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Evaluation of digital therapy in Dementia and aging in China

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Abstract:

In China, dementia become more and more seriously with the rapid increasing aging population, which bring significant burdens on health care systems, society and family. There are many barriers and challenges in dementia prevention diagnose, and treatment. Digital therapy in Hainan funded by the local government has been used by the healthcare system to conduct cognitive screening for the elderly above 60 years. The program demonstrates efficiency of digital therapy, and has proved cost-effective. This paper suggests that the model of digital therapy motivated by local governments, not only can help promoting the health system on dementia, but also educating health care professionals, enhancing screening capabilities of dementia, building a referral system and so on, should be expanded in other developing regions.

Keywords: digital therapy, dementia, aging problem, evaluation,China

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1. Introduction: Dementia and Aging Problem

1.1 Overview of Aging in China

1.1.1 Demographic Trends

As the country with the highest population in the world for decades, China has been navigating the changes in its population structure for the past 50 years[1]. Statistically speaking, the life expectancy in china has elevated from 66.9 to 74.52 years for men and 70.65 to 7.92 years for women, from the year 1990 to 2017[2].

The Communist leaders of China had realized the need of addressing the problem of declining fertility rates and increasing life expectancy since 2000[3], partially as an outcome of the former one-child policy from 1979 to 2015. However, the implementation of two-child policy in 2016 and three-child policy in 2021 had not moderated the impacts of the accelerating aging process. It is predicted that 20% of the total population in China will be composed of those aged over 65 years and above by the year 2033, leaving a significant and urgent gap for the current government and citizens to address [1].

1.1.2. Social Impacts of Aging

It is well argued that China has not prepared enough to solve the problems of its older population from the aspects of economy, social security and family structure. The demographic shift has caused great burden for the whole Chinese society, as the age dependency ratio being 15.9% in 2017 and is expected to escalate to 43.6% by 2050, accounting almost half of the total population in China.

Due to the significant increase in the number of elderly people, the present healthcare system of China has been facing escalating demand of treatment of diseases, with institutions to deal with the shortage of healthcare equipment and services, social security to tackle with the increasing costs of pension payments, and family to provide support despite their largely shrinking size[3].

1.2 Prevalence of Dementia in China

Dementia is a cognitive disease associated with mental and physical disorders among elderly individuals. The demographic changes which led to an increasingly aging population contributes to prevalence of dementia especially Alzheimer's disease in China. In elderly people aged over 65 years old, the incidence rate of dementia was 5.14%, and it increased largely with age, approaching around 23% among those aged over 85 years old in 2009[4].

1.3 Burden and Gap of Current Care

In a global perspective, the number of elderly people with dementia in China accounted for about 25% of the total population with dementia in the world[5]. This suggests significant burdens placed on the caretakers of those patients with dementia, especially with the case that China has not yet adequately prepared for the changes in psychological, material, and systematic senses.

a. As suggested by previous study, first of all, the elderly population is facing problems regarding income, as China's per capital GDP was only around 1,000 USD than the general level of developed countries which was 5,000 to 10,000 USD. Financial burden is placed both on the patients and their caretakers, reducing the accessibility of healthcare treatment especially for those in rural areas.

b. Secondly, the current healthcare system is flawed because of the lack of health awareness among older people. The national health literacy survey of China in 2013 had the result of health literacy of elderly people being only 5.76%, thus reflected the problem of elderly population focusing more on the treatment rather that prevention of diseases.

c. Thirdly, filial piety, which is a highly valued concept of Confucianism in the traditional Chinese culture, has been eroded by the changing social and economic structure of China. This is coupled with the fact that the family size in China has been shrinking, as the average Chinese household was composed of 5.3 people before when one-child policy was forced, decreased to 3.02 in 2012, well known as the "4-2-1" structure. In addition to that, the rapid urbanization in China restricted the children of the working force to be entirely considerate of their parents, and also caused a gap of understanding. Therefore, a huge burden can be found on singletons of Chinese families, and the problems of shortage of existing home and community institutions still have a long way to be solved[3].

1.4 Digital Health Landscape in China

1.4.1 Rise of Digital Health Solutions

One of the possible solutions of to tackle with the current gap in care would be digital medicine technology. Digital health services have been widely applied in China and the market has a promising outlook, especially with the development of mobile internet, big data, cloud storage, machine learning and AI in recent years.

For example, the Chinese National Healthcare Security Administration and National Health Commission promoted the development of Internet Plus health care services during the COVID-19 pandemic, demonstrating the Chinese government's explicit support for online medical services. It is evaluated to have the potential to improve accessibility, convenience, cost-effectiveness more than those existing models[6].

1.4.2 Future Directions

With the growing role of digital technology in addressing aging and dementia problems in China, many challenges regarding data breaches, patient trust, access inequality, technological literacy and ethical concerns over AI come in the way. However, its future potentials of expanding e-health to raise accessibility and applying wearable technology to ensure real-time monitoring significantly outweigh the costs and setbacks. With more supportive government initiatives in terms of policies and investments, we can expect better healthcare outcomes and demographic trends in future for China and their people[7].

2. Challenge and opportunity

2.1 Challenge

2.1.1 Limited Digital Literacy Among Older

Most of the elderly in China are used to the traditional way of achieving information and seldom use computers or smart phones, which makes them feel strange and difficult when using the Internet and social software. As people age, their cognitive levels continue to decline, and they become increasingly resistant to learning new knowledge and technologies, making the popularization of digital health more challenging[8]. In addition, many elderly people also lack confidence in using the Internet, and gradually produce anxiety. The elderly are the largest audience for digital health, so improving their digital literacy is crucial.

2.1.2 Data Privacy and Security Concerns

In China, digital therapies for elders have raised a series of data privacy and security issues. The digital therapy platform has achieved a large amount of personal information of patients through user registration, including medical history and disease prediction. Due to the government's authority to access citizens' personal information, the storage methods of this data and whether personal information can be carefully protected are worrying. For elderly people who are not sensitive enough to their privacy rights, the cost of data leakage is very low and can easily cause serious impacts[9]. In addition, if digital therapy providers cooperate with third-party companies, whether these companies can strictly obey China's laws and regulations on digital privacy has become a challenge.

2.1.3 Lack of Standardization and Regulation

In China, the rise of digital therapies for dementia and elders faces significant challenges due to a lack of standardization and regulation. The number of platforms is increasing day by day, but the quality is uneven. The signing of unified agreements, the use of treatment methods, and the selection of drugs among various platforms cannot guarantee the quality and effectiveness of digital therapy. In addition, the lack of standardized estimation by professional institutions means that there may be operations that do not meet clinical standards, which will bring Immeasurable risks to elderly patients[10].

2.1.4 Accessibility and Infrastructure Limitations

In China, the use of digital therapy for dementia and aging populations is growing, but it faces significant challenges related to accessibility and infrastructure limitations. Due to the significant technological differences between urban and rural areas, the access to digital therapy is extremely uneven among different regions. Many rural areas lack high-speed Internet, intelligent equipment and complete medical infrastructure, which means that digital development can only bring convenience to elder people in developed areas, but it is difficult for the elderly in broader rural areas to enjoy this technology[11].

2.2 Opportunity

2.2.1 Expanding Healthcare Access

With the increase of dementia related cases, deploying digital therapy can effectively expand the healthcare coverage of digital therapy for dementia and aging in China. By implementing this decision, the government can quickly improve the construction of rural basic medical care, help narrow the gap in medical levels between urban and rural areas, and extend this convenience to remote or undeserved areas.

2.2.2 Cost-Effective Solutions

Digital therapy may be a more cost-effective option compared to traditional care. This therapy digital platform reduces the frequency of using expensive medical equipment in hospitals, thereby lowering transportation costs and waiting times. Medical workers can follow up on patients' disease progression online and intervene in a timely manner before the condition worsens through digital therapy, greatly reducing hospitalization and registration costs and improving medical services in economically underdeveloped areas such as rural areas[12].

2.2.3 Integration of AI for Predictive Care

In China, the aging population is growing rapidly, and the timely detection of the disease is crucial to the treatment of Alzheimer's. Through artificial intelligence and third-party digital platforms, clinical doctors can remotely monitor dementia patients, use wearable devices to track health indicators such as heart rate, sleep patterns, and

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physical activity to predict potential health problems, intervene in a timely manner, and slow down disease progression[13].

2.2.4 Government and Policy Support

The support of the Chinese government and policies for digital treatment of dementia and aging provides significant opportunities to strengthen medical services for the elderly population. In recent years, China's aging index has gradually increased, and government policies are increasingly tilted towards safeguarding the health interests of the elderly. The 'Healthy China 2030' blueprint is a national strategy that focuses on improving public health[14]. This policy creates opportunities for integrating digital treatments for dementia, making it easier for third-party digital health platforms to integrate their products with national policies and receive government support. In addition, the Chinese government has launched various funding programs aimed at encouraging medical technology innovation, which greatly support the development of advanced digital treatment solutions and narrow the economic gap between urban and rural areas.

3. Creative solutions

3.1 Technological innovation in digital treatment

3.1.1 Early diagnosis and screening

In the traditional clinical assessment and cognitive testing of Alzheimer's disease, most of the conclusions are drawn through face-to-face interviews with doctors, observation and some oral tests or paper-and-pencil tests, combined with the experience of doctors. This approach is subjective and inefficient. China has developed digital detection products for cognitive disorders, through the collection and analysis of users' speech speed, error, instantaneous memory, delayed recall and other dimensions of data, to assess the risk of cognitive ability. The medical image data is analyzed via artificial intelligence algorithms to facilitate the provision of decision support for doctors and the system and enable diagnoses[15].

3.1.2 Personalized treatment plan

Personalized treatment refers to the use of digital machines such as AI to tailor personalized treatment and rehabilitation programs according to the patient's own situation. Ai-driven approaches have revolutionized personalized treatment strategies. In drug discovery, virtual screening and drug reuse, guided by predictive models, can accelerate the identification of effective treatments. AI also helps tailor therapeutic interventions by predicting individual response to treatment and monitoring patient progress, thus allowing for dynamic adjustment of care plans[16].

3.1.3 Virtual Reality and Augmented Reality Therapy

Virtual reality technology is increasingly being recognized as a potentially valuable tool in dementia-related research and care for cognitive and physical assessment as well as therapeutic interventions. VR-based interventions have been used as health promotion tools to improve mobility, prevent falls and train cognitive abilities in people with dementia and those at risk of developing dementia[17].

One VR game, sea hero quest, is being used to boost Alzheimer's research. David Reynolds, chief scientist at Alzheimer's Research UK, said the very act of playing games could help prevent cognitive disorders. "Just like physical exercise, we know that keeping the brain active is very beneficial and can also help reduce the risk of reducing or, if you have cognitive disease, slowing the progression of cognitive disease," he said.

3.2 policy innovation

3.2.1 Comprehensive Policy Framework and Strategic Planning

In recent years, China has promulgated many policies to control the aging population and Alzheimer's disease. For example, the Notice of the General Office of the National Health Commission on the Promotion of Alzheimer's Disease Prevention and Treatment (2023-2025) mentioned that China will carry out the promotion of Alzheimer's disease prevention and treatment between 2023 and 2025. Through extensive publicity and education, early screening and intervention, special training and guidance, and the establishment of a dementia prevention and treatment service network, the campaign aims to enhance the sense of health gain of the elderly and promote healthy aging.

3.2.2 Regulations and Market Development

With the development of science and technology and the popularization of the Internet, health and medical data are gradually complete and transparent. The Personal Information Protection Act imposes strict requirements on obtaining informed consent of individuals, promoting data protection and compliant use.

China has perfected relevant laws and regulations on digital health. For example, the 14th Five-Year Plan for the development of the big data industry provides a top-level design for the development of digital health. At the local level, several measures to accelerate the development of digital therapy industry in Hainan Province: Provide support and guarantee for the whole cycle of digital therapy.

China has actively participated in global exchanges and

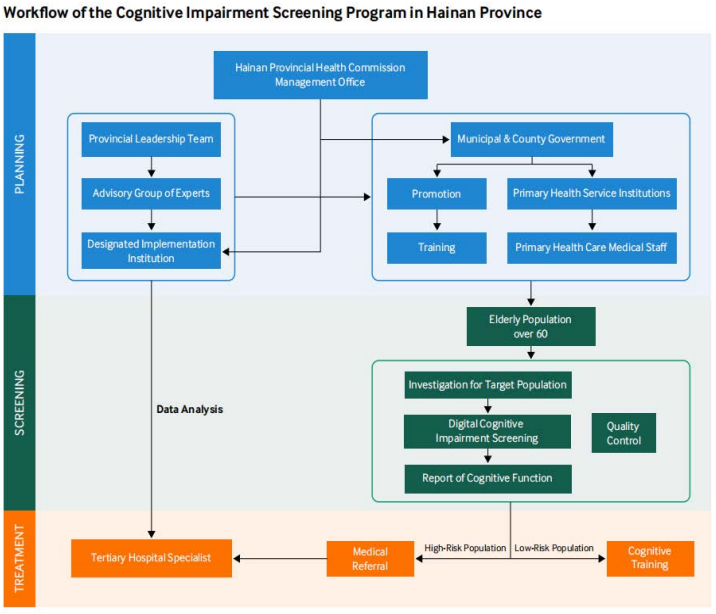
cooperation in the field of digital health, including participating in the World Health Organization's 2021-2030 Decade of Action on Healthy Aging. It has established strategic partnerships with the University of Chicago, the University of California, San Francisco, and the affiliated Hospital of the University of Tokyo Medical Science Center in Japan to promote academic exchanges and personnel training. Through cooperation and communication with professionals from different countries, we learn advanced technologies and update development models.

4. Project implementation

In 2022, Hainan, a developing region in China, wrote digital therapy into the 14th Five-Year Development Plan of Hainan Digital Health for the first time. Hainan Provincial Health Commission initiated a project about utilizing digital therapy to do dementia risk screening and cognitive rehabilitation, Hainan Province's Cognitive Impairment Screening Program, promoted the initial formation of a cognitive impairment diagnosis and treatment service system in the province.[18] The project was funded about 19.72 million RMB by the local government and carried out by Hainan General Hospital and the entire health system. It was designed for people who were at risk of cognitive impairment and were 60 years of age or older. The Beijing Aging Brain Rejuvenation Initiative MCI Rapid Screening Instrument (SCREEN Instrument) was designed to provide a rapid screening tool to older adults in the community. The results indicate that it demonstrated high sensitivity (0.731) and specificity (0.656), supporting its effectiveness and efficiency as a validated instrument for community-based cognitive impairment and dementia risk screening.[18] The Geriatrics Center of Hainan General Hospital (GCHGH) used the clinically recognized SCREEN Instrument on a province-wide scale within the context of the program. [18]

The program was the largest digital screening program for a province in China in a single year, reaching 240,904 senior citizens in 18 cities and counties in Hainan. There were lots of advantages, such as empowering health care professionals, enhancing public awareness of dementia at the early stage and efficiency of dementia screening, providing a useful way for other regions to deal with the aging problem. The cost of a digital screening is about 81.86 RMB per person(19.72 million RMB/240,904 participants).[18]

From the project, nearly 30% were found at the MCI high risk stage. And the individuals testing positive were suggested to referrals to tertiary hospitals for more precise diagnoses. Those with milder conditions were encouraged to engage in digital rehabilitation training or participate in research projects.[19] It turned out that digital screening has greatly improved screening efficiency. At the same time, the program increased healthcare-seeking behavior related to cognitive impairments. Early detection can help fast-track the diagnostic process of MCI, facilitate appropriate referrals for cognitive and neuropsychological evaluation, and prevent negative outcomes associated with undetected cognitive impairment.[20]



Source: The authors

Figure 1: Workflow of the Cognitive Impairment Screening Program in Hainan Province[20]

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5. Cost-effectiveness analysis

5.1 Methods

5.1.1 Incremental Cost-Effectiveness Ratio (ICER)

Incremental Cost-Effectiveness Ratio (ICER) is a crucial analytical device in health economics. It is especially used to measure the additional cost of health and wellness outcomes gotten per unit, which is normally measured in terms of quality-adjusted life years (QALYs).[21] This sign plays a vital duty in contrasting the economic worth of brand-new interventions with existing therapy strategies.

In practice, ICER is particularly suitable for assessing new dementia therapies, and healthcare decision-makers have to take into consideration both monetary costs and the resulting health benefits. For example, a brand-new medicine might effectively decrease cognitive decline and enhance the patient's quality of life, but the financial impact - such as the rate of the drug and any related health care costs - need to carefully consider these benefits.

ICER estimation includes establishing the cost and wellness end result distinctions in between brand-new treatments and standard interventions. If ICER is reduced, it reveals that the new therapy is economical and provides substantial health benefits for added financial investment. However, high ICER might show that the new therapy does not offer adequate fringe benefits to justify its cost.

By using ICER, health care service providers and decision-makers can focus on treatments, not only to boost patient outcomes, but likewise to optimize the allocation of sources within the healthcare system. This procedure sustains wise decision-making and makes sure that the funds are utilized to provide therapies with the best general value and effectiveness, so as to enhance client care and promote the sustainability of health care.

5.1.2 Quality-Adjusted Life Years (QALYs)

Quality-adjusted life years (QALYs) are an extensive indicator that aims to measure the worth of health outcomes by incorporating the quality and quantity of life. Particularly, QALY not only thought about the life expectancy got, yet also the quality of these years, and made a thorough assessment of the health benefits.[22] In the context of dementia and elderly treatment, QALY is widely made use of to compare the effectiveness of various nursing models, such as home care and institutional care. By gauging just how different interventions influence the quality of life and life expectancy of patients, cost-effectiveness analysis (CEA) can properly identify which nursing techniques offer the highest possible QALY within a specific spending plan.

Additionally, QALY can be made use of to assess the impact of emerging technologies (such as remote health monitoring and wearable devices) on boosting the quality of life of mental deterioration people. These innovations not just promote real-time tracking and data feedback to adjust nursing plans, but also may lower the general problem of the health care system. By analyzing QALY related to these developments, decision-makers can obtain useful insights right into their cost-effectiveness and ensure that healthcare treatments enhance the health of patients while maximizing resource allocation. Ultimately, QALY supplies key proof for health care decision-making, promotes the constant improvement of individual treatment, and promotes the efficient use resources.

5.1.3 Sensitivity Analysis

Level of sensitivity analysis is an essential technological device used to examine specifically how adjustments in essential variables (such as price or performance) affect the general cost-effectiveness of healthcare treatments, consequently assisting to manage the uncertainty of Cost-Effectiveness Analysis (CEA). In the context of mental deterioration treatment, sensitivity analysis is specifically beneficial in explaining the uncertainty induced by aspects such as adjustments in the rate of illness development, the accessibility of caregivers or the long-lasting prices related to different treatments. By methodically examining various situations, this technique enhances the performance of the CEA study results, making it feasible for decision-makers to understand the feasible series of end results based upon different anticipations.

As an example, when introducing digital health technology to mental deterioration patients, sensitivity analysis can be made use of to examine how fluctuations in tools expenses or adjustments in patient outcomes influence the overall cost-effectiveness of these interventions. The analysis supplies understandings right into one of the most vital factors of technological success and aids to determine possible risks. By considering these unpredictability, healthcare service providers and decision-makers can make smarter choices to make sure that resources are effectively assigned while making the most of advantages to people. Lastly, sensitivity analysis helps to understand the economic effect of healthcare interventions much more thoroughly and advertises much better planning and source administration in mental deterioration care.

5.2 Application

Early screening for dementia helps to recognize clients quicker. By contrasting the cost of testing with the possible cost savings of long-term care, the healthcare system can show the financial benefits of early detection. It is

really essential to compare drug treatment with non-drug treatment. This assists to identify which options are much more reliable and inexpensive for mental deterioration patients. Selecting the most effective nursing model - home care, community care or institutional care - needs consideration of expense and person requirements. This makes sure the efficient use resources. Digital health devices, such as telemedicine, can boost dementia treatment. Analyzing their costs shows how they can improve client treatment and decrease the demand for face-to-face consultation. Evaluating different long-term care strategies aids to allot resources carefully. Evaluating expenses and results makes it possible for service providers to concentrate on efficient nursing options. It is extremely vital to support home caregivers. The evaluation of jobs that supply subsidies and training demonstrates how they help caretakers and minimize the total expense of treatment. Tasks to promote a healthy lifestyle can prevent dementia. Analyzing its efficiency will aid verify that it is reasonable to buy these initiatives, so regarding boost community health and reduce prices.

6. Conclusion

China is experiencing a rapid aging problem nowadays, and dementia becomes the serious illness for the elderly. It is necessary for the government to take more attention to deal with it, especially in undeveloped and developing regions. Legal frameworks can thus have a major impact in facilitating or hindering progress in this field. Digital therapy in Hainan has proved to be an efficiency and cost-effective way. For future, more studies should be implemented on the ethical aspect, such as getting sufficient data, data privacy and security, data quality and so on.

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