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Parents' information needs and perceptions of chatbots regarding self medicating their children

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This qualitative study aimed to better understand parents' information needs and perceptions of chatbots for self-medicating their children and developing chatbots for self-medication. A qualitative study was employed. Semi-structured interviews were conducted from October 2023 to December 2023. The interview data were analysed using a thematic analysis method. A total of 26 participants were interviewed by trained interviewers. Four key themes were identified: (1) Multiple information needs for self-medication; (2) Factors promoting the use of chatbots in self-medication; (3) Factors hindering the use of chatbots in self-medication; and (4) Expectations and suggestions for chatbots design. The parents' perspective provided important insights into the design of the chatbot conversational interfaces that could help improve parents' practice of self-medicating their children. Although most participants were unfamiliar with chatbots, they were generally optimistic about their convenience, reliability, and benefits that would reduce medical burdens and cross-infection. When designing chatbots in the future, we will focus on the privacy and financial security, information recognition and cost issues to design chatbots with various transmission forms, communication interaction, health tracking and feedback functions.

Keywords Self-medication, Parents, Children, Information needs, Chatbots, Qualitative study

Self-medication, defined as the use of medicines to treat self-diagnosed illnesses or symptoms without a healthcare provider's prescription, was reported as a common phenomenon of interest to public health, particularly among children^{1,2}. As the primary implementers of self-medication for children, parents directly impact the safety and effectiveness of this practice. Globally, studies have reported that self-medication for children by their parents ranges from 32 to 86.6%^{3,4}. Common medicines include cough and cold medicines (CCM), fever-reducing pain relievers (such as paracetamol and ibuprofen), respiratory medications, gastrointestinal medicine, antibiotics and vitamin supplements³.

Children are still developing and have different pharmacokinetics (PK) and pharmacodynamic (PD) characteristics, so they are vulnerable to adverse drug events⁵. Every year, nearly 9 million children under the age of five die worldwide, a large proportion of which are caused by the irrational use of medicines⁶. Surveillance data from the United States has reported that more than one-third of poisonings in children under five years of age are caused by medical abuse⁷. During childhood (three to eleven years of age), children's nervous and endocrine systems, blood-brain barriers, liver detoxification capabilities, and other bodily tissues are not fully developed. Consequently, even minimal usage of incorrect medication can lead to irreversible harm, including impaired liver and kidney function, secondary infections, increased risk of asthma, dental enamel dysplasia, and hearing loss^{8,9}. Hence, minimising the risks associated with parental incorrect self-medication is paramount for ensuring pediatric health and safety.

China has 253.38 million children aged 0–14. A recent national survey conducted in China revealed that 24.21% of parents reported having self-medicated their children in the past 12 months¹⁰. Studies by Lin et al. have shown that the rate of unreasonable self-medication was as high as 12–32%, and inappropriate use of antibiotics for respiratory tract infections in Chinese children is very rampant^{10,11}. A recent meta-analysis reported that the incidence of parents improperly self-medicating children was as high as 57%¹². Parental knowledge is considered one of the biggest risk factors for medication safety. Contrary to the prevalence of parent's self-medicating children, they have a limited understanding of the related knowledge regarding self-medication. Therefore, providing adequate knowledge and support information is essential to ensure the safe

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and effective use of medications when self-medicating their children. Parents' information needs not only cover the knowledge of the drug itself, such as the safety of drug use, dosage, time, potential side effects, disease management, treatment compliance, etc., but also include information about when to seek medical treatment, how to monitor symptoms, how to deal with emergencies and other health management related information¹³. Without the necessary information, parents would make bad decisions and create unnecessary health risks. In this process, the issue of how to clarify the information needs of parents for self-medication becomes an urgent and pervasive challenge.

Emerging digital health technologies, particularly conversational agents, offer promising avenues for engaging users and serving as effective self-medication management tools^{14–16}. These agents, commonly called chatbots, interact with users in natural language through text or voice mediums¹⁷. Their potential for driving behaviour change in health-related contexts is evident through their adept handling of data processing in conversations, encompassing data input, analysis, and output stages¹⁸. The increasing widespread availability of technology and internet access underscores chatbots' ability to provide easily accessible, self-serving, and appealing health information and services. Recent evidence underscores the potential to enable users to actively participate in self-management tasks, which provide flexible on-demand support, personalised assistance, and sustained connectivity, thus mitigating the limitations of remote healthcare services^{19,20}.

However, despite their promise, chatbots remain predominantly utilised for promoting healthy lifestyles, smoking cessation, and medication adherence, with scant attention devoted to parents self-medicating their children²¹. In addition, existing research mainly focuses on chatbots' acceptability and positive health outcomes, lacking a comprehensive understanding of users' needs. Therefore, understanding parents' information needs is key to developing more user-friendly and functional health support tools, which can provide the functions and personalized services actually needed by parents. Addressing these considerations is crucial for optimising the design and functionality of chatbots to support self-medication management effectively. Consequently, there is a pressing need for a descriptive qualitative approach based on naturalistic inquiry to deepen a better understanding of user needs and preferences, thereby informing the refinement of chatbot interventions to enhance parents' practice for self-medicating children. This study endeavours to bridge this gap by exploring parents' information needs and perceptions of chatbots for self-medicating their children, contributing to advancing digital health interventions in this domain.

Methods

Study design

The descriptive qualitative study is part of a larger research project using mixed research methods to develop chatbots designed to improve parents' behaviour for self-medicating their children. The larger research projects last about three years. This study will guide the design of Chatbots' basic interface and functions.

From October 2023 to December 2023, this study was conducted at Xiangya Hospital, Central South University, China. A descriptive qualitative approach was adopted based on naturalistic inquiry²². Two trained researchers conducted in-depth interviews with 26 parents with at least one child. The methods of this research were performed in accordance with the consolidated criteria for reporting qualitative research (COREQ)²³.

Research question and research hypothesis

The main research questions of this study were as follows: (a) What information needs do parents have for self-medicating their children? (b) What do the parents think of chatbots for self-medicating their children?

We hypothesized that chatbots could help parents self-medicate their children and improve medication safety. Our purpose was to design chatbots, so this qualitative study would provide a basis for chatbots' interface settings.

Acknowledging the likelihood of limited exposure to chatbots technology among participants, an introduction to chatbots was provided through a description and a short explanatory video. We have included the links to both the original Mandarin video and the English version to enhance understanding for a global audience (<https://haokan.baidu.com/v?pd=wisenatural&vid=16579218761689348899> and <https://m.youtube.com/watch?v=o9-ObGgfpEk&pp=ygUHY2hhdGJvdA%3D%3D>). The chatbot was described as 'a system capable of communicating with individuals, often referred to as a virtual assistant or coach, though it is not a human. The presented video showcased a text-based health chatbot, focusing broadly on health and wellness without specifying any particular medical condition or emphasising children's self-medication.

Participants and recruitment

Recruitment for this study employed a combined approach of purposive sampling and maximal variation sampling through the electronic medical information system of Xiangya Hospital, Central South University. Through purpose sampling, parents related to the research topic could be selected, which could ensure the relevance of data and save time and cost. Through maximal variation sampling, individuals with the greatest difference were selected, thus capturing the diversity of research objects. The sampling strategy aimed to encompass diverse clinical and sociodemographic characteristics; participants with varying ages, regions, educational levels, family relationships, and economic status were recruited. Specifically, the goal included a varied representation: at least five parents or guardians aged 40 and above, five from minority ethnic backgrounds, five males, five with education levels below college, and five individuals managing and administering at least three medications to their children. This intentional blend of purposive and maximal variation sampling sought to capture a comprehensive spectrum of perspectives on information needs and chatbots across different demographic groups. Considering the different cultural backgrounds, this study deliberately selected two non-Chinese participants. After identifying cases, the researchers explained the purpose and significance of the

study to potential participants by telephone and obtained the participants' verbal consent. Then, the face-to-face interviews were conducted.

The inclusion criteria for participants are as follows: (a) being a parent of a child younger than 18 years, (b) caring for the child, (c) being able to read Chinese, and (d) only one parent from each family participated in the interview, both parents were not interviewed together. Participants with severe cognitive, mental, or conscious impairment were excluded. All participants in contact agreed to participate in the interview. Sample size determination relied on data saturation, where participant information reached a point of repetition without introducing new code during analysis, indicating saturation²⁴. After interviewing 26 parents and analysing the data, the team agreed that the data had reached saturation and that data collection had stopped.

Ethical approval and consent

The study was approved by the Ethics Committee of Xiangya Hospital of Central South University (registry ID: 202307165). Written informed consent was obtained from all participants. Participants could decline to answer any questions and withdraw from the study at any time. The study complied with the Declaration of Helsinki. All individual and institutional data were encrypted and saved by the researchers. Only researchers have access to the data.

Data collection

The same researchers conducted each interview to ensure consistency. All the authors had experience in child health care and qualitative research. To maintain objectivity and avoid conflicts of interest, there will be no pre-existing relationships between the interviewers and the participants. Each interview took place in a private office, involving only the participant and the interviewers. Two skilled qualitative researchers trained in interview techniques conducted in-person, semi-structured interviews using an interview guide. Before the interviews commenced, the interview guide underwent pilot testing. We selected 3 parents from the target group as pilot participants and conducted pilot interviews in person by members of the research team. In the pilot interview, the interviewees were able to understand and answer the questions without confusion or difficulty in understanding. The interview duration was properly controlled, each interview lasted about 60–90 min, and all scheduled interviews were completed without any participants withdrawing or requesting early termination. The semi-structured interview began with a brief introduction to the topic (for example, the definition and interpretation of "Self-medication"). Subsequently, participants shared insights into their current practices regarding self-medication for children and their specific information needs. Then, researchers introduced the chatbot through a description and a short explanatory video. Following the video presentation, participants were asked to share their perceptions regarding the potential use of a chatbot to support children's self-medication. Insights into perceived barriers and facilitators in using a chatbot for this purpose were also solicited. The interviews were audio recorded with the consent, and the duration ranged from 64 to 172 min, with an average of 69 min. During and after each session, the interviewers took brief notes. Additionally, they recorded pauses, sounds and tones, specific emotional expressions, and specific body language. Demographic information for respondents was entered into a standardised data sheet and sorted in Excel. The interviews were conducted in Chinese. All interviews were audio-recorded in their original language without translation during the data collection phase, and the transcripts were subsequently translated into English for the purposes of this study. The translation was performed by a bilingual researcher proficient in both Chinese and English, who has expertise in qualitative research. The translated text was reviewed by a second bilingual researcher to ensure accuracy. In cases where discrepancies were identified, the original Chinese text was revisited to ensure fidelity. Additionally, a back-translation approach was used to further verify the quality and accuracy of the translation.

Data analysis

After the interviews, within a 24-h, the researchers transcribed the audio recordings into textual form while making annotations concerning the interviewees' emotional shifts and facial expressions. The team checked for accuracy before analysing, and the data analysis methodology involved Braun and Clarke's thematic analysis method²⁵, encompassing several pivotal steps: (a) Thoroughly reviewing the interview transcripts multiple times to grasp the underlying thematic essence, (b) Identifying specific details pertinent to the facilitation of self-medication in children using chatbots technology, initiating the creation of preliminary codes, (c) Organising and grouping these initial codes into latent themes, (d) Scrutinising and validating these latent themes further, potentially refining or amalgamating themes based on criteria evaluating their internal coherence and external variations, (e) Delineating the content and vocabulary of each thematic domain. The initial coding was independently carried out by two authors, with a third author regularly monitoring and intervening in case of differing opinions. Then, the fourth author reviewed all coding results. In the process of inductive coding and deductive classification, if there was any inconsistency, the research team engaged in discussions to achieve consensus, thereby ensuring the precision of the study's outcomes. Finally, the research group discussed and reviewed all the identified themes and categories.

Results

A total of 24 Chinese participants and two non-Chinese participants were interviewed. The differences in age, education level, income, region, and so on among the participants broadly reflected the information needs of self-medication and the perception of chatbots. Table 1 shows the detailed demographic characteristics of the participants. Figure 1 shows the thematic map that reveals the connections between the four main themes.

| Demographic characteristics | Frequency(%) |
|--|--------------|
| <i>Age(years)</i> | |
| ≤ 30 | 3 (11.5) |
| 30 to 40 | 16 (61.5) |
| ≥ 40 | 7 (28.0) |
| <i>Gender</i> | |
| Female | 19 (73.1) |
| Male | 7 (26.9) |
| <i>Education level</i> | |
| Junior high school and below | 9 (34.6) |
| Senior high school or technical secondary school | 5 (19.2) |
| College or bachelor's degree | 10 (38.5) |
| Master's degree or above | 2 (7.7) |
| <i>Marital status</i> | |
| First marriage | 14 (53.9) |
| Remarriage | 3 (11.5) |
| Others (divorced, widowed, unmarried) | 9 (34.6) |
| <i>Areas</i> | |
| Urban | 11 (42.3) |
| Rural | 15 (57.7) |
| <i>Number of parents' children</i> | |
| 1 | 8 (30.8) |
| ≥ 2 | 18 (69.2) |
| <i>Monthly income (CNY)</i> | |
| < 3000 | 3 (11.5) |
| 3000–5000 | 15 (57.7) |
| > 5000 | 8 (30.8) |
| <i>Experience of parents self-medicating children during the past three months</i> | |
| Yes | 12 (46.2) |
| No | 14 (53.8) |
| <i>Children's age (years)</i> | |
| ≤ 3 | 2 (7.7) |
| 4 ~ 6 | 10 (38.5) |
| 7 ~ 12 | 13 (50.0) |
| ≥ 13 | 1 (3.8) |
| <i>Experience using chatbots</i> | |
| Yes | 3 (11.5) |
| No | 23 (88.5) |
| <i>Attitude towards chatbots</i> | |
| Positive | 24 (92.3) |
| Negative | 2 (7.7) |

Table 1. Demographic characteristics (n=26). CNY stands for Chinese Yuan.**Theme 1: multiple information needs for self-medication***Common pediatric medications information list*

Participants noted that self-medication is somewhat convenient for simple diseases such as colds, coughs, diarrhea, etc., that do not require a visit to the doctor. However, medications differ from ordinary commodities; their efficacy and side effects coexist, and medication information is complex. Unable to use the right drug can cause irreversible harm to children. Therefore, they hoped to understand the common pediatric diseases and the corresponding medications so that children with simple diseases could be correctly handled to enhance the safety of self-medication.

I often struggle to identify the right medication for my child's frequent colds and fevers. I would like to know more about the types of medication corresponding to common diseases such as fever-reducing medicine and anti-nausea medication. (P4)

It is also a challenge for parents to choose the appropriate dosage of medications for different children. The physiological functions of children's bodies are not yet mature, and the process of drug absorption, distribution,

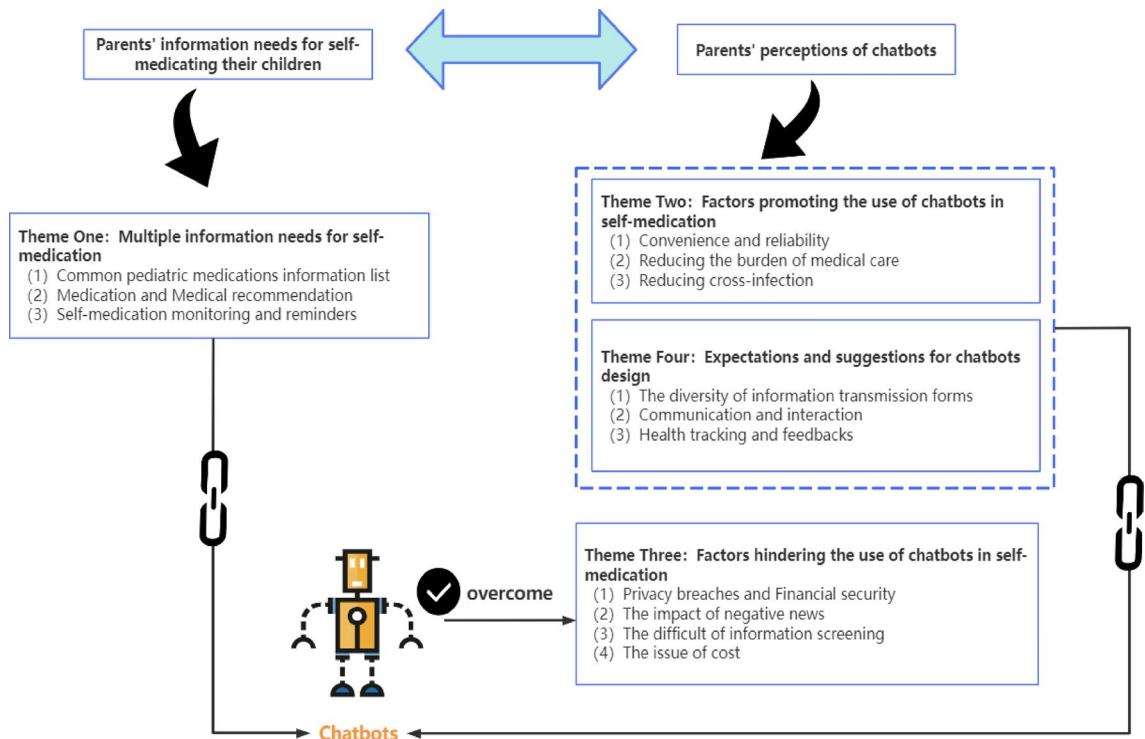


Fig. 1. A thematic map revealing the basis for the development of chatbots.

metabolism and excretion in the body is different from that in adults, so the dosage of children's drugs is not a simple reduction of the adult dose. Many parents said that while they knew which drugs to take for the disease, they were unclear about the dosage and timing, so they were eager to know the right amount and time of medication to prevent over- or under-dosing and to ensure that drugs were used for the best results. Additionally, they wanted to understand the basic principles of medication use in children, precautions, and treatment of common problems, such as adverse drug reactions and possible side effects, to make the right decision in the process of self-medication.

My child had a poor immune system, from time to time fever, cold. After finding out which medications to use, I wanted to know the precautions for taking them. The dosage and how to take them, like whether they should be taken before or after meals... It would be even better if I had this information. (P13)

I wished I knew more about the potential side effects, contraindications and storage requirements for the medications I gave to my child. (P1)

Medication and medical recommendation

Participants noted that the causes of childhood illness were intricate, and selecting the appropriate medication based on the cause was crucial. Still, that lack of professional medical knowledge often made it difficult to identify complex causes. So, they wanted to be able to get the *first* diagnosis and recommendations based on symptoms.

If I described my child's symptoms and then shot the video, it could immediately make a first diagnosis and give me relevant medication notifications, which would be something I desperately needed. (P25)

If my child had a rash on his skin, how would I have identified whether it was due to an allergy or a skin disorder? We all knew that different causes might necessitate different medications. Then, we wanted to know what medications were recommended for this disease and how to take them... (P19)

Some parents noted that they don't know the risks of their children taking the drugs or when and how they work. They often worry about the safety and reliability of over-the-counter drugs. A clear explanation of the drug's safety and reliability would alleviate their concerns. In addition, some participants believed that different routes of administration had different therapeutic effects. The choice of the route of administration is directly related to the speed, intensity and duration of drug action, which in turn affects the treatment of the disease and the child's health. There is a pressing need for parents to compare medication administration methods and selection advice.

Understanding the differences between administering medication orally or through injections would help me make informed decisions. (P21)

When self-medication was not available or the condition was urgent, parents thought that guidance in selecting appropriate medical institutions could reduce the waiting time and save time cost for them and their children.

Recommending the nearest medical facility would be a great convenience for parents. At the same time, they hoped to foresee common issues during the medical process in advance to take appropriate measures.

Choosing the right healthcare facility for my child was overwhelming. Clear guidance would make this process less daunting. (P14)

Navigating the medical process is complex, and I often feel lost. Having a list of common issues to anticipate would be beneficial. (P1)

Self-medication monitoring and reminders

With the fast pace of modern life, parents said they are too busy with work or other tasks to remind their children to take their medicine on time. Almost all participants wanted to be able to send automatic reminders based on a preset time to ensure that the child did not miss the time to take medication, thus better managing the child's health. Therefore, the reminders of the frequency and time of medication would be very helpful to busy parents.

The best thing I needed would be a reminder of the times to take medications because there were many pressures and duties, such as work and household chores. (P17)

Parents noted that encountering issues during the self-medication process was common, and having related reminders and readily available solutions would alleviate their concerns. Parents hoped that by monitoring the relevant indicators after children's medication, they could timely evaluate the effect of medication and find potential adverse drug reactions to take necessary intervention measures to ensure the safety of children's medication.

Understanding which indicators to monitor after administering medication would provide me with peace of mind about my child's well-being. (P3)

Theme 2: factors promoting the use of chatbots in self-medication

Convenience and reliability

Some participants thought high-quality medical resources are mainly concentrated in big cities and developed areas, while rural and underdeveloped areas are relatively poor in medical resources. Due to the shortage of medical resources, many patients are faced with the problem of difficult medical treatment. Most participants expressed a positive attitude towards the chatbots, outlining that they could be concise, useful, and user-friendly. Many parents said that due to the limitations of personal work and professional resources, coupled with limited time and energy, the convenience of chatbots would enable them to deal with some simple diseases of their children at home. The rich medication advice and medication information of chatbots would enhance parents' confidence in self-medicating their children and could reduce unreasonable medication behaviour.

How convenient it would have been to use a chatbot to help manage my child's medication, just like chatting with a friend on a mobile phone! It could remind me when to take the medication and answer questions about what to take. Like a clever little assistant, it could remind me at any time...I thought it would have been a handy tool to help me manage my child's health more effectively. (P18)

Reducing the burden of medical care

Many parents stated that the chatbot would solve the pain points of busy work and life and waiting in line, allowing them to handle some minor ailments of its children at home. They could quickly obtain first diagnosis suggestions and medication guidance through chatbot, avoiding unnecessary hospital visits. Some simple medical problems would be solved at the family level, thereby reducing the pressure on the medical system and contributing to the easing of strained medical resources so that medical resources could be more rationally allocated to patients requiring urgent and complex treatment.

As far as I am concerned, there is a lack of pediatric professionals around me, and coupled with my busy work schedule, I was very reluctant to take my child to the hospital for simple illnesses...As an ordinary citizen, I was willing to use such intelligent means (chatbots) to obtain relevant information. If you could develop such an APP to provide us with these resources, that could alleviate the burden of seeking immediate medical help for minor issues. (P7)

Reducing cross-infection

The hospital is the place where the patients gather. Because of the large number of patients, the complicated conditions and the great mobility of people, the risk of cross-infection is relatively high, especially for children with relatively weak immunity. Three participants noted that if there were chatbots, the initial treatment and care of children would be carried out at home, thus avoiding the prolonged exposure of children in the hospital environment, reducing the chance of contact with pathogens, and reducing the possibility of contact with other patients in the hospital.

I had to wait in line to go to the hospital. There were so many children in the hospital, and I was worried that he would cross-infect my children. If you can do this well (chatbots), then these problems won't exist. (P22)

Theme 3: factors hindering the use of chatbots in self-medication

Privacy breaches and financial security

Most parents were concerned that chatbots would collect users' personal information while interacting with users, including sensitive data such as children's names, ages, medical histories, and medication records. Once personal information is leaked, they might be exposed to fraud, identity theft and other risks, resulting in property damage or credit damage. In today's digital age, cybersecurity and privacy protection are critical, especially when dealing with sensitive data involving personal financial information.

I was open to sharing limited information, but when it came to sensitive data, like my child's face, I would have preferred privacy measures such as blurring or using partial images. (P3)

I would be cautious about linking my financial accounts such as Alipay to any platform (including a chatbot), and would prioritise its security. (P15)

The impact of negative news

For most non-medical residents, drug advertising is an important way for them to learn about drugs. However, there are serious phenomena of falsification and exaggeration of curative effect in drug advertisements on the main mass media, newspaper, TV, Internet and radio. Some parents said they would not trust the information from intelligent devices such as chatbots because of the negative news.

Because we had seen a news report before about a person who sought medical advice on Baidu (A Chinese search engine and technology company, similar to Google) but ended up passing away, sometimes I didn't fully trust information found online. (P9)

The difficulty of information screening

In the online world, various information is emerging in an endless flow, and many advertisements exist. The accuracy and reliability of this information are uneven, making it difficult for parents to make correct judgments. Participants would be concerned that the drug information provided by chatbots lacked the guidance and review of professional doctors, resulting in them being unable to correctly distinguish key information such as drug indications, usage and dosage, and adverse reactions.

Now the information is overwhelming. Maybe the information provided by chatbots might not be selected. We wouldn't know whether the advice given to you was correct or incorrect I would be also concerned about unsolicited advertisements while using chatbots. (P1)

The issue of cost

Many parents said they would consider cost performance and prefer to take their children to a hospital they were familiar with if chatbots charged. If the service cost is too high, it would cause some users to seek other, more economical forms of self-medication or consult a professional doctor.

From the perspective of an ordinary user, if the cost of a chatbot were the same as going to a local hospital, I would choose to go directly to the local hospital because we have a good understanding of it. However, if your charges were the same but you were equipped with better doctors and nurses than our local hospital, I would be more inclined to choose you instead. (P15)

Theme 4: expectations and suggestions for chatbot design

The diversity of information transmission forms

Affected by factors such as age, education level, area and personal habits, as well as differences in the multiple cognition, current needs, personal interests and digital literacy of chatbots, parents have obvious differences in the application scenarios and preferences of chatbots and their needs for self-medication chatbots are more diverse in the forms of information transmission.

If the video is very long, young people would feel it is a waste of time and may be willing to watch some words and pictures. However, some education levels, such as rural mothers, are low, so video is more intuitive for them. So I feel that there should be text, pictures, and videos so that they can choose their suitable form according to the time and preferences of different people. (P6)

In addition to individual differences, participants choose different forms in different situations. When the child has mild symptoms, the text form will be selected first, but when the child's condition is complex or to carry out complex operations, it is necessary to look at pictures or videos. In general, simpler and more efficient is better.

We were both very busy at work, so I prioritised reading text and pictures quickly. But when we didn't understand the picture, I would watch the video; for example, my child had asthma, and he wanted to do atomisation inhalation at home, like more complex; if only looked at the picture and text, it was certainly not understood, then I must watch the video. (P17)

Communication and interaction

Parents are often very nervous when their children are sick; their anxiety and need for quick judgment of their children's illness make it difficult to distract themselves and describe symptoms in detail by typing. In this case, communicating with chatbots through voice allows parents to quickly and accurately describe their children's symptoms while taking care of their children. When it comes to self-medication, parents wanted to have direct access to support and advice from medical professionals. Most participants expected chatbots to provide

real-time online counselling services, allowing parents to communicate with medical professionals via voice recognition.

When the child is not comfortable, I am very anxious, and the child has been crying there; you also let me type words to describe; I am certainly not willing to. It would be best if it (chatbots) could know my exact description of the symptoms and conditions by voice. (P15)

I think the most important thing is to have a platform that can provide support and advice by healthcare professionals. (P26)

According to different needs, parents wanted to choose different interaction frequencies. Some parents thought the child was not sick and would not be willing to communicate with chatbots. Some parents thought that to maintain a fixed interaction frequency with chatbots, they all hoped that chatbots could immediately make feedback according to the request.

I expected the chatbot to respond promptly whenever I had queries. When interacting with the chatbot, I preferred it to address my concerns quickly and clearly. (P10)

I thought it's reasonable to interact with the chatbot once a day or once a week to promptly ensure I get the necessary medication reminders and health management advice. Each interaction lasts only a few minutes, ensuring I get the information I need quickly and without spending too much time. (P5)

Health tracking and feedback

Parents think self-medication is a long-term process, and continuous monitoring and feedback are crucial for children. Participants hoped that chatbots would record the user's health information and the type, dosage, and frequency of drugs used. They hoped that according to the user's scheduled time after taking the drug, the system could automatically asked the user whether the child's condition had improved and whether there were any adverse reactions to ensure drug safety and compliance.

In addition to giving information about medications, keeping information about children's health condition saved time, which would be very important to us. (P8)

After taking this drug for a while, it would give me feedback on whether the effect was good or bad. If the drug didn't work, it (chatbots) could further recommend experts to us. Hopefully, chatbots had those functions. (P22)

Discussion

To our knowledge, the study is the first to explore parents' information needs for self-medicating their children and their perceptions of chatbots. Parents strongly demand relevant information about common pediatric drugs, medication and medical recommendations, reminders, and monitoring. This is consistent with the needs of parents for children's medication management in previous research, such as giving medications correctly, scheduling and attending doctor's appointments, identifying side-effects of medications or treatments, etc.²⁶. However, the study provides a deeper understanding of the need for information. In addition, through qualitative interviews, this study explored the promoting and hindrance factors of chatbots in self-medication in-depth and collected the participants' suggestions on the functional design of chatbots. Although most participants had no contact with chatbots before, they had an optimistic outlook towards using them in self-medication practice.

In our survey, a considerable part of the population did not have the relevant knowledge of medication, including dose, timing, drug interactions, drug selection, access, adverse drug reactions and side effects. This is consistent with the study by Tarciuc et al.²⁷, which argues that when parents self-medicate their children, they are prone to errors due to limited knowledge. Our interview showed an urgent need for parents to understand the information related to common pediatric medications, such as common diseases and corresponding medications, dosage and precautions for medications, etc., which is similar to the study by Tang et al.²⁸. Safe medication requires the right patient to take the right medication in the right way at the right time²⁹. Medication must be evaluated individually according to age, weight, and other information for children as a special group. The use method, dosage, administration route and course of treatment of various drugs are determined by rigorous clinical trials and doctors' judgment of patients' conditions combined with theory and experience and can not be changed at will⁸. The World Health Organization (WHO) has found that self-medication by individuals with less knowledge of drugs may lead to multiple potential risks³⁰. Additionally, our research has found that most parents were busy with work, so they easily forgot the time spent taking medication and monitoring related indicators. All participants needed reminders and monitoring, such as medication timing reminders, monitoring indicators after medication reminders, and possible issues and countermeasures reminders during self-medication. This is consistent with the results of the study conducted by Griffin et al.³¹ on the self-medication needs of hypertensive patients. Unlike Griffin et al.'s study³¹, our study has identified some additional needs for parents, such as access to symptom diagnoses and recommendations, clear explanations of drug safety and reliability, and medical provider referrals. Some parents have shown that the self-diagnosis of children is based primarily on the experiences of friends and family and past drug use rather than on a correct understanding of symptoms. The etiology of children is complex and diverse, and proper diagnosis is the prerequisite of safe medication use. Judging the disease based on symptoms and recommending appropriate drugs is essential. When recommending drugs for parents, it is also urgent for them to obtain a detailed explanation of drug safety and the best medication administration methods. If self-medication does not solve the current problem, getting recommendations about the appropriate medical institutions and any issues arising during the medical process is necessary.

With the development of Internet technology, digital medical care has gradually become a trend to improve the efficiency of medical care. Our research found that chatbots, as an emerging digital technology, coexist with parents' concerns and expectations, which is aligned with research by Mehdizadeh et al.³² While most had not used chatbots before, almost all agreed that they could be helpful in the management of self-medication, such as reminding people to take medication, providing information about medication and communicating with members of the healthcare team. Through the professional medication knowledge provided by chatbots, parents can scientifically use medicines for children at home, avoiding aggravation or repeated attacks caused by improper medication, thereby reducing the need to go to the hospital, particularly benefiting parents in rural areas where medical facilities are less developed, providing them with great convenience. However, despite these advantages, we found that there are still some challenges to overcome. Participants expressed concerns about privacy breaches, the security of funds, the accuracy of information provided, and the cost. Therefore, to implement the technology in practice, it is necessary to continue to discuss and address the above issues and strengthen technical support, such as finding low-cost equipment, maintenance plans, and network services. It is important to show users how to set a secure password, download a password manager, and stress the importance of correctly identifying information. While we found no article investigating parents' perceptions of chatbots for self-medicating children, we found several studies on self-management and medication management applications that included users' needs similar to the themes identified in our study. For example, health self-management systems that support children with acute lymphoblastic leukemia and their caregivers include a knowledge base, self-management skills, self-assessment reports, and reminders³³. Chatbots have a unique advantage over other medication management applications. They can provide instant and personalized feedback by simulating a conversation with a human. This interactive way of communication can better meet parents' immediate needs than static APP information, it can also increase parents' sense of interaction with the platform, provide them with emotional support, help them build a sense of trust and dependence. Previous studies have investigated the common functions of commercially available drug management applications for medication alerts, information about medications (e.g., benefits, side effects, interactions, and uses), symptom tracking, and the ability to share data with family members or physicians³⁴. Our research combines parents' information needs for self-medicating children and expands on these perspectives by providing additional understanding and nuance regarding chatbots, delving into user experience.

Similar to the previous study³², our research revealed several design suggestions for information transmission, conversational interface and interaction frequency, and user experience. Participants' views varied according to usage scenarios and sociodemographic characteristics, and the chatbots' ability to personalise is important to participants. Therefore, it is necessary to design diversified forms of information transmission to meet individual needs. Many parents believe that chatbots will be valuable if they can achieve intelligent voice recognition and interaction and be compatible with medical advice or health tracking applications through multiple delivery forms, which is aligned with the research conducted by Echeazarraga et al³⁵. Each child's health and medical history is unique, and medical professionals can provide personalised medical advice based on the child's specific circumstances. Hence, the online consultation function of medical professionals is ready to be developed. Since self-medication is a long-term process, the chatbots must retain significant details about user preferences and medication routines, and may expand the conversation according to objectives, self-belief in capability, and health conditions. This suggests a need to explore interfaces that better suit the needs of these populations.

In modern Chinese society, self-medication has a profound social background. Many drug advertisements appear in the media, especially on television, with mixed messages, few health professionals, and poorly organised health care systems. These are potential risk factors for self-medication. Li et al.³⁶ found that among the 6020 medicines for children in China, only 238 were approved by the Food and Drug Administration for use in children. At the same time, the rest were preparations for adults, and many prescription drugs could be purchased in pharmacies without a prescription. Government regulations classify drugs as prescription and over-the-counter, but enforcement remains weak. Chatbots should be designed to continuously evaluate the needs and suggestions of parents while fully researching the barriers and facilitators to integration in the social environment and assessing the safety and quality of the information they provide, which can improve medication compliance and ensure the treatment effect.

Limitations

The study has several limitations that should be considered when interpreting its findings in other contexts. First, although this study considers different demographic characteristics when sampling, due to the vast territory of China, participants are still concentrated in Hunan Province, and the information needs for self-medicating children and perceptions of chatbots may not be universal. Second, the study's main participants were mothers. The children's needs and suggestions are also important references for the design of chatbots, and future research can explore the views and needs of other family members (such as the children themselves and the fathers). Third, urban parents in the study were overrepresented, which may influence attitudes toward chatbots. More rural parents should be recruited for future research. Fourth, because purposeful sampling is a non-probabilistic method used in qualitative research, we cannot control the potential impact of confounding variables or perceived differences based on individual sociodemographic characteristics.

Conclusion

Chatbots will offer a more personalized, interactive and responsive form of support than other applications, allowing real-time communication based on individual needs. As the research revealed, parents have diverse information needs for self-medicating children, and they are generally positive about chatbots because of their convenience and the advantages of reducing medical burden and cross-infection. This study will guide the

design of chatbots' basic interface and functions that improve parents' self-medicating behaviour for children. We will design the interface according to the information needs of users, and make chatbots have diversified functions to meet the personalized needs of different groups of people. In the future, it is necessary to overcome privacy leakage and ensure the security of funds from a multidisciplinary perspective. Additionally, the accuracy of information, various forms of information transmission, and the functions of voice interaction feedback and consultation should be evaluated in more detail.

Data availability

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

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Author contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Xueyi Wei, Xiuwen Chen, Liqing Yue, Peng Liao. The first draft of the manuscript was written by Xueyi Wei and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Declarations

Competing interests

The authors declare no competing interests.

Additional information

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