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Research on design strategies for elderly wearable glucose meters based on positive experience design theory

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Abstract. According to data from the Chinese Guidelines for the Diagnosis and Treatment of Diabetes in the Elderly, there are approximately 35.5 million elderly diabetic patients over the age of 65 in China, accounting for 1/4 of the total number of elderly diabetic patients worldwide, and this number is still on the rise. This article analyzes and studies the wearable glucose meters for the elderly from the characteristics and lifestyle features of elderly diabetic patients, starting from the perspective of user experience and combining with the Positive Experience Design theory. The design strategies for elderly wearable glucose meters based on the Positive Experience Design theory are concluded, aiming to enhance the blood sugar control experience of the elderly and promote their active participation in blood sugar management, in order to improve the diabetes management experience and health status of the elderly.

Keywords: positive experience design, elderly, wearable glucose meter, design strategy

1. Introduction

With the intensification of the aging trend in China's society, the issue of elderly health management has gradually become prominent. Diabetes, as a lifelong chronic metabolic disease, has gradually become one of the main diseases threatening the health of the elderly. The Diabetes Branch of the Chinese Medical Association predicts that the prevalence of diabetes in the elderly population over 60 years old exceeds 18%, which is 8-10 times that of the 20–30-year-old age group [1]. As a key tool for diabetes management, the design of glucose meters should ensure functionality and accuracy while also focusing on the user experience and emotional needs of elderly users. The Positive Experience Design theory emphasizes focusing on users' emotional needs in the design process, enhancing product value and user stickiness by improving user experience and satisfaction. Therefore, this study is based on the Positive Experience Design theory to explore the design strategies for wearable glucose meters for elderly diabetic patients, in order to provide them with a more friendly and convenient blood sugar monitoring experience.

2. Elderly diabetic patients

2.1. Physiological characteristics of elderly diabetic patients

Diabetes, as a chronic metabolic disease, has many differences in physiological characteristics for elderly patients compared to young patients. The following are the main physiological characteristics of elderly diabetic patients:

1. Physiological function decline: With the increase of age, the physiological functions of various organs in the elderly gradually decline. Elderly patients often have other chronic diseases, which not only increase the complexity of diabetes treatment but may also affect the treatment effect. At the same time, their liver and kidney functions are also declining, the speed of drug metabolism slows down, which may lead to the accumulation of drugs in the body, increasing the risk of drug side effects. Therefore, when treating with medication, special attention should be paid to the dosage and interval of medication [2].

2. Sensory decline: The sensory organs of the elderly (such as vision, hearing, touch, etc.) may decline, which will affect their perception of pain, temperature, color, etc. For diabetic patients, sensory decline may lead to their inability to perceive or judge the symptoms of hypoglycemia (low sugar reaction) in time, such as dizziness, palpitations, sweating, etc., there are potential dangers in daily life.

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3. Decreased mobility: With the increase of age, the muscle mass and strength of the elderly gradually decrease, and the range of joint motion may also be limited, which may lead to a decrease in their mobility. Exercise is very important for blood sugar control, and the decline in mobility may affect the management of diabetes.

2.2. Psychological characteristics of elderly diabetic patients

Diabetes is not only a physiological disease but also a psychological burden. In the elderly group, diabetic patients face unique psychological challenges, the following are the main psychological characteristics of elderly diabetic patients:

1. Anxiety and fear: Diabetes is a chronic disease that requires long-term monitoring and control. Elderly diabetic patients may feel anxious or fearful due to concerns about the long-term nature of the disease and the potential complications.

2. Depression: Diabetes may lead to depressive emotions in patients, especially when they face strict dietary restrictions, frequent blood sugar monitoring, and possible complications. Depressive emotions may affect their cooperation with treatment, thereby affecting blood sugar management.

3. Loneliness: Many elderly people may face a reduction in social activities after retirement, coupled with the trouble of the disease, which may make them feel lonely. Social support is very important for the management of diabetes, so loneliness may affect the health status of the elderly.

4. Resistance to treatment: Due to misunderstandings about the disease or fear of the treatment process, some elderly people may have a psychological resistance to treatment. This may affect their cooperation with treatment, thereby affecting the treatment effect.

2.3. Life characteristics of elderly diabetic patients

1. Dietary control: Dietary regulation occupies an important position in the management of diabetes, and its significance is more prominent for elderly diabetic patients. They often need to limit the intake of sugar, salt, and fat to maintain blood sugar within the normal range. At the same time, it is also necessary to ensure adequate intake of protein, vitamins, and minerals to maintain health. However, overly strict dietary control may have a negative impact on the nutritional status of the elderly, so it is advisable to do so under the guidance of a doctor [3].

2. Exercise habits: Exercise has an indispensable role in the management of diabetes. Moderate exercise can help the elderly maintain weight, improve physical metabolic efficiency, and thus help control blood sugar levels. However, elderly diabetic patients must be cautious when exercising, choose exercise forms that are suitable for their own health status, and prevent excessive exercise leading to physical damage.

3. Medication management: For many elderly diabetic patients, taking medication on time is a key way to control blood sugar. However, due to the natural decline of memory or other health conditions, they may find it difficult to ensure taking medication on time. Therefore, family members or caregivers need to regularly remind the elderly to take medication on time and explain to them the importance of taking medication as prescribed by a doctor.

4. Self-monitoring: Self-monitoring is an important part of diabetes management. Elderly diabetic patients should regularly monitor blood sugar levels to understand their physical condition. Through self-monitoring, they can promptly detect blood sugar abnormalities and take corresponding measures for adjustment.

5. Social interaction: Social interaction is of great significance to the physical and mental health of the elderly. By participating in social activities and joining diabetic patient support groups, elderly diabetic patients can share experiences and encourage each other with other patients, thereby improving the quality of life and obtaining better diabetes management methods [4].

3. Overview of the development status of wearable glucose meters

Wearable glucose meters are devices that monitor blood sugar 24 hours a day, usually using sensor technology, embedding tiny electrodes as sensors under the skin to detect the concentration of glucose in the blood, and transmitting information to monitoring and display devices through wireless radio frequency, thereby achieving real-time monitoring of the user's blood sugar levels. The design forms of wearable glucose meters are diverse, including bracelets, watches, chest straps, etc. [5]. These design forms aim to provide convenient wearing methods so that users can monitor blood sugar levels anytime and anywhere. In the design process of wearable glucose meters, user experience is regarded as one of the important factors. To improve user acceptance and effectiveness, some glucose meters focus on simplifying the operation interface, providing intuitive data display, and providing personalized reminders and feedback functions. In addition, some glucose meters also consider comfort and durability, choosing appropriate materials and designs to ensure long-term wearing comfort and stability [6].

As an emerging medical device, wearable glucose meters are gradually becoming an important tool for diabetes management in the elderly. However, despite continuous technological advancements, the elderly still face many challenges when using glucose meters. Traditional glucose meter designs usually focus on functionality and accuracy, while neglecting the cognitive abilities, vision, and hearing characteristics of the elderly. In addition, many elderly people feel confused about using glucose meters because they cannot understand complex operation steps or how to correctly interpret the results. Therefore, wearable glucose meters need further research and innovation to meet the special needs of the elderly and improve product usability and acceptability.

4. Overview of positive experience design theory

4.1. Meaning of positive experience design

Positive Experience Design is an emerging design theory that integrates the concepts of positive psychology into the field of design. This theory is based on positive psychology and advocates for creating positive experiences for users through correct design interventions, thereby enhancing their subjective well-being.

Positive psychology originated from Carl Jung's concept of optimism in the early 20th century. In 2000, the President of the American Psychological Association and other psychologists established positive psychology as a new discipline based on this foundation. In 2012, Professor Desmet from Delft University of Technology in the Netherlands first applied positive psychology to design and researched and established the design theory of positive experience. This theory is committed to exploring the connotation of a good life for humans, with the ultimate goal of improving people's subjective well-being [7].

4.2. Framework model of positive experience design

After proposing the concept of positive design, the Desmet team constructed the positive design framework. They believe that positive design measures intentionally increase people's subjective well-being, thereby increasing their lasting appreciation for their lives. The framework divides positive design into three levels - designing for pleasure, designing for personal meaning, and designing for virtue, which can be reflected in all areas (such as health, work, interpersonal relationships, etc.), but the behaviors they exhibit are personalized and vary from person to person, depending on the individual's living environment and life domain.

1. Designing for pleasure: Focuses on the happiness of enjoying the present moment, that is, the subjective well-being achieved through the sum of individual brief pleasures. The focus is on the here and now, the presence of positive emotions and the absence of negative emotions: relaxation, entertainment, no worries. Products can evoke positive emotions (maximizing pleasure and comfort) or reduce negative emotions (minimizing pain and discomfort), and the design itself can also be a direct source of pleasure.

2. Designing for personal meaning: Focuses on the happiness that comes from personal meaning. The focus is not on short-term emotional impact, but on the individual's (long-term or short-term) goals and aspirations, such as obtaining a diploma, building a treehouse, owning a palace, or completing a marathon. Personal meaning can also come from the recognition of past achievements or the perception of progress towards future goals. Based on this, products can become resources for people to achieve these goals.

3. Designing for virtue: Focuses on the happiness that arises as a byproduct of virtuous behavior. Here, the issue turns to the moral level: "Am I showing a sense of honor in my actions?" This question itself implies a normative distinction between what is good (such as the cultivation of abilities, altruism) and what is bad (such as the loss of dignity, the pleasure of sadism), which is unrelated to the things we may enjoy or pursue. On the negative side, products may also promote or even stimulate non-virtuous behaviors, such as the production using polluting technology or products that stimulate unsustainable consumption [8].

4.3. Significance of positive experience design for elderly wearable glucose meters

Currently, there are various types of wearable glucose meter products on the market, but there is no vertical classification in the user groups. The elderly, as a large group in China's diabetic population, lack targeted glucose meter designs, leading to many elderly diabetic patients having a negative psychology towards blood sugar management, an important blood sugar control behavior, thereby affecting their own health status.

Through wearable glucose meters, the elderly can monitor their blood sugar levels anytime and anywhere, and grasp their health status in a timely manner, which is not only conducive to the prevention and control of chronic diseases such as diabetes but also improves the quality of life and happiness of the elderly. When elderly users use wearable glucose meters to monitor their blood sugar levels, they will feel more confident and independent. This confidence comes not only from the control of their own health but also from the trust and reliance on technology, which helps to improve the social ability and quality of life of the elderly. For the elderly, their physical function declines, and they may find it difficult to operate complex procedures, so positive experience design can reduce the difficulty of using the glucose meter for the elderly through simple and easy-to-understand operation interfaces and processes, improving the effectiveness of the glucose meter and the satisfaction of the elderly. At the same time, the elderly has a higher sensitivity to the body, and comfort and aesthetics are very important for their use experience. Positive experience design can improve the comfort and aesthetics of wearable glucose meters through humanized design concepts and detail processing, making the elderly more willing to use the glucose meter and maintain good living habits [9].

5. Research on design strategies for elderly wearable glucose meters based on positive experience design theory

5.1. Personal happiness level

Simple and easy-to-use operation is the basic requirement for the design of elderly wearable glucose meters. The elderly face the decline of physiological and cognitive abilities, and they are often troubled when dealing with complex operations and multiple steps. Therefore, when designing wearable glucose meters, it is necessary to ensure that the use steps are simple and easy to get started. This can be achieved by optimizing the operation process, setting default values, and implementing one-click operations, thereby reducing the threshold of use. In addition, the glucose meter should use intuitive symbols and signs to guide the elderly to complete the pairing and wearing process smoothly, and set simple and labor-saving hand movements. The interface of the accompanying App or mini-program should also be simple and clear to reduce the cognitive burden of the elderly in the blood sugar control process.

Comfortable and convenient wearing design is a key requirement for the design of wearable glucose meters. Wearable glucose meters are in direct contact with the skin of elderly users, and as the elderly age, the loss of collagen makes the skin relatively thin, and the design of wearable glucose meters should fully consider the physiological characteristics and daily life habits of the elderly group. The parts in contact with and adhered to the skin should be made of thin, soft, and breathable materials; the sensor casing should be made of light, smooth, and wear-resistant materials [10]. At the same time, reasonably adjust the size, thickness, and weight of the sensor to improve the comfort of the elderly when wearing, and reduce the gravity and pressure brought by the glucose meter in daily life.

Emotionally intelligent interaction experience needs to meet the characteristics of the emotional needs of the elderly. For example, by using gentle voice prompts, friendly interface colors, and personalized user interfaces, a warm atmosphere is created. At the same time, the accompanying App or mini-program should provide visual charts and reports of blood sugar data to help the elderly better understand their health status [11-12].

5.2. Personal development level

Real-time intelligent data processing is an essential factor in the blood sugar management process. Wearable glucose meters must have the ability to monitor and process data in real time for a long period, automatically analyze user blood sugar data, and transmit it to the associated mobile application or mini-program via Bluetooth. At the same time, the device should have the function of storing blood sugar data for a fixed period, such as saving real-time blood sugar data within 24 hours, for reference during subsequent visits. The mobile application or mini-program should provide corresponding health advice based on real-time blood sugar concentration and predict blood sugar trends to remind elderly users to take corresponding measures.

The most important thing is the guarantee of safety. Considering the decline of the elderly's self-protection ability, and the wearable glucose meter will be worn on the elderly for a certain period of time, the design of the wearable glucose meter should ensure safety. Fully consider safety factors in the design, such as anti-misoperation, waterproof, safety lock, stability and other functions, to ensure that the product can operate normally in various environments. At the same time, an alarm function should be added to the glucose meter and the bound software or mini-program to remind elderly users to take reasonable medication, contact relatives and friends, and seek emergency help when blood sugar is too low or too high.

5.3. Virtue behavior level

Follow the concept of sustainable development. Use recyclable and sustainable materials as materials for the manufacture of wearable glucose meters to ensure that the product is convenient for recycling and reuse after the end of its life cycle, without causing pollution and destruction to the environment.

Friendly and caring data sharing helps to improve the blood sugar control experience between elderly diabetic patients and their relatives and friends. Wearable glucose meters need to have the function of sharing data with family members, relatives, medical institutions, or caregivers to provide more thoughtful and professional health management services for the elderly.

Active and stable community communication is one of the keys to the effectiveness of blood sugar management applications for the elderly. By building a comprehensive and harmonious community platform, we can not only provide more comprehensive and professional blood sugar management services for elderly users but also help them establish a healthier and more positive lifestyle. This mobile application can include sections and content such as healthy diet sharing, medication experience exchange, exercise advice, expert online Q&A, spiritual care mutual aid, and health information push, providing comprehensive and intimate online services and communication for the elderly during the tense blood sugar management period, weakening the elderly's fear and fear of diabetes, and enhancing the happiness and satisfaction of blood sugar management [13].

6. Conclusion

This paper takes elderly diabetic users as the research object, analyzes the physiological and psychological characteristics of elderly diabetic patients, and provides new design strategies for the design of elderly wearable glucose meters from the perspective of positive experience design theory, improving the elderly users' experience and psychological compliance with the glucose meter, enhancing the use value and user stickiness of the glucose meter, and enhancing the positive experience

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