

# Research on the Reform and Development of Hospital Clinical Medical Engineer's Career under the New Situation

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**Abstract:** Objective To explore the practical effect and value of the career reform and development of clinical medical engineers in hospitals. Methods A hospital in Xi'an reformed the career development of clinical medical engineers, allowing clinical medical engineers to deeply participate in the whole process management of medical equipment, and forming an in-depth communication and cooperation relationship with clinical departments. The management effects of clinical medical engineers before and after the reform were compared. Results Through the reform of the career of clinical medical engineers, the satisfaction of clinical departments with newly purchased medical equipment and the satisfaction of clinical departments with the services of clinical engineers have significantly improved ( $t=-5.028$ ,  $T=-5.432$ ;  $P<0.001$ ), the satisfaction of clinical departments with timely maintenance of medical equipment increased ( $t=-2.130$ ;  $P < 0.05$ ). After the reform, the number of articles published in Chinese journals, the number of articles published in English journals and the number of applications for scientific research projects have significantly increased, with the growth rate reaching 47.8% , 57.1% and 50.0%, respectively. Conclusions The hospital has achieved remarkable results in the career reform and development of clinical medical engineers, which is of demonstrative significance for the exploration of the career development of clinical medical engineers.

**Keywords:** Clinical medical engineers, Career reform, Medical equipment, Scientific research.

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## 1. Introduction

In recent years, with the development of medical technology and people's attention to life and health, the scale of hospitals is getting bigger and bigger, and medical equipment is becoming more and more high-end and sophisticated. More and more diseases with potential microscopic lesions can be discovered in advance through medical equipment[1]. How to manage so many high-end and sophisticated medical equipment to maximize the use value of medical equipment is a difficult problem in front of hospital managers.

Under the new situation, clinical medical engineers should be the core of hospital equipment management and technical personnel. They have rich knowledge and experience in medical equipment and consumables. Meanwhile, they always pay attention to the latest development of global medical equipment and international frontier medical and industrial crossover research[2]. They also have a global clinical engineering vision and can play an important role in the management of medical equipment in hospitals. The medical equipment management department of a hospital in Xi'an has actively explored and reformed the work function of clinical medical engineers. This study conducted a comparative study on the management effect of clinical medical engineers before and after the reform, in order to verify the value and demonstration significance of the work function reform of clinical medical engineers.

## 2. Research Materials and Methods

### 2.1. Research Materials

Clinical medical engineers in medical equipment management department of a hospital in Xi'an were selected as the research objects. The inclusion criteria were as follows : (1) the engineers had been working in hospital for more than 5 years; (2) the professional titles were junior and intermediate engineers; (3) the engineers should be under the age of 40. Exclusion criteria were : (1) the degree of the engineer was below bachelor's degree; (2) the engineer was on vacation; (3) The engineer had some physical diseases. According to inclusion and exclusion criteria, a total of 16 clinical medical engineers were included in the study.

### 2.2. Research Methods

The management staff of medical equipment management department of a hospital in Xi'an determined the following ten aspects of the job responsibilities of clinical medical engineers after a year of preliminary research.

1) Suggestions on regional configuration planning of large medical equipment

Equipment level of large medical equipment on behalf of the health level of a region. However, large-scale medical equipment should be rationally distributed from a regional or even national perspective to avoid vicious competition among medical institutions and waste of medical resources[3]. At present, the purchase of large-scale medical equipment in China is subject to the examination and approval system of the National Health Commission and provincial health administration departments. Therefore, it is a research

direction for clinical medical engineers to obtain the most reasonable allocation planning suggestions from the population density, number of health institutions, regional disease distribution, local medical level and other factors through scientific calculation methods.

2) Functional area planning and design for new hospital construction

With the development of economy and the improvement of medical level, people's demand for health is strengthening, and the construction of new hospitals and new areas of existing hospitals is constantly carried out. Therefore, the rational layout of functional areas in the new hospital or new hospital area is an important issue affecting the future development of the hospital. Clinical medical engineers should be able to provide comprehensive planning and design suggestions for functional areas from the aspects of medical convenience, safety, sensory control requirements and future development of the hospital through continuous summary and research[4].

Medical equipment selection and optimal configuration

In the medical equipment bidding procurement process of the past, as the use of personnel, doctors and nurses only consider what kind of medical equipment is needed from the user's perspective. However, only from the user's perspective to choose to buy medical equipment is often not the most appropriate, there will be a variety of problems, such as after-sales service is not timely, the failure rate is too high, the price of equipment accessories is too high, and so on. Clinical medical engineers should be able to give comprehensive advice on the selection and optimal configuration of medical equipment from various aspects such as price, quality, after-sales service, convenience of use, accuracy of diagnostic results, and acceptance of patients.

4) Cost-benefit analysis of medical equipment

Clinical medical engineers should be able to analyze the benefits of various departments and the cost benefits of various medical devices by obtaining the income, original value, various expenditures and start-up time of various medical devices, so as to provide important data support for the later equipment purchase demonstration and the construction and development of various departments in the hospital[5].

5) Adverse event monitoring of medical devices

The causes of medical equipment adverse events are as follows: (1) the quality of medical equipment itself leads to sudden failures in the operation of the equipment; (2) mechanical and circuit fatigue occurs due to long-term fatigue operation of medical equipment, such as speed change, core component shift, brightness change, power failure, communication failure, etc.; (3) accidental system errors occur in medical equipment; (4) misoperation by staff; (5) Equipment accessories fall off, leak, failure, etc.; (6) Sudden power failure, water cut off, gas cut off, etc. (7) The dumping or falling of medical equipment causes harm to patients; (8) Adverse events accidentally caused by other medical devices. Adverse event monitoring of medical equipment is an important work related to hospital medical health safety[6]. Clinical medical engineers should have the ability to monitor adverse events of medical equipment, summarize the causes of adverse events, and give reasonable equipment configuration and department management suggestions.

6) Radiation management of large medical equipment

The clinical medical engineers should be able to regularly test the safety and stability of radiological devices in large

medical facilities, perform parameter correction and maintenance, and supervise radiation protection during examination and treatment. In radiation management, engineers should contact relevant institutions every year to test the radiation areas that can produce radiation, evaluate the radiation safety and protection status, and give reasonable rectification suggestions from the professional perspective of radiology protection for the areas that fail to meet the radiation detection standards.

7) Preventive maintenance and breakdown repair of medical equipment.

Preventive maintenance and failure repair of medical equipment are the basic skills that clinical medical engineers should possess. The preventive maintenance of medical equipment can eliminate safety hidden danger in time, reduce the security risks brought by a unexpected accident, improve medical equipment on time effectively and reduce the maintenance cost. Clinical medical engineers should be trained by equipment manufacturers and have the ability to carry out preventive maintenance and fault repair of medical equipment combined with their own professional knowledge and skills[7].

8) Manage the whole process of medical equipment from procurement to scrap

Clinical medical engineers should be able to master the whole process of management from medical equipment procurement to scrap. They should also be familiar with every link of operation and matters needing attention, strictly abide by the rules and regulations and related laws and regulations. Engineers can provide professional answers and support to clinical departments when they encounter problems in each link of medical equipment management, so as to ensure that all procedures of equipment management are legal and compliant.

9) Measurement and quality control of medical equipment

Compulsory measurement of medical equipment is an important means to ensure the accuracy of each parameter of medical equipment and ensure medical safety. Compulsory measurement and testing of medical equipment is an important work content of clinical medical engineers[8]. Clinical medical engineers should establish measurement files for all medical equipment requiring compulsory measurement and testing to ensure that all equipment requiring measurement can obtain timely measurement and testing. At the same time, clinical medical engineers should be able to master the quality control methods of various medical equipment, and carry out quality control and parameter calibration of medical equipment with the help of various quality control instruments.

10) Carry out scientific research jointly with clinical departments

Clinical medical engineers should have the interdisciplinary scientific research ability of medicine and engineering. They could comprehensively apply the knowledge of physics, mathematics, chemistry, materials science, biology and computer science in their professional knowledge. They could also solve clinical problems with engineering thinking, and cooperate with clinicians to carry out scientific research. For example, radiomics research is very popular in recent years. By obtaining a part of the image data of tumor patients, clinical medical engineers can use computer algorithms to extract features from the regions of interest in the images to establish a model, and finally verify the model, which can be used to assist doctors to predict the

benign and malignant, staging, prognosis, molecular typing of tumors[9].

## 2.3. Observation Indicators

### 2.3.1. Satisfaction Questionnaire

Before the job function reform of clinical medical engineers and one year after the implementation of the function reform, 50 medical staff were randomly selected from clinical departments to conduct questionnaire surveys on the job satisfaction of medical equipment management, including the satisfaction with the use of newly purchased medical equipment, the satisfaction with the services of clinical medical engineers, and the satisfaction with timely maintenance of medical equipment.

### 2.3.2. Statistics of Scientific Research Achievements

One year after the implementation of career reform, a statistical analysis was conducted on the scientific research achievements of the enrolled engineers in the hospital, and a comparison was made with the scientific research achievements of the year before the reform, including the number of articles published in Chinese journals, the number of articles published in English journals and the number of applications for scientific research projects.

## 2.4. Statistical Analysis

SPSS18.0 software was used for statistical analysis of the data obtained in 2.3.1. The satisfaction data were quantitative data and analyzed by t test.  $P < 0.05$  indicated that the statistical data had statistical significance, and  $P < 0.001$  indicated that the statistical data had very significant statistical significance. The growth rate is used to represent the statistical changes of scientific research achievements in 2.3.2.

## 3. Results

### 3.1. Survey Results

The satisfaction survey results of clinical departments before and after the career reform of clinical medical engineers are shown in Table 1. It can be concluded from Table 1 that through the career reform of clinical medical engineers, the satisfaction of clinical departments with newly purchased medical equipment and the satisfaction of clinical departments with the services of clinical engineers have significantly improved ( $t = -5.028, t = -5.432; P < 0.001$ ), the satisfaction of clinical departments with timely maintenance of medical equipment increased ( $t = -2.130; P < 0.05$ ).

**Table 1.** Satisfaction Survey results of Clinical Departments before and after career reform of clinical medical engineers (Score,  $\bar{x} \pm s$ )

Group	Satisfaction with the use of newly purchased medical equipment	Satisfaction with timely maintenance of medical equipment	Satisfaction with the services of clinical medical engineers
Before	86.63±4.43	85.43±4.67	85.89±3.73
After	90.79±3.82	87.09±2.89	89.88±3.62
t	-5.028	-2.130	-5.432
P	0.000	0.036	0.000

### 3.2. Statistical Analysis of Scientific Research Achievements

The statistical analysis results of scientific research results in 1 year before and after the career reform of clinical medical engineers are shown in Table 2. It can be concluded from

Table 2 that, after the career reform of clinical medical engineers, in the medical equipment management department, the number of articles published in Chinese journals, the number of articles published in English journals and the number of applications for scientific research projects have significantly increased, with the growth rate reaching 47.8%, 57.1% and 50.0%, respectively.

**Table 2.** Statistical analysis and comparison of scientific research results of clinical medical engineers within one year before and after the career reform

Group	Number of articles published in Chinese journals	Number of articles published in English journals	Number of applications for scientific research projects
Before	23	7	2
After	34	11	3
Growth rate	47.8%	57.1%	50.0%

## 4. Discussion

Clinical medical engineers is a modern hospital medical equipment management and technical personnel, in most of China's hospital, clinical medical engineers education level is low, many engineers are not in biomedical engineering, lead to clinical medicine professional skills enough reserves, clinical medical engineers main job duty is mainly manifested in the maintenance of medical equipment, and some other complicated and routine work. There are not enough prospects for career development, so many engineers do not have enough motivation to further learn and innovate in their work.

In recent years, the Ministry of Education of China has called for the construction of new engineering talent system and vigorously promoted interdisciplinary talent training. As the source of clinical medical engineers, biomedical engineering is a typical comprehensive discipline of engineering and medicine, which is the key point of new engineering construction[10]. At the same time, large hospitals in China are in need of senior talents. In recent years, the educational level of the staff recruited has been increasing year by year. The educational level of clinical medical engineers is generally at the bachelor's or even master's level, and these engineers have high professional level and certain

scientific research ability. These conditions provide important support for the career reform and development of clinical medical engineering in hospitals.

The administrator of a hospital in Xi'an attaches great importance to the career development of clinical medical engineers. After long-term communication and research, ten directions of the career reform and development of clinical medical engineers have been explored, leading the career reform and development direction of clinical medical engineering. In this study, in the statistical analysis of the satisfaction questionnaire survey, clinical medical engineers made reasonable suggestions on the procurement selection and optimal configuration of medical equipment in clinical departments through the comparison of medical equipment survey, so that the clinical departments purchased the most appropriate medical equipment, and the satisfaction of clinical departments with the newly purchased medical equipment was significantly improved. At the same time, as clinical medical engineers are deeply involved in all aspects of medical equipment management related to clinical department management, the use effect and management quality of medical equipment in clinical departments are improved, so the satisfaction of clinical departments with the services of clinical engineers have significantly improved. In the aspect of medical equipment maintenance and fault repair, the technical level of medical equipment maintenance has been improved and the timeliness of medical equipment maintenance and fault treatment has been improved due to the emphasis on self-learning of basic professional knowledge and the strengthening of technical training of clinical medical engineers by manufacturers. Therefore, the satisfaction of clinical departments with timely maintenance of medical equipment increased. In the statistical analysis of scientific research results, as clinical medical engineers use multidisciplinary knowledge and to carry out scientific research with medical staff of clinical departments, their medical engineering thinking is formed and their scientific research thinking is cultivated in the process, the number of articles published in Chinese journals, the number of articles published in English journals and number of applications for scientific research projects increased significantly.

## 5. Conclusions

To sum up, a hospital in Xi'an has carried out an innovative reform on the career development of clinical medical engineers. After the reform, engineers have been deeply involved in the whole process management of medical equipment and formed an in-depth communication and cooperation relationship with clinical departments. As a result, the satisfaction of clinical departments with newly purchased medical equipment, the satisfaction of clinical departments with timely maintenance of medical equipment and the satisfaction of clinical departments with the services of

clinical engineers increased to varying degrees. Meanwhile, the number of articles published in Chinese journals, the number of articles published in English journals and number of applications for scientific research projects of clinical medical engineers in medical equipment management department of the hospital have increased significantly in a year. The hospital has achieved remarkable results in the career reform and development of clinical medical engineers, which has a demonstration significance for the career development exploration of clinical medical engineers.

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