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Exploring the Development Model of Senior Care Industry and the Application of Smart Senior Care based on Multi-Country Practices

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Abstract: The purpose of this paper is to explore the development status and practice mode of the global elderly care industry. Through in-depth analysis of the elderly care industry in the United States, Japan, the United Kingdom, Australia, Berlin, Germany, and Singapore, this paper reveals the differences and similarities between the countries in terms of the main body of the elderly care industry, types of services, service modes, operation modes, and typical cases. Meanwhile, this paper also focuses on the application of smart elderly care in different countries, such as the advanced technology support in the United States, the meticulous service in Japan, the community elderly care model in the United Kingdom, the management of nursing homes in Australia, the smart residential system in Berlin, Germany, and the all-round service system in Singapore. By analyzing these practice cases, this paper aims to provide useful reference and inspiration for the development of China's elderly care industry, and to promote the wide application and development of smart elderly care in China. This paper argues that smart aging will become the future development trend of the aging industry, and countries should strengthen exchanges and cooperation to jointly promote the innovation and development of the aging industry.

Keywords: Aging Society; Pension Industry; Smart Pension.

1. Introduction

With the aggravation of global population aging, the senior care industry has become the focus of attention of various countries. In order to cope with the challenges of the aging society, countries have explored the development mode of senior care industry suitable for their own national conditions, among which smart senior care has attracted much attention as an emerging development direction. This paper analyzes the senior care industry in the United States, Japan, the United Kingdom, Australia, Berlin, Germany, and Singapore, and explores the similarities and differences in the main body of the senior care industry, types of services, service modes, operation modes, and typical cases in each country. The study reveals the development characteristics and trends of the elderly care industry in each country, aiming to provide reference and inspiration for the innovation and development of China's elderly care industry. Meanwhile, this paper focuses on the application of smart aging in different countries and analyzes the practice cases, aiming to provide reference for the wide application and development of smart aging in China.

2. U.S. Senior Living Industry Practices

The United States, as a developed country with a high degree of population aging and strong economic strength, has relatively advanced practical experience in the field of intelligent ageing. The United States has a perfect social security system, a developed market operation mode and active social organizations, making full use of social resources to solve the problem of old age. Since 1984, the U.S. began to explore related practical measures, Hartford, Connecticut, the integration of intelligent building equipment, the construction of the "City Building", opened up the development of the smart home industry. 1999, because the United States has a more decentralized living environment, Virginia and other states have gradually established the elderly medical service fleet, the use of Internet of Things (IoT) technology. In 2006, Carnegie Mellon University, together with other universities such as the University of Pittsburgh, established the Center for Quality of Life Technologies (CAST) to conduct research on assistive technologies for the elderly and disabled. The Center for Aging Services Technologies (CAST) and related laboratories are also working on technologies to support active ageing and geriatric care.

2.1. The Main Body of the Industry

Table 1. U.S. Smart Aging Market Startups by Category

Categorization	Element
Nursing	Monitoring Solutions, Nursing and Collaborative Care Solutions
Health	Monitoring solutions, diagnostic solutions for various management tools, predictive solutions
Access class	Sensory Enhancement Solutions, Daily Activity Access Solutions, Transmission Solutions
Furniture	Senior living facility and agency search, home care, facility and maintenance home renovation services program
Interactive category	Social gaming

The U.S. smart senior care service adopts market-oriented operation, and companies such as Samsung, Apple, and

Philips actively research and develop smart senior care products and carry out ageing-friendly transformation. Market startups are mainly categorized into five major categories: nursing, health, access, furniture and interaction. The government, on the other hand, provides policy protection, establishes a unified service platform, and promotes data sharing and public resource saving.

2.2. Types of Services

In terms of health management, telemedicine services in the United States help the elderly to seek medical treatment at home, covering chronic disease management and remote treatment. Virginia and other states have set up mobile medical networks to provide services such as home visits and health status tests. In addition, home electronic monitoring systems can regulate indoor temperature and monitor the physical activity of the elderly.

With regard to learning and recreation, U.S. insurance companies allocate social care budgets to happy aging (preventive aging), home care, and residential care. Happy ageing includes participation by the elderly in activities such as hobby classes and social recreation.

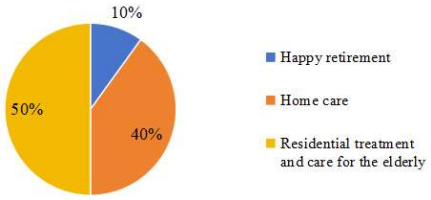

Figure 1. U.S. Government Social Pension Budget Allocation Percentage

2.3. Service Model

CCRC is a community-based senior care model in the U.S. that provides day care, health management and other services, combining smart senior care with community and institutional care, while the PACE model provides medical care for the disabled and semi-disabled elderly, combining short-term medical care with long-term care.

2.4. Mode of Operation

The United States has established a home-based telemedicine consulting service that brings in professional medical organizations to provide advice on multiple modes of communication. Mobile medical networking service fleets provide home-based elderly with services such as home medical consultations. The Government allocates the pension budget to insurance companies, which manage the pension budget by means of corporate operation and provide diversified pension services.

2.5. Typical Cases

The New York Wing Hong Adult Day Care Center provides a healthy and hygienic dining environment, various kinds of fitness facilities and activity equipment. In terms of health management, the elderly can order meals through the touch-screen computer, and the computer program automatically matches the appropriate dishes. In terms of learning and entertainment, the center offers computer training courses to teach the elderly how to operate electronic equipment and software, and to promote social exchanges among the elderly.

Figure 2. Computer training courses

3. Japan's Elderly Care Industry Practices

Japan, with its high degree of aging, faces similar problems as China. In the area of smart ageing, Japan has utilized its advantages in information technology and smart technology to develop smart ageing equipment and multifunctional robots.

3.1. The Main Body of the Industry

The Government promotes the development of the intelligent ageing industry by formulating policies, providing subsidies and focusing on supporting the research and development of products such as mobility assistance and health monitoring. Enterprises are actively developing intelligent elderly care products and robots, such as "machine coats" and intelligent wheelchairs, and applying them to medical settings and home care. With policy support, nursing robot development has become a hot spot, and companies such as Honda and Toyota have also ventured into this field. Japan's scientific laboratories have also developed a number of exoskeleton robots and a series of wearable assistive robotic systems that can help some of the elderly in need to achieve normal walking trips, and has been applied, such as Japan's University of Tsukuba, Cybernics Laboratory development of HAL has been developed from HAL-1 to HAL-5, the appearance of the appearance has become more sophisticated and beautiful.

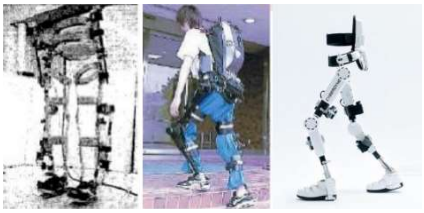

Figure 3. HAL-1, HAL-3, HAL-5

3.2. Types of Services

In terms of life care, nursing robots such as shampooing robots and feeding robots provide convenience for the elderly. For health management, health data monitoring and tracking is realized through APP and IoT technology. Smart living products such as smart tags and smart clothing help family members track dementia patients in real time. Smart home devices such as sensors and cameras ensure the safety of elderly living alone. Smart mobility systems, on the other hand, ensure safe driving and walking for the elderly through IoT devices. In addition, there are interactive therapeutic robots such as the seal-shaped robot paro to alleviate loneliness among the elderly.

3.3. Service Model

Japan has developed smart housing and smart senior living communities to provide comfortable and safe living environments and a full range of services for the elderly.

Elderly organizations have also invested in smart equipment and robots to improve service efficiency.

3.4. Mode of Operation

Japan's smart elderly adopts the model of "government + enterprise + information technology platform", in which the government formulates policies and provides subsidies, enterprises develop products, and information technology platforms provide technical support.

3.5. Typical Cases

Panasonic's "Shinshourien" nursing home makes full use of digital technology to provide care and attention to the elderly through intelligent furniture and equipment, telemedicine terminals, and intelligent robots. The Ichimikai Group has introduced the SoftBank Pepper as a senior citizen robot to compensate for staff shortages and provide entertainment and rehabilitation services. There are also multifunctional robots such as Robear, a caretaker robot, and Smiby, a baby robot, to provide life care and emotional comfort to the elderly.

Figure 4. Robear robot

Figure 5. Smiby the baby robot

4. An Overview of the Practice of the UK's Aged Care Industry

4.1. Industry Leaders

The British Government plays a central role in the field of intelligent ageing, not only providing policy and financial support, but also actively promoting the construction of intelligent elderly homes, with the aim of improving the quality of life of the elderly through the use of modern technology. Since 1990, the British government has embarked on the practice of community care and integrated the concept of "healthcare integration" to build a comprehensive community care system for the elderly through information technology. In addition, the Government encourages the research, development and application of robotics, especially in the field of elderly service robots.

4.2. Types of Services

Life care: The British Government encourages the research and development of home care robots, such as the Care-O-bot 3 developed by the University of South Hertfordshire, which assists the elderly in completing household chores, climbing up to fetch things, opening doors and welcoming guests, etc., so as to enhance the convenience of life for the elderly.

Health management: Recording the health status of the elderly through intelligent elderly medical care systems and producing electronic medical records for easy access by doctors and patients at any time. At the same time, the application of telemedicine and mobile medical technology allows the elderly to receive timely medical services and advice even at home.

Humanistic care: The British Government-led research and development of "virtual companion" technology provides emotional support and security for the elderly by interacting with them, analyzing their needs and responding to them, as well as monitoring their health data and notifying medical institutions in a timely manner.

4.3. Service Model

Intelligent senior apartments: Organizations such as the Life Trust of the United Kingdom have integrated the concept of intelligent ageing into the construction of apartments, realizing real-time monitoring of the daily lives of the elderly and intelligent services through intelligent home systems and robotic care.

Medical care community: Combining the community-based home care model, using information technology and intelligent means to establish a comprehensive service platform, integrating independent living, assisted living and professional care for the elderly in the community, and providing convenient, professional and efficient medical care services for the elderly.

4.4. Mode of Operation

In the United Kingdom, the main approach to ageing at home is through the establishment of community-based intelligent ageing services centers, which provide convenient and safe services for the elderly through the use of fully functional and easy-to-operate ageing products. Its mode of operation is "government + community service station + information platform for the elderly".

4.5. Typical Cases

Smartwatch: access Audar AI Health IoT Cloud Intelligence Center in various ways to achieve in-depth optimization of health data and worldwide health care services.

Care-O-bot 3, a home care robot: The robot not only helps older people with household chores, but also serves as an emotional comforting companion, stimulates activity and seeks help through the call function in case of problems. Its LCD screen also displays different facial expressions depending on the tasks accomplished, increasing interactivity.

To summarize, the United Kingdom has made remarkable progress in the field of smart elderly care, providing the elderly with more convenient, efficient and safe elderly care services through the organic combination of government-led, technological innovation and community services.

Figure 6. Care-O-bot 3 robot

5. Australian Aged Care Industry Practices

Australia is also facing the problem of population ageing, so the country is actively exploring health and health care technologies for the elderly in the construction of its elderly living and health care service system, using intelligent medical solutions, combining high-end care concepts, product services and technological research and development, in order to cope with the challenges posed by population ageing.

5.1. The Main Body of the Industry

Under the pressure of an ageing population, Australia has gradually increased its emphasis on the smart ageing industry, using information technology tools to enhance the quality of life of the elderly. Aged-care service enterprises, including for-profit enterprises and non-profit organizations, have become direct providers of smart aged-care services, while the Government supports the development of this industry through financial subsidies and supervision and management. With the advancement of smart ageing, new technologies such as telemedicine and electronic medical records have been widely used in the health and aged-care sector, with far-reaching impacts on business design, economic efficiency and staff working conditions. In addition, the Australian Federal Government has launched the Golden Opportunity Plan for Home and Community Aged Care, which utilizes information technology to provide daily care for the elderly and improve their quality of life.

5.2. Types of Services

Life care and services: Australian nursing homes have introduced advanced equipment and facilities to provide diversified care services, including daily life care, recreational and sports care, and dementia care. Intelligent technology plays an important role in aged care services, such as the care information system developed by the Sapphire Group, which has computerized the care service system and formed an intelligent network service support.

Health management: Australia continues to innovate in the design and production technology of aged care products, with leading products such as 'bionicear' and CPAP. Smart medicine cabinets remind seniors to take their medication on time and record the time and location of the medication, improving the safety and convenience of aging in place.

Humanistic care: Australia has used digital and intelligent technologies to encourage the elderly to increase their social interaction and enrich their social life. Some nursing homes have introduced a robot, Zora, which reduces the sense of loneliness among the elderly through eye and verbal communication.

5.3. Nursing Homes and Home Care

Nursing homes: Australia has a long history of institutionalized care for older people who are medically dependent and unable to live independently. Admission to nursing homes is based on a government health test and is subsidized according to income. Some nursing homes use surveillance technology and cameras to monitor elderly people's outings and movements, enhancing the peace of mind of family members. Dementia wards use smart technology to provide security for the elderly and guide them back to safe areas.

Ageing in place: Australia uses medical information management systems and equipment to monitor the health data of the elderly, and medical specialists provide telemedicine guidance through video and other means. Progress has been made in equipment monitoring for falls among the elderly, and RFID technology helps the elderly to track goods in their homes, create shopping lists that are automatically sent to stores, and help them to cope with cognitive impairments through photographs and other information.

5.4. Mode of Operation

The operation model of smart ageing in Australia is centred on "government + aged-care service enterprises/families + information technology platform". Aged-care service enterprises directly participate in or undertake aged-care work, while the government provides financial subsidies and supervision and management. In recent years, Australia has gradually favored the model of ageing at home, using technology to allow the elderly to enjoy smart ageing services at home.

5.5. Typical Cases

In 2015, a nursing home in Perth, Australia, introduced the "Zora" robot. Developed by QBMT in Belgium, the 57-centimeter-tall robot has speech synthesis, winking and nodding functions, and is able to interact and communicate one-on-one with elderly people based on recognizing their language. Zora has been widely used in nursing homes in the US and Europe, and can reduce the workload of caregivers. However, it can only perform simple and repetitive tasks at present, which is still a gap compared with professional caregivers. This case demonstrates Australia's active exploration and application of robotics in the field of smart ageing.

Figure 7. Robot "Zora".

6. Coverage of Residences with AAL Systems in Berlin, Germany

6.1. Project Background

AAL (Ambient Assisted Living) is an intelligent solution for the elderly in Germany. In the face of Germany's continuous population growth and Europe's overall low birth rate, the German government has actively adopted AAL technology, aiming to meet the needs of the elderly and help them restore their ability to take care of themselves, which has been gradually lost due to ageing.

6.2. Smart Space Application Analysis

The application of the whole-house AAL system means that modern sensor transmission technology is widely used in the home environment to make all home devices intelligent. This system is based on a scalable intelligent technology platform that responds instantly to changes in the occupant's condition and environment for precise analysis and judgment.

When the monitoring system detects emergencies such as falls, unconsciousness, breathing difficulties, etc., it will immediately notify pre-programmed emergency contacts, including family members, emergency centers and care companies.

AAL systems are used in a wide range of applications, including information communication, flexibility enhancement, mobility assistance, medical monitoring, safety and security, home care and living space optimization. Most of the devices in the home can be operated by remote control, while the electronic alarm device in the living room serves as the core of the AAL system, assisting the control center in all-round monitoring. All sensors record data on the elderly's daily life and analyze it in depth, even including details such as the time of taking medication.

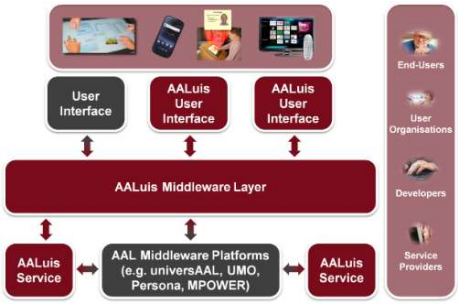

Figure 8. AAL Environmental Assisted Living System

In the bedroom design, the beds are designed with half of them lifting up and down, making it easy for those living with the elderly or their caregivers to check on them at any time. The bedding is made of special materials that are both breathable and waterproof, making it easy for the elderly to change and organize. Sensors underneath the mattress can monitor the activity status of the elderly, and if they remain inactive for a long period of time or if there is any abnormality, an alarm will be issued and an emergency contact will be contacted immediately. In addition, the "I" notch on the bedroom wall and the design of the automatic lifting bar provide a convenient way for the elderly with paralyzed lower limbs to move around.

The corridor from the bedroom to the bathroom is fitted with soft "night-vision lights" to prevent the elderly from being stimulated by bright lights in the middle of the night. The bathroom is equipped with a smart sink that automatically shuts off when the water level reaches a set level, preventing water from overflowing. SOS and alarm buttons are located throughout the room, while the smart floor in the restroom alerts seniors when they enter. Family members and caregivers only need to install the appropriate software on their mobile phones to remotely and synchronously check the elderly's life and activity data, realizing all-round care and attention.

7. Singapore's Aged Care Industry Practices

Singapore also faces a high level of population ageing. According to the Singapore Department of Statistics (DOS), up to 20% of older persons live alone without children; about one-third live with their children (including widowed or divorced cases), while up to 14% live completely alone. More worryingly, the number of older persons living alone is expected to increase rapidly.

7.1. Industry Players and Policy Support

To build an active and healthy aging society, the Singapore government has made technology capitalization a core strategy, incorporating a number of policies into its "Smart Nation" initiative. 2014 saw the launch of the "Smart Nation 2025" ten-year plan, which aims to In 2014, Singapore launched the Smart Nation 2025 10-year plan, which aims to make extensive use of information technology and enhance data sharing. As part of this plan, in 2015, the Infocomm Development Authority of Singapore deployed fitness robots in senior citizen activity centers, aiming to improve the health of seniors while increasing their access to high technology. In addition, the Government encourages elderly organizations to adopt technology in the provision of services for the elderly through a number of funding schemes.

7.2. Types of Services and Innovations

7.2.1. Health Management

Singapore has introduced the concept of "Smart Health Assist", which utilizes technology such as wearable sensors to remotely monitor the health of chronically ill patients. The Singapore Health Authority plans to launch a "Vital Signs Monitoring System" to remotely monitor the vital signs of older people with specific diseases (such as diabetes or lung disease) and automatically transmit readings to trained personnel for real-time monitoring and decision-making. Meanwhile, Singtel, Singapore's largest telecom operator, has partnered with a number of vendors to launch a smart health monitoring program to monitor the health of patients and the elderly by tracking health data such as blood pressure monitors, thermometers, weighing scales, glucose meters and pulse oximeters.

7.2.2. Humanistic Care

In the area of humanistic care, since October 2015, Robo Coach robots have been widely used in more than 20 senior centers in Singapore. These robots interactively guide seniors through exercise and fitness programs to improve their physical health. In the future, the Singapore Government plans to further develop Robo Coach into a companion for the elderly to take care of their physical and mental health.

7.3. Service Models and Smart Homes

7.3.1. Joyful Age Apartments

Senior Citizen Residences (SCRs) are HDB's "affordable housing" for seniors living alone or with their spouses only, and are usually built in well-established communities with good access to public amenities and transportation. Through intelligent means such as Smart Health Assist, elderly monitoring and alert systems, telemedicine and sensors, Singapore provides a safer and more comfortable living environment for older persons living alone.

7.3.2. Smart Apartments

Under the impetus of the Smart Nation Program, Singapore is actively developing smart condominiums, of which the Soon Fook Hin project is a typical representative. Located in the Bishan-Thomson area of Singapore, the condominium has about 1,200 residential units on a site of 36,985.7 square meters, with comprehensive living facilities in the surrounding area. Soon Fortune Residences introduces the all-round Smart Home concept, adopting an advanced intelligent home management system to make residents' lives smarter. Residents can control their home air-conditioning, electronic door locks, intelligent monitoring, washing

machines and electrical appliance switches through their cell phones, as well as monitor the health and activity status of the elderly through the mobile app. In addition, Shun Fook Heen has also launched 63 "The Gold Standard" units, which are equipped with a variety of age-friendly amenities, such as a bed system for detecting body temperature and heartbeat, to cater to the special needs of the elderly.

7.4. Mode of Operation

In the specific operation of the smart ageing industry in Singapore, the Government has taken a leading role in formulating a series of policy initiatives to encourage technological innovation, and guaranteeing the smooth implementation of smart ageing services through unified deployment and funding schemes. Therefore, the operation mode of Singapore's smart elderly care industry can be summarized as "government + family/elderly care institutions + information service platform".

7.5. Typical Example: Robo Coach, a Fitness Robot

Robo Coach is a fitness robot developed by students at Singapore Polytechnic in 2014. After a trial at an elderly activity center, the robot has been deployed in more than 20 elderly activity centers in Singapore since October 2015.Robo Coach has movable metal arms that can lead the elderly in various stretching movements. It has two screens, located on the head and chest, which can interact with seniors by displaying facial expressions and memorizing some of the commands. At the same time, the screen in front of the chest can also show an instructional video to provide the elderly with movement breakdown guidance.Robo Coach has a voice recognition function, which can provide the elderly with 15 kinds of movement demonstrations under the instructions, and determine whether the elderly are doing the movements correctly through the sensor device. Considering the physical condition of the elderly, Robo Coach will slow down the speed of the demonstration to ensure that each elderly person can follow the teaching progress.

Figure 9. Robo coach instructs seniors on exercise

8. China Haier Smart Home Care Platform

8.1. Project Background

As early as 2006, Haier Smart Home has been actively exploring safety, health, humanization and personalization on a nationwide scale with a focus on facilitating the user experience, and using technology to satisfy the desire of all users, including the elderly, for a better life.

8.2. Wisdom Mode Application Analysis

Haier from the intelligent life, combined with Haier full ecological to create a community recreation center + home recreation scene + recreation services cloud platform health ecology, home-based community-based to bring a full range of health management services, to provide the community peace of mind, the family rest assured that the wisdom of the health of the integrated solution.

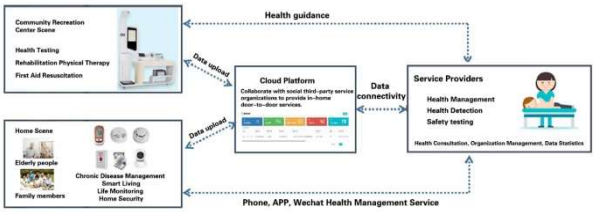

Figure 10. Haier Smart Home Service Model

Build a smart home care and recreation scene, from the community to the residents of the systematic health management allows the elderly to fully experience the wisdom of health services supporting.

The first is the creation of a whole-house security scene, indoor emergency call information, environmental monitoring information and home security monitoring information together to form a whole-house intelligent hub system, connecting all smart home devices and access to the Internet, synchronizing the use of smart home, 360-degree guarding home security.

Figure 11. Whole House Security Scenario

The second is the physical management of the elderly with chronic diseases, forming health scenarios, helping the elderly to form a daily testing habit, transmitting the testing data to the health data service platform to intelligently analyze the health testing data of the elderly, and forming the corresponding health management tasks, and through the AI and the health service personnel to carry out the health guidance, return visits and interventions for the elderly to help the elderly to improve through their daily life styles, dietary habits, to improve the health condition and improve the quality of life.

Figure 12. Disease Management for the Elderly

The third is the creation of health scenes for the disabled and semi-disabled people, intelligent healthy sleep detection for long-term bedridden disabled people, multi-dimensional comprehensive collection of sleep information through professional-grade ultra-thin sensors, so as to realize the monitoring and early warning of the physical state of the elderly, and the issuance of safety badges for the semi-disabled people and the elderly with memory loss, real-time

location monitoring, and according to their trajectory of action and physical condition can be timely send call for help signal, affection number, call and other services.

Figure 13. Health Scenarios for the Semi-Disabled Elderly

9. Conclusion

Through in-depth analysis of the elderly care industry in the United States, Japan, the United Kingdom, Australia, Berlin, Germany and Singapore, this paper explores in detail the practice of each country in terms of the main body of the elderly care industry, types of services, service modes, operation modes and typical cases. It is found that each country has developed its own distinctive senior care industry according to its own economic, social and cultural background. Meanwhile, smart elderly care, as the future development trend of elderly care industry, has been widely used and developed worldwide.

By analyzing the practice cases of the senior care industry in these countries, this paper provides useful reference and inspiration for the development of China's senior care industry. We should learn from the successful experiences of other countries, strengthen the research and development and application of smart aging technology, and promote the innovation and development of China's aging industry. At the same time, communication and cooperation among countries should be strengthened to jointly meet the challenges of the aging society and realize the sustainable development of the senior care industry.

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