

Analysis of the Effect of Systematic Pre-Job Training for Nurses in Isolation Wards during the COVID-19 Pandemic

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Abstract

Objective: To explore the effect of systematic pre-job training for isolation ward nurses during the Corona Virus Disease 2019 (COVID-19) pandemic.

Methods: Establish a pre-job training program for the isolation ward for COVID-19, standardize the content of theoretical and skill training, formulate training SOPs, and conduct training for the nurses using online teaching assessment, video teaching, on-site scenario simulation operation drills, as well as real-time protection guidance and supervision. 60 nurses from non-infectious departments temporarily selected by the hospital were trained; the theoretical knowledge scores, quarantine techniques, and nursing quality of nurses before and after the training were compared, and the effect of the intervention was evaluated. **Results:** The scores of the COVID-19 protection theory test were 81.17 ± 8.46 after the nurses were trained for 3 days. The pass rates of hand hygiene compliance tests and protective clothing putting-on and taking-off practices were 96.67% and 100%, respectively. There was no significant difference between the scores of the COVID-19 protection theory test for the nurses that were trained for 3 days and the scores for the nurses originally at the quarantine zone (81.59 ± 7.59 , $P > 0.05$). The pass rate of hand hygiene compliance and the pass rate of protective clothing putting-on and taking-off practices were significantly improved compared with those before training (81.67% and 56.67% respectively, $P < 0.001$). The scores of the COVID-19 protection theory test at 30 days of training were 95.67 ± 5.89 , which were significantly higher than those at 3 days of training ($P < 0.001$).

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The qualified rate of disinfection and quarantine in the first month for the trained nurses entering the isolation ward was 89.47%; compared with that for the nurses originally in the isolation wards (94.7%), there was no significant difference ($P > 0.05$). The comprehensive nursing ability scores of bedside nurses in the first month of training were 80.14 ± 5.63 , which were lower than those of nurses originally in the isolation wards (86.88 ± 4.53 , $P < 0.05$).

Conclusion: Systematic pre-job training for nurses in isolation wards can help improve nurses' knowledge of the COVID-19, self-protection awareness, and protection skills, and can quickly train nurses who are competent for work in isolation wards. It is an important guarantee of "zero infection" for medical staff, and it can quickly and effectively help medical institutions respond to the COVID-19 pandemic in an emergency.

Keywords

Corona Virus Disease 2019 (COVID-19), Nurses, Systematic, Pre-Job Training

1. Introduction

Since the outbreak of Corona Virus Disease 2019 (COVID-19), many shifts of medical staff across the country have been dispatched to Wuhan, while other provinces and cities have also been facing severe threats of imported epidemic cases. As a designated hospital in Guangdong Province with medical and nursing experience in regard to SARS, our hospital was the first to treat such patients in isolation wards. With the development of the pandemic situation, 250 beds need to be prepared to treat patients with COVID-19 in response to the notification from the superior. The main treatment objects are patients who need to be isolated and observed. Severe patients are transferred to the designated first-level hospital for treatment. In order to quickly adapt to the work requirements of the emergency state, a large number of isolation ward nurses need to be quickly trained. Systematic Approach to Training (SAT) is a procedural training method advocated and promoted by the International Atomic Energy Agency [1], including 5 stages: training needs analysis, training syllabus design, training material preparation, training implementation, and training effect evaluation and feedback. During the reconstruction of the isolation wards, our hospital adjusted the training strategy in a timely manner on the basis of the original regular training courses, adopted a systematic pre-job training method, and quickly trained the first batch of nurses in the non-severe isolation wards, so that the hospital achieved a staged victory in the pandemic response.

2. Subjects and Methods

2.1. Training Subjects

According to the progress of the wards reconstruction, 60 nurses of different le-

vels were selected from each department of the hospital, and divided into isolation area 1 nurse and isolation area 2 nurses according to the staffing level requirements. Among the nurses, 2 were male and 58 were female, with an age of 27.68 ± 4.34 years old; there were 7 nurses with intermediate professional titles, 39 with primary professional titles, 13 in their standard training, and the length of service was 5.38 ± 4.21 years. All 60 nurses who have received standardized training in the infection ward for 3 - 6 months have participated in the uniform technical training for putting on and taking off protective clothing in the hospital [2].

2.2. Training Objective

After training, nurses serving other specialties can cope with the nursing of mild patients at any time during the peak period of the epidemic, master self-protection skills, and achieve zero occupational exposure rate. It can quickly respond to the peak of the epidemic, rebuild the isolation ward, and put it into use, so as to achieve the reasonable allocation of human resources, fight immediately, respond to the war, and win.

2.3. Methods

2.3.1. Set up a Training Team

1) An emergency training team for nursing staff was set up, led by the director of the nursing department; one section nurse was designated as the isolation ward pre-job training team leader, another section nurse as the deputy team leader, another one as training secretary, and additional 3 as in-service technical instructors, responsible for formulating training outlines, compiling training materials and assessment standards and specifically supervising implementation and effect testing. The above-mentioned 6 nursing experts included one intensive care specialist nurse in ICU, one national second-level psychological counselor, one wound therapist, two infection specialists, and one person with an intermediate title in respiratory medicine. 2) From the infectious disease department, the respiratory department, and the ICU department, one head nurse and one nurse team leader who have worked in the SARS wards, and 4 senior nurses with training experience in the area were selected as the trainers.

2.3.2. Preparation of Training Materials

Before compiling materials, members of the emergency training team conducted a baseline survey of the nurses' knowledge and attitudes and conducted in-depth interviews with nursing managers and clinical nurses in existing isolation wards. After understanding the nurses' needs for the current situation of the pandemic and the nursing content of the pandemic response, the team summarized the needs into 15 items and conducted a study needs survey on the nurses who were about to be transferred to the isolation wards in the form of questionnaires (see **Table 1**), after which the basic framework for the preparation of training materials was finally determined. The training materials were divided into public

Table 1. Investigation on study needs of nurses in isolation wards for pre-job training.

	Items	Very needed	Generally needed	unnecessary	Demand rate (%)
1	Comprehension of the diagnosis and treatment methods of COVID-19	43	15	2	96.7
2	Improvement of the prevention and control capacity of COVID-19	60	0	0	100
3	Improvement of personal protection	60	0	0	100
4	Improvement of the comprehensive application ability of public health emergency time knowledge	41	19	0	100
5	Increase of confidence in dealing with the COVID-19 pandemic	34	26	0	100
6	Study of how to use new equipment	58	2	0	100
7	Comprehension of fire safety knowledge	19	37	4	93.3
8	Understanding of the setting of the three zones and two lanes of the isolation ward	55	5	0	100
9	Essential nursing training for respiratory specialists	32	12	0	90
10	Training of pediatric disease observation points	15	36	9	85
11	Special operation training 1: nasopharyngeal swab specimen collection method	55	5	0	100
12	Special operation training 2: putting on and taking off protective clothing (including putting on masks and goggles)	31	19	10	83.3
13	Special operation training 3: hand washing method	3	7	50	16.7
14	Special operation training 4: how to use non-invasive ventilator	41	10	9	85
15	Special Operation Training 5: how to use high-flow humidifier	32	16	12	80

training materials and special intensive training materials for entering the isolation ward. The public training materials were the latest document guidelines listed on the hospital OA system, which included: theoretical knowledge related to COVID-19 (such as epidemiology, etiology, clinical manifestations, diagnosis, treatment, prevention, and control), the Technical Guidelines for the Prevention and Control of New Coronavirus Nosocomial Infection in Medical Institutions issued by the National Health Commission, the Pneumonia Treatment Plan for Novel Coronavirus Infection (Fifth Edition) issued by the National Health Commission, and some materials regarding disinfection and isolation systems and technologies. The special intensive training materials for entering the isolation ward were compiled on the basis of needed contents for hospital ward reconstruction [3], including workflow, responsibilities of each class, environment, and surface disinfection methods, garbage disposal, self-protection guide, special operation technical process, various emergency plans in the isolation ward, walking routes, etc.; the materials were compiled into a book after being reviewed and approved by the Nursing Department and the Hospital Infection Department.

2.3.3. Implementation of Systematic Pre-Job Training

1. Pre-job training standard operating procedures (SOP) development

Before the training was carried out, a detailed and feasible training SOP was formulated. The specific content included the uniformly set training objectives, subjects, content, processes, and assessments. Each site had a fixed person in charge who was responsible for special training content to ensure that training could be carried out in accordance with unified procedures and standards at each site. Six nursing experts were pre-trained using SOP, and the SOP was perfected according to the pre-training results.

2. Centralized training in batches

The pieces of training were conducted in 6 sites in the newly constructed isolation wards (consistent with the layout of the original isolation wards in operation, receive and cure non-severe covid-19 pneumonia patients). Due to the pandemic situation, people should not gather together, so centralized pieces of training were conducted on 10 people per batch at each site, and each site held 3 training sessions every day; in each training site, respective skill demonstration, training, and assessment would be conducted on 10 nurses at a batch, and the training lasts for two consecutive days. On the third day of training, the nurses were divided into two groups, while nurses in each group took a turn to get evaluated by three instructors altogether. The training nurses were evaluated for the process of entering and leaving the polluted area. All 60 nurses received unified and standardized training and evaluation. Be able to deal with the collection of nasopharyngeal swab specimens, high flow humidification, and oxygen supply, the observation of patients' condition changes, the handling of patients in and out of the hospital, transportation inspection, and the handling of occupational exposure, etc.

3. Online theory learning

1) The training courses were recorded into videos according to the training content. The training group will dub the operation video in the later stage, give detailed explanations and demonstrations of the details, difficulties, and attention points in the operation, and then post it to the WeChat group for online learning, requiring everyone to master the newly posted contents within 24 hours. During the centralized training, each site designed questions according to the learning content combined with the actual clinical situation or simulated cases; at the same time, the key and updated knowledge points were highlighted by the designated program of “One Post Per Day” to deepen the trainees’ memory. 2) All staff logged onto the website of <https://www.91huayi.com/> to conduct self-study and assessment and completed 2 points of Class I credits.

2.3.4. Continuous Training and Supervision

After 3 days of training, 30 nurses directly entered work mode in the functioning non-severe isolation ward to replace the original nurses on shifts. Real-time protection supervision was carried out through the isolation ward monitors, and timely reminders and real-time guidance were provided to everyone to ensure that each nurse strictly followed the protection process, that no pollution occurred in every action and every step, and that the whole process of entering and leaving the isolation ward was truly supervised. Another 30 nurses assisted in the preparation of the other two standby isolation wards in the early stage. During the preparation period, 2 - 3 nurses were selected for the whole process every day. In the later period, the 30 nurses were transferred to the fever clinic to replace the original staff on rotation. No matter in the isolation ward or in the early stage of the fever clinic work, it was required that the new and old nurses of each shift (at least two people) enter and leave the isolation ward together, so as to check and remind each other when putting on and take off protective equipment and check each other for any omissions and shortcomings. At the same time, with the help of online learning platforms, WeChat groups, QQ groups, and other channels, the training teachers would answer questions related to nurses’ learning norms in real-time, and continue to update the learning content of the documents. In addition, the Nursing Department organized quality control personnel who had been uniformly trained twice a week to check the implementation of the regulations in the isolation ward and fever clinic and solve problems or difficulties encountered in the implementation of the regulations in a timely manner. The nurses’ feedback on common problems included the prevention and treatment of facial pressure ulcers caused by wearing N95 masks and the process treatment of patients with special conditions. Through feedback during implementation, it was ensured that the nurses had a good grasp of the normative content.

3. Evaluation Methods

3.1. Theory Test Assessment

So, the jump was utilized to establish the relevant content theory for online as-

assessment of COVID-19 protection. The types of questions included multiple-choice questions and true-false questions. The full score was 100 points, and score ≥ 70 points were considered a pass. The theoretical evaluation was conducted on 60 trained nurses and 29 nurses with anti-epidemic experience in isolation wards during the first week of training; 60 trained nurses have tested again one month after the training.

3.2. Operational Practice Assessment

Pre-training designated test cases for the nurses: the patient had blood oozing after the blood draw, and there was more blood on the skin to deal with. At the end of the site training, the hand hygiene compliance and technical assessment of putting on and taking off protective clothing were evaluated using the scenarios of entering and leaving the contaminated area and collecting throat swab specimens for simulated patients. The training nurses' hand hygiene compliance and the pass rate of putting on and taking off protective clothing before and after training were compared then.

3.3. Work Quality Assessment

Export the nursing quality control data from the nursing department, and randomly select the original isolation ward nurses' work quality scores for one month and compare them with the work quality scores of the trained nurses in the first month of entering the isolation ward.

3.4. Statistical Methods

SPSS 13.0 software was used for statistical analysis, and the count data were expressed as frequencies and tested by χ^2 . Measurement data were expressed as mean \pm standard deviation ($\bar{x} \pm s$), and a t-test was used for comparison between groups. $P < 0.05$ indicated that the difference between groups was statistically significant.

4. Results

4.1. Comparison of the Scores of the COVID-19 Protection Theory Test on Nurses after 3 Days of Training and on Nurses Originally in the Isolation Ward

After 3 days of training, the scores of the COVID-19 protection theory test were 81.17 ± 8.46 , while the scores of nurses originally in the isolation ward were 81.59 ± 7.59 . There was no significant difference between the two groups of scores ($P > 0.05$), as shown in **Table 2**.

4.2. Comparison of the Trainees' Scores after 3 Days of Training and 30 Days after Training

The scores of the COVID-19 protection theory test after 30 days of training nurses were 95.67 ± 5.89 , which were significantly higher than those after 3 days

Table 2. Comparison of the scores of the COVID-19 protection theory test of nurses in the isolation ward before and after training ($\bar{x} \pm s$).

Category	Number of people	Score after 3 days of training	Score after 30 days of training	t value	P value
Training nurses	60	81.17 \pm 8.46	95.67 \pm 5.89	-9.027	<0.001
Former isolation ward nurses	29	81.59 \pm 7.59			
t value		-0.233			
P value		0.82			

of training ($P < 0.01$), as shown in **Table 2**.

4.3. Comparison of Hand Hygiene Compliance and Pass Rate of Putting on and Taking off Protective Clothing for Nurses before the Training and 3 Days after the Training

Before the training, the compliance rate of hand hygiene and the pass rate of putting on and taking off protective clothing were both low, at 81.67% and 56.67%, respectively. After the training, the compliance rate of hand hygiene and a pass rate of putting on and taking off protective clothing were significantly improved, reaching 96.67% and 100% respectively, and there were significant differences compared with the rates before training ($P < 0.05$, $P < 0.001$), see **Table 3**.

4.4. Comparison of Nursing Work Quality in Isolation Wards

The qualified rate of disinfection and quarantine for trained nurses working in the isolation ward for one month was 89.47%, which was not significantly different from that (94.7%) in a random month for nurses originally in the isolation ward ($P > 0.05$). The comprehensive bedside nursing ability [4] score of the trained nurses was 80.14 ± 5.63 , which was lower than that of the nurses originally in the isolation ward, which was 86.88 ± 4.53 ($P < 0.05$). See **Table 4** for details.

5. Discussion

5.1. The Development of a Systematic Training Program Is the Basis for a Good Training Effect

In regards to this study, the training time was short, and the nurses came from various departments of the hospital; the seniority of the nurses ranged from 0 to 6 years, and none of them had work experience in isolation wards. Therefore, the training operation was difficult. Considering this, we have repeatedly contemplated the training program in terms of training content, methods and channels, regarded the training plan for all employees of the hospital as the basis and finally formed a systematic training program. In addition, we did a pre-training test by taking the training firstly for 3 days according to the set SOP and found that the hand hygiene compliance of the trained nurses and the pass rate of

Table 3. Comparison of hand hygiene compliance and pass rate of putting on and taking off protective clothing before and after training [n = 60, % (case)].

Category	Hand hygiene compliance rate	Pass rate of putting on and taking off protective clothing
Before training	81.67 (49)	56.67 (34)
3 days after training	96.67 (58)	100 (60)
χ^2	6.98	33.19
<i>P</i>	0.008	<0.001

Table 4. Comparison of nursing work quality in isolation wards.

Category	Qualified rate of disinfection and quarantine (%)	Comprehensive bedside nursing ability score (points, $\bar{x} \pm s$)
Trained nurses (n = 30)	89.47 (68/76)	80.14 \pm 5.63
Former isolation ward nurses (n = 29)	94.7 (72/76)	86.88 \pm 4.53
χ^2/t	1.45	1.98
<i>P</i>	>0.05	<0.05

putting on and taking off protective clothing were significantly improved compared with those before the training ($P < 0.05$, $P < 0.001$). However, there was no significant difference between the scores of the COVID-19 protection theory test for the trainees and the scores for the nurses originally in the isolation ward ($P > 0.05$). On the fourth day, nurses were trained to directly enter the isolation ward to work, successfully replacing the work of the entire batch of nursing staff originally in the isolation ward, reducing the pressure on the hospital to build further isolation wards. One month later, through the quality control inspection data of the Nursing Department, the qualified rate of disinfection and quarantine management of the trained nurses in the isolation ward was 89.47%, and there was no significant difference compared with the nurses originally in the isolation ward ($P > 0.05$); no adverse events occurred, and the nurses were capable of working in isolation wards. However, the comprehensive nursing ability score at the bedside of the trained nurses was lower than that of the nurses originally in the isolation ward ($P < 0.05$), which was related to the lack of specialized nursing experience of the trained nurses entering the isolation ward for the first time. It is believed that through continuous training and supervision in the later period, it can be gradually improved.

5.2. Update of Training Materials in Time to Ensure the Accuracy of Training

With the development of the COVID-19 pandemic, the treatment plan and protection standards are constantly updated. Combined with the practical expe-

rience of the current isolation ward and the actual situation of the hospital, the training content should be updated in real-time, adjusted, and distributed in time to ensure that the training content is “taught correctly, learned in standard, and utilized properly”. In this study, theoretical training was carried out through the Internet using WeChat groups and multimedia video teaching, etc., so that the trainees could quickly comprehend the theoretical knowledge of COVID-19 prevention and control. After 3 days of training, the theoretical test score was 81.17 ± 8.46 , which presented no significant difference compared with that of the nurses who originally worked in the isolation ward ($P > 0.05$). At the same time, the key and updated knowledge points were highlighted through the designated program of “One Post Per Day”, which made the training more convenient, efficient, and effective. It allowed the trained nurses to master theoretical knowledge more accurately. The theoretical test score of the trained nurses on COVID-19 prevention and control was 95.67 ± 5.89 after 30 days of training, which was significantly higher than that after 3 days of training ($P < 0.01$).

5.3. Unified and Standardized Training Methods Are the Guarantee of Good Training Results

On-site teaching in isolation wards can enable medical staff to standardize protective operations and improve the correct rate of operation in clinical practice, so that medical staff can deeply appreciate the importance of correctly putting on and taking off protective clothing, and require themselves more rigorously [5]. This training was carried out in the newly built isolation ward, and it adopted a training form dominated by site-based and standardized training, supplemented by various online and offline learning forms. The SOP was formulated before training, and the training was carried out in accordance with the standard operating procedures and requirements of systematic training. At the same time, the training adopted the forms of communication and interaction, out-station assessment, online test, evaluation, and feedback, etc. These flexible forms were combined with the test assessment form, so as to rapidly improve the hand hygiene compliance of the trainees and the pass rate of putting on and taking off protective clothing, allowing the trained nurses to comprehend a number of specialized technical operations, and deepening the trainees’ understanding and mastery of the COVID-19 prevention and control content and workflow. There was no significant difference in the qualified rate of disinfection and quarantine practices between the trained nurses working in the isolation ward in the first month and that of the nurses originally in the isolation ward ($P > 0.05$).

5.4. Continuous Training Supervision to Consolidate the Mastery of Training Content

After the intensive training, we continued to repeatedly post knowledge points every day, discuss and study problems in the workgroup, combine the theory with practice, and use video monitoring to supervise the implementation of

nursing standards, so as to promote nurses' comprehension of the training content. It can significantly improve the training effect and further deepen the nurses' grasp of COVID-19 prevention and control content at different levels. Although the comprehensive nursing ability score at the bedside of the trained nurses in the first month was lower than that of the nurses originally in the non-severe isolation ward, there were no adverse events and they were competent for nursing work in the isolation ward. However, it can also be seen that continuous training and supervision should preferably be carried out continuously, and the supervision should last for more than one month. Nan *et al.* also proposed that the learning curve showed a continuous upward trend with the increase in the number of operations [5].

COVID-19 is an acute respiratory disease with strong infectivity, rapid infection spread, and a wide contagious range. How to accurately and quickly convey epidemic-related professional knowledge and nursing response plans to nurses who have never entered the isolation ward is a major challenge facing healthcare organizations. Through systematic pre-job training in isolation wards, our hospital enabled nurses to quickly familiarize themselves with the environment, adapt to the transformation of equipment and processes, master the current pandemic prevention and control information, effectively prevent and control, and truly achieve the goal of "winning the battle of zero infection".

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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