Optimization Design of Nurses' Work in Primary Hospitals in the Post Epidemic Era - A Case Study of Hospital Y

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Abstract. There are only 1,516 Grade 3A hospitals in many cities in China, while there are 31,605 primary hospitals. Therefore, the study of nurses' work problems in primary hospitals is conducive to finding new ways to improve nurses' work efficiency and new ideas to improve the problems. This project analyzes and improves the problems such as duplication, cumbersome routes, and inefficiency of ward allocation and nurses' work routes and workflow in departments. By improving the ward layout and optimizing the workflow, the solution to the problem of nurses' work efficiency was achieved, and the improved solution was measured to verify its authenticity and reasonableness.

Keywords: Nursing work, Optimal design, layout, Post-pandemic era

1 INTRODUCTION

1.1 Problems Faced by the Surgical Department

Surgical units face more problems and the influencing factors are inefficiency of nurses, excessive queuing office, irrational storage of medical supplies, complicated workflow of nurses, and poor visualization and work management. It can be divided into the low motivation of nurses' work; complicated procedures at the payment office; unclear classification of the drug room, irrational discharge of instruments; many routes for nurses to go back and forth, and the failure of fixed positions to play a role.

1.2 Distribution Analysis of Wards in the Surgical Department

The investigation found the following problems in the ward layout of the surgical department: no obvious grading of the ward, in the same room the patient's level of care is different. patient arrangement is unreasonable; the first level of care patients are far away from the nurses' station, while the second and third level of care patients are closer to the nurses' station. Due to the different levels of care of individual patients and the complexity of the level of care of the patients for whom the nurses are responsible, when the same nurse is responsible for patients with different levels of care, it is often

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necessary to run a very long distance, thus increasing the difficulty of the nurses' nursing work and increasing the fatigue intensity of the nurses.

2 OPTIMIZING THE EFFICIENCY OF NURSES' WORK

2.1 Analysis of Nurses' Daily Working Routes

The nurse's route[1] is as follows: enter the locker room from the stairwell to put on protection and start work; go to the nurse's station to get the Drug Count Sheet; go to the store room to count the drugs; go to the nurse's station to get the Instrument Calibration Sheet; go to the instrument room to count the instruments; go to the store room to get the drugs; place the drugs at the nurse's station and the dispensary; and get the drugs and distribute them to the patients on the various wards. As can be seen in Figure 1, the route is complex.

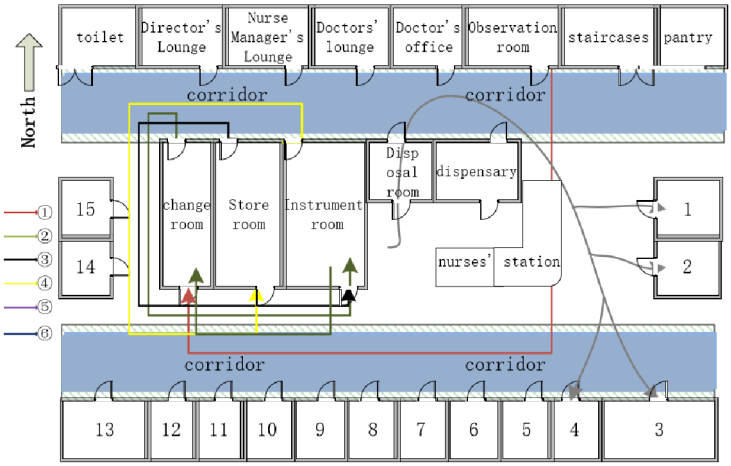

Fig. 1. Road map of a nurse's work

2.2 Nurse Workflow Analysis

From the road map analysis, it can be seen that the daily work flow[2] of nurses is complex and changeable, and the work flow of nurses is complicated, and the field investigation finds that nurses walk around many times to fill in various forms, which takes up to 20 times a day. Therefore, the hospital's regulations[3] are unreasonable, increasing the distance that nurses walk.

As shown in Table 2, we need to measure heart rate for three experiments, before and after labor and after rest[4], which resulted in a mean value of 77 heart rate before operation, a mean value of 126 heart rate after operation[5], and a mean value of 75 heart rate after rest, and a value of increase C = B - A = 49 rate of increase D = C / A =

63.67% Then we need to measure oxygen[6] consumption (O) and body surface area S, which is obtained by the following formula:

$$O=0.5+0.02*(b-75) \quad (1)$$

$$S=0.0061*H+0.0128*W-0.01529 \quad (2)$$

Where: b is the heart rate (beats/min);The oxygen consumption is calculated to be 1.52; the body surface area is 0.14777;

Energy metabolic rate formula: M = oxygen consumption (L / min) × oxygen heat price (kcal / L) / body surface area (m^2)

Calculated: M = 1.524.825/0.14777 = 4.97 (kcal /min/m^2) Judgment of the labor grade as heavy

Energy metabolic rate per hour is: 4.9760 = 258.2(kcal /h/m^2)

Relative metabolic rate: RMR(M1.2B)/B=7.8; Checking the table gives a metabolic rate of 140%;

energy expenditure = 4.97*4.1868*1.7444 = 36.29; substitute labor time and rest time and labor rate in the formula for labor time, respectively.

Table 1. Fatigue Measurement Record Sheet

Fatigue Measurement Record Sheet			
Name	Nurse Y	sex	woman
age	24	condition	well
Height (cm)	154	Weight (kg)	54
Location (indoor/outdoor)	indoor	Temperature（C°）	27
Action Item Name	X	Number of actions (Pcs)	50
Mean pro-operational heart rate A (beats/min)	77	Mean post-operational heart rate B (beats/min)	126
Value added C = B - A	49	Rate of increase D = C/A	63.67
Level of labor	repetition	Rest recovery time (min)	5
energy metabolic rate M（kcal/h/m^2）	258.2	relative energy metabolic rate（RMR）	7.8
Fatigue relief rate（%）	115	Reasonable labor hours T（min）	7.18
rest time T（min）	2.17	labor rate T_w	76.8

Measurement of heart rate			
	Pro-operational heart rate	Post-operational heart rate	Heart rate at rest
The first time	76	124	68
The Second time	78	128	78
The third time	77	126	79
Mean value	77	126	75

can be derived:

$$T_{RT}=\left(\frac{M}{16.75}-1\right)T_{LT} \qquad T_w=\frac{T_{LT}}{T_{LT}+T_{RT}}*100\% \qquad T_{LT}=\frac{100.47}{M-16.75} \quad (3)$$

Where: RT is rest time and LT is labor time

It was calculated that the labour time was 7.18 min, the rest time was 2.17 min and the labour rate was 76.80%.

3 DESIGN AND ANALYSIS OF IMPROVEMENT PROGRAMME

After an in-depth analysis, the team decided to change the direction of the warehouse[7] entrance and exit of the warehouse: enter from the north side of the warehouse and exit from the south side. After the improvement, the nurses can go to the changing room to change the protective clothing with the "Drug Number List" and "Instrument Calibration List" after arriving at work, and then take the "S" route to check the number of drugs and instruments. The actual distance travelled was calculated to be 103 metre less.

3.1 Optimization of Surgical Nurses' Workflow in Hospital Y

As shown in Table 2, the optimized daily workflow for nurses was reduced by 5 steps and the distance was reduced by 40 meters. Efficiency was increased by 23.5 per cent. The first-level nursing process is reduced by 7, the walking distance is shortened by 170 metre, and the time is reduced by 3.9 minutes; in which the 40-minute checking of drugs is changed to checking once an hour, and nurses can check the drug dosage by the way when they are carrying out the first-level nursing care, which reduces the number of times and distances that nurses have to walk repeatedly.

After the improvement analyse by the modelling approach, the MOD number was reduced from 124 to 85 and the efficiency of the nurses in dispensing medication was improved by 31%.

Table 2. After the improvement of MOD method in nurses' dispensing work

Assignment: Nurse Dispensing (Improved) Operator: Nurse Y, Hospital Y Analyst: xxx			Date: 2023/6/23		People:1 Mod: 85
No.	Left-handed movements	analytic	Right hand action	analytic	mod value:
2	Reach for the bag	M2GO	Reach for the medication list	M2GO	15
3	Move to the cabinet	6W5	Look at the list	D3E2	5
4	Reach for the medication	M4G1	grip and hold	H	30
5	Move to initial position	6W5	Packaging of drugs	M1GO	5
6	Handing medication to patients	M3PO	wait	BD	30
consider					85

3.2 Proposed Solution and Result Analysis

(1) Work Environment

①Implement the "6S" management mode, all medicines are labelled and classified, and visual management is implemented; all forms are uniformly placed in the filing cabinet of the disposal room. ②Using the graphic method and colour method, dangerous goods and medical contaminated goods are clearly marked; paths are marked so that family members will not get lost in the department.③Wards are managed in zones and sections to adjust the original ward allocation and re-grade the wards: wards 6, 7, and 8 are primary care wards, wards 5, 9, 10, 11, and 12 are secondary care wards, and wards 1, 2, 3, 4, 13, 14, and 15 are tertiary care wards. ④ Changing the one-way door of the storehouse that circulates from south to north to circulate from north to south to shorten the walking distance of nurses.

(2) Workflow

①Remove the redundant form-filling process and replace it with a process where the nurse receives the form using electronic equipment and scans the code to confirm after checking. ② the original every 40 minutes to confirm the status of the patient's infusion into every hour to confirm, reduce the number of nurses to repeat the walk. ③The original dispensing process is simplified, changing "passive" dispensing into "active" dispensing, and "people waiting for medicine" into "medicine waiting for people.

4 CONCLUSION

Using the optimized route and room layout, the distance of a single nurse to care for a patient is reduced by 25 meters, and the total distance is reduced by 2,500 meters. The process of dispensing and delivering medicine by nurses has been significantly improved, the process of delivering medicine has been simplified, the service process and actions of nurses have been standardized, and the proficiency of nurses has also been greatly improved after using standard operating procedures.

With the optimized routes and room layouts the nurse dispensing and delivery process has been significantly improved, the delivery process has been simplified, and the nurse service process and actions have been standardized. This program has been validated for generalizability and has been implemented throughout the hospital.

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