Journal of Clinical and Nursing Research, 2024, Volume 8, Issue 6
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Application Effect of Feedforward Control in Outpatient Blood Specimen Management

Meiying Lu*

Guigang City People's Hospital, Guigang 537100, Guangxi Province, China

***Corresponding author:** Meiying Lu, ll452961@163.com

Abstract: *Objective:* To analyze the application effect of feedforward control in outpatient blood specimen management. *Methods:* 1,200 patients who had their venous blood collected in outpatient phlebotomy room of our hospital's outpatient clinic from January 2021 to April 2021 were selected as study subjects and divided into 600 cases in the control group and 600 cases in the observation group. The two groups of patients were compared in terms of their satisfaction with the staff, the efficiency of the nurses and the quality of nursing care, turnaround time before specimen analysis, the rejection rate of the blood specimens, and the time of result reporting. *Results:* After the implementation of feedforward control, patients' satisfaction with staff, nurses' work efficiency and quality of care, turnaround time before specimen analysis, specimen rejection rate, and result reporting time in the observation group were significantly higher than those in the control group ($P < 0.05$). *Conclusion:* The application of feedforward control in the management of outpatient blood specimens has significant effect, which effectively improves patients' satisfaction, enhances the efficiency of nurses and the quality of nursing care, shortens the turnaround time of specimens before analysis and the reporting time of results, and reduces the rejection rate of specimens.

Keywords: Feedforward control; Venous blood specimen; Nursing management; Application effect

Online publication: July 18, 2024

1. Introduction

Test quality is the lifeline of the laboratory, the quality control of specimens before test analysis is the primary link of test quality, the correct specification of blood specimen collection and timely delivery is the premise and basis of test quality assurance; relevant studies at home and abroad have shown that the cause of errors in test results is largely related to the poor quality of the specimens [1-3]. This paper explores the application value of feedforward control in the management of outpatient blood specimens, improves patient satisfaction, and achieves good research results.

2. Information and methods

2.1. Clinical data

In this study, 1,200 cases from the outpatient clinic in our hospital from January to April 2021 were selected as

the study subjects. 600 patients who had their blood collected in the outpatient clinic in January and February 2021 were the control group, with 302 males and 298 females and an age range of 54.37 ± 9.97 years old; 600 patients who had their blood collected in the outpatient clinic in March and April 2021 were the observation group, with 305 males and 295 females and an age range of 55.64 ± 10.03 years old.

Inclusion criteria: (1) Patients' visiting card information was complete, including name, gender, ID number, telephone number, address; (2) Patients and their families were aware of the study and signed the informed consent form. Exclusion criteria: (1) Presence of serious comorbidities or end-stage diseases; (2) Presence of infectious diseases; (3) Poor compliance and unable to cooperate with the study. The difference between the general information of the two groups was not statistically significant ($P > 0.05$) and was comparable, as shown in **Table 1**.

Table 1. Comparison of the general information of the two groups of patients

Indicators		Control group (n = 600)	Observation group (n = 600)	t/χ^2	P
Age [mean ± standard deviation (SD), years]		55.45 ± 8.30	52.64 ± 10.13	0.887	0.376
Gender	Male	302	305	0.030	0.862
	Female	298	295		
Academic qualifications	Junior high school and below	217	215	0.879	0.831
	High school or junior college	165	159		
	University and above	207	218		
	Postgraduate and above	11	8		
Number of phlebotomy	For the first time	224	239	0.791	0.374
	Two or more times	376	361		

2.2. Intervention methods

The control group implemented routine management: Nurses provided verification and general behavioral guidance to patients requiring blood collection. The observation group adopted feedforward control for the management of outpatient blood specimens, the specific methods are as follows.

2.2.1. Establishment of a special management team for feedforward control

The core members consisted of the director of the laboratory department, the head nurse of the phlebotomy room, and the head of the specimen team, each of whom was composed of one member. Among them, the feedforward control group of the nursing team was headed by the head nurse of the phlebotomy room, with four nursing cadres as team members. The specimen testing quality control team of the laboratory technician group was led by the director of the laboratory department, with the quality manager, technical manager, and leaders of various specialty groups serving as team members.

2.2.2. Formulation of standards and methods for feedforward control

The management stage before control included formulating the standard blood specimen collection process, standardizing specimen collection behavior, implementing various rules and regulations, and providing business training and safety awareness education for phlebotomy nurses. The management stage during control included assigning fixed personnel for specimen reception and transportation, and stipulating specimen transport time according to different types of specimens. The management stage after control included establishing a quality

monitoring and early warning system for blood specimen management in outpatient clinics (patient satisfaction, nursing efficiency and quality of care, turnaround time before specimen analysis, specimen rejection rate, and result reporting time).

2.2.3. Feedforward control of interdisciplinary teamwork

(1) Nursing team interventions

(a) Patient health education: According to the patient's medical order form, nurses verbally informed the patient in advance of the relevant precautions before the examination and the reason for phlebotomy, so that he or she can actively cooperate. Nurses informed the patients about the time of fasting; to quit smoking and drinking 3 days before blood collection, and avoid running, cycling, climbing stairs, and other strenuous exercise before blood collection. Those who check blood lipids were fasting for 10 to 12 hours.

(b) Phlebotomy standards of nursing staff: (i) Strict aseptic technique was used, and povidone-iodine was applied for disinfection and allowed to dry before the puncture was performed. (ii) Repeated punctures at the same site were avoided if no blood was obtained on the first attempt to prevent blood cell damage. (iii) The tourniquet was not applied for too long or too tightly; the compression time was kept under 30 seconds. (iv) Blood was not drawn from the patient's arm, and the arm was not tapped. (v) When multiple tubes of blood were being collected, attention was paid to the order of collection (blood culture bottle - anticoagulant tube - non-anticoagulant tube). If there was no blood culture bottle, the order of blue tube - red tube - green tube - purple tube - gray tube (yellow tube) was followed. (vi) After blood collection, the blood was slowly injected into the test tube along the tube wall, avoiding forceful injection. The anticoagulant tube was gently shaken after collection to ensure the anticoagulant was thoroughly mixed with the blood [2,3].

(2) Test specimen group team interventions

The collection, storage, classification, and reception of specimens were standardized. This included the verification of test names, the selection of appropriate sample tubes, the checking of barcode labels for accuracy, the ensuring that the blood volume meets requirements, the inspection for hemolysis or coagulation in the blood, and the proper storage of blood specimens. Additionally, each blood specimen was scanned into the system for record-keeping.

(3) Testing technician team interventions

The leader of the specimen testing quality control team played a leading role, collaborating with team members to establish standards for the blood specimen testing process, various regulations, and conducted technical training and safety awareness education for laboratory technicians to standardize specimen testing practices. Blood specimen quality was assessed using a flow cytometer (Shanghai Sanwei Medical Equipment, Registration No. 20172402482, Model FACSVia), with results recorded.

2.3. Evaluation methods

Through the outpatient blood specimen management quality monitoring and early warning system, including patient satisfaction, nursing staff's efficiency and quality of care, turnaround time before specimen analysis, specimen rejection rate, and result reporting time. The scheme was as follows: (1) Patient satisfaction was reflected in the waiting time of patients, the service attitude of nurses, blood drawing techniques, and the reporting time of results [4,5]. (2) Random tracking was taken to calculate the waiting time t for blood collection of n patients, and then calculate the average value as the waiting time for blood collection [6], waiting time = total

waiting time for blood collection of outpatients during the investigation period/total number of investigations. Through quality control management, the average waiting time for patients had been reduced from 24.2 minutes to 7.7 minutes. Effective management of waiting times for blood sampling can therefore significantly improve patients' timely consultation rates and satisfaction levels, as well as accelerate patient turnover [7].

2.4. Evaluation indicators

Statistical comparison of the two groups of patient satisfaction, nurse work efficiency, and the reporting time of the results.

2.5. Statistical methods

SPSS21.0 statistical software was used to analyze the data. The count data was expressed as rate, and the comparison between groups was made by *t*-test of independent samples, and the difference was considered statistically significant with $P < 0.05$.

3. Results

3.1. Comparison of waiting time for venous blood collection and specimen transport time between the two groups

The time used by the observation group was less than that used by the control group, and the difference was statistically significant with $P < 0.05$, as shown in **Table 2**.

Table 2. Comparison of waiting time for intravenous blood collection and specimen transport time between the two groups (mean ± SD)

Groups	Number of cases	Waiting time (min)	Transport time (min)
Control group	600	24.2 ± 3	6.52 ± 1.73
Observation group	600	20.7 ± 3	5.89 ± 1.73
t	-	3.36	-2.427
P	-	0.038	0.016

3.2. Comparison of the number of phlebotomy and specimen qualification of venous blood collection in the two groups

The number of successful blood collection with one shot and qualified specimens in the observation group were higher than that of the control group, and the difference was statistically significant with $P < 0.05$, as shown in **Table 3**.

Table 3. Comparison of the number of successful blood collection with one shot and qualified blood specimens in the two groups (mean ± SD)

Groups	Number of cases	Successful blood collection with one shot (cases)	Qualified specimen (cases)
Control group	600	568	558
Observation group	600	588	586
t	-	9.437	14.685
P	-	0.002	< 0.001

3.3. Comparison of the turnaround time before specimen analysis and result reporting time of the two groups

The time used in the observation group was less than that used in the control group, and the difference was statistically significant at $P < 0.05$, as shown in **Table 4**.

Table 4. Comparison of turnaround time before specimen analysis and result reporting time between the two groups (mean ± SD)

Groups		Number of cases	Turnaround time before specimen analysis (min)	Results reporting time (min)
Chemiluminescence group	Control group	600	47.91 ± 9.60	91.93 ± 14.57
	Observation group	600	36.82 ± 6.47	77.25 ± 9.55
	t	-	7.42	6.533
	P	-	< 0.001	< 0.001
Biochemical group	Control group	600	35.89 ± 12.38	92.65 ± 18.07
	Observation group	600	20.07 ± 5.32	71.87 ± 12.68
	t	-	9.122	7.269
	P	-	< 0.001	< 0.001

3.4. Comparison of nursing satisfaction of phlebotomy in the two groups

The nursing satisfaction of the observation group was significantly higher than that of the control group ($P < 0.05$), as shown in **Table 5**.

Table 5. Comparison of the number of satisfied cases of phlebotomy in the two groups (mean ± SD)

Groups	Number of cases	Patient satisfaction (cases)	Standardized phlebotomy techniques	Qualified specimen (cases)
Control group	600	566	568	558
Observation group	600	592	588	586
χ^2	-	16.679	9.437	14.685
P	-	< 0.001	0.002	< 0.001

4. Discussion

The collection, transfer, and transport of venous blood specimens are multi-step, systematic, and related to blood collection nurses, specimen transporters, and test technicians [8], accurate and effective test results are controlled by the three stages of pre-analysis, analysis, and post-analysis, respectively [9,10].

4.1. The implementation of feedforward control can effectively improve the number of qualified blood specimens

The results of this study showed that the observation group had a significantly higher blood sample qualification rate after standardizing nurse venous blood collection compared to the control group ($P < 0.05$); and the observation group had significantly lower waiting time and blood specimen transport time than that of the control group, ($P < 0.05$). This shows that the management effect of outpatients' blood specimens with feedforward

control is significant, suggesting that the reason for the increase in the rejection rate of outpatients' blood specimens is related to the neglect or lack of standardized collection of blood specimens by some nursing staff, especially in the higher incidence of new nurses and recruits. In order to further standardize the various operations of nurses' blood collection in addition to the establishment of a training group, it is also important to optimize the configuration of nursing positions during the peak period of blood sampling, using a combination of experienced nurses with less experienced ones, timely technical guidance is provided to newly assigned nurses who are unfamiliar with the procedures, helping them become proficient in blood drawing processes and operations.

4.2. Management of feedforward control can promote multi-team cooperation

Our hospital shortens the specimen transport time by standardizing the nurses' blood sample collection time, adjusting the specimen transport and delivery process, increasing the delivery manpower and sampling frequency. In this paper, the turnaround time of chemiluminescence and biochemistry groups' test items was taken as the statistical target, and the statistical results showed that the turnaround time of the specimen of the chemiluminescence group after the use of the feedforward control management was in the range of 39.24 ± 11.87 minutes, and the result reporting time was in the range of 84.40 ± 20.19 minutes. The turnaround time of specimens in the biochemistry group was 24.48 ± 12.49 minutes, and the reporting time of results was 80.18 ± 24.57 minutes, which shortened the time of specimen delivery and facilitated reporting of test results.

5. Conclusion

To sum up, actively carrying out feedforward control management is the premise and foundation of test quality assurance, which is of great significance for improving the qualified rate of blood specimens and enhancing patient satisfaction.

Disclosure statement

The author declares no conflict of interest.

References

[1] Shi Y, Ma Z, Cui W, et al., 2018, Comparative Analysis of Epidermal Growth Factor Receptor Gene Mutation Detection in Lung Adenocarcinoma Biopsy Tissue, Pleural Fluid and Blood. Chinese Journal of Pathology, 47(10): 775–779.

[2] Tang H, Wang H, Wu Y, et al., 2020, Application and Effect Analysis of FMEA in Outpatient Blood Specimen Collection. Hospital Management Forum, 37(6): 80–82 + 69.

[3] Chen Y, 2017, The Effect of Feedforward Control of Nursing Staff on the Quality of Blood Specimens. Journal of Nurse Advancement, 32(11): 996–998.

[4] Chai XB, Zhou YJ, Xu T, et al., 2017, Research on the Application of ROBO System in Laboratory Pre-Test Quality Management. International Journal of Laboratory Medicine, 38(22): 3214–3215.

[5] Liu X, 2020, Study on the PDCA Cycle Method to Improve the Timely Rate of Emergency Biochemical Test Result Return. China Health Standard Management, 11(7): 126–127.

[6] Yu C, Ma Y, Xiang X, et al., 2019, Application Effect of Quality Control Circle in Shortening Waiting Time for Venous Blood Collection of Outpatients. Contemporary Nurses (Lower Decade), 26(04): 174–176.

[7] Xing L, 2015, Application Analysis of Quality Nursing Service in Outpatient Phlebotomy Room. Continuing Medical

Education, 29(8): 166–167.

[8] Han L, Lu P, Cai W, et al., 2018, Closed-Loop Management of Intravenous Blood Specimens. Journal of Nursing, (7): 60–62.

[9] Zhang Y, 2017, Effectiveness of Feed-Forward Control Intervention in Improving the Quality of Blood Specimens. Medical equipment, 30(24): 190–191.

[10] Chen J, Wang L, Chang L, et al., 2019, Evaluation of the Performance of Two Chemiluminescence Reagents for the Detection of HBsAg in Blood Screening. Chinese Journal of Blood Transfusion, 32(1): 30–34.