The application of specialised management assistants in demand forecasting of human resources

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ABSTRACT

Objective: Based on a theoretical analysis and through working practice, this paper presents the experience of the scientific use of the manpower demand prediction method and practical process of specialised business assistants in clinical departments.

Methods: A spot observation, interview and public information inquiry were conducted, and SPSS20.0 Chinese software was used to make a statistical prediction of the business growth (P < 0.05).

Results: The specialist management assistant prepared the manpower needs assessment report for the department, and the hospital organization personnel department adopted the recommendation in the manpower needs assessment report and put it into the hospital's recruitment plan for the following year.

Conclusion: The blood purification centre of specialised business assistants in patients in the medical market, service people, workload and equipment operation efficiency analysis data analysis. It was found that an effective prediction model that supports decisions regarding the hospital's scientific allocation of human resources is advantageous to the hospital's human resource optimisation, improves both operation equipment efficiency and patient satisfaction and is worthy of application and popularisation.

1. Introduction

The challenges that public hospitals face in terms of human resources are diverse and related to the economic and medical levels of the region.

The Ethiopian government needs to loosen the regulations, give hospitals more autonomy and implement mechanisms that emphasise the quality of the health services rather than the quantity of human resources that are supplied [1]. The effectiveness of human resource management (HRM) is of particular interest for hospitals in Sub-Saharan Africa [2]. To optimise resource allocation, improve resource utilisation efficiency and maximise resource benefits, many consortia and corporate hospitals in Taiwan learnt how to improve the operation and management of hospitals from enterprise management concepts and methods, which is an effective way to improve hospital operation performance. As one of the effective management modes of fine management in modern hospitals, specialist management assistants are an effective management method to improve hospital labour productivity and maximise resource efficiency in foreign hospital management practice. Sichuan West China Hospital was the first hospital in China to learn from Taiwan Chang Gung Memorial Hospital's enterprise management theory and method and set up a professional management post named ‘specialised management assistant’ (hereinafter referred to as specialised assistant), which is highly praised by the hospital management field both at home and abroad [3]. Moreover, foreign countries have set up professional operation management positions [4, 5, 6]. Through the practice and exploration of HRM by our specialised management assistants, we have gradually formed a model to improve business using management tools and methods to consider multiple dimensions of a market analysis, equipment utilisation rate, economic efficiency and patient satisfaction to improve business with reasonable human resources and management innovation [7, 8, 9].

Under China's existing public hospital management system, how to successfully introduce the post function of the specialised management...
assistant and give full play to the role of a specialised management assistant in connecting hospitals and departments are still in the exploratory stage. Optimising medical processes and improving the utilisation efficiency of medical resources and the social and economic benefits of hospitals remains a challenge. The following is an example of the practice of human resources demand forecasting in the blood purification centre (hereinafter referred to as the centre) to demonstrate the experience of the specialised management assistant of the centre in the scientific use of human resources demand forecasting methods and practice process in clinical departments.

2. Materials and methods

2.1. Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki and approved by the ethics committee of Baogang Hospital.

2.1.1. Basic information about the centre

2.1.1.1. Personnel. The centre is equipped with two doctors and 17 nurses, with an average age of 37.4 years old. All of them have a bachelor's degree and reasonable professional title structure. Four of them are part-time or other.

2.1.1.2. Assets. The fixed assets of this centre are nearly more than 30 million yuan, with a housing area of more than 1,400 square meters. This is divided into the general dialysis area and dialysis room for hepatitis C and hepatitis B patients from the structural-functional area, with staff, patients, dirt, logistics and emergency access. There are 55 dialysis beds, 50 dialysis machines, six hemofiltration machines and two advanced bipolar reverse osmosis water treatment machines. This means that 60-80 beds of hemodialysis machines can be used at the same time, as well as other emergency equipment.

2.1.1.3. Medical technology. The centre is affiliated with the Department of Urology, and the technical items that are carried out include hemodialysis, hemodialysis filtration, hemoperfusion, heparin-free dialysis, simple ultrafiltration, ascites re-transfusion and other blood purification items. Additionally, temporary vascular access, permanent vascular access and arteriovenous endovascular fistula can be carried out here. Meanwhile, as a training unit in the region, its medical technology level, nursing level and medical safety quality are guaranteed.

2.1.1.4. Patient group. Kidney transplantation has obvious advantages in the region. At present, the total number of patients with chronic renal failure or organ transplantation diseases in the hospital is 270, and the number of patients who can be admitted for hemodialysis treatment is 200.

2.1.1.5. Business situation. The centre is open 5.5 days per week from 07:30 to 18:30 and includes two shifts of dialysis patients. Regarding the patient demand, the service volume in 2018 was the fastest-growing year in recent years.

2.1.2. Industry development

In February 2009, Changzheng Hospital added a fourth shift in the second half of the night to the traditional three shifts of hemodialysis service and introduced night dialysis from 22:00 to 06:00, thus becoming the only hemodialysis centre in China that provided 24-hour service at that time [4]. In the context of the national advocacy of public health services and the policy support for medical reform, to meet the needs of more patients, more hospitals nationwide are now offering 24-hour dialysis services, which can exchange time for space. The three-shift mode and 24-hour services aim to meet the differentiated needs of work and certain patients to a greater extent, and the two service modes solve the contradiction between patients working in the daytime and dialysis [5].

Hospital A is a 3A general hospital in this city, and the hemodialysis unit in the nephrology department operates in four shifts. The routine three shifts operate between 07:30 and 21:00, and the additional fourth shift has been operational for nearly a year. With an average dialysis duration of 2 h, the cost remains the same, and the number of patients is low and kept within 20 due to multiple factors.

2.1.3. Investigation method

Interview and information queries are common research methods [1,2] that are used to collect more comprehensive information. On-site visits, interviews and public information query. Information, including that relating to personnel, assets, equipment and the patient volume of each hospital, can be obtained through on-site visits. In the interviews, the hospital leader was asked about the development of the department and the growth of business volume in recent years. Through public information inquiries, we can calculate the number of hospitals that can carry out hemodialysis and the shift system of each hospital. All participants signed an informed consent form for inclusion in the study.

2.1.4. Statistical analysis

This study used SPSS 20.0 for data processing, and a regression analysis was used to predict the business growth statistics, with $P < 0.05$ being statistically significant.

3. Results

3.1. General information

After the field survey, the known data was analysed using the data table comparative analysis method, and the specific information is shown in Table 1. The results show that 10 hospitals can carry out dialysis, including eight public hospitals and two non-public hospitals. There are 339 sets of equipment in the city (the number of conventional beds and dialysis equipment is the same). The number of dialysis patients in the city is approximately 920. At present, A hospital is carrying out the three-shift mode. The hospitals that are carrying out dialysis were assigned using the empirical method (the hospitals were assigned using the empirical analysis method, and the results were considered comprehensively along with high reliability). The results showed that the top three competitiveness values were Hospital A, Hospital B and another hospital. The top three service efficiency values were Hospital A, another hospital and Hospital I.

3.2. Expected workload

The expected hemodialysis workload of a tertiary hospital is based on the historical base period data of the two shifts from 2013 to 2018. Through relevant prediction methods, it was predicted that the three shifts can serve 306 patients, and the number of service visits is projected to be 44,352, which is an increase of 7,939 visits compared with the previous year (the two shifts), with a growth rate of 21.8%. The three shifts can be realised by increasing the number of staff to meet the demand of patients.

3.2.1. Forecast of two shifts in 2019

A hospital had two shifts. The working hours were from 07:30 to 16:30, with 200 patients and 19 staff. The ratio of patients to nurses was 0.31. According to the known conditions, the linear regression method was used to study, and SPSS 20.0 was used to predict the total number of people served by the centre from 2013 to 2018 during these two shifts. The results show that $R = 0.901$, which is close to 1, and the model is established. $P = 0.004$, $P < 0.05$, the model is significant, as shown in Figure 1.
According to the linear regression model, under the known conditions, it can be predicted that the annual number of people who are served by the centre in the two shifts in 2020 will be 36,570, which is an increase of 157 people compared with 2018, with an increase rate of 4.3%. Through the fitting value, the most important influencing factor is the high flux hemodialysis project from 2016 to 2018, with an average growth of 223% over the past three years. As an abnormal value, it has become a key factor in the growth of department business.

With the current two-shift service mode, under the condition of constant human resource allocation, work efficiency, working hours and equipment investment (i.e. the three growth modes), the business growth rate has slowed down to 4.3%, which is far lower than the average growth rate of 8.99% over the past six years. It is likely that the 5% business growth target issued by the hospital in 2019 will not be achieved. Therefore, to accelerate business growth, the input of human resources elements is required, including increasing the number of staff, opening the three-shift service mode and choosing to exchange the input of human resources for business improvement space, which has become a sufficient and necessary condition for the development of hospitals and departments.

### 3.2.2. Forecast of three shifts in 2019

The number of patients and nursing staff as the key variables of three shifts can be controlled by linear regression curves, and the number of

**Table 1. Analysis of dialysis hospitals.**

| No. | Name       | Grade          | Dialysis equipment | Number of patients | Maximum daily reception | Competitive value | Outstanding characteristics                                                                 | Number of patients received in three shifts by single machine |
|-----|------------|----------------|-------------------|--------------------|------------------------|-------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| 1   | Hospital A | Grade III A    | 55                | 200                | 165                    | 9                 | 17 nurses, 2 doctors, outstanding medical quality and comprehensive technical                  | 3.6                                                           |
| 2   | Hospital B | Grade III A    | 39                | 260                | 156                    | 9                 | 26 nurses, 5 doctors, 3 shifts, add 4th shift, expansion contract has been publicized [6]       | 6.7                                                           |
| 3   | Hospital C | Grade III A    | 57                | 150                | 168                    | 9                 | Preemptive, policy support [7]                                                                | 2.7                                                           |
| 4   | Hospital D | Grade III A    | 30                | 50                 | 90                     | 6                 | Cooperation with Taipei Show Chwan Hospital, regular guidance                                  | 1.7                                                           |
| 5   | Hospital E | Grade III A    | 25                | 30                 | 75                     | 5                 | Less patients, more room for growth                                                            | 1.2                                                           |
| 6   | Hospital F | Grade III A    | 39                | 80                 | 117                    | 8                 | Expansion completed, high motivation                                                           | 2.1                                                           |
| 7   | Hospital G | Grade III A    | 27                | 40                 | 81                     | 8                 | Obvious advantages of hospital and department growth                                           | 1.5                                                           |
| 8   | Hospital H | Grade III A    | 10                | 20                 | 30                     | 5                 | Newly constructed building, sufficient funds and high potential                                | 2.0                                                           |
| 9   | Hospital I | Grade III A    | 50                | 60                 | 150                    | 6                 | Expansion completed, diverse marketing methods, strong competitiveness, lowest cost, and greatest efforts to obtain external support | 1.2                                                           |

Note: Maximum reception/day = dialysis equipment * 3 shifts; A hospital has four shifts.

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**Figure 1.** Regression model of “two shifts a day” in blood purification center.
doctors and technicians of three shifts as the number of necessary increases and indirect factors are not controlled. Therefore, the comparison chart of the trend of nursing manpower investment and the number of patients to be served must be constructed first, as shown in Table 2 and Figure 2 (through data calculation, the error is ±5, and the error rate is 5.88%).

According to the prediction of the number of patients in three shifts in 2019, the total demand for dialysis service in 2019 is calculated as follows: 308 people * 3 times/week * 4 weeks * 12 months = 44,352 people (Note: remove the abnormal influencing factors and ensure the quality of medical care. The average dialysis time is 3 times a week.)

### 3.2.3. Business growth with the three-shift service model

The results of this study ([44,352 visits – 36,413 visits]/36,413 visits = 21.8%) meet the business growth needs and other requirements. See Table 3 for details. By adding 13 staff, the workload is relatively reduced, which is conducive to part-time staff starting work, service volume improvement, amortised cost reduction and medical quality and safety.

### 3.2.4. Prediction of business income of three shifts

Taking the number of service people as the independent variable and the income as the dependent variable, using SPSS 20.0 software to do the linear regression analysis and inferring the income from the number of service people in 2019, the results show that $R^2 = 0.999$, and the regression equation is $P < 0.05$ (see Table 4 for details). This indicates that the regression equation is meaningful, and the representative reaches 99.9%. According to the statistical results, the regression equation is as follows: income = $489,561 \times$ number of people, and the income in 2019 was 21,713,099 Yuan.

### 3.3. Cost comparison

Data system retrieval combined with the data provided by the cost of each department of the hospital and edited with EXCLE shows that the direct cost method was used to apportion the direct data costs of the logistics and administrative departments. The annual service volumes of the hemodialysis centre and all medical staff were used as the apportionment factors. As the full-cost items were complicated, we referred to the measurement method of West China Hospital, which operates scientific management, and used the scientific model Equipment Economic Operation Benefit Analysis (Report) and Equipment Cost Data Analysis (Table) as the algorithm form of the equipment cost for the specialist management assistant. Among them, Equipment Cost Data Analysis (Table) records in detail the equipment use, operating and labour costs, medical equipment fees and overhead costs to measure the total costs, net income and single equipment use. Equipment Economic Operation Benefit Analysis (Report) can conduct scientific measurements from the equipment return on investment cycle, financial security analysis and return on investment.

#### 3.3.1. Comparison table of shift personnel cost and average service cost

The specialised management assistant scientifically uses Equipment Economic Operation Benefit Analysis (Report) and Equipment Cost Data Analysis (Table) as the algorithm form of the equipment cost. Taking the monthly average full-cost wage of 9,815 in a 3A hospital as a constant, the amortisation of fixed assets and equipment costs and other indirect costs will gradually reduce with the increase in service volume. The hemodialysis machine has a 5-year depreciation period, and the service cost comparison table is obtained. See Table 5 for details.

#### 3.3.2. Shift comparison table

The comparison table of the two and three shifts is shown in Table 6. From the perspective of staffing and economic management, a 3A hospital should choose a moderate degree of three shifts, as this forecast is better.

### 4. Discussion

As the economy develops, people's awareness of health has greatly improved. With the continuous improvement of national medical insurance policies and implementation of medical reform policies, such as a performance appraisal of three-level public hospitals, the operation and management levels of hospitals has created a challenge [10, 11, 12, 13]. As the representative of heavy asset management, many famous hospitals abroad have professional operation and management positions [14, 15, 16]. Previously, some scholars have conducted relevant research on hospital operation management [17, 18, 19, 20]. The specialist operation assistant regularly analyses the daily operation data of the department, investigates the operation problems, assists the communication between the department and various functional departments and builds a bridge between the hospital and the department. This makes it easier for the needs of the department to be solved on time. The establishment of specialised operation assistants has changed the original extensive management mode. A fine operation analysis optimises the allocation of department manpower, equipment, beds and other resources to maximise the utilisation efficiency of limited resources and meet the requirements of modern hospital management. The specialist operation assistant management system has significantly improved the operation efficiency of hospitals. In addition to improving the volume of medical services, it improves the operation efficiency and benefits of departments and ensures the benign and sustainable development of the departments through measures such as strengthening cost control and performance distribution reform. However, there are also some problems in the operation assistant management system. For example, the assistant lacks clinical professional knowledge of the corresponding department, and it is difficult to put forward professional guidance on a department's clinical development and technology and scientific research innovation, which needs to be improved in the future. With the continuous deepening of the medical reform and requirements of establishing a modern hospital management system, the role of an operation assistant in hospital fine management will become increasingly important. By analysing the operation data of clinical departments, the operation assistant excavates the problems related to cost control, resource allocation, process management and the technology development and solves them on time to comprehensively improve the fine management level of hospitals and departments.

### Table 2. Positive correlation between shift and the number of patients served.

| No. | Dialysis beds | Number of shifts | Number of nurses | Number of doctors | Number of technicians | Number of patients | Working time Documentation requirements [4] |
|-----|---------------|-----------------|------------------|-------------------|----------------------|-------------------|--------------------------------------------|
| 1   | 55            | one shift       | 10               | 2                 | Part-time            | 100               | 7:30–12:30, 5 h                           |
| 2   | 55            | two shift       | 17               | 2                 | Part-time            | 200               | 7:30–18:30, 11 h                          |
| 3   | 55            | three shift     | 28               | 3                 | 1                    | 300               | 7:00–23:00, 16 h                          |

Note: the number of patients served is based on two shifts. Under the same external conditions such as sufficient dialysis beds and patients, the Basic Standard for Hemodialysis (Trial) and the Management Standard of Blood Centre (Trial) [8] require that the number of beds in the department has a positive correlation with nurses, doctors and technicians. Staffing and predicting the number of patients by equivalence method.
In this study, the practice of human resources demand forecasting in our hospital’s centre was used as an example to show the experience of the specialist management assistant in the scientific use of human resources demand forecasting methods and practice processes in clinical departments through on-site visits, interviews and public information queries. Business growth statistics forecast was conducted using SPSS 20.0. Based on the results of the study, a human resources needs assessment report was prepared, and recommendations for the human resources needs assessment report were adopted by the hospital organisation and personnel department and included in the hospital recruitment plan for the coming year. Therefore, the effective prediction model obtained in this study supports the scientific allocation of human resources in hospitals, which is conducive to the optimisation of human resources in hospitals and improvement of the efficiency of operating equipment.

4.1. Strengths and limitations of this study

There are several advantages of this study. First, this study used on-site squatting, interviews and public information queries. Therefore, detailed information was collected, and the results obtained using different methods were verified with each other to eliminate illogical error information. Second, through scientific forecasting, the centre found that ‘three shifts a day’ could be carried out with additional staff, which not only improved social benefits by satisfying the needs of patients but also reduced costs and improved operational efficiency and patient satisfaction. Third, at present, dozens of tertiary public hospitals in China have set up a new position of specialist operation assistant. The results of this study will help to establish a model for more large public hospitals to manage their operations in a way that is both in public interest and efficient.

There are several limitations of this study. First, only a data analysis was conducted in this study, and no questionnaire projects were designed in which patients and medical staff participated. Second, the personal capacity of the office staff through increased overtime, night shift and overtime allowances were not considered in this study. Third, the investigation unit of this study was only the centre, and a follow-up study of multiple blood purification centres is still needed. Further limitations

| No. | Number of staff | Number of patients | Number of patients served per capita | Bed to nurse ratio |
|-----|----------------|-------------------|-------------------------------------|-------------------|
| 1   | A Three shifts | 31                | 260                                 | 8.4               | 0.67               |
| 2   | *Grade III A Hospital Two shifts | 19          | 200                                 | 10.5              | 0.31               |
| 3   | *Grade III A Hospital Three shifts | 32          | 308                                 | 9.6               | 0.51               |

Table 3. Staff shift load.

| Model | Standardized coefficients | T     | Significance |
|-------|---------------------------|-------|--------------|
| 1     | Beta                      |       |              |
|       | Number of people          | .158  | .882         |

Table 4. Projected revenue of three shifts operations.

Table 5. Comparison of shift staffing costs and average service costs.
include human resource considerations, such as a lack of counsellors and security personnel.

**Declarations**

**Author contribution statement**

Shuai Wang: Conceived and designed the experiments.
Lingfeng Wang: Conceived and designed the experiments.
Dai Liu: Performed the experiments.
Yan Xin: Performed the experiments.
Guixia Sun: Analyzed and interpreted the data.
Yanyan Wang: Analyzed and interpreted the data.
Jingyu Wang; Li Ping: Contributed reagents, materials, analysis tools or data.

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**Data availability statement**

Data included in article/supp. material/referenced in article.

**Declaration of interest's statement**

The authors declare no competing interests.

**Additional information**

No additional information is available for this paper.

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**References**

[1] P.P. Gile, J. van de Klundert, M. Buljac-Samardzic, Human resource management in Ethiopian public hospitals, BMC Health Serv. Res. 22 (1) (2022) 763.