



A Study on the Service Design of Self-health Management for Adolescents with Asthma Based on Persuasive Technology

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Abstract. Based on persuasion theory to solve the existing problems in the process of self-health management of adolescent asthma patients and build a more effective asthma self-health management service system. Firstly, research methods such as observation method and in-depth interview methods are used to obtain the potential needs of users, and through the analysis of the behavior of adolescent asthma patients, the persuasion design problems existing in the current asthma self-health management process are extracted, and then the corresponding persuasion design strategies are formulated to guide the design of the asthma self-health management service system by combining the theory and analysis tools of service design. Based on the research results of self-health management for adolescent asthma patients, the corresponding persuasion service design strategies are proposed in three aspects: enhancing user motivation, enhancing user ability, and giving user behavior trigger points. Finally, the persuasion design strategy was applied to the design practice of an asthma self-health management service system, and the feasibility of the persuasion service design strategy was initially verified.

Keywords: Asthma · Persuasive technology · Self-health management · Service design

1 Introduction

Subsequent paragraphs, however, are indented. The WHO predicts that the number of people with asthma will increase to 400 million worldwide by 2025 [1] while studies show that only 44.9% of Chinese patients meet the asthma control criteria defined by GINA (Global INitiative for Asthma) Asthma is a chronic respiratory disease requiring long-term, standardized, and individualized self-management. Asthma control rates are low due to complex medication regimens, recurrent asthma conditions, and poor patient compliance [2]. To solve this problem, the study proposes a non-medical means of design intervention, that is, based on persuasive technology and service design concept, through in-depth research, insight analysis of the behavior problems of service recipients, combined with the behavior change strategy of persuasive technology, the construction of

a persuasion service method for self-health management of adolescent asthma, and the design of an asthma self-health management system of “equipment + application + service” to promote more conscious and spontaneous participation of patients in self-health management, improve the compliance and effectiveness of treatment of asthma patients, so that asthma can be well controlled.

2 Persuasive Design Theory

A deeper understanding of the mechanisms and drivers of behavior formation is key and fundamental to effectively influence and motivating behavior change [3], for this purpose, scholars in the fields of psychology and economics have conducted a lot of relevant research, among which, the persuasive design and FBM (Fogg behavior model) behavior model proposed by Fogg have received more attention in recent years. Persuasive design refers to the use of persuasive technology in design to intervene in users’ behavior and change their behavioral habits or thoughts to achieve certain persuasive goals. The FBM behavior model in persuasive design provides insights into users’ behavioral characteristics in three dimensions: motivation, ability, and trigger, and explains in detail why persuasive behavior occurs [4, 5] (see Fig. 1). Based on the FBM behavioral model theory, the asthma self-management service system needs to create positive motivation for users, enhance their ability to perform, and add triggers for the occurrence of user behaviors to motivate users to perform self-health management behaviors. Introducing persuasive design into the asthma self-health management service system to guide patients’ behavior and thus improve the effectiveness of the self-health management system.

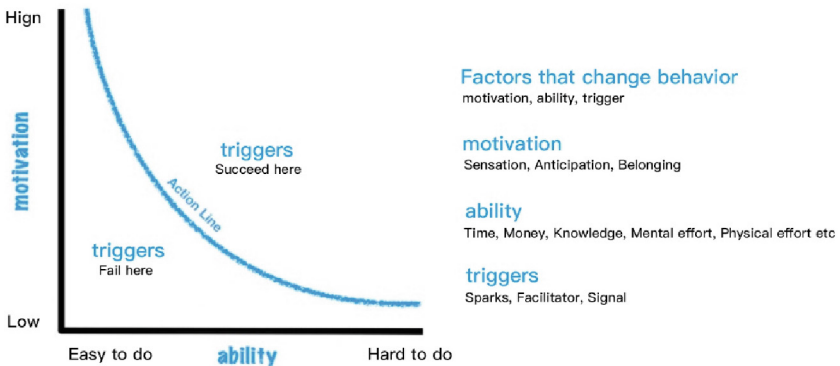


Fig. 1. Fogg behavior model for persuasive design (Adapted from Fogg [4]).

Persuasion design can be applied to numerous domains that need to encourage the participation of target users, such as educational learning [6] and electronic entertainment [7]. Recent developments in mobile Internet technology have expanded the application of persuasion technology in health management, and constructing persuasion strategies, will have a positive impact on both the user’s health and society [8]. In this study, we

will use the FBM behavioral model of persuasion design to analyze the health behaviors of adolescent asthma patients to construct appropriate persuasion design strategies for asthma self-health management service system design.

The study follows the research methodology of “Obtaining behavioral information - Insight into behavioral needs - Developing persuasion strategies - Outputting design solutions” (see Fig. 2), to provide new ideas for the design of self-health management for asthma patients. Firstly, we used questionnaires, user interviews, user profiles, and other qualitative and quantitative research methods to obtain behavioral information on adolescent asthma patients, and analyzed the data information to extract the current user experience problems in the process of self-health management. To address the problems of self-health management, according to the theory of the FBM behavior model, and also combined with the theory and analysis tools of service design, corresponding persuasive service design strategies are proposed in three aspects of enhancing user behavior motivation, enhancing user behavior ability, and increasing user behavior trigger mechanism, respectively, to guide the design of asthma self-health management service system.

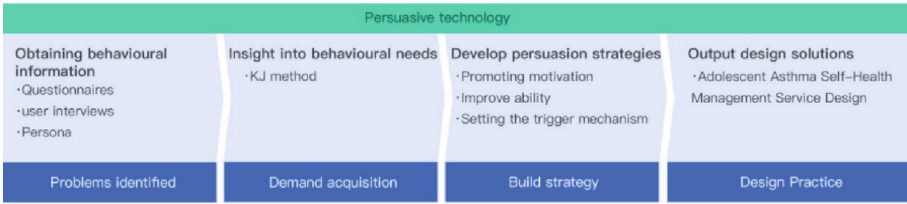


Fig. 2. Research method.

3 Analysis of User Behavior of Adolescent Asthma Patients

3.1 Asthma Self-health Management User Research

To explore the pain points and needs of adolescent patients in the process of self-health management and to propose corresponding persuasion strategies and service design methods, the study adopted an in-depth interview method and conducted in-depth discussions with sixteen relevant users, including different groups of adolescent patients, their family members and doctors. The interviews started with the daily management of asthma and explored various aspects of asthma self-health management, such as self-examination of health conditions, work and rest habits, medication use, and attitude toward health management. Based on the feedback obtained from the interviews, we sorted out the ways for patients to acquire knowledge and develop the ability of self-health management and summarized the contact points that are more in line with patients’ psychological expectations.

3.2 Analysis of Asthma Self-health Management Behavior

In this study, the KJ method was used to organize and classify the scattered problems obtained from the interview and research. First, as much information as possible about

the relevant self-health management problem points was organized and collected, and the summarized problem items were made into cards and categorized according to the degree of similarity between each problem item to obtain a preliminary table of patients' self-health management problems, which was divided into three categories in total: lack of motivation, lack of ability and lack of triggers. The following Table 1 gives a summary of the self-health management problem.

Table 1. Patient self-health management problem

Problem Category	Problem Description
lack of motivation	Lack of communication partners Lack of recognition and encouragement Not aware of the importance of self-health management Lack of awareness and confidence in self-health management Negative emotions during long-term treatment
lack of ability	Difficulty in adhering to management behaviors and poor execution Unable to discern their health status Not knowing how to promote healthy behaviors Unclear asthma allergens, leading to irritation Lack of access to learning about self-health management Broad medical advice and lack of guidance on specific behaviors Lack of knowledge of medication/monitoring/application Complex and cumbersome procedures for regular follow-up visits
lack of triggers	Forgetting to implement the plan that was made Not self-testing/medicating on time

4 Persuasive Service Design Strategies for Asthma Self-management

4.1 Enhancing User Behavior Motivation

When motivation is high, users can do difficult tasks, but once motivation subsides, then users will only do simple tasks. From the perspective of enhancing motivation for self-health management in adolescents with asthma, inform strategy, reward strategy, and identification strategy can be adopted, see Table 2.

Inform Strategy. Given the reality that adolescent asthma patients are less aware of self-health management, the first step is to improve the knowledge of adolescent patients about asthma disease management, the more knowledge they have, the more they will pay attention to the management of their disease, and the higher their willingness and motivation to participate in self-health management. Health education for asthma patients can be positive, by showing successful cases to enhance users' confidence in the results of behavior change and raise patients' "hope", thus achieving the purpose of increasing

Table 2. Persuasion Strategies and Design.

Persuasion Strategies	Persuasive Design
Inform	Send asthma health information
Reward	Earn medals/points and redeem prizes
Identification	Build a community of doctors/patients

patients' motivation; at the same time, it can also be persuasive by conveying a negative sense of "fear" to keep patients alert to the onset of their condition, thereby increasing motivation for health management and promoting behavior change.

Reward Strategy. Adolescent asthma patients need to control their condition through regular medication and self-examinations. Patients suffer from both physical and psychological stress during long-term treatment and are prone to negative emotions. The periodic health management of patients is quantified, and when the condition shows a stable trend, patients are given certain medals or point rewards to increase their sense of achievement and also increase the fun of the health management process, thus enhancing patients' motivation to persist in the long term.

Identification Strategy. Often, people will behave differently than usual to increase social identification. Specifically, when patients are supervised by others, they generally behave in a manner consistent with the expectations of the supervisor. Especially for adolescent patients, it is necessary not only to monitor their condition but also to pay attention to whether the patient implements actions according to the established health management plan. In addition to the supervision of adolescent patients by their guardians, it is also possible to facilitate communication among patients by building a patient communication community and achieving mutual supervision and encouragement through punch card recording, thus helping patients with health management.

4.2 Enhancing User Behavior Ability

There are two ways to improve patients' self-health management ability. One is to improve users' ability, that is, when patients perform a certain behavior, users think it is simple and effective in the process of performing the behavior. The second is to reduce the difficulty of user behavior implementation so that patients feel it is simple and controllable in expectation. To improve the self-health management ability of adolescents with asthma, objective refinement strategy, information simplification strategy, and fast access strategy can be used, as shown in Table 3.

Refine Objectives Strategy. User research results show that many adolescent patients have low execution of self-health management behaviors, and by refining health management tasks, patients' ability to self-manage their health can be enhanced. Refinement

Table 3. Persuasion Strategies and Design.

Persuasion Strategies	Persuasive Design
Objective refinement	Quantification of cyclical management tasks
Information simplification	More understandable information presentation
Fast access	Online doctor-patient communication platform

of goals is to break down large goals into simple individual tasks, thus enhancing the execution of behaviors. In asthma self-health management, a step-by-step persuasive strategy that combines the actual situation of the patient to develop a corresponding monthly and daily plan health management program for the patient can avoid making the patient give up in the process of action by becoming intimidated.

Information Simplification Strategy. Information simplification means that the presentation of information is delivered to users in an easy-to-understand way so that they can better understand the content and translate it into action. Visual feedback is given to patients on the effectiveness of their long-term self-health management. By setting up task progress bars, patients are given a clearer picture of the completion of their health management tasks, which in turn motivates patients to have confidence in their health management.

Fast Access Strategy. Asthma patients need to visit hospitals regularly for follow-up and long-term customized treatment, which is a complicated process, and this problem can be solved by building an accessible communication platform. Relying on Internet technology to analyze patients' self-examination results, give scientific health interventions, regularly track patients' health status and make corresponding health improvement plans, and register for medical appointments through online methods to reduce the difficulties for patients to go to hospitals so that patients can change their lives more actively and have their health effectively managed.

4.3 Set User Behavior Triggers

The process of target behavior execution is an important part of asthma self-management. In different scenarios, users have different motivations and abilities, and adding trigger points at key moments will prompt the target behavior. In the design of self-health management for adolescent asthma, the corresponding persuasion design strategies are reminder strategy and feedback strategy, see Table 4.

Reminder Strategy. That is, the user is urged to perform health management by setting a regular alarm clock. Although health management for asthma patients is multi-dimensional, the core is the management of self-examination and medication, and the

Table 4. Persuasion Strategies and Design.

Persuasion Strategies	Persuasive Design
Reminder	Quantification of cyclical management tasks
Feedback	Online doctor-patient communication platform

reminder strategy will work at the point where users need to manage. Teenage patients spend most of their time at school, so providing personalized reminders based on the user's work schedule and behavioral habits will have a more effective persuasive effect.

Feedback Strategy. By providing users with the right feedback at the right time, it can make them aware of the correctness of their behavior, thus inspiring enthusiasm and promoting higher frequency and longer-term adherence to management behaviors by patients. Distinguish between completed and uncompleted tasks, and when users persist in completing health management tasks, create a completion feedback interface that sends encouraging messages to give users a greater sense of accomplishment and thus successfully implement behavioral persuasion.

5 Design Practice Based on Persuasion Strategies

Based on the persuasive service design strategy proposed above, the asthma self-health management service system is constructed. Through the functions of health status self-examination, medication reminder, exercise control, health monitoring, outdoor environment inquiry, remote consultation, and communication, we help patients improve their self-management and develop good living habits to truly achieve the effect of asthma self-health management.

5.1 Asthma Self-management Smart Product Design

For the design of medical products for asthma self-management, two key products with high utilization rates in the treatment process were selected, namely nebulizer inhaler and peak flow meter (see Fig. 3). The nebulizer can nebulize the medication so that it can directly enter the lungs, which has an obvious effect on the treatment of asthma. Considering the persuasive strategy of rapid access, the nebulizer is designed in the form of a wearable device watch, which is not only convenient for adolescents to carry around but also monitors the physiological signals of the patient, which is easy for the patient's family to view. It also reminds adolescent patients to take their medication through the beeping or vibration of the watch, thus improving the compliance of patients to take their medication. The purpose of the peak flow meter is to determine the patient's respiratory disease condition through expiratory volume, and this data can be used to develop the patient's rehabilitation plan. When in use, the test data will be displayed on the screen, and patients can get real-time feedback on their health status by observing the data on

the screen. At the same time, the intelligent peak flow meter is connected to the cell phone server, which can automatically obtain the user's usage behavior detection data and carry out data recording and processing.



Fig. 3. Medical Product Design for Asthma Self-Management.

5.2 Asthma Self-management Persuasion Service Design

The service blueprint reflects the operation process of the asthma self-management service system, by finding the touch points in the system and intervening in the persuasive design tools, we achieve a truly effective health management design. The service blueprint depicts in detail the service system and service flow of asthma self-health management in health status self-examination, medication reminder, and other related medical product experiences as well as online health monitoring, outdoor environment inquiry, remote consultation and communication. The interaction demarcation line, visual demarcation line, and internal interaction line divide the service system behavior into four parts: user behavior, front-end behavior, back-end behavior, and support process, involving different stakeholders including patients, patients' families, doctors, and merchants [9]. The service blueprint provides an accurate depiction of the asthma self-management service system visually (see Fig. 4).

An important aspect in the construction of the asthma self-management service system is the software application design, the core of which is to provide a platform for users to develop self-management plans, self-check health status, remote consultations, and environmental status inquiries. Information architecture, as a tool for information

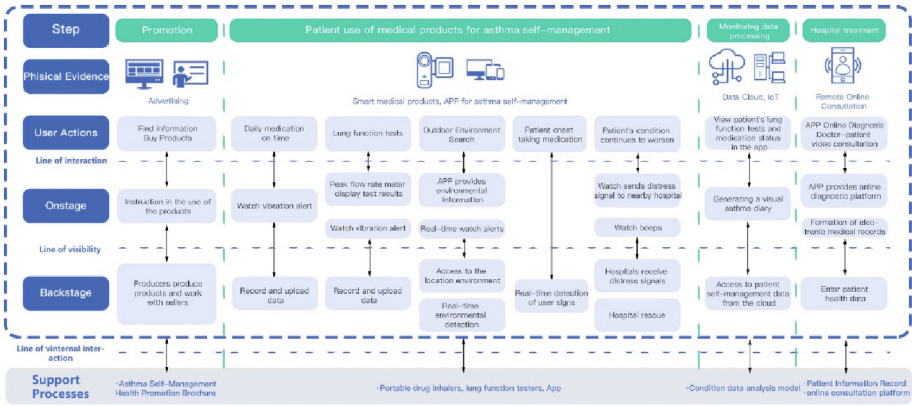


Fig. 4. Service blueprint.

organization, can integrate various functional modules in the asthma self-management application and build a clear logical framework [10], the asthma self-management user interface is mainly divided into the hospital side and patient side (see Fig. 5).

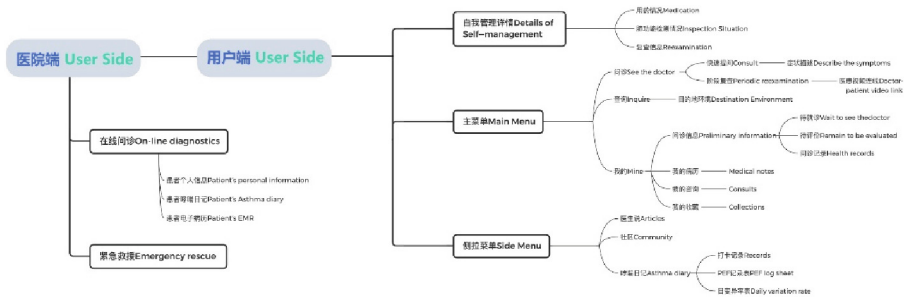


Fig. 5. Information architecture.

The Hospital Side. The hospital side is mainly divided into the online consultation module and the emergency relief module. In the online consultation module, doctors can regularly conduct remote online video consultations with patients, and can also view data such as patients’ personal information, asthma diaries, and electronic cases to help doctors make a diagnosis. The emergency rescue module allows the hospital to rescue the patient as soon as possible when the patient sends an emergency call for help.

The Patient Side. The patient side consists of a self-management module, online consultation module, query module, user center module, and community module. The self-management module includes the patient’s medication record, pulmonary function monitoring record, and physiological data such as heart rate and blood pressure, so that the guardian can monitor the patient in real-time, and at the same time, the guardian can set the time and frequency reminders related to the self-management content according to the actual needs of the patient, and can also view the trend forecast chart of

the condition after the periodic use. The online consultation module includes a quick question function and a stage review function. The quick question is mainly for patients to describe their questions for doubtful problems or symptoms and then be answered by professional medical personnel; the stage review is a video online consultation with individual primary care doctors to meet the needs of asthma patients who need regular review. The query module facilitates users to inquire about the air and environmental conditions of their destinations to avoid asthma attacks due to environmental-induced factors. The user center module contains the user's electronic medical history, consultation information, and condition management diary. The main purpose of the community module is to provide a channel for asthma patients to communicate with other asthma patients, to learn from the experience of others in self-management, and to serve as an incentive for patients to persevere. In addition to this, it also includes authoritatively released scientific articles and knowledge mini-classes to enhance patients' knowledge of the condition. The application interface of the hospital side and patient side is shown in Fig. 6.

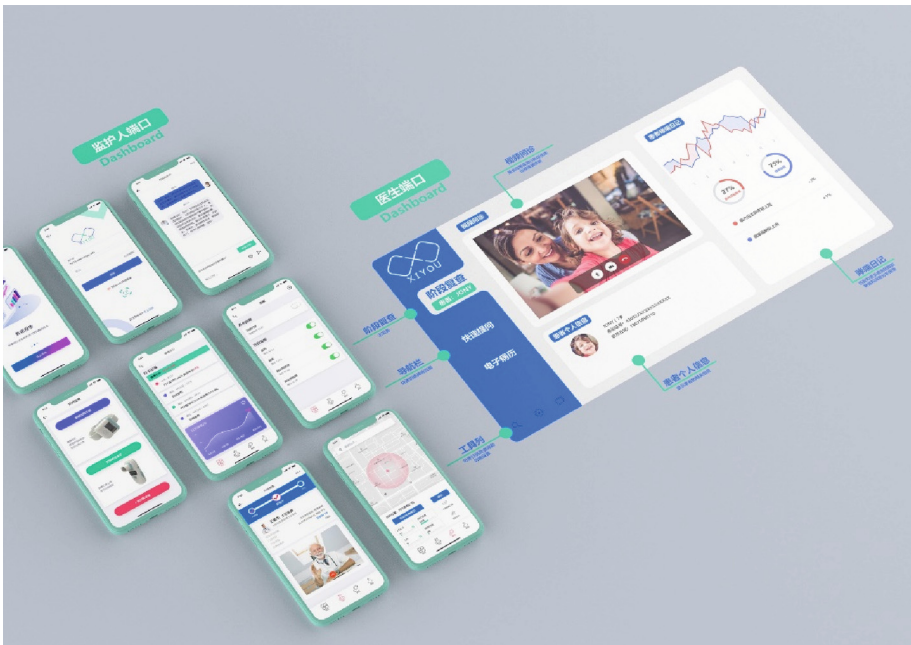


Fig. 6. Application interfaces.

6 Conclusion

Using the theoretical tools and methods of persuasive technology and service design to analyze the behavior of adolescent asthma patients in self-health management, the behavioral characteristics of users and their needs in behavior execution can be clarified,

so that more reasonable and efficient service models for changing user behavior and user attitudes can be developed. It is hoped that through these methods, we can find the conditions that drive the generation of behaviors for adolescent asthma patients and obtain a continuous quality experience, and promote the positive development of the self-health management service system.

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