% of the nurses have a D3 Nursing education	0.1	2	0.2
2.2	The service schedule guide has not regulated the provisions of the service schedule during the pandemic	0.1	3	0.3
2.3	There is no uniformity in making official schedules during the pandemic	0.1	2	0.2
2.4	Nurse qualifications (PK level) in the service schedule for each shift are still not optimal	0.1	3	0.3
2.5	Service schedules are still being made manually	0.1	2	0.2
	Total	1		2.7

Table 2 describes each success determinant's rating between 1 and 4 where 1 = very few serve as the main weaknesses, 2 = minor weaknesses, 3 = small strengths, 4 = main strengths. The ranking quality of each determining factor of success in the odds and threats is then summed up by the number of 2.7.

Tabel 3 Matriks EFE

No	Internal Factor	Quality	Rating	Score
1.	Opportunity			
1.1	The government's reward is in the form of incentives for nurses who work in the COVID-19 area	0.1	3	0.3
1.2	KMK No. HK.01.07 / MENKES / 169/2020 concerning the establishment of a referral hospital for infectious diseases	0.1	3	0.3
1.3	There is support from the Hospital Accreditation Commission (KARS) to hospitals in dealing with COVID-19 (circular letter No. 602 / SE / KARS / VII / 2020	0.1	3	0.3
1.4	There are volunteers	0.1	3	0.3
1.5	There is a reference to staff management (working hours) in the isolation room	0.1	3	0.3
2.	Threat			
2.1	The increasing number of Covid-19 patients	0.1	3	0.3
2.2	Public demands regarding the handling of COVID-19	0.1	2	0.2
2.3	The risk of exposure to infectious diseases (COVID-19) to the nurse on duty	0.1	2	0.2
2.4	There were frequent large scale demonstrations	0.1	3	0.3
	Total	1		2.5

Table 3 describes each determinant's rating of success between 1 and 4 where one = very little serves as an opportunity/threat, 2 = less serves as an opportunity/threat, 3 = is an opportunity/threat, 4 = very act as an opportunity/threat. The amount then sums up the ranking weight of each determinant of success in the odds and threats.

Figure 1 Internal External Matrix (IE)

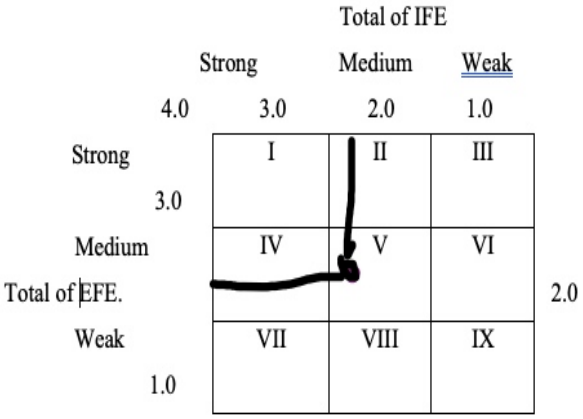


Figure 1 shows the EFE (2,5) and IFE (2.7) matrices indicating cell V's position in the hold and maintains strategy. In this strategy, it can be done market penetration and product development (8). Market penetration by maintaining and improving the quality of nursing care is through official schedules during the COVID-19 pandemic. Meanwhile, product development is based on the development of nurse service schedule guidelines during the COVID-19 pandemic. Plan of action based on the analysis made includes the development of official schedule guidelines, simulation of office schedule creation, and socialization of official schedule guidelines during the COVID-19 pandemic.

Innovation Program

The analysis results became the basis for drawing up a follow-up plan using the POSAC framework, which began with a planning function in the form of a review of official schedule guidelines owned by the hospital to further draft guidelines for the official schedule during the COVID-19 pandemic. Then, organizing and powering was carried out by coordinating and discussing with the Nursing Department, academic supervisors and conducting literature studies. So, those draft guidelines were produced for the official schedule during the COVID-19 pandemic. Furthermore, the author conducted a briefing in simulation and socialization of draft guidelines for official programs during the COVID-19 pandemic. The author could not do the trial because of the limitations during the pandemic.

Simulation of schedule creation was conducted to three Heads of Rooms using a Microsoft Excel spreadsheet. Each head nurse was allowed to make scheduling a service. The selected power calculation used the Douglas formula. In the innovation program of creating a service schedule during the COVID-19 pandemic, each nurse would make direct contact for 4 hours for each shift. The service schedule would be given the codes P1, S1, and M1 for nurses who made contact in the first 4 hours. P2, S2, and M2 for nurses who would make direct contact in the next 4 hours.

The author used the formula "COUNTIF" in excel format to make it easier to calculate the number of hours worked, weekdays, attendance, absence, and the number of nurses on duty in each shift. Before scheduling, the author did the calculation of energy needs using the Douglas formula. To adjust the use of PPE for 4 hours, the number of energy needs calculated was multiplied by two. In anticipation of leave, holidays, and unexpected events, the author, adds back 50%. Furthermore, forecasting was carried out to determine the estimated number of nurses who would be on duty in each shift. The simulation of the creation of official schedules during the COVID-19 pandemic can be seen in Figure 2.

The simulation process of creating official schedules during the COVID-19 pandemic was also evaluated. The simulation evaluation results obtained the average assessment of the Head nurse on the implementation of office scheduling simulation during the COVID-19

pandemic by 75 out of 100. This indicated that the Head nurse gave a positive reception to make changes in the official schedule. The results of the simulation evaluation can be seen in Table 5.

Table 5 Evaluation of Simulation

NO	Statement	Percentage
1.	The Head nurse assessed those simulation activities increased knowledge in making official schedules during the COVID-19 pandemic	100 %
2.	The head nurse assessed that the simulation using the computerized scheduling format that had been provided made it easier to work	100 %
3.	The head nurse stated that the office scheduling with a computerized format that had been provided could be implemented in the hospital	100 %
4.	The head nurse considered that network problems and the ability to use computers were obstacles in making official schedules	33,3 %
5.	The head nurse thinks that a sudden change of energy is an obstacle in making official schedules	66,7 %

Table 5 shows that the simulation evaluation results of the creation of official schedules during the COVID-19 pandemic are running well. However, there are obstacles related to the internet network and the Head nurse's ability they use computers.

Figure 2 Simulation of COVID-19 Isolation Room office schedule

JADWAL DINAS
RUANGAN COVID-19

NO	NAMA	POSISI	Skill Mix	S 1	S 2	R 3	K 4	J 5	S 6	M 7	S 8	Jumlah Hari kerja/bulan	Total Jam Kerja/bulan
1	Ns. AAA	HN		P	P	P	P	P	L	L	P	23	161
2	Ns. B	Ka. Tim 1	PK 1	L	P	P	P	P	P	L	L	21	147
3	Ns. C	Lakwat	Pra PK	P1	S1	M1	L	L	P1	M2	L	5	41
4	Ns. D	Lakwat	PK 1	P2	S2	M2	L	P2	S1	L	M2	6	48
5	Ns. E	Lakwat	Pra PK	S1	M1	L	P2	S2	M1	L	L	5	41
6	Ns. F	Lakwat	PK 1	S2	M2	L	L	P1	S2	M1	L	5	41
7	Ns. G	Lakwat	Pra PK	L	P2	S2	M2	L	P2	S2	L	5	38
8	Ns. H	Lakwat	PK 1	M1	L	P2	S1	L	L	P2	S2	5	38
9	Ns. I	Lakwat	Pra PK	M2	L	L	P1	S1	M2	L	P2	5	41
10	Ns. J	Lakwat	PK 1	L	P1	P1	L	M1	L	S1	M1	5	41
11	Ns. K	Lakwat	Pra PK	L	L	S1	M1	L	L	P1	S1	4	31
12	Ns. L	Lakwat	PRA PK	L	L	S1	S2	M2	L	L	P1	4	31
13	Ns. T	Ka. Tim 2	PK 1	L	P	P	P	P	P	L	L	22	140
14	Ns. N	Lakwat	Pra PK	P2	S2	M1	L	P2	M2	L	L	5	41
15	Ns. O	Lakwat	PRA PK	P1	S1	M2	L	L	P1	S1	M1	6	48
16	Ns. P	Lakwat	PK 1	S2	M1	L	P1	S1	L	L	P1	5	38
17	Ns. Q	Lakwat	PRA PK	S1	M2	L	S2	M2	L	P2	S2	6	48
18	Ns. R	Lakwat	Pra PK	L	P1	P2	L	P1	S2	M1	L	5	38
19	Ns. S	Lakwat	PK 1	M2	L	L	P2	S2	M1	L	P2	5	41
20	Ns. U	Lakwat	Pra PK	M1	L	P1	S1	M1	L	P1	S1	6	48
21	Ns. U	Lakwat	PK 1	L	P2	S2	M2	L	P2	M2	L	5	41
22	Ns. V	LAKwat	PRA PK	L	L	P1	M1	L	S1	S2	M2		
	P1 (4 jam)	Total P1		2	2	3	2	2	2	2	2		
	P2 (4 jam)	Total P2		2	2	2	2	2	2	2	2		
	S1 (4 jam)	Total S1		2	2	2	2	2	2	2	2		
	S2 (4 jam)	Total S2		2	2	2	2	2	2	2	2		
	M1 (4 jam)	Total M1		2	2	2	2	2	2	2	2		

DISCUSSION

Nurse scheduling is the arrangement and allocation of available nurse time to perform pre-planned tasks to minimize costs, equitable distribution of workloads, and nurse satisfaction (9-11). During the COVID-19 pandemic, there was a shortage of nurses and the

use of personal protective equipment (PPE) in isolation rooms. This can lead to fatigue, increased workload and can trigger psychological disorders (3-4). So, the arrangement of shift length must be made to improve nurses' quality (7).

The author innovates the scheduling of services during the COVID-19 pandemic by emphasizing maintaining the health of nurses and ensuring patient safety and quality of care (7). Therefore, the length of working hours in each shift is made. The arrangement made in the service schedule is the division of time the nurse made direct contact with the patient.

Work shift patterns in COVID-19 isolation rooms at RS X are 7-hour morning shifts, 7-hour afternoon shifts, and 10-hour night shifts. This follows the statutory provisions that the scheduling of health workers during the COVID-19 pandemic is a maximum of 40 hours a week, with a daily working time of 7-8 hours, and must not exceed 12 hours (12). However, a nurse's length of time using complete personal protective equipment in a COVID-19 isolation room should not exceed 7 hours in one use (13). Thereby, the author divides the time the nurse makes direct contact in scheduling the service each shift to 4 hours for the morning and evening shifts and 5 hours for the night shift.

The difference in length of nurse shifts while on duty is in line with research conducted by Xia Zhang (2019)(14) found that nurses prefer the length of working hours 4 hours per shift. This is influenced by several factors such as the use of personal protective equipment in isolation rooms, the physical and emotional needs of nurses, and the intensity and safety of nurses' work. The division of shifts in the shift certainly requires additional energy. Research conducted by Gao et al. (2020) (7) that during the COVID-19 pandemic, a Head nurse must adjust the working hours of nurses dynamically and increase the number of nurses on duty to reduce the workload of nurses if the health of nurses is expected to perform optimal nursing care. Lack of human resources in scheduling can be prepared with nurses' assignment and placement according to the level of competence and level of dependency of patients.

Skill mix arrangement in the official schedule is to place the competency column in the official schedule form. It is expected to help the performance of nurses in the program of the service. Skill mix in the service schedule during the COVID-19 pandemic is needed to improve understanding between team members and work efficiency and reduce stress on nurses in isolation rooms (7). Research conducted by Rizany (10) obtained that skill mix in scheduling services proved effective and facilitate work in the room, so it is expected to improve patient care quality (15).

Furthermore, nurses' level of competence can be attributed to the ratio and level of dependency of patients. In Indonesia, the nurse career level division consists of five levels of clinical nurses (PK), namely PK I, II, III, IV, and V (16). In the isolation room of COVID-19 (deep and surgical diseases), nurses with PK I level can perform the treatment to patients with independent dependency level, with the ratio between nurses compared to patients is 1:8-10 (17-18).

Scheduling at RS X uses centralized scheduling by mid-level managers and Top Managers and the head nurse's decentralization. The centralization process flow is *Kasubwat* planning internal mobilization power between managed treatment rooms is temporary for every room in need. If the mobilization of power is still lacking, the room will submit to the Head of Inpatient Installation. The Head of Inpatient Installation will mobilize from other *Kasubwat* who is still in his internal zone. If the Installation is no longer able to mobilize and requires new energy, it will propose to the Field of Nursing. The head nurse carries out a decentralization schedule by managing the service schedule under nurses' characteristics and the ward's needs. Management of service schedules is necessary as data for the provision of reinforcement to nurses in the form of incentives provided by the government (19).

The author developed the scheduling service applied in RS X by creating an automatic formula in Microsoft Excel. The official scheduling format can then be accessed using a google spreadsheet or sharing share using a local area network (LAN) connection owned by RS. This aims to facilitate centralization and decentralization in the scheduling of nurse services. The creation of quality service schedules can automatically improve resource efficiency, staff and patient safety, staff and patient satisfaction, and workload (20).

Rescheduling during pandemics is often due to understaffing (11). It needs simple, fast, and workable rescheduling. The automatic scheduling formula, it will make it easier for nursing managers to reschedule. Lack of power in a room should be pursued first with internal hospitals' addition to suppress financing and still maintain the quality of care (11).

Nursing managers' role as reforming agents is crucial to strive for a change running optimally (21). According to Kurt Lewin, there are three stages in making changes such as unfreezing, moving, and refreezing. At the unfreezing stage, nursing managers must convince the Head nurse to manage the official schedule during the COVID-19 pandemic. At the moving scene, it is starting to move to plan the implementation of change agents. Furthermore, the unfreezing stage is after the completion of innovation's performance by ensuring the retention of changes that have been made (22). Up to now, the author has made a change for the agent to the moving stage. Meanwhile, the unfreezing step will be continued by the hospital.

CONCLUSION

Service schedule planning requires good management, so that nursing personnel can be rationally allocated to optimize the allocation of nursing personnel. They can reduce the workload of nurses, improve the quality of nursing care, and improve nurses' physical and mental health during the COVID-19 pandemic. Planning can be started by establishing a precise regulation of the scheduling process.

Scheduling formulas during the COVID-19 pandemic should be created in an automated format and using technology that is easy for nurses to apply. Socialization of the use of online service scheduling is needed to facilitate the implementation. Coordination is required between nurse managers related to energy mobilization during the pandemic to maintain nursing services quality.

Hospitals can optimize the scheduling of computerized services in coordination with the information technology (IT) in hospitals and the use of adequate internet connections to facilitate the process of existing innovation applications. Improvements and adjustments to the formula still need to be made for ease of implementation.

STRENGTH AND LIMITATION

Innovations made by the author in the form of schedule guidelines and the creation of computer-based service schedules are considered to facilitate nurses in managing official schedules. This innovative program's weakness is the problem identification process done online so that the data obtained is not maximal. The scheduling of the service that is made still has limitations, such as a template that is not interesting. The formula must be adjusted to the needs of the room and the constraints of understaffing in the hospital that will tend to hinder the implementation of the scheduling of the office that has been made.

The nursing field can make policies related to scheduling during the COVID-19 pandemic, carry out implementation trials in units, monitoring and evaluating the implementation of innovative programs, and provide adequate internet connections.

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