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ORIGINAL RESEARCH

Assessing the Needs of Patients with Cancer and Healthcare Professionals for a Digital Pain Management System: A Qualitative Study

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Objective: To understand the willingness of patients and healthcare workers to use, as well as their needs for, an intelligent cancer pain management platform. The findings will serve as a reference for developing cancer pain management tools in China.

Methods: A Purposive sampling was used to conduct semi-structured interviews from March to June 2024 with patients experiencing chronic cancer pain, their family members, and healthcare workers in the oncology departments of two tertiary grade A hospitals in Shanghai, China. Data were analyzed using the Colaizzi's seven-step analysis.

Results: The needs of patients and healthcare workers for a cancer pain management app were categorized into five themes, namely, recording of pain status, medication reminders, health education, social support, and artificial intelligence assistance.

Conclusion: Future development of an advanced cancer pain management platform must address the multiple challenges currently faced in out-of-hospital cancer pain management, while also considering the needs and preferences of patients and healthcare workers. The platform should integrate features such as visualization of patients' pain trends, online medical education, peer support, real-time counseling, artificial intelligence assistance, and guidance for at-home self-management and supervision.

Keywords: cancer pain, mHealth, pain management, artificial intelligence, needs assessment

Introduction

Cancer pain is a chronic secondary pain syndrome that can result in muscular, skeletal, and neuropathic pain, typically caused by injury, metastasis, or treatment of the primary tumor.[1] A recent systematic review reported that the global prevalence of cancer pain is 44%, with the prevalence in patients with advanced metastatic and terminal cancers ranging from 55% to 66%. Nearly one-third of these patients experience moderate to severe pain.[2] As oncology bed turnover increases and day ward management models become more common, an increasing number of patients are being triaged to primary community hospitals or returning home for cancer pain management between treatments in China. Poorly controlled cancer pain can lead to unnecessary hospitalizations, significant consumption of medical resources, and increased healthcare costs. A large cross-sectional survey of Chinese out-of-hospital patients with cancer pain showed that 73.94% experienced moderate or severe pain, 35.24% reported incomplete adherence to analgesic medications, and 52.62% suffered from constipation.[3] Several factors, including the uneven distribution of medical resources, insufficient supervision by healthcare professionals, patients' fear of opioid addiction, and a lack of pain management-related training, pose great challenges to the standardized management of out-of-hospital cancer pain in Chinese patients.[4] The high incidence of cancer pain and the difficulty in its control impose a substantial burden on individual patients, their families, and society at large, seriously affecting patients' quality of life.

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The Chinese Guidelines for Diagnosis and Treatment of Cancer Pain (2018 Edition) recommend systematic promotion and education regarding pain relief knowledge, as well as the establishment and improvement of a follow-up system for cancer pain patients.[5] In the era of rapidly evolving digital technology, mHealth applications are a promising tool for supporting out-of-hospital patients with cancer pain with evidence-based resources and a convenient follow-up communication platform, equipping them with the skills needed for self-management. These technologies can help patients shift from passively waiting for assistance to taking proactive steps to manage their health. In developed countries, such as the Netherlands, the United States, and Spain, the use of mHealth interventions in cancer pain management is already well established, significantly improving patients' pain control and quality of life[6] and reducing hospitalizations among patients with advanced cancer.[7] The application of mHealth interventions for cancer pain management has advanced significantly in developed countries. However, in China, the development and application of apps for cancer pain management are still in their early stages. Most current approaches rely on telephone and WeChat follow-ups, and comprehensive, user-friendly, and widely adopted out-of-hospital cancer pain management platforms are lacking. This gap hinders the standardization and digitalization of cancer pain management. Although the initial functional modules of an "Internet +" continuing care information platform for patients with cancer pain have been constructed using expert consultation methods, most existing platforms in China do not fully address the needs and preferences of patients and their caregivers for intelligent cancer pain management. Furthermore, the specific requirements of medical staff for such platforms remain unclear. The out-of-hospital management of cancer pain is a complex and lengthy process. Understanding and addressing the multifaceted health management needs of patients with cancer throughout this process is essential to improving their quality of life. In this study, we aimed to interview healthcare professionals, patients, and family caregivers to explore the perspectives and needs of these three groups. The goal was to provide a theoretical basis for the development of a cancer pain continuous care platform that better aligns with the expectations of healthcare professionals and patients in China.

Objectives and Methods

Participants

Purposive sampling was used to conduct semi-structured interviews from March to June 2024 with patients experiencing chronic cancer pain and healthcare workers in the oncology departments of two tertiary grade A hospitals in Shanghai, China. The study complies with the Helsinki Declaration and was approved by the Medical Research Ethic Committee of Naval Medical University (approval no. NMUMREC-2021-026). Informed consent was obtained from all participants. The inclusion criteria for patients, family members, and healthcare professionals were as follows. Patients had to be at least 18 years old, with a clinical diagnosis of malignancy and pain caused either by the tumor or its treatment. The patient must have experienced pain within the past week and have an expected survival time of more than six months. Family members, who had to be 18 years or older, was required to provide home care for the older patient with cancer pain without receiving payment for their services. Both the patient and the family member needed to be capable of using smartphone software, participate voluntarily in the study, have no communication barriers, demonstrate good comprehension skills, and be able to cooperate with the study. For healthcare professionals, doctors had to have more than five years of experience in oncology treatment, hold a master's degree or higher, and volunteer to participate in this study. Nurses also needed to have more than five years of experience in caring for oncology patients, hold a specialist degree or higher, and be willing to participate in this study. Exclusion criteria for patients included having a mental abnormality or serious cognitive dysfunction, pain not caused by cancer or its treatment, or being in a critical and life-threatening condition. For healthcare professionals, exclusion applied to those unable to complete the interview, lack knowledge of cancer pain, or being unable to understand the study's content. Specific information of patients and their families is presented in Table 1, and information of healthcare personnel is presented in Table 2. All subjects signed an informed consent to participate in the study, which included the publication of anonymous direct responses and quotes.

Methods

Formulation of the Interview Outline

A preliminary interview outline was developed based on a review of the literature, discussions among the research team members, and consultations with experts in the pain management department. Pre-interviews were conducted with two

Table 1 Basic Information of Patients and Their Families

Number	Sex	Age (years)	Educational Attainment	Patient's Cancer Type
F1	Male	54	Three-year diploma	Lung cancer
F2	Female	35	Bachelor's degree	Gastric cancer
F3	Female	40	Bachelor's degree	Colon cancer
P1	Female	50	Junior high school	Breast cancer
P2	Female	59	Junior high school	Colon cancer
P3	Male	61	Primary school	Gastric cancer
P4	Male	57	Junior high school	Pancreatic carcinoma
P5	Female	63	High school	Liver cancer
P6	Male	72	Primary school	Gastric cancer
P7	Male	68	Junior high school	Gastric cancer

Abbreviations: F, family member; P, patient.

Table 2 Basic Information of Healthcare Workers

Number	Sex	Age (years)	Educational attainment	Job title	Work experience (years)
D1	Male	39	Doctorate	Deputy chief physician	10
D2	Female	33	Master's degree	Attending doctor	5
D3	Female	41	Doctorate	Deputy chief physician	10
D4	Male	36	Master's degree	Attending doctor	7
D5	Female	35	Master's degree	Attending doctor	6
N1	Female	39	Bachelor's degree	Co-chief superintendent nurse	18
N2	Female	28	BAchelor's degree	Senior nurse	5
N3	Female	29	Bachelor's degree	Senior nurse	6
N4	Female	35	Three-year diploma	Nurse supervisor	10
N5	Female	29	Bachelor's degree	Senior nurse	6
N6	Female	28	Bachelor's degree	Senior nurse	5
N7	Female	31	Bachelor's degree	Senior nurse	8
N8	Female	27	Bachelor's degree	Senior nurse	6
N9	Female	25	Three-year diploma	Nurse	5
N10	Female	24	Three-year diploma	Nurse	5

Abbreviations: D, doctor; N, nurse.

patients, one doctor, and one nurse, after which the outline was refined based on the results of these preliminary interviews. The main points of the interview are outlined as follows. For patients: (1) What difficulties or barriers do you face in managing pain at home? (2) What barriers could be addressed using information technology? (3) Would you be willing to use smartphone software to help manage your pain symptoms? (4) If such software were available, what features would you expect it to include, such as pain monitoring, pain assessment, online consultations, or health

education? For healthcare professionals: (1) How is pain currently managed after patients are discharged, and what issues might arise? (2) If an intelligent software platform were used for cancer pain management, what features should it have, and what suggestions would you offer? For example, functions, such as pain information, assessment and monitoring, and online consultation, could be considered.

Data Collection Method

Face-to-face semi-structured interviews were used for data collection. The researcher conducted the interviews, explaining the study's purpose to both patients and healthcare workers beforehand. Informed consent was obtained, and the interviews were recorded with the participants' consent. Patients with cancer pain or their family members were invited to participate in the semi-structured interviews, which took place in their wards for approximately 30–40 minutes, ensuring that the process did not disrupt their treatment or rest. Clinicians and nurses involved in oncology care were similarly invited for interviews lasting approximately 30–40 minutes, held in a hospital-provided conference room. Prior to the interview, appointments were scheduled with the pertinent medical professionals to conduct this interview during their non-clinical hours. Data collection continued until data saturation was achieved.

Data Analysis Method

The interviewer transcribed the audio recordings verbatim within 24 hours of the interviews. The data were then analyzed using the Colaizzi's seven-step analysis method.[8] The transcriptions were coded and analyzed using NVivo 11 plus software, and the results were subsequently summarized and refined into themes.

Results

Demands from Patients and Family Caregivers

The four demands for a digital cancer pain management platform from patients and family caregivers are convenient pain status recording, medication reminders, health education, and social support. First, many patients with cancer pain expressed a desire for a system that would allow them to easily document their daily pain, enabling doctors to better understand and manage their condition. One participant (P5) noted, "It would be nice to quickly record my pain every day as part of my routine, so I can bring it to the doctor when needed". Another participant (P6) said, "For example, every time you suddenly have pain, you can record it, so that the doctor can see it directly when the time comes". Second, some patients wanted accurate medication reminders based on the doctor's instructions. One individual (P2) shared, "I can set an alarm to remind me. After I enter the doctor's instructions, the app can intelligently remind me, for example, that it's time to take my medicine every day at 8 o'clock. As I take so many medicines every day, sometimes the treatment plan changes, and I take different medications. As I get older, I often forget how to take them". The third demand was for health education. Many patients and caregivers expressed a need for easy access to reliable online resources about pain management through the mHealth app. They suggested that personalized information would be helpful after hospital discharge. A participant (F1) said, "Disseminating knowledge, such as what are the causes of some pain-related illnesses, how to prevent them in daily life, and how to take care of them, would be helpful". Another noted, "For example, if we are discharged from the hospital, I definitely want to ask the doctor, 'What should I eat? What should I avoid?' If that information is in the app, I can check it out. Let us say if you have a stomachache, you can look up what's suitable to eat, whether it's vegetables or dietary therapy, that would be great". Another patient added, "The information provided has to be personalized and useful for me specifically". Finally, social support was an important request, with many patients hoping for the ability to contact their physicians for real-time feedback and assistance. One participant (P7) said, "If I bring up pain for the first time, I can get help, and the doctor can respond within 24 hours, so that I can get timely feedback". Another participant (P3) added, "I hope to get what you would call tracking-type help or feedback-type help". A different participant (F2) said, "If any pain is reported to the app, the doctor can immediately provide feedback and suggest measures to relieve the pain in the current situation". In addition to professional support, some patients also expressed interest in peer support from fellow patients. A participant (P6) shared, "There are a few people in the group who have recovered and are dedicated to encouraging others by sharing their methods. With the same symptoms, everyone communicates in the group and shares any good treatments".

Demands rom Medical Staff

The demands for a digital pain management platform from medical staff were varied. The first demand was for real-time data recording and visualization. Currently, the management of cancer pain in oncology patients after hospital discharge mainly relies on long-term oral analgesics, making precise control and real-time dosage adjustments particularly important. Physicians emphasized the significance of recording patients' pain data in all aspects, including daily pain scores, the number of pain outbreaks, the exact time of day the pain occurs, and its impact on sleep. One doctor (D1) stated, "We hope that the patient can answer two questions: first, whether they can control their cancer pain with the prescribed medication dosage, and second, whether they experience breakthrough cancer pain daily. We adjust the next day's medication according to the number of breakthrough cancer pain episodes they had that day". Another doctor (D3) added, "We would like to know the exact timing of the pain. For example, how long does the medication control their pain after they take it in the morning? If the patient is already in pain two or three hours before the next dose is due, it indicates that the morning dose was insufficient". A doctor (D4) also noted, "In our clinical practice, we can also consider whether the pain is interfering with sleep. If the pain does not disturb sleep, it may not require strong opioid intervention". A doctor (D1) emphasized, "We are also very concerned about the adverse effects of the medication on the patient". Another doctor (D2) highlighted, "Constipation is a common issue for many patients, so it is important to record adverse effects as well". In addition to pain data recording, most interviewees expressed the need for data visualization in the form of graphs and charts. A nurse (N2) remarked, "The pain diary can be turned into a graphical analysis, and if the patient records their pain daily, a curve or line chart can show the trend". A doctor (D2) said, "If we can encourage patients to use the platform, it will be beneficial for us doctors. By simply opening the software and viewing the chart, we can determine whether to adjust their medication". Another demand was for health education support. In clinical practice, patients often have limited knowledge of pain management and misconceptions about morphine-type analgesics. Given the hospital's heavy workload and limited time, medical staff expressed the need to provide online education through live broadcasts or recorded lessons. A doctor (D5) explained, "After the Opium Wars, there has been a significant misunderstanding about morphine analgesics, especially among the older generation. Morphine opioids are frightening to them. We use far less morphine per capita in China compared with Western countries". A nurse (N4) suggested, "Recorded lectures are fine, but keep them simple. Nowadays, there are many animated videos, and they are easy to understand after watching them". Another nurse (N1) proposed, "A regular live broadcast, perhaps at a fixed time every Wednesday evening, could be used to address questions about home cancer pain management, and we oncology nurses would love to be involved in this". There was also a request for autoresponders to handle frequently asked questions (FAQ). Currently, most patients communicate with their doctors through WeChat during pain episodes, but oncologists have a heavy workload. Doctors suggested building a FAQ system to improve efficiency in out-of-hospital cancer pain management. A doctor (D3) noted, "We could create a list of 100 common questions and use artificial intelligence (AI) to provide robotic auto-replies. For common questions, the automated system can give an immediate response". A doctor (D2) agreed, "If every patient uses WeChat to ask the same questions, the doctor's workload becomes overwhelming". A doctor (D1) added, "When the FAQ system cannot address a patient's concern, they can then reach out to us for a personalized response. For example, if a patient reports a headache or dizziness after taking morphine, the automatic response could explain that these side effects usually resolve within 2–3 days". Another important feature requested was medication reminders. Some patients exhibit poor medication compliance, and healthcare professionals hope to set up a reminder system to improve adherence to standardized cancer pain management protocols. A nurse (N7) explained, "Regular medication reminders are essential. Some patients, especially those new to the medication, may skip doses if they are not in pain". A nurse (N8) added, "Another issue is unauthorized dosage increases. Some patients take extra medication when they experience pain, so we need reminders to ensure they take the medication on time and at the correct dosage". Finally, healthcare professionals expressed the need for a dose conversion function for common analgesics. The process of cancer pain management is long and complex, often requiring changes in the type of analgesic, administration mode, or dose due to variations in pain intensity or adverse reactions. Currently, oncologists manually calculate dose conversions using formulas, but they expect that AI could simplify this process. A doctor (D1) said, "For example, if a patient is taking OxyContin 10 mg every 10 hours, what would be the equivalent morphine dose

for breakthrough cancer pain? It would be great if the system could provide that information at the press of a button". A doctor (D3) remarked, "If a patient can no longer take OxyContin, I need to switch them to another medication". A doctor (D2) elaborated, "If there is a dose conversion function integrated into the system, it becomes more convenient for the doctor to adjust the medication based on the patient's current intake of morphine. This is because there is a conversion ratio between morphine, oxycodone, and fentanyl. Additionally, subcutaneous and oral administrations have different conversion factors. For example, the subcutaneous dose is one-third of the oral dose, while the oral dose is three times the subcutaneous dose. When switching to fentanyl, the dose must also be adjusted accordingly. Temporary breakthrough cancer pain can also be calculated as a separate dose in this process".

Discussion

Previous studies on cancer pain management apps for patients mainly focused on pain monitoring, symptom tracking, reminders, education, and support coordination.[7] The most frequently emphasized functions include real-time assistance on the doctor's side and viewing patient pain diaries and reminders for follow-up appointments on the patient's side.[9,10] The results of this study align with those of previous research. However, through qualitative interviews, we have gained a deeper and more specific understanding of the design requirements for each functional module. The stakeholders' functional requirements for the patient side in this survey mainly include a pain diary, online popular science resources, medication reminders, and social support. The functional requirements of healthcare professionals for the doctor's side mainly include the visualization of patient pain trends, health education support, and AI-assisted management.

Pain Diary

In this survey, both patients and healthcare professionals expressed the desire for the cancer pain management platform to include a pain status recording feature. The demand for this function is particularly urgent among healthcare professionals. The interviewed doctors emphasized that the app should comprehensively, dynamically, routinely, and quantitatively record patients' pain status. Effective control of patients' pain during home recovery is essential for the accurate adjustment of medication, and the visualization of charts and graphs can facilitate communication between patients and doctors, improving clinical efficiency. The ecological momentary assessment (EMA) based on mobile medical apps is currently widely used in cancer pain management. This method allows for dynamic assessment of both regular and breakthrough cancer pain through an app, which automatically generates a fluctuating curve of the patient's pain levels.[11–14] EMA is a real-time, naturalistic data collection method designed to study behaviors, emotions, and experiences in real-world settings.[15] In contrast to traditional methods that rely on retrospective recall, EMA collects data at specific points in time or immediately following particular events, thereby increasing the accuracy and representativeness of the data. Through the app, patients can record the intensity and nature of their pain, its impact on their mood and activity, and the coping strategies they are adopting, all in real time or upon the onset of pain. This reduces recall bias and provides more reliable data compared with retrospective monitoring. Emphasizing the importance of this feature in future designs of cancer pain management apps is crucial to provide clinicians with richer, real-time pain information, allowing them to develop more effective pain management strategies.

Online Popular Science Resources

In this study, both healthcare professionals and patients expressed a strong desire for increased educational and training support features. The findings indicated that oncology healthcare professionals had a positive attitude toward recording pain management videos and conducting regular live broadcasts to answer patients' questions about cancer pain management. Meanwhile, patients expressed a desire for personalized health education content tailored to their needs. In China, the majority of studies have provided patients with health education support by establishing a cancer pain education resource library within an app for patients to access. Additionally, some studies have implemented the regular distribution of cancer pain knowledge through WeChat, with unified content pushed at set intervals each day.[12,16–19] However, this content usually fails to meet the individualized pain management needs of patients, offering limited support for self-management. The learning resources embedded in the app, such as videos, text, and images, are static tools for science popularization. These resources often lack targeted, dynamic updates, making it difficult to address the

evolving needs of patients with cancer pain in a timely manner. They also do not provide longitudinal support for the dynamic changes that occur in the cancer pain experience. The cancer pain management app designed by Azizoddin et al can provide short and tailored popular science content based on participants' current pain levels, mood, medication use, and sleep patterns, utilizing instant adaptive intervention algorithms. In a user acceptability test, patients with cancer pain rated this customized information as "engaging, tailored to their needs, and easy to navigate.[20,21] Just-In-Time Adaptive Intervention is an emerging approach to providing real-time, personalized support, aiming to leverage digital health technologies to provide the right support to the right person at the right time.[22] The medical staff interviewed in this study expressed a desire to address the latest questions from patients during home cancer pain management through weekly live Q&A sessions, providing dynamic support that complements the built-in resources of the app. Considering patients' demand for personalized cancer pain education, future designs of cancer pain management apps may benefit from incorporating algorithm-driven personalized content delivery and regular online live Q&A sessions. These features could help align popular science content more closely with patients' specific needs, thereby optimizing cancer pain education and enhancing self-management support.

Medication Reminders

The interviewed patients and healthcare professionals expressed a strong demand for medication management features. Wang et al[23] showed that home caregivers of elderly patients with cancer pain also had a high demand for the medication guidance function of a cancer pain management app, which aligns with the findings of this interview. Numerous studies have revealed that patients with cancer pain often miss medication doses, take incorrect measurements, self-discontinue medication, or reduce dosages due to concerns about addiction or adverse reactions, creating significant challenges in pain management.[10,24] Several studies have incorporated medication reminder modules into cancer pain management platforms. Greer et al[25] showed that mHealth app can improve medication compliance for chemotherapy drugs in oncology patients, while Chen et al[26] reported a reduction in constipation incidence during out-of-hospital opioid analgesic use through timed guidance on the WeChat platform. In their study, Zhang et al[10] found that healthcare professionals set the name, frequency, dosage, and method of daily medication based on each patient's condition. The patients in this study expressed a preference for a one-click entry of their medication orders, with some elderly patients requesting voice reminders. These insights can serve as valuable references for the design of future medication reminder modules, with the potential to improve medication adherence, patient engagement in self-management, and overall health outcomes.

Social Support

The patients interviewed in this study expressed a high demand for social support functions. Patients with cancer pain hoped for real-time responses from authoritative healthcare professionals when they encountered difficulties, as well as opportunities for communication and mutual support with fellow patients. Consistent with previous research, home caregivers of elderly patients with chronic obstructive pulmonary disease and patients with elderly cancer pain also exhibited a high demand for peer support functions in mobile medical apps.[23,27] Good peer support and strong family support can alleviate patients' stress, help maintain their physical and mental health, and improve their overall quality of life.[28] The participation of medical professionals is equally important. As Liu et al[29] demonstrated, they established two communication platforms, expert consultation and patient's home, within the interactive cancer pain self-management app. In two separate studies, Kamdar et al and Villegas et al integrated a clinical alert function into their cancer pain management apps, which triggered real-time feedback from clinicians when the patient's pain score significantly increased or the dosage of analgesics rose.[11,30] A systematic review showed that apps with an instant messaging module resulted in greater improvements in metrics such as patients' cancer pain levels, quality of life, and the frequency of pain flare-ups. Real-time communication with healthcare professionals may be a key factor influencing the effectiveness of cancer pain management apps.[31] In the future, when designing the patient-facing aspects of cancer pain management apps, attention should be focused on patients' strong demand for social support modules. The role of this module in out-of-hospital cancer pain management is essential. In addition, incorporating an early warning system to ensure that healthcare professionals can intervene immediately at critical moments, as well as promoting compliance with

standardized management through family involvement and peer education, will be key measures for improving patient outcomes.

AI Assistance

In this survey, the responding physicians expressed a desire for the cancer pain management app to include built-in AI assistance functions to optimize the cancer pain management process. They mainly hope to receive assistance in responding patients' FAQ and in converting drug doses, a need that may stem from the lower doctor-patient ratio and heavier workloads that physicians in developing countries often face. Currently, most patients with cancer pain in China contact their doctors through WeChat, a social networking software, or by phone when they encounter problems managing their pain at home. Some studies have implemented an expert consultation module within the app, allowing patients to contact healthcare staff for one-on-one online consultations and guidance when they have questions during their at-home pain management.[29,32] However, healthcare professionals involved in managing the mHealth platform still have their own workloads, and their availability online is limited. As a result, the timeliness of their interactions with patients can be restricted, leading to delays in responding to messages and a reduction in the convenience that the mHealth platform aims to provide.[9] Kamdar et al developed a cancer pain management app that categorizes patient-reported outcomes data through AI to quickly identify barriers to pain control. This is followed by patient-facing education and real-time responses provided through the app.[30] These findings are consistent with the expectations of the physicians interviewed in this study that common questions would be answered by AI while more complex questions would be addressed manually by healthcare professionals. Although no previous studies have reported the presence of a dose conversion module for commonly used analgesics on the doctor's side of a cancer pain management app, such a function could reduce clinicians' workload and improve the efficiency of cancer pain management. Thus, incorporating this feature into future AI-assisted modules could serve as a valuable direction for app development. This would provide significant support for healthcare professionals in optimizing cancer pain management strategies and ultimately improving patient prognosis.

Clinical Implications

This qualitative study evaluates patient and healthcare provider perspectives on an intelligent cancer pain management platform. Utilizing multi-angle interviews, the research uncovers previously overlooked user needs in the development of such platforms in China. Findings indicate that user requirements for a cancer pain management application are organized into five themes: pain status recording, medication reminders, health education, social support, and AI assistance.

Study Limitations

However, there are some limitations to our study. The interviewed cancer pain patients were all older than 50 years old, and the needs of the youth group were missing from the study results. Second, due to objective factors, this study was conducted in only two tertiary hospitals in Shanghai, with limited sample representation. In the future, there is still a need for further research on cancer pain patients in different regions and age groups in China to obtain more accurate and representative results.

Conclusion

In summary, this study explored the challenges of out-of-hospital cancer pain management and the specific needs for intelligent solutions through in-depth interviews with patients with cancer pain, primary family caregivers, and healthcare professionals. Based on the demands, this paper proposes a vision for constructing an intelligent management platform for patients with cancer pain. Such a platform could provide a reference point for future follow-up design, facilitate the development of out-of-hospital cancer pain management tools in China, and promote the dissemination of high-quality popular science resources of cancer pain. Ultimately, this could improve the quality of life for patients with cancer pain in China.

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