

RESEARCH ARTICLE

Implementing caregiver management measures in general hospitals to prevent the COVID-19 pandemic

Xiaoman Zhang¹  | Wei Wang¹ | Xiaojing Zhao¹ | Haihui Cheng¹ | Yang Song¹ | Xinhong Song²

¹Department of Cardiology, Shandong Provincial Hospital Affiliated to Shandong First Medical University, Shandong, China

²Property Supervision and Management Office of Provincial Hospital Affiliated to Shandong First Medical University, Jinan, China

Correspondence

Xinhong Song, Property Supervision and Management Office of Provincial Hospital Affiliated to Shandong First Medical University, Jinan, China.

Email: xinhong6812@163.com

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Abstract

Aim: To summarize the whole process management measures for caregivers of inpatients in a non-new coronavirus pneumonia designated hospital in China during the novel coronavirus pneumonia epidemic. The implementation of these measures is mainly to prevent the virus pandemic caused by crowd gathering.

Design: A quasi-experimental study.

Methods: Novel coronavirus pneumonia prevention and control measures were implemented in the 'pre-hospital link, hospitalization link and discharge link' for the whole process of the hospitalized patients' caregivers. To evaluate the effects by time point inspection, the results were fed back using information technology for quality improvement.

Results: The results of three time point inspections indicated that the management quality of many projects improved continuously ($p < 0.05$). From January to June of 2021, 20 departments implemented a facial recognition information management system. The ratio of patients/caregivers admitted was 1:0.528~1:0.965; It was found that it is effective to implement the whole process management measures. The facial recognition system plays a key role in the comprehensive management of the caregivers.

KEYWORDS

2019 novel coronavirus, caregivers, facial recognition, general hospital, inpatients, whole process management

1 | INTRODUCTION

Since the end of December 2019, many cases of 'unknown fever with pneumonia' have occurred in Wuhan, Hubei Province, which were identified as pneumonia caused by 2019, novel coronavirus

infection through laboratory genetic testing and virus isolation (Liu & Liu, 2020). The National Health Committee named the infection novel coronavirus pneumonia (2019-nCoV) on February 8, 2020 (Chan et al., 2020; Li et al., 2020), identifying fever, fatigue, dry cough, a few with nasal obstruction, runny nose, sore throat

Xiaoman Zhang and Wei Wang are co-first authors. They contributed equally to this work.

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and diarrhoea as its symptoms (Huang et al., 2020; Wang, Tang, & Wei, 2020). The 2019-nCoV infection has strong interpersonal infectivity and is mainly transmitted by respiratory droplets or contact. It has been included in class B infectious diseases list under the People's Republic of China law on the prevention and control of infectious diseases, and is managed in accordance with class A infectious diseases (Jin., 2020). At present, 2019-nCoV has been highly valued by medical institutions and governments at all levels due to great urgency in preventing its spread and treatment (Wang, Horby, et al., 2020). The Omicron mutant strain that appeared in South Africa at the end of 2021 is spreading rapidly in more than 170 countries around the world with a super transmission power exceeding all previous mutant strains, and the world has ushered in the fifth wave of the new coronavirus Pneumonia (referred to as New Coronary Pneumonia) epidemic, the daily new confirmed cases exceeded 580,000 at the highest (WHO., 2022). From February 26 to 4 May 2022, a total of 54,886 local confirmed cases of new coronary pneumonia in China have exceeded the cumulative number of confirmed cases nationwide from the outbreak in Wuhan to the end of 2021. With the sharp increase in the number of infected people, the epidemic prevention strategies of various countries are facing unprecedented challenges. How to achieve a balance or even win-win in the prevention and control of the virus and the people's livelihood and economy is a major problem faced by all countries in the world. (Zhang et al., 2022).

The management and control of crowded public places are essential to prevent the spread of the novel coronavirus as it has high interpersonal transmissibility (Chen et al., 2020). There have been a number of family, ship, church, community, prison and even hospital cluster infection events at home and abroad during the pandemic, which raised several challenges for global health management (Phelan et al., 2020). A hospital is a high-risk area where people with confirmed or suspected novel coronavirus gather. Moreover, it is impossible to stop work or isolate hospital employees at home unlike some other industries due to the particularity of hospital work. So the only means of preventing spread is to take control measures such as 'limiting the number, limiting activities, limiting contact and maintaining distance'. As the number of inpatients and staff cannot be reduced in the daily operation of a hospital, caregivers have the characteristics of mobility and controlling their movement is the easiest breakthrough point for controlling the spread and reduce the aggregation. Therefore, it is necessary to carry out focused management of the caregivers. It is relatively easy to cancel visits as long as the system is clear and the mission is well done for hospitals. However, due to the need for informed consent, life care and psychological support, have caregivers around is essential for some patients. Nevertheless, caregivers can easily become a carrier and spreader of the virus, increasing the risk of cross infection if they travel between the society, family, ward and special examination departments frequently. Therefore, the management of caregivers is a systematic project that requires multi-department cooperation in order to control the number of caregivers from the source and reduce their

flow and aggregation by process reconstruction and guarantee support. It has very practical significance for the prevention and control of a hospital epidemic.

General specialty hospitals mainly adopt a bayonet management model to manage the accompanying staff, relying on the management of medical staff or auxiliary workers at the end, which increases the workload of nurses and reduces the effective nursing work time. Control measures specific to 2019-nCoV were implemented at the Shandong Provincial Hospital Affiliated to the Shandong University in the 'pre-hospital link, hospitalization link and discharge link' for the whole process of the hospitalized patients' caregivers to control their numbers from the source. The comprehensive management was carried out in caregivers of inpatients from the aspects of quantity control, risk screening, epidemic investigation and notification, double card management of 'ID card and companion card', auxiliary inspection and accompany inspection service, pre-examination and verification of medical insurance, etc. The time point inspection was implemented to evaluate the effects and the results were fed back by information means to promote the continuous improvement of quality.

The hospital in which the study was conducted was not a designated hospital for patients with new coronary pneumonia, so there were no patients with confirmed new coronary pneumonia in the research subjects. The implementation of comprehensive management for caregivers avoids the risk of infection caused by the gathering of people to a certain extent. The process of comprehensive management also included a face recognition system. The advantage of this system is that it can complete identity recognition without contacting the target. Currently, this system is widely used for hospital outpatient visits, fee payment, medical insurance reimbursement and other links. At present, the global epidemic is still developing. One of the main driving forces for the development of the epidemic is the gathering of people, the high frequency of people's movement and the wide range of movement.

Due to the mobility of inpatient caregivers, they should be the focus of nosocomial infection control. Therefore, it is necessary to take caregiver management measures during the critical period of the development of the epidemic to prevent the gathering of people in the hospital and reduce the risk of infection. Our hospital successfully reduced the flow and aggregation of caregivers from process reconstruction and support, so this paper presents the findings of our study for institutions interested in preventing the spread of 2019-nCoV.

2 | METHODS

2.1 | Research participants

From July 2020 to June 2021, we studied the caregivers in 65 wards of Shandong Provincial Hospital Affiliated to Shandong University. All participants were informed about the study and they agreed to participate in it.

2.2 | Management strategy

2.2.1 | Joint action of multiple departments to control the number of inpatients in the pre-hospital link

Control the number of inpatients based on protection requirements

The 2019-nCoV prevention and control office, medical department, nursing department, inpatient department, hospital sense office, medical insurance office and outpatient department issued a joint document setting down the inpatient admission criteria and caregiver management for COVID-19, and issued following relevant regulations: Identify patient hospitalization and surgical indications, and control the period of surgery and non-emergency patients appropriately according to changes in the status of the pandemic, based on the normal admission of emergency surgery patients and childbirth patients. According to the prevention and control requirements, the layout of the departments on site had to be surveyed, the beds had to be re-planned and the number of patients admitted were to be determined in order to ensure the safety of clinical personnel. The number of patients admitted in the non-critical medical area could not exceed two-thirds of the fixed number of beds in the room; at least one bed had to be reserved in each area. The patients were not assigned caregivers in principle, they were required to get the doctor's consent if they needed caregivers. All hospitalized patients were required to bring the electronic admission certificate issued by the doctor and provide complete personal information. After the information was entered, it could be queried on the HIS system so that facial recognition of the patient and the escort could be carried out.

Hospital entrance screening

An ID card access control system was installed at the outpatient entrance and emergency entrance. Patients and caregivers had to brush their ID cards for registration. Infrared temperature monitoring was carried out at all entrances, and the staff accompanied them to the hot clinic and register when the infrared temperature was greater than 37.3°C, while other caregivers were not be admitted to the hospital at the same time and wearing masks were mandatory. The staff checked the patient's health code, which is green under normal circumstances. The health code turns yellow or red if the patient has passed through a high-risk area in the past 14 days or is a suspicious close contact person. Based on health code assessment, we took measures to isolate relevant personnel and reported them to relevant departments as soon as possible.

Preparation for admission of patients' caregivers

Outpatient physicians conducted a comprehensive examination of the travel history, contact history and health status of the patients and caregivers who were going to be in the hospital according to the close contacts criteria, and made registration records carefully. We conducted educational sessions for patients with relevant risks and instructed them to isolate themselves. We posted educational materials at the admissions office and informed patients to reduce visits.

We also instructed patients about hand hygiene protocols and how to wear a mask correctly. We opened the windows at intervals to increase personnel distance and reduce personnel gathering. Once the patient and the accompanying staff completed the hospitalization procedures, their facial information was collected. Facial information collection can be collected in three ways: (1) For patients and companions with ID cards, self-service machines can be used for face recording through ID card reading + camera capture. (2) For patients and companions who do not carry an ID card, their identity can be checked through the ID photo or micro-police. (3) For children, elderly patients and accompanying persons who do not have an ID card, or cannot use self-service kiosks and mobile phones, application can be made through manual services. After the process is completed, the facial information of the patient and the accompanying staff is sent to the gate control platform, and the facial information of the control personnel is sent to the gate of the ward through the gate control platform and operations such as discharge deletion and deletion. After the facial information is sent to the turnstile, the face can be swiped at the ward building. During the hospitalization period, the number of people entering and leaving the ward every day, personal information, etc., can be monitored through the platform.

2.2.2 | Nurse-led management of the caregivers during hospitalization

Signed the 'Notification of Pneumonia Epidemic Investigation of New Coronavirus Infection'

The nurse responsible for the admitted patient checked their health code and collected the nucleic acid test results of the patient and companion within 48h. The admission procedure could be further processed only if the result was negative. In addition, we informed the patient that only one companion was allowed during admission, took temperature twice a day and checked the health code. The nurse was responsible for checking the travel history, contact history and health status of the caregivers according to the criteria for close contacts and guide them to fill out the 'Notification of Pneumonia Epidemic Investigation of New Coronavirus Infection', which was formulated by the hospital lawyer and multiple administrative departments. It had four parts: the introduction, basic information, questionnaire and signature confirmation. The introduction explained the legal obligations and responsibilities of the patients and caregivers during the epidemic prevention and control period, and requested for their cooperation. The basic information included name, ID number, home address, work unit and contact information; the questionnaire section had five questions with 'yes' or 'no' options that had to be answered truthfully: (1) Have you been in high-risk areas where cases continue to spread in the past 14 days? (2) Have you come into contact with patients with fever or respiratory symptoms such as cough from high-risk areas where the local cases continue to spread within the past 14 days? (3) Have you contacted returnees in areas where local cases have continued to spread? (4) Do you have any contact history with suspected or confirmed

patients with the new coronavirus infection in the past 14 days? (5) Have you had fever, cough, shortness of breath and asthma after mild activity within the past 14 days, or weak limbs, general weakness, muscle aches, headaches, diarrhoea, nausea, vomiting or any other symptoms? In the signature section the patient, caregivers and doctor signed and the time of signature was recorded.

Health education and personal protection on entering the department

The nurse instructed every new patient and their caregiver about the new coronavirus pneumonia prevention guidelines and various rules and regulations. The patient and caregivers were (1) Instructed to wash their hands properly, wear a mask and use paper towels or elbows to cover the nose when coughing or sneezing. (2) Asked to wear a mask at all times except meal times. (3) Asked to wash hands before, during and after preparing food, after coughing, going to the toilet, after touching a stranger's limb, after touching public goods and discarding a pollution mask. (4) Instructed to move in the ward as little as possible. It was forbidden to walk or gather and chat in the corridor, and a distance of at least one meter was to be maintained while talking to people. (5) Told to enhance physique by drinking water regularly, keeping warm and resting and enhancing nutrition. (6) Discard masks properly. Used masks had to be folded from the inside and dropped into designated garbage bags. (7) Cooperating with nurses to monitor body temperature was requested.

Management of identity cards and accompanying cards

The ward implemented strict 24h access control and did not allow visits. Each patient was allowed to stay with only one escort who was in a healthy and stable state. The head nurse issued the accompanying card that clearly indicated the caregiver's name and the ID card with the doctor's order. The caregivers could enter the ward with the accompanying card and ID card. The department had to register the entry and exit time of the accompanying person in the hospital accurately, and when the caregiver had to be replaced, the accompanying and ID card issued to the first caregiver were recovered and destroyed, and then replaced with new cards for the new caregiver. In addition, the caregivers were required to get two certificates issued while visiting the hospital restaurant and other areas. After the patient's 'accompany' medical order was stopped or they were discharged, the accompanying card was recovered and destroyed.

Temperature monitoring and risk screening

Infrared temperature monitoring was carried out when caregivers entered and exited the department. The temperature of the caregivers was routinely monitored at 7 am and 3 pm daily and reported by scanning the QR code. Accompanying caregivers who had fever and respiratory symptoms after admission, were led to the fever clinic by special medical staff. The caregivers who were suspected or diagnosed with new coronary pneumonia were isolated, followed by strict handling of the respiratory secretions, excreta, vomit and other treatment by a designated person who entered the quarantine area according to the specified normative route.

Special inspection for caregiver management

Patients requiring elective surgery needed to complete routine examinations, lung CT or DR examinations before admission. No abnormalities could be processed before admission, in order to reduce the time for special examinations in the hospital. Physicians minimized the need for unnecessary examinations and strictly followed standards. Special inspection appointments were automatically completed on the Internet. Tasks such as accompanying inspections and sending test specimens were completed by hospital field staff to reduce the frequent movement of accompanying staff in the hospital.

Dining management

The restaurant designated by the hospital provides food for patients and caregivers. The General Affairs Department designs QR codes for ordering meals according to the ward bed distribution. Ordered meals were sent to the ward by staff to prevent escort personnel from stepping out to buy meals and reduce the risk of cross-infection.

2.2.3 | Pre-discharge preparation for medical insurance

In order to avoid cross-infection, we implemented the advance planning of hospital service to simplify the reimbursement procedures for medical insurance patients. The doctor conducted a medical insurance pre-review in the patient's temporary medical order interface. If there were three special cases of 'patients with a single hospitalization of more than 100,000 yuan, patients admitted in 2019, discharged in 2020, and staying in the emergency department for a long period of time before the hospitalization, there are multiple days of emergency department observation expenses', the nurse contacted the medical insurance review window, and arranged an appointment with the review staff before letting the patient's accompanying staff handle it, to shorten the settlement period for the centralized payment of medical expenses during the review and reduce the gathering of accompanying staff.

2.2.4 | Observation of the effectiveness of the implementation of the caregiver management measures

The Nursing Department and the Hospital Infection Office organized personnel to set up an audit team, train spot observers and check the implementation of the management measures of the caregivers in each area of the hospital. The personnel were asked to analyse the reasons for the problems, provide feedback for improvement and supervise the office group. The scope of inspection included the inpatient ward, hospital entrance, elevator entrance, restaurant and other public areas. The management regulations for hospital-related caregivers were issued on February 3. We conducted three time-point observations in the first week, the second week and the fourth week after the implementation, and the observation time was 8:00-11:00 am and 14:00-16:00 pm. The audit contents are detailed in [Table 1](#).

TABLE 1 Management standards and audit methods for caregivers

Management standards	Audit method
24h access control in wards	View on site
No more than one patient caregiver	View on site
The medical record has a 'accompanied by caregiver' if there is a caregiver	View medical records
Implement the patient care management and visiting system strictly, and no visits during hospitalization	View on site
Inform caregivers about prevention and control and related legal responsibilities	Checking data
Temperature monitoring of caregivers	View history
Inspect the replacement caregivers thoroughly based on the close contact criteria	View medical records, interviews
Caregivers wear masks (ward, elevator and hospital entrance)	View on site
The caregivers did not go out to eat	View on site, interviews

2.2.5 | Using information technology to conduct quality feedback

The Office of 2019-nCoV Prevention and Control established corporate WeChat management office software. The health self-reporting platform was opened on the 'workbench' interface. Caregivers conducted daily health self-reports. We used the bedside interactive system to send new coronary pneumonia educational materials. Nurses reported patients with a temperature > 37.3°C daily on the information system, and strengthened the temperature monitoring of the caregivers. The department shared digital reports on the workload of the ward, number of caregivers and implementation of the management measures of the caregivers. The statistics of the nursing department were summarized to make improvements.

2.3 | Data collection methods

2.3.1 | Implementation of comprehensive management measures

The number of caregivers was aggregated from the digital report of the department, and the implementation of the management measures for the caregivers was aggregated from the audit data.

2.3.2 | Facial recognition information management system operating indicators

(1) The monthly number of patients admitted to the 20 departments that implemented the face recognition information management system is obtained by the HIS system; (2) The number of patients and caregivers registered for facial recognition, that is, number of recognized persons was extracted from the face recognition information management system; (3) The ratio of accompanying persons/patients admitted was calculated. The number of persons registered by facial recognition/the number of patients admitted.

2.4 | Study design and subjects

Our study used a quasi-experimental research method, taking the accompanying staff of inpatients in a general ward of a tertiary grade A general hospital in Shandong Province from June 2020 to July 2021 as the research object. Accompanying personnel in intensive care unit, operating room, emergency observation room, neonatal room, delivery room, isolation ward and other places are excluded.

2.5 | Statistical methods

The data were verified by two researchers, and the statistical analysis was performed using SPSS 18.0 software. Count data were described by frequency, composition ratio, etc., and analysed by a chi-square test. The measurement data were described by mean ± standard deviation, and R × C. The comparison of the data by the Pearson χ^2 test was performed at the test level of $\alpha = 0.05$, and $p < 0.05$ was considered statistically significant.

2.6 | Ethics approval

We obtained approval from the ethics committee of Shandong Provincial Affiliated to Shandong First Medical University (NO.2016-130). All participants gave informed consent to participate in this study.

3 | RESULTS

3.1 | Audit results of the implementation of management measures for inpatient caregivers

The results of three time point inspections indicated that the management quality of many projects improved continuously ($p < 0.05$), see [Table 2](#).

TABLE 2 Audit results of the implementation of management measures for inpatient caregivers

Item	1st	2st	3st	χ^2	p
	Qualified/Total	Qualified/Total	Qualified/Total		
No more than 1 patient caregiver	2913/3237(90.00%)	3010/3202(94.00%)	3615/3766(96.00%)	104.8	<0.001
The medical record has a 'leave a caregiver' if there is an caregiver	2484/3105(80.00%)	3081/3209(96.01%)	3145/3209(98.00%)	783.5	<0.001
No Visitors	2396/3237(74.02%)	2889/3209(90.03%)	3080/3209(95.98%)	719.1	<0.001
Notice signed by the replacement caregiver	2589/3135(82.58%)	2719/3126(86.98%)	3067/3130(97.99%)	408.7	<0.001
Routine body temperature and check the health code twice a day	2910/3105(93.72%)	3112/3200(71.00%)	3250/3256(99.82%)	202.7	<0.001
Caregivers wear masks(Ward entrance)	1738/3105(55.97%)	2272/3200(71.00%)	2926/3705(78.97%)	426.4	<0.001
Caregivers wear masks(Elevator entrance)	2912/3200(91.00%)	2980/3105(95.97%)	3678/3688(99.73%)	322.5	<0.001
Caregivers wear masks(Hospital entrance)	3040/3200(95.00%)	3011/3105(96.97%)	3660/3688(99.24%)	113.1	<0.001

TABLE 3 Operation status of face recognition information management system

Time	Number of patients admitted (No.)	Number of face recognition patients registered (No.)	Number of registered face recognition of caregivers (No.)	The ratio of the patient to the caregiver
Jan.	3031	1400	1600	1:0.528
Feb.	2017	1300	1946	1:0.965
Mar.	3363	1700	2600	1:0.773
Apr.	3303	1800	2699	1:0.817
May.	3159	1696	2539	1:0.804
Jun.	3119	1500	2300	1:0.737

3.2 | Operation status of face recognition information management system

From January to June 2021, 20 departments implemented a facial recognition information management system, and received 2017–3363 patients each month, of which 1300–1800 were registered for patient facial recognition, and 1600–2699 were registered for caregiver facial recognition. The ratio of the number of patients to the caregivers was 1:0.528–1:0.965, see [Table 3](#).

4 | DISCUSSION

4.1 | Whole-process management to ensure the implementation of novel coronavirus pneumonia prevention and control measures

In order to implement the routine epidemic prevention and control work of 'preventing the import from outside and the rebound from inside', 'Make the request, according to the State Council to deal with the new coronavirus pneumonia outbreak zone spreading mechanism on the new crown normalized pneumonia epidemic prevention and control work guidance of spirit and superior departments epidemic prevention and control command file requirements, the hospital should implement the preview and triage, monitoring, diagnosis, isolation, report and treatment work' (General Office of the National Health Commission., [2020](#)). Admission to discharge is a vertical

change process. Nurses are required to provide patients with comprehensive and professional quality nursing services. Under this concept, the management of patient caregivers should also run through the process. The pre-hospital session is one of the key steps in the management of the caregivers. Zhong Nanshan et al. pointed out that 43.8% of the patients had fever during admission, 67.8% had cough, 5.0% nausea or vomiting and 3.8% had diarrhoea. The proportion of non-fever patients with new coronary pneumonia is higher than those with SARS-CoV (1%) and MERS-CoV (2%) infections. Therefore, if we focus on detecting fever, patients who do not have fever may be missed (Guan & Zhong, [2020](#)). The hospital in our study regarded outpatient treatment as the key point of infection prevention and control. Patients and caregivers with symptoms of recent self-limited upper respiratory tract infection were screened comprehensively (Paules et al., [2020](#)). We implemented strict patient admission standards and controlled the number of caregivers according to the protection requirements. Hospital entrance screening and hospital admission preparation were helpful to further exclude the unqualified caregivers from entering the ward. The whole inpatient process was the main focus of the management of caregivers, and it was also an important link for nurses to lead and coordinate all departments to carry out all-round meticulous management. 'The notification of novel coronavirus infection pneumonia investigation' can enable caregivers to clarify their legal obligations and responsibilities during the epidemic prevention and control. 'Enter the department for propaganda and education, implement personal protection' can help caregivers implement a package of prevention and control measures such as hand

hygiene, wearing masks and correct coughing etiquette. 'ID card and caregiver's dual card management' prevents unqualified personnel from entering the hospital and ward; 'body temperature monitoring and risk investigation' helps discover risk population in a timely manner; 'special examination, caregiver management and dining management' reduce the flow of accompanying personnel in and out of the hospital effectively. Preparation for discharge, shortening settlement cycle, reducing the aggregation of caregivers and continuous follow-up platform to provide health guidance and medical path for patients and caregivers can help prevent and control the epidemic situation.

4.2 | Continuous improvement against weak management points

The inspection results of the quality management time points of the caregivers showed that, 'implement access control management, the medical records of those with caregivers include 'stay with others' orders, no visitors, the replacement attendant signs the notice, the caregivers were monitored and registered twice a day, no dining out for caregivers' was relatively low during the first audit. Management promotion and other measures were continuously improved based on feedback, the difference was statistically significant ($p < 0.05$). The management of double certificates at the entrance of inpatient area and hospital was more standardized, but the ratio of using double certificates at the entrance of the elevator was only 23%–46%. The main reason for this was that the property elevator staff was responsible for the verification. There are many elevators, and verification by limited staff members takes a long time, so it is difficult to implement the checks when there was a large flow of people. Therefore, the hospital management amended the regulations, and on the basis of doing a good job in the starting link (hospital entrance) and the end link (ward entrance), the public area of the hospital will no longer carry out double certificate inspection. The proportion of attendants who wore masks at the entrance of wards and elevators was high (91%–100%). However, the rate of wearing masks inside the wards was relatively low. Although there was a significant improvement after continuous improvement ($\chi^2 = 16.695$, $p < 0.001$), there were still the following problems: the attendant did not wear a mask in the corridor, the catering room, or while in bed, or did not continue to wear a mask, or wore masks irregularly (not covering the nose and mouth, covering the chin, not tightly sealed, etc.), or took off the masks while speaking. We still need to increase awareness and supervision, strengthen the quality control of the department and help people develop behavioural habits.

4.3 | Face recognition information management system hasten ward attendant management

In our study, the facial recognition management system used computer network systems, video cameras, image acquisition, face recording, picture pre-processing and other technologies to

store the facial images of the caregivers in the facial recognition database at the source. The facial information was sent to the gate management platform, and then sent to the face recognition all-in-one machine in each ward. On capturing the facial features, the face-recognition machine cross-checked it against the database. If the person was in the database, the gate would be opened to realize the function of brushing the face and opening the door. According to the above system design, the hospital installed the face recognition equipment at the entrance of the ward building to manage and control ward personnel based on facial recognition, so that caregiver management could take place in the front and centre of the entire process, instead of relying on the final link. Moreover, the facial recognition information management system could be deployed continuously over 24h and control the recognition frequency, effectively reducing duty staff at the gate, improving the efficiency of ward management and reducing the labour intensity of medical staff. Applying information-based methods for the management of caregivers can reduce the time and energy spent by nurses on access control and caregiver management, giving them more time to invest on patients' observation, care and safety.

5 | CONCLUSION

The epidemic prevention and control of the new type of coronavirus pneumonia is still continuing, and the majority of medical workers must make every effort to fight the epidemic. Due to the mobility of inpatient caregivers, managing them is an essential part of infection control. The caregiver management measures taken by Shandong Provincial Hospital during the new crown pneumonia epidemic can prove to be useful in infection management. In the duration of the study, the hospital's medical staff, work staff, patients and caregivers did not get cross-infected at the hospital. We recommend that every hospital should have in-patient caregiver management measures tailored to their own circumstances (Huang et al., 2021).

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CONFLICT OF INTEREST

The authors report no conflict of interest.

DATA AVAILABILITY STATEMENT

The data sets used for the current study are available from the first author on reasonable request.

ORCID

Xiaoman Zhang  <https://orcid.org/0000-0003-3428-1640>

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