

Original Article

Application of big data technology in community-based integrated medical and elder care for elderly patients with chronic diseases

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Abstract: Objective: We aimed to investigate the application value of big data technology in community-based integrated medical and elder care for elderly patients with chronic diseases. Methods: Big data technology was introduced on October 2018 for integrated medical treatment and elderly patient care in the community, and a comparative analysis was conducted between 2017 and 2018. Results: The incidence rates of name error and quantity error in the data management in 2017 were higher than those in 2018 (both $P < 0.001$), and the incidence of untimely data entry (data entry that was too early or too late) was also higher in 2017 than in 2018 (both $P < 0.01$). Conclusion: The application of big data technology in community-based integrated medical treatment and elderly patients care with chronic conditions can markedly increase the management efficiency and improve the care of senior patients service. Also, this technology can help to reduce the error rate in data management, improve the quality of senior patient rehabilitation and healthcare as well as home-based smart services, and reduce the incidence of potential adverse events throughout the whole process of this integrated care in a significant way.

Keywords: Big data technology, grassroots community, management of elderly patients with chronic conditions, application value

Introduction

Since the population in China has been increasingly aging, the number of elderly patients with chronic diseases has also been increasing in this nation [1]. As a result, there is now an urgent grassroots need in the community to determine how to standardize the management of these patients, how to use advanced science and technology to improve the combined medical treatment and elderly care services, and how to enhance the management of the senior community service center in order to ensure safe and reliable medical care for the elderly.

In the traditional management of the care for older patients with chronic conditions, large amounts of complex data needs to be input to the computer manually, which can result in frequent occurrence of errors, including errors in the names and quantities and untimely data entry. These issues can cause large a workload and low work efficiency and keep the managers

from accurately tracking and managing the elderly patients [2, 3]. Therefore, it is essential to find ways to improve the integrated medical and elderly care services in the community, which can help to maintain the health of the patients, ensure their medication safety, and improve the equalization of basic public health services in China. Some literature has documented that the application of big data technology can effectively prevent the mistakes made in the community-based integrated medical and elderly care and in management of the community senior service center for elderly patients with chronic diseases. However, most of these studies mainly focused on the use method of the big data technology rather than the actual effects of this technology on the management of the elderly patients in a grassroots community [4].

Therefore, in order to explore the application value of big data technology in community-based integrated medical and elder care for the

elderly patients with chronic diseases, we conducted a quantitative comparative analysis of the quality of the combined care and management in the community senior service center in 2017 and 2018.

Materials and methods

General information

A quantitative comparative analysis was performed on the quality of a community-based integrated medical and elderly care regime and the management of the community senior service center for elderly patients with chronic conditions in 2017 and 2018. The frequency of data input in the care management was more than 200 times each day.

Methods

The statistical data was divided into two stages. The data in the first stage was from January 2017 to December 2017, and the data in the second stage was from October 2018 to October 2019. The occurrence of data errors, the timeliness of the data entry, and the incidence of potential adverse events in the integrated care and in the management of the community senior service center were analyzed and compared between the two stages.

During the data management in the first stage, the managers collected information from the elderly patients in the community using a household survey or they obtained the information from the medical institutions. The information was then checked and filled into the records sheets by the managers, followed by manual entry into the computer [5, 6].

During the second stage, big data technology was introduced, of which the Internet Plus was the hardware part. Internet Plus in our study covered not only the big data resource sharing platforms in various institutions but also included the networks formed by wearable medical devices, remote video monitoring systems, and other intelligent information means (i.e. remote webcam, smartwatch, remote sphygmomanometer, remote blood glucose meter, and remote electrocardiographic monitoring instrument). The technology can promote a seamless connection between the patients and medical staff and improve the humanization and timeliness of the medical services. During this stage, patients could enjoy the convenience brought

by the internet, as they could make an appointment, have an online consultation or teleconsultation, and purchase medicine by calling a hotline or using a website, mobile application, or social media without leaving home. The staff members were trained, and a standard and unified database for these elderly patients in the community was established. The information of the elderly patients was entered into the database, and changes in their living conditions and physical conditions were input in a timely manner [7, 8]. In addition, the big data technology provided the elderly patients with a fast avenue for treatment, so as to fully meet the needs of these patients.

Outcome measures

In this study, we conducted direct observation and retrospective analysis to analyze the incidence of data errors, the timeliness of data entry, and the number of potential adverse events in the combined medical and elderly care services and in the management of the community senior service center for elderly patients with chronic conditions.

The data errors included name error and quantity error, which were made by the managers when entering the information to the computer. Time error referred to untimely data entry (data entry that was more than one hour early or late) by the managers in response to an event. All errors were reviewed by the managers to assess whether the error was associated with a potential adverse event. According to the WHO definition, a potential adverse event could be induced by a critical error that may harm the patients, but that error was finally intercepted due to various reasons [9].

Patient satisfaction with management quality was also assessed. Patients received a questionnaire from the community leader and were asked to score the management quality of the managers at the end of each work period. The results were summarized at the end of 2018. A score of 80-100 points indicated high satisfaction; a score of 60-79 points indicated satisfaction; a score of 0-59 points indicated dissatisfaction. Overall satisfaction rate = (number of high satisfaction + number of satisfaction)/total number of cases * 100% [10].

The community leader also evaluated the management quality of the managers at the end of work, and the results were summarized at the

Table 1. General information of the managers ($\bar{x} \pm sd, n$)

	Gender (male/female)	Age (year)	Working period (year)
First stage (n = 30)	20/10	20.93±3.24	8.92±9.91
Second stage (n = 30)	19/11	21.26±3.87	8.73±9.20
t/ χ^2	0.370	1.527	0.134
P	0.847	0.663	0.894

Table 2. Incidence rates of the data errors (n (%))

	First stage	Secondstage	χ^2	P
Time of data entry	6723	7318		
Name error	6 (0.09%)	0 (0)	4.611	<0.001
Quantity error	15 (0.22%)	0 (0)	16.345	<0.001

Table 3. Timeliness of data entry in the management (n (%))

	First stage	Second stage	χ^2	P
Times of data entry	6723	7318		
Data entry that was too early	56 (0.83%)	33 (0.45%)	8.119	0.004
Data entry that was too late	363 (5.40%)	324 (4.43%)	7.113	0.008

Table 4. Incidence of potential adverse events (n (%))

	Times of management	Potential adverse events
First stage	6723	35 (0.52%)
Second stage	7318	3 (0.04%)
χ^2		29.862
P		<0.001

end of 2018. The management was rated as excellent if an event was managed accurately and quickly; the management was rated as good if an event was managed accurately but not quickly (for example, the community residents needed to wait in line for the service); the management was rated as poor if errors occurred in the management with an error rate over 5% and the management process was slow [11]. Overall good management rate = (number of excellent management + number of good management)/total number of cases * 100% [10].

Statistical analysis

Statistical software SPSS 22.0 (IBM, USA) was applied for data analysis. The normality test was performed for the measurement data, and

the data that was normally distributed is presented as mean \pm standard deviation. Comparison between the two groups was performed by t-test. Count data are expressed as number or percentage and were examined by chi-square test. $P < 0.05$ indicated a statistically significant difference.

Results

General information of the managers in the two stages

In order to ensure the accuracy of our study results, basic information of the managers including gender, age, and working period was first compared between the two stages, and no intergroup differences were found (all $P > 0.05$). See **Table 1**.

Error rates in the data management in the two stages

After introducing big data technology in the second stage, the incidence rates of the name error and quantity error made by the managers decreased significantly compared to those in the first stage (both $P < 0.001$). See **Table 2**.

Timeliness of data entry in the two stages

After using big data technology, the data entry became timelier in the combined medical and elderly care and in the management of the community senior service center (both $P < 0.01$). See **Table 3**.

Potential adverse events in the two stages

Compared to the first stage, the incidence of potential adverse events was much lower in the second stage ($P < 0.001$). See **Table 4**.

Patient satisfaction with the management in the two stages

The patient overall satisfaction with the management by the thirty managers in the first stage was lower than that in the second stage (63.33% vs. 90.00%, $P < 0.05$). See **Table 5**.

Table 5. Patient satisfaction with the management (n (%))

	High satisfaction	Satisfaction	Dissatisfaction	Overall satisfaction rate
First stage (manager n = 30)	15	4	11	19 (63.33%)
Second stage (manager n = 30)	25	2	3	27 (90.00%)
χ^2				5.960
P				<0.05

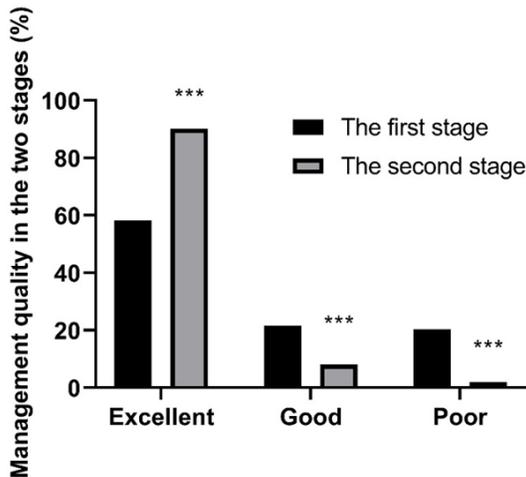


Figure 1. The management quality compared with the first stage, ***P<0.001.

Management quality in the two stages

The overall good management rate in the second stage was higher than that in the first stage (98.14% vs. 79.75%, $\chi^2 = 83.424$, P<0.001). See **Figure 1**.

Discussion

Although China has been strengthening the training of nurses specialized in elderly care service, statistics show that there is still a serious shortage of nursing staff for the elderly patients, and the professional skills of the nurses needs to be improved [12]. Meanwhile, the community-based combined medical and elderly care and the service in the community senior service center are key components in elderly care management in a grassroots community. We checked some previous studies and found that the application of big data technology may directly affect the community-based integrated medical and elderly care and the management of community senior service centers for the elderly patients with chronic diseases [13]. The rational use of big data technology can help to improve the health care manage-

ment of elderly patients, ensure the personal safety of the patients, and improve the integrated care and the management of community senior service centers.

In the present study, we found that the introduction of big data technology could lower the error rates in the data management. The incidence of data errors made by the managers was reduced to 0, and the incidence rate of the potential adverse events was reduced to 0.04%. Moreover, big data technology could improve the timeliness of data entry. Before introducing big data technology, all information had to be entered manually, and data entry was often delayed, which could prevent the medical staff from obtaining the health information of the elderly patients in a timely manner [14]. Some studies revealed that the data entered in the big data systems could help the managers to obtain accurate and objective information, which contributed to the quality of the subsequent management [15]. In this study, we found that after using big data technology, the recording of the information of the elderly patients became timelier, and the traceability of these patients was improved, which ensured overall benefits of the community, patients, and medical institutions. Also, big data technology could effectively reduce the incidence of potential adverse events. During daily work, even though most of the potential adverse events can be prevented, a small number of potential adverse events may still occur, and some of them are caused by unavoidable factors. Hou et al. reported that the use of big data technology can prevent human errors to the greatest extent [16]. When big data technology was not used, the managers needed to manually enter the treatment records of the patients from the patients' records, which could be a challenging task. It has been reported that extra manpower and time are often needed for checking the entered information multiple times in order to avoid errors in the entry of medical orders, clinically [17]. In this study, we found that the use of

big data technology could reduce the occurrence of potential adverse events caused by errors made in manual entry and reduce the workload and time of checking by the managers [18, 19]. After using big data management tools, the patient satisfaction rate also increased. The application of big data technology is not only conducive to the data analysis in the subsequent stage of the management but also helps to ensure task implementation in the community.

In conclusion, the application of big data technology can make essential contributions to the proper management of the care of elderly patients with chronic diseases [20]. Big data technology can greatly improve the work efficiency and reduce the workload of the managers. By uploading the information of the patients to the big data network system, patient care can be tracked and managed throughout the whole process, which can effectively improve the combined medical and elder care for elderly patients with chronic diseases and improve the management efficiency of the community senior service centers [21, 22]. However, there were still some limitations in the study since we only investigated the error rate, timeliness of the data entry, and incidence of potential adverse events. Therefore, more studies need to be conducted in the future for a more thorough investigation of the application value of big data technology.

Disclosure of conflict of interest

None.

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Application of big data in integrated medical and elderly patient care

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