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Investigating the demands for mobile internet-based home nursing services for the elderly

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ABSTRACT

The great value of home nursing services in the treatment of ailments in elderly patients has attracted increasing attention. This study describes a new mobile internet-based home nursing service system and investigates the reasons for its use among elderly patients. 520 cases of mobile internet-based home nursing services were investigated. The proportion of major reasons to use mobile internet-based home nursing services among the elderly was analyzed and the satisfaction rate was investigated. The constituent ratios of nursing care for pressure ulcers, peripherally inserted central catheter (PICC), subcutaneous injection, general stoma care, psychological care, and intramuscular injection were 61.35%, 28.85%, 6.15%, 1.92%, 1.35%, and 0.38%, respectively. The satisfaction rate with mobile internet-based home nursing services among elderly patients was 100%. Considering the demand for home nursing services for elderly patients, this is the first time that a new mobile internet-based home nursing service has been applied to provide home nursing services to elderly patients and meet their home nursing service needs. Treatment for pressure ulcers, PICC, subcutaneous injection, general stoma care, psychological care, and intramuscular injection were found to be the main reasons to use mobile internet-based home nursing services among the elderly. The new mobile internet-based home nursing service system provides convenient home nursing services to elderly patients and ensures that they get equal rights in home nursing. The results provide basis for healthcare policy makers to formulate new home nursing policies for elderly patients.

INTRODUCTION

As humans enter an aging society, the demand for home nursing services for elderly patients will increase rapidly. Health administrative departments all over the world are seeking to effectively meet the needs for home nursing services of elderly patients with chronic diseases. The great value of home nursing services in the treatment of ailments in elderly patients has attracted increasing attention. Research on the acceptability, feasibility, and cost-effectiveness of providing home nursing services to elderly patients has been widely conducted.¹⁻³ What kind of home nursing services are needed for the elderly? It is a difficult problem faced by health administrative departments worldwide.

Significance of this study

What is already known about this subject?

- ▶ The demand for home nursing services for elderly patients has increased rapidly.
- ▶ The great value of home nursing services in the treatment of ailments in elderly patients has attracted increasing attention.

What are the new findings?

- ▶ Considering the demand for home nursing services for elderly patients, this is the first time that a new mobile internet-based home nursing service has been applied to provide home nursing services to elderly patients.
- ▶ Nursing care for pressure ulcers, peripherally inserted central catheter (PICC), subcutaneous injection, general stoma care, psychological care, and intramuscular injection were found to be the main reasons to use mobile internet-based home nursing services among the elderly.

How might these results change the focus of research or clinical practice?

- ▶ Doctors and nurses should pay more attention to nursing care for pressure ulcers, PICC, subcutaneous injection, general stoma care, psychological care, and intramuscular injection to improve the quality of life and prolong the life of elderly patients.
- ▶ The results of this study provide basis for healthcare policy makers to formulate new home nursing policies for elderly patients.

A new mode of mobile internet-based home nursing service was established in Shanghai which can provide convenient and effective home nursing services to elderly patients using mobile internet and smartphones. It has effectively resolved the need for home nursing services of elderly patients. It has also encouraged registered nurses from general public hospitals to provide home nursing services to elderly patients suffering from chronic diseases at home. The new mobile internet-based home nursing service is an 'online application and offline service' model and is supervised by the government's health administrative department,



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which formulated standards of service to ensure the quality of the nursing service provided. Research on home nursing services has been carried out. The purpose of this study is to describe the new mobile internet-based home nursing service system and investigate the reasons for its use among elderly patients. The results will provide basis for health administrative departments to formulate corresponding home nursing service policies for elderly patients.

METHODS

In a telemedicine center of a university-affiliated hospital, an observational study was conducted from October 1, 2018 to August 10, 2021. A total of 520 cases of using the new mode of mobile internet-based home nursing service for elderly patients (aged ≥ 60) were investigated. The elderly patients using the new home nursing service suffered from chronic diseases and needed long-term home nursing services after being hospitalized and discharged from the hospital.

This new mode of providing home nursing service was carried out using an internet information technology platform which has facilities and technical personnel and uses information technology and an information security system. In this study, the application process to use the home nursing service for elderly patients is simple and convenient with the use of internet technology and smartphones. Elderly patients can place an order for home nursing service by simply clicking on the application (app) on their smartphones. Elderly patients who cannot use smartphones were assisted by family members when placing an order for a home nursing service. After receiving the order on the app, a nurse directly goes to the elderly person's home to provide nursing services.

The processes involved in the new mobile internet-based home nursing service are shown in the following in chronological order:

1. Elderly patients place orders for home nursing services by clicking on the app on their smartphones.
2. Medical institutions assess applicants' health status and obtain informed consent after informing them of service content, responsibilities, and possible risks.
3. Medical institutions provide mobile phone app positioning tracking system and nursing work recorder to trace service behavior.
4. Medical institutions provide nurses with a one-button alarm device and personal accident insurance to protect and ensure their personal safety.
5. Nurses who had at least 5 years of clinical nursing experience and technical title were selected to provide home nursing services to elderly patients.
6. Nurses should abide by relevant laws, professional ethics, and technical operation standards to guarantee quality of nursing.
7. After receiving nursing service, elderly patients sign for confirmation. Nurses then pack the medical waste and take it back to the hospital for harmless treatment.
8. Medical record data obtained during the process of providing home nursing service were kept during the whole process to ensure that they can be queried and traceable.

The processes involved in the new mode of mobile internet-based home nursing service are shown in [figure 1](#),

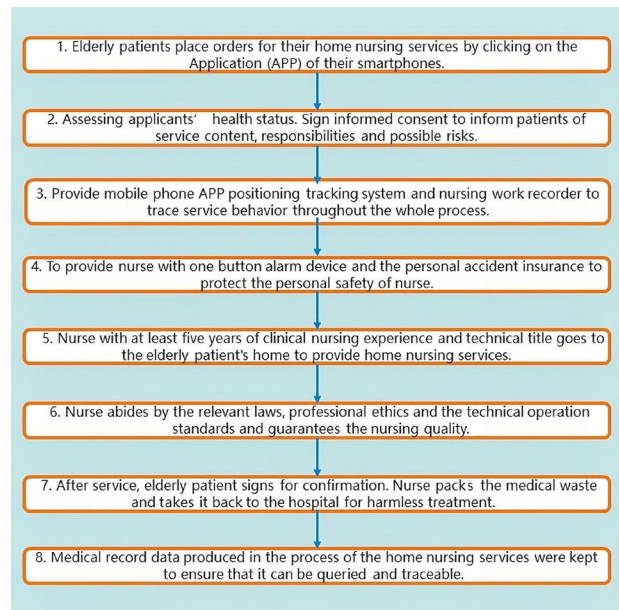


Figure 1 Flow chart of the processes involved in the new mode of mobile internet-based home nursing service.

while the app for the new mode of mobile internet-based home nursing service is shown in [figure 2](#).

The health administrative department carries out supervision over the mobile internet-based home nursing service through a management platform via the internet. Medical institutions take effective measures to prevent possible risks, establish medical disputes and risk prevention mechanisms, formulate contingency plans, and protect the legitimate rights and interests of the elderly patients and the nurses. [Table 1](#) shows the main content of the new mobile internet-based home nursing service for elderly patients.

Gender, age, and the reasons for use of mobile internet-based home nursing services of elderly patients were recorded and analyzed. The proportion of the major reasons for using the new mobile internet-based home nursing service among elderly patients was analyzed. Statistical analysis of data was performed using IBM SPSS Statistics V.20.0. $P < 0.05$ was considered statistically significant. Informed consent was obtained from all individual participants included in the study.

RESULTS

The study analyzed 520 cases of using the new mode of mobile internet-based home nursing service for elderly patients. Among these 520 cases, 183 were from elderly men and 337 were from elderly women. The number of female elderly patients using the mobile internet-based home nursing service was more than that of male elderly patients. The satisfaction rate of using the new mobile internet-based home nursing service among the elderly patients was 100%. Nursing care for pressure ulcers (prevention and nursing of stress injury) ($n=319$, 61.35%) and nursing care for peripherally inserted central catheters (PICC) (maintenance of PICC) ($n=150$, 28.85%) were found to have the highest rates among elderly patients using the new mobile internet-based home nursing service. The constituent ratios of these two demands were also the highest, followed by

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Figure 2 Application for the new mode of mobile internet-based home nursing service.

subcutaneous injection (n=32, 6.15%), general stoma care (n=10, 1.92%), psychological care (n=7, 1.35%), and intramuscular injection (n=2, 0.38%). The constituent ratios of the six major reasons to use the new mode of mobile internet-based home nursing service were 61.35%, 28.85%, 6.15%, 1.92%, 1.35%, and 0.38%, respectively (see table 2).

DISCUSSION

In this study, it was found that nursing care for pressure ulcers, PICC, subcutaneous injection, general stoma care, psychological care, and intramuscular injection were the main mobile internet-based home nursing services applied for by elderly patients.

There are some limitations to the study. This is a single-center study with a relatively small sample size of elderly patients and the observation time was relatively short. It is necessary to conduct a long-term observation study with multiple centers and with larger samples in the future.

China has now entered an aging society, with the aging population increasing rapidly. At the end of 2019, there were 253.88 million elderly people (aged ≥ 60) in China, more than the total elderly population in Europe. Shanghai is the first city with the highest degree of population aging in China. In 2019, there were 5.1812 million elderly people (aged ≥ 60) in Shanghai, accounting for 35.2% of the total population. The aging population is increasing rapidly, with the proportion of elderly population of the total population increasing from 7% to 14%, marking the transition from an 'aging society' to an 'aged society'.

However, the ability of medical institutions at all levels to provide home nursing services and healthcare to the elderly remains very limited. Mobile internet-based home nursing services may meet the demands for home nursing among elderly patients.

Although several research has focused on using mobile technology in nursing homes, it is important to conduct research on mobile internet-based home nursing services. This is important for several reasons. Nursing of elderly patients is ultimately performed by nurses and mobile devices cannot replace nurses in providing patient care. Nurses are the key persons who determine the quality of nursing services provided to elderly patients. Mobile devices can only help nurses in providing nursing services to elderly patients. Research on the application of mobile devices in nursing homes only provides application scenarios for mobile devices. Therefore, conducting research on mobile internet-based home nursing services is more important than conducting research on use of mobile tools in nursing homes.

In other countries, research on home nursing services has been targeted to patients with a single disease, such as diabetes, chronic heart failure, and senile psychosis. In our study, several types of home nursing services could be provided to elderly patients with multiple chronic diseases as the mobile internet-based home nursing service is based on multiple clinical disciplines from large general hospitals. Mobile internet-based home nursing services have obvious advantages compared with other modes of home nursing services, and it is necessary to do some research on mobile internet-based home nursing services.

In mobile internet-based home nursing, allocation of nursing staff and communication between nurses and elderly patients are very important. In the study of Ree,⁴ staffing and communication factors were found to be the strongest predictors of person-centered nursing. In our study, nurses with rich nursing experience were selected to provide high-quality home nursing services to elderly patients. The allocation of nursing staff and communication between the nurses and the elderly patients were fully guaranteed. The main subjects of our study on mobile internet-based home nursing services were elderly patients discharged from general hospitals. The purpose of providing mobile internet-based home nursing services is to improve the quality of life of elderly patients and reduce their rehospitalization rate. In the study of Simning *et al*,⁵ elderly patients who received home nursing services had better discharge outcomes, were less likely to be hospitalized, and had lower risk of mortality. This indicated that home nursing services are beneficial to the health, prognosis, longevity, and quality of life of elderly patients.

Sweden and other developed countries are putting deliberate efforts into electronic health (eHealth) and digitalization of home nursing, and it was found that eHealth services have big potential in this area.⁶ In our study, mobile internet technology was used in the field of home nursing service. Offline home nursing service and online internet technology were closely combined, which helped to achieve good outcomes by improving the prognosis of elderly patients and reducing their readmission rate. It effectively resolved the difficulties of providing home nursing services to elderly patients with chronic diseases who have been

Table 1 Main content of the new mode of mobile internet-based home nursing service for elderly patients

Number	Nursing service items	Main content of the mobile internet-based home nursing service
1	Prevention and nursing care for stress injury	<ul style="list-style-type: none"> ▶ Assessment of possibility of stress injury. ▶ Guidance on prevention of stress injury. ▶ Taking preventive measures, such as turning over and cleaning the skin.
2	Chronic wound care	<ul style="list-style-type: none"> ▶ Evaluation of chronic wound types and grades (pressure injury, diabetic foot). ▶ Cleaning the wound surface and removing necrotic tissue. ▶ Changing the dressing and dressing.
3	General stoma care	<ul style="list-style-type: none"> ▶ Evaluation of stoma site (stomach, intestine, bladder) and the surrounding skin. ▶ Routine cleaning and maintenance of the skin around the stoma. ▶ Guidance on prevention of complications.
4	Nursing care for difficult stoma	<ul style="list-style-type: none"> ▶ Evaluation of stoma site (stomach, intestine, bladder) and the surrounding skin. ▶ Treatment of stoma and its surrounding complications ▶ Selection of appropriate stoma care supplies and replacement of chassis and pouch.
5	Special stoma care	<ul style="list-style-type: none"> ▶ Evaluation of the special stoma sites and skin, such as cholecystostomy. ▶ Cleaning and maintaining the skin around the colostomy. ▶ Dealing with related problems. ▶ Replacement of chassis and pouch. ▶ Prevention of complications and other precautions.
8	Nursing care for incontinence dermatitis	<ul style="list-style-type: none"> ▶ Evaluation of patients with incontinence. ▶ Selecting appropriate dressings, nursing supplies, and methods. ▶ Providing health guidance to patients and caregivers.
7	Nursing care for indwelling catheter	<ul style="list-style-type: none"> ▶ Perineum disinfection. ▶ Replacement of urinary catheter and urine collection bag. ▶ Implementation of catheterization technique (female). ▶ Fixation of urinary catheter. ▶ Training of bladder function and guidance for pelvic floor muscle exercise.
8	Nasal feeding care	<ul style="list-style-type: none"> ▶ Checking whether the gastric tube is in the stomach. ▶ Nasal feeding through the gastric tube.
9	Maintenance of peritoneal dialysis tube	<ul style="list-style-type: none"> ▶ Environmental assessment. ▶ Peritoneal dialysis operation. ▶ Evaluation and disinfection of outlet. ▶ Dressing replacement and pipeline fixation. ▶ Assessment and recording of exudate.
10	Maintenance of PICC	<ul style="list-style-type: none"> ▶ Checking the position of PICC pipeline. ▶ Disinfecting the wound. ▶ Changing the dressing. ▶ Pulse positive pressure sealing tube. ▶ Providing routine management and maintenance guidance for patients and caregivers.
11	Nursing care for gastrostomy and enterostomy	<ul style="list-style-type: none"> ▶ Evaluation of the tube. ▶ Flushing of the fistula tube. ▶ Skin care around the fistula and fixation of the tube. ▶ Replacement of the fixed film. ▶ Enteral nutrition in the fistula tube. ▶ Health education.
12	Drainage tube nursing	<ul style="list-style-type: none"> ▶ Evaluation of the tube and drainage fluid. ▶ Care of the skin around the drainage tube and dressing replacement. ▶ Replacement of drainage bag, drainage ball, and drainage bottle. ▶ Health education.
13	Intramuscular injection	<ul style="list-style-type: none"> ▶ Evaluation of the type of injection drugs, injection site, allergic history of patients, etc. ▶ Selection of the appropriate injection site according to the specific situation of patients. ▶ Injection operation.
14	Subcutaneous injection	<ul style="list-style-type: none"> ▶ Evaluation of the type of injection drugs, injection site, allergic history of patients. ▶ Selection of the appropriate injection site according to the specific situation of patients. ▶ Injection operation.
15	Blood glucose monitoring	<ul style="list-style-type: none"> ▶ Peripheral blood glucose collection. ▶ Guiding patients to effectively control blood glucose.
16	Venous blood collection	<ul style="list-style-type: none"> ▶ Evaluation of the blood collection site and blood vessels of patients. ▶ Skin disinfection and blood collection. ▶ Guidance on matters needing attention after blood collection. ▶ Transport of blood samples.
17	Mid-course urine collection	<ul style="list-style-type: none"> ▶ Perineum disinfection. ▶ Guidance and retention of urine samples during the collection method. ▶ Specimen transport.
18	Collection of common specimens	<ul style="list-style-type: none"> ▶ Routine urine samples, sputum specimens, fecal samples, and other collection methods guidance and retention. ▶ Specimen delivery.
19	Atomization inhalation	<ul style="list-style-type: none"> ▶ Selection of atomizer. ▶ Atomization inhalation operation. ▶ Observation of disease condition. ▶ Guidance on cleaning after atomization.

Continued

Table 1 Continued

Number	Nursing service items	Main content of the mobile internet-based home nursing service
20	Oxygen inhalation	<ul style="list-style-type: none"> ▶ Evaluation of the environment, hypoxia, and nasal cavity. ▶ Guidance on the method of oxygen inhalation.
21	Monitoring of vital signs	<ul style="list-style-type: none"> ▶ Evaluation of the patient's condition. ▶ Measurement of body temperature, pulse, respiration, and blood pressure correctly. ▶ Interpretation of measurement data and guidance on related knowledge. ▶ Disinfection of the thermometer.
22	Physical cooling	<ul style="list-style-type: none"> ▶ Evaluation. ▶ Selection of physical cooling tools. ▶ Guidance on contraindications for cooling. ▶ Remeasurement of body temperature.
23	Nursing care for sputum suction	<ul style="list-style-type: none"> ▶ Evaluation of awareness, oxygen saturation, blood pressure, respiratory secretions, and other conditions of patients. ▶ Selection of the appropriate suction tube and the appropriate negative pressure. ▶ Oxygen supply, humidification, and sputum suction. ▶ Observation of vital signs and disease changes of patients.
24	Bladder irrigation	<ul style="list-style-type: none"> ▶ Evaluation of patients' condition and the patency of urinary catheter. ▶ Clamping the catheter for bladder irrigation. ▶ Dealing with complications and other abnormal conditions.
25	Enema	<ul style="list-style-type: none"> ▶ Evaluation of awareness and contraindications in patients. ▶ Selection of the appropriate enema method and drug according to patients' condition and the purpose of enema. ▶ Inform the attention after enema.
26	Health guidance for chronic diseases	<ul style="list-style-type: none"> ▶ Health guidance for chronic diseases such as hypertension, coronary heart disease, stroke, malignant tumor, diabetes, etc.
27	Home nutrition support	<ul style="list-style-type: none"> ▶ Evaluation of gastrointestinal symptoms and nutritional status of patients. ▶ Evaluation of daily nutritional intake of patients. ▶ Formulation of home nutrition support program. ▶ Carrying out health education on nutrition support.
28	Pain care	<ul style="list-style-type: none"> ▶ Evaluation of location, nature, degree, and cause of pain. ▶ Taking effective pain relief measures. ▶ Relieving pain pressure by psychological nursing.
29	Physical rehabilitation guidance	<ul style="list-style-type: none"> ▶ Evaluation of limb function of patients. ▶ Formulation of a rehabilitation plan according to different limb parts. ▶ Training, supervising, and guiding the rehabilitation function of the limbs. ▶ Evaluation and adjustment of the effect. ▶ Publicizing and guiding related knowledge on limb rehabilitation.

PICC, peripherally inserted central catheter.

bedridden for a long time. This is an innovation of mobile internet technology in the field of geriatric nursing.

In many Western countries, institutional care is being shifted to home nursing. Næss *et al*⁷ assessed the health and functional aspects of home-dwelling elderly patients to identify their need for nursing interventions and how these needs were met. They found that resources for home nursing should probably be used in a more flexible and proactive way and should aim to preserve functional status, minimize symptom burden, and prevent avoidable hospitalizations. In

our study using mobile internet technology, resources for home nursing services were used in a flexible and proactive way to prevent avoidable hospitalizations and reduce the medical expenses of elderly patients as well as the burden on their family members. Family members can avoid frequent visits to hospitals to accompany their elderly, thus saving time and cost.

In Japan, the demand for home nursing services among the elderly population is increasing. Naruse *et al*⁸ found that residents living in municipalities with a lower reachable proportion of the elderly population are less likely to use home nursing services and that public health interventions should increase the reachable proportion of the elderly population in order to improve home nursing service use. In our study, the reachable proportion of the elderly population is relatively high and the application process for home nursing service is very convenient with the use of mobile internet technology and smartphones. Elderly patients can place orders for home nursing services by simply clicking on the app on their smartphones. After receiving the order on the app, a nurse goes directly to the elderly person's home to provide nursing services.

In clinical nursing practice, it was found that family members were often unable to appropriately manage elderly patients with pressure ulcers at home. In the study of Lee *et al*,⁹ it was found that elderly patients in South Korea who received home nursing services were less likely

Table 2 Constituent ratio of the major reasons to use the new mode of mobile internet-based home nursing service among elderly patients (aged ≥60)

Order number	Classification of the major reasons to use mobile internet-based home nursing services among elderly patients	Cases of home nursing service (n)	Constituent ratio (%)
1	Nursing care for pressure ulcers (prevention and nursing of stress injury)	319	61.35
2	Nursing care for PICC (maintenance of PICC)	150	28.85
3	Subcutaneous injection	32	6.15
4	General stoma care	10	1.92
5	Intramuscular injection	2	0.38
6	Psychological care	7	1.35

PICC, peripherally inserted central catheter.

to be hospitalized due to pressure ulcers, especially those with mildly impaired mobility and cognitive function. The results showed the importance of home nursing services, including providing timely and effective nursing service for long-term treatment of pressure ulcers in elderly patients. In our study, it was found that pressure ulcers were the leading reason to use mobile internet-based home nursing services, accounting for 61.35% of the total demand for home nursing services. Why do elderly patients frequently suffer from pressure ulcers? First is due to their long-term bedridden condition, which is usually associated with diseases such as paralysis, diabetes, etc. Elderly patients are more prone to suffer from pressure ulcers since they do not engage in activities due to their relatively weak physical fitness, which then results in ischemia, hypoxia, and malnutrition of the compressed skin. The second reason is that the local skin tissue becomes necrotic due to long-term compression, which increases the risk of pressure ulcers. The incidence of pressure ulcers increases since the action of friction and the skin aging in elderly patients. Elderly patients are prone to suffer from the complications of pressure ulcers due to their weak ability for tissue repair. The third reason is due to fecal incontinence among elderly patients who have been bedridden for a long time. If the excreta were not cleared in time, they will cause skin irritation. Skin ulceration occurs when the skin has been exposed to a moist environment for a long time. The local skin will affect the normal blood flow and will lead to pressure ulcers due to the long-term lack of nutrition.

Treating pressure ulcers is a type of pressure injury prevention nursing. Pressure ulcers not only reduce the quality of life of elderly patients, but also consume a lot of medical and nursing resources. Organizations for the prevention and control of pressure ulcers have been established in the USA and Europe in recent years. A series of related studies have been carried out in this field which have played a positive role in the prevention and control of pressure ulcers in elderly patients. Nurses should be familiar with the causes of pressure ulcers in elderly patients. Prevention and control of pressure ulcers are of great significance in improving the quality of life and in reducing the rate of mortality among elderly patients. Nurses caring for elderly patients should regularly turn the patient's body over and wash them regularly. After defecation, the sheets and clothes need to be immediately changed with clean ones. Once pressure ulcers are found in an elderly patient, they should be treated as soon as possible.

PICC is a new type of central venous catheterization developed in recent years. Due to the long indwelling time, less trauma, fewer complications, being non-life-threatening, and high success rate of venipuncture, it has been widely used in the chemotherapy of patients with tumor, as well as for total parenteral nutrition infusion, rescue of critically ill patients, long-term infusion treatment, and in some other fields. In our study, nursing for PICC was found to be the second most common reason (at a rate of 28.85%) to use the mobile internet-based home nursing service for elderly patients. This is because the incidence of tumors in elderly patients is relatively high and many elderly patients with tumors need to use central venous catheter for regular chemotherapy.

In the study of Murtaugh *et al.*¹⁰ the effectiveness of early, intensive home health nursing and physician follow-up within a week versus less intense and later postacute care in reducing readmissions among patients with heart failure discharged to home healthcare was compared. It was found that closer coordination between home health and medical providers in the clinical management of patients with heart failure immediately after hospital discharge should be highly valued. In our study, home nursing services for elderly patients after discharge were more closely managed and coordinated with the use of mobile internet, which also served as a bridge between the elderly patients and the nurses/physicians after discharge. With mobile internet and smartphones, nurses and physicians can understand changes in elderly patients' conditions and provide effective treatment in a timely manner.

The quality of nursing staff providing mobile internet-based home nursing services is very important to ensure the safety of elderly patients. Ree *et al.*¹¹ assessed the relationship between elderly patients' safety and the quality of nursing staff and found that the quality of nursing staff is important to patient safety and that teamwork seems to be a significant contributing factor to patient safety when providing home nursing services. Building sound teams with mutual trust and collaboration should be an essential part of patient safety. In our study, in order to ensure the safety of mobile internet-based home nursing services for elderly patients, nurses with more than 5 years of clinical work experience were selected. Since mobile internet-based home nursing services are managed by the nurse management department of general public hospitals and supervised by the government's health administrative department, the quality of home nursing and the mutual cooperation among the nurse team to provide high-quality nursing service to elderly patients are ensured.

Continuing medical education for nurses providing home nursing services to elderly patients is of great importance. In the study of Katahira and Tsukasaki,¹² it was found that nurses are key to home nursing services and that it might be advantageous to increase nursing staffing and provide care guidelines and training opportunities to improve nurses' self-efficacy. In our study, the nurses providing home nursing services to elderly patients were all from large public general hospitals and so the number of nurses was sufficient. The management departments for nursing in public hospitals regularly carry out continuing medical education and nursing skills assessment in order to improve nurses' skills and the quality of nursing.

Because nurses need to go to patients' home in order to provide nursing service, the safety of nurses must be highly valued. Fujimoto *et al.*¹³ studied violence toward nurses conducting psychiatric home visits and found that it is important to promote measures to prevent violence; they also emphasized monitoring of visits. In our study, we attached great importance to the personal safety of nurses who provide home nursing services. In the process of providing home nursing services, nurses are provided with a mobile protection device with a one-button alarm function, which they can press when they are in danger. These measures protected the safety of nurses providing home nursing services.

The success of home nursing services for elderly patients depends on the cooperation, help, and support of the family members of elderly patients. Le Manach¹⁴ found the importance of coordination of all those involved in the home nursing service to ensure the needs of the patient are respected, and this coordination must maintain a fine balance between the patient's privacy within their home and the intrusion of the caregiving professional. In our study, nurses were asked to pay attention to protecting elderly patients' privacy when providing home nursing service, and they received full cooperation from family members and the elderly patients. Therefore, good nursing has been achieved.

Home nursing services can provide effective psychological nursing services to elderly patients. In the study of Rabinowitz *et al*,¹⁵ it was found that providing psychological nursing services to rural elderly patients using telemedicine is a helpful, cost-effective, and acceptable face-to-face treatment. It was accepted by the elderly patients and their family members and has led to successful patient management. In our study, offline psychological care was carried out by nurses who provide home nursing services at elderly patients' home. Online psychotherapy for elderly patients was performed by clinicians and nurses via a telemedicine system at a telemedicine center. This combination of online and offline modes of psychotherapy has been widely recognized by elderly patients and their family members.

In the study of Chitnis *et al*,¹⁶ it was found that home-based end-of-life care has the potential to reduce the demand for acute hospital care and increase the number of people able to die at home. In the USA, hospice care for qualified patients is covered by Medicare. We have planned to carry out family-based hospice care to provide psychological comfort to dying elderly patients and improve their psychological feelings, which can reduce the demand for hospice care for elderly patients in large-scale general hospitals.

In the study of Fukui *et al*,¹⁷ it was found that different systems of categorization in home nursing agencies could ensure appropriate healthcare policies that will allow them to provide better home nursing services based on patient and staff characteristics and regional needs. This study from Japanese scholars on home nursing services is similar to our study to some extent. The difference is that we applied the latest mobile internet technology and smartphones to provide home nursing services to elderly patients. In our study, the nurses in large-scale general hospitals could provide home nursing services as soon as elderly patients place an order for a service using the app on their smartphone. Mobile internet-based home nursing services are an innovative product of the integration of internet technology and home nursing service for elderly patients.

As the main executors of mobile internet-based home nursing service, the health status of nurses should be highly concerned. In the study of Agosti *et al*,¹⁸ a high rate of absenteeism due to illness was found among nurses in Sweden and therefore the health of nurses should be highly valued. In our study, the health of nurses who use their spare time to provide mobile internet-based home nursing services has been taken seriously by the department of nursing management of large general hospitals. Providing home nursing services was reasonably arranged and the workload each week was strictly controlled to ensure that

nurses have sufficient time to rest. Only by ensuring their health can nurses provide better quality home nursing service to elderly patients.

In the study of Bogaisky and Dezieck,¹⁹ it was found that the rate of hospital readmission among elderly patients discharged to nursing homes was higher than of elderly patients discharged to home and received home nursing services. The results showed that providing nursing services to elderly patients at home is significantly better than providing nursing services at nursing homes after discharge. Home nursing services significantly reduce the risk of hospital readmission of discharged elderly patients. It was demonstrated that providing home nursing services to elderly patients is of great clinical value. The new mobile internet-based home nursing service discussed in our study may provide a new means of reducing the readmission rate among elderly patients.

In the study of de Britto *et al*,²⁰ it was found that the use of a mobile health solution with a geolocating feature by a home nursing service team increased compliance to the home nursing service plan. In our study, home nursing services are based on mobile internet, making full use of the advantages of mobile communication, internet technology, and smartphones. It greatly improves the efficiency of home nursing services and increases the satisfaction of elderly patients. In the study of Chen *et al*,²¹ it was found that informal home nursing service is the best in terms of healthcare outcome efficiency issues compared with community-based, formal home nursing services and nursing home services. Health improvement/outcome of the elderly with the informal home nursing service is heavier concentrated than that of community-based formal home nursing and nursing home services. In our study, the mobile internet-based home nursing service is the same as the informal home nursing service and can improve the outcomes of elderly patients at reduced cost. From the perspectives of healthcare outcome efficiency, the results of our study are similar to those of de Britto *et al*.²⁰

In the study of Joe *et al*,²² the use of home nursing services by community-dwelling elderly women was investigated to determine the nature of services required by those living alone. It was found that community-dwelling elderly women who live alone have greater service needs and higher rates of discharge from hospital. In our study, it was found that elderly women have greater demands for home nursing services than elderly men. This may be due to the fact that the average life expectancy of elderly women is longer than of elderly men, and perhaps also because elderly women are more likely to suffer from chronic diseases than elderly men, leading to older women needing more home nursing services.

At present, COVID-19 has spread in 114 countries. In the study of Yan and Yang,²³ it was found that rehabilitation of patients with COVID-19 with respiratory, physical, and psychological dysfunctions is particularly important. Traditional face-to-face rehabilitation is associated with high risk of infection and mobile internet rehabilitation nursing will be more feasible.²³ Elderly patients are susceptible to COVID-19 and the mortality rate of COVID-19 is high among them. The new mobile internet-based home nursing service evaluated in our study can provide home nursing service to elderly patients, preventing their need to

frequently visit large crowded hospitals and thus reducing the risk of contracting COVID-19, which then will help control the prevalence of COVID-19. Nurses providing home nursing services explained the preventive measures for COVID-19 to elderly patients and their family members, which may also contribute to reducing the prevalence of COVID-19.

Home nursing services may reduce health inequalities, especially for long-term bedridden elderly patients with chronic diseases, and improve the quality of life of elderly patients. With the increase in aging population, the demand for home nursing services for elderly patients will increase significantly. How to meet the growing demand for home nursing services for elderly patients is a serious challenge. Our goal is to make the use of home nursing services for the elderly as easy and convenient as online shopping.

Shanghai has become an aging city. More and more elderly people need to be provided with home nursing services. The huge demand for home nursing services for elderly people is promoting the rapid development of home nursing services. Elderly people like to receive nursing services at home since home is a place of emotional and physical associations and memories and is comfortable for them. Moreover, the family's unique warm atmosphere has a special therapeutic effect on them and family care will be conducive to their recovery.

The rapid development of internet technologies such as the fifth-generation mobile networks technology (5G) and the popularity of smartphones for the elderly made the goal of receiving nursing services at home a reality. More and more elderly patients are using the app on their smartphones to request for home nursing services. The new mobile internet-based home nursing service in this study provided a new solution to meet the rapidly growing demands for home nursing services for elderly patients.

In summary, the function of the new home nursing service system discussed in our study has important clinical value. First, the new home nursing service system can provide multiple nursing care to elderly patients with multiple diseases at the same time. Therefore, it can better meet the needs of elderly patients with multiple chronic diseases. Second, it can provide home nursing service to elderly patients and prevent frequent visits to large hospitals, which may reduce the risk of nosocomial cross-infection of COVID-19 during the COVID-19 pandemic. Third, the new home nursing service system is managed by the nursing management departments of general public hospitals and is supervised by the government's health administrative department, ensuring the quality of nursing services and ensuring elderly patients receive high-quality home nursing services.

CONCLUSION

Considering the demand for home nursing services for elderly patients, this is the first time that a new mobile internet-based home nursing service has been used to provide home nursing services to elderly patients. In this study, nursing care for pressure ulcers, PICC, subcutaneous injection, general stoma care, psychological care, and intramuscular injection were found to be the main types of mobile internet-based home nursing services provided to

the elderly. The new mobile internet-based home nursing service system provides convenient nursing services to elderly patients and guarantees they get equal rights in home nursing. The results of this study provide basis for healthcare policy makers to formulate new home nursing policies for elderly patients.

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Patient consent for publication Consent obtained directly from patient(s).

Ethics approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the Ethics Committee of Shanghai Municipal Eighth People's Hospital (no 2019-006).

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REFERENCES

- 1 Tang V, Choy KL, Ho GTS, *et al*. An IoMT-based geriatric care management system for achieving smart health in nursing homes. *IMDS* 2019;119:1819–40.
- 2 Cui F, Ma L, Hou G, *et al*. Development of smart nursing homes using systems engineering methodologies in industry 4.0. *Enterp Inf Syst* 2020;14:463–79.
- 3 Lorca-Cabrera J, Grau C, Marti-Arques R, *et al*. Effectiveness of health web-based and mobile app-based interventions designed to improve informal caregiver's well-being and quality of life: a systematic review. *Int J Med Inform* 2020;134:104003.
- 4 Ree E. What is the role of transformational leadership, work environment and patient safety culture for person-centred care? A cross-sectional study in Norwegian nursing homes and home care services. *Nurs Open* 2020;7:1988–96.
- 5 Simning A, Orth J, Wang J, *et al*. Skilled nursing facility patients discharged to home health agency services spend more days at home. *J Am Geriatr Soc* 2020;68:1573–8.
- 6 Rydenfält C, Persson J, Erlingsdottir G, *et al*. eHealth services in the near and distant future in Swedish home care nursing. *Comput Inform Nurs* 2019;37:366–72.
- 7 Næss G, Kirkevold M, Hammer W, *et al*. Nursing care needs and services utilised by home-dwelling elderly with complex health problems: observational study. *BMC Health Serv Res* 2017;17:645.
- 8 Naruse T, Matsumoto H, Fujisaki-Sakai M, *et al*. Measurement of special access to home visit nursing services among Japanese disabled elderly people: using GIS and claim data. *BMC Health Serv Res* 2017;17:377.
- 9 Lee HJ, Ju YJ, Park E-C, *et al*. Effects of home-visit nursing services on hospitalization in the elderly with pressure ulcers: a longitudinal study. *Eur J Public Health* 2017;27:822–6.
- 10 Murtaugh CM, Deb P, Zhu C, *et al*. Reducing readmissions among heart failure patients discharged to home health care: effectiveness of early and

- intensive nursing services and early physician follow-up. *Health Serv Res* 2017;52:1445–72.
- 11 Ree E, Wiig S. Employees' perceptions of patient safety culture in Norwegian nursing homes and home care services. *BMC Health Serv Res* 2019;19:607.
 - 12 Katahira N, Tsukasaki K. Nursing care in multifunctional small group homes providing day, visiting and overnight services for older people living at home. *Int J Nurs Pract* 2016;22:605–15.
 - 13 Fujimoto H, Greiner C, Hirota M, *et al.* Experiences of violence and preventive measures among nurses in psychiatric and Non-Psychiatric home visit nursing services in Japan. *J Psychosoc Nurs Ment Health Serv* 2019;57:40–8.
 - 14 Le Manach V. [The role of the nurse coordinator within in-home nursing care services]. *Soins* 2016:44–6.
 - 15 Rabinowitz T, Murphy KM, Amour JL, *et al.* Benefits of a telepsychiatry consultation service for rural nursing home residents. *Telemed J E Health* 2010;16:34–40.
 - 16 Chitnis XA, Georghiou T, Steventon A, *et al.* Effect of a home-based end-of-life nursing service on hospital use at the end of life and place of death: a study using administrative data and matched controls. *BMJ Support Palliat Care* 2013;3:422–30.
 - 17 Fukui S, Yamamoto-Mitani N, Fujita J. Five types of home-visit nursing agencies in Japan based on characteristics of service delivery: cluster analysis of three nationwide surveys. *BMC Health Serv Res* 2014;14:644.
 - 18 Agosti MT, Andersson I, Ejlertsson G, *et al.* Shift work to balance everyday life - a salutogenic nursing perspective in home help service in Sweden. *BMC Nurs* 2015;14:2.
 - 19 Bogaisky M, Dezieck L. Early Hospital readmission of nursing home residents and community-dwelling elderly adults discharged from the geriatrics service of an urban teaching hospital: patterns and risk factors. *J Am Geriatr Soc* 2015;63:548–52.
 - 20 de Britto FA, Martins TB, Landsberg GAP. Impact of a mobile health application in the nursing care plan compliance of a home care service in Belo Horizonte, Minas Gerais, Brazil. *Stud Health Technol Inform* 2015;216:895.
 - 21 Chen C-C, Yamada T, Nakashima T, *et al.* Substitution of formal and informal home care service use and nursing home service use: health outcomes, decision-making preferences, and implications for a public health policy. *Front Public Health* 2017;5:297.
 - 22 Joe A, Dickins M, Enticott J, *et al.* Community-Dwelling older women: the association between living alone and use of a home nursing service. *J Am Med Dir Assoc* 2020;21:1273–81.
 - 23 Yan J, Yang G. Nursing standard of Internet-based rehabilitation for patients with coronavirus disease 2019. *Zhong Nan Da Xue Xue Bao Yi Xue Ban* 2020;45:513-517.